Kalix: Stay, Play, Grow

Report for F7013B - Development Project

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INTRODUCTION AND METHODOLOGY

This project is part of the course F7013B - Development Project where the aim is to apply the knowledge and skills, acquired in previous courses in urban planning into a concrete planning project. Kalix city centre was the area of focus for this redevelopment project. The main focus of the work is to create a city centre that is well-adapted to the climate and serves the people living and visiting Kalix. The work is divided in four main chapters: analysis, vision, major concepts and urban design.

The project team was composed of 12 students with various fields of expertise: five urban planning students and six engineering students (civil, electrical and project management). Each group tried to add value to this urban planning project within their field of expertise.

The project work was divided into three focus areas:

- Urban planning analysis and concept proposals
- Energy analysis
- Three creativity sessions to propose ideas for attractivity
    - Energize the city's shops
    - Wayfinding and lighting
    - Unique feature of Kalix

ANALYSIS

Introduction to Kalix

Quick Facts about Norrbotten County (City Population, 2016)

- Area: 1815,02 km²
- Altitude: 10 m
- Geographic coordinates: latitude = 65° 51’ 11’’ North and Longitude = 23° 9’ 19’’ East
- Population of the municipality of Kalix: ≈20 000 people (4th most populated city in Norrbotten Province). Population in Kalix: ≈ 7 500
- Kalix river: one of the major rivers in Norrbotten county
- Connected by road E4 (south of Sweden) to E10(west of Sweden) and E8 (Finland).

Figure 2. Geographical placement of Norrbotten County.

Norrbotten County

Some figures (City Population, 2016)

-Contains Norrbotten province and Lapland province. Capital: Luleå

-Area: ≈ 100 000 km²

-Population: ≈ 250 000 (density: about 2.5/km²) (increased during the last hundred years)

-GDP: ≈ 60 000 million SEK (2004)

Figure 1. Geography of Sweden.

Geography

- The northernmost county of Sweden; covers almost one quarter of Sweden's surface
- Around: Norway, Finland and Sweden
- Contains the Arctic Circle, and two thirds of Swedish Lapland
- Sparsely inhabited

Bigger towns of Norrbotten county:

- Haparanda: 49,9km
- Råneå: 45,1km
- Luleå: 78,7km
- Boden: 102,5km
- Överkalix: 77,1km
- Övertorneå: 77,3 km

History

- During the Middle Ages: a no man's land; some Sami, Kvens and others
- After the Middle ages: Swedish kings colonise and Christianise the area, but some minorities (Sami) maintain their own culture and customs
- The coat of arms of Norrbotten county combines the arms of the provinces Västerbotten and Lappland

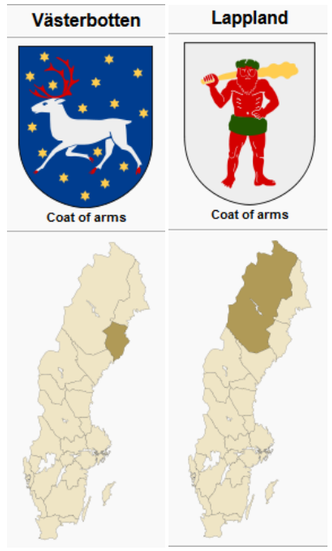

Figure 3. Municipality icons.

Culture

- Different from the rest of Sweden, because many cultures can be found there: Sami culture, Finnish culture, Swedish settler-culture (climate, midnight sun, mid-winter darkness)
- The old Swedish and Finnish dialects survived in this area and are spoken by a great number of people
- "I am not a Swede, I am a Norrbothnian"

Politics

- To coordinate the interests of the county, to promote the development of the county, to establish regional goals
- Swedish social democratic workers' party (≈52% in Norrbotten): the oldest and largest political party in Sweden
- During the 20th century: strong mobility in and out of the country. Many young people move south because of high unemployment. People feel misunderstood or economically abused by the south, namely Stockholm

Agriculture

- Grains (important part of the industry), potatoes, turnips
- The most important plant: grass, used as hay for the livestock

Culture and Environment

Archipelago

Has the 2nd largest number of islands (792 islands), after Luleå

Many different and special islands

Rånön (the largest island of Sweden), Bergön (the best sauna), Halsön (white sand beach), Malören (true gem with a small village and a church)

The archipelago is important to the people of Kalix

In summer: sailing races organized by the Kalix sail and race boat society

Kalixlöjrom

A culinary speciality specific to Kalix, referred to as caviar of Kalix

Fish eggs but the taste is different because of the large influx of fresh water from the huge rivers in and around Kalix. Unique taste because of a special mix of elements (for instance: a unique ratio between strontium and barium)

EU has granted the Protected Geographical Status for this speciality; present at many Nobel dinners

Kalix church (+ wooden chapel)

The most interesting building in Kalix: a very interesting history

The northernmost medieval church of Sweden

Constructed during the 15th century (exact time not known)

The church is mentioned for the first time in a letter of indulgence, which is the oldest written record from Kalix and the only letter of indulgence issued from the Diocese of Luleå

The church has been pillaged by Russians twice; and has been renovated many times

Architecture: a typical representation of late medieval hall churches found in the north of Sweden

Attractivity

At first, we explored the potential of the Norrbotten region. To begin, The region develops and uses well natural conditions. The pillars of the economy are mining and steel industries, forestry, wood and paper industries. Climate of this region is very particular and attract. The cooling and cold climate, with winter activities attract a lot of people. A positive point is that General competence is high and people are generally multilingual (English included). The region need all types of engineering excellence : energy, mining, aerospace, railways, roads… A proposition strategy is to attracting international talent, technology, ideas and investment. A dynamic environment where people can grow will attract innovative talent and innovative companies and maybe working together (between municipalities, regional organizations, good and long-term partners) to facilitate new investments.

We analyzed the different things that make the city attractive. We tried to find out why tourists or locals came to Kalix to find out what is already there. Indeed, it is necessary to understand why people come to Kalix to live all his life as well as for tourism only. Then, it is necessary to find channing which allows to attract them.

For attract locals, Kalix has many advantages. To begin, there are many infrastructures for education. (kindergarten, after-school, high school, special school, art school). It is necessary to attract young people who would like to stay here. The municipality has around 1,700 employees, and Norrbotten county council has around 775 employees. Furthermore Kalix is on the major road Lulea and Haparanda, it is easy to go in these city to work in example. The major industry in Kalix, and also in the whole of eastern Norrbotten, is the pulp and paper factory Billerud Karlsborg, with around 430 employees and a turnover of SEK 1.8 billion per year. Kalix has an IT centre with several hundred people employed in the call centre sector, providing services to all of the Nordic countries. (Kalix Kommun, 2016)

Tourism has mainly been in place for nature and leisure activities (beach ...) and in winter for cold, snow... A lot of hotels and lodgings are available, in particular during ski season. They organize many activities during these times (Festivals, concerts ...). We want to find a idea to attract more people in Winter and all seasons. Maybe, we find something unique like Ice Hotel but never see before (creativity sessions) and possible all seasons.

It is also possible to see different infrastructure for both, tourists and locals:

- Close to nature
- Outdoors activity (sports field)
- Summer beach
- Pool and gym
- Hockey
- Library
- Association for sports and activities for people
- Church
- Hospital
- Winter opportunity to ice skate on the frozen river
- Museum
- Many proposed event on the whole year
- Commercial areas
- Kalix archipelago
- A lot of activities in Kalix are winter activities and especially near the river. It is therefore important to find activities that are possible in summer as well as in winter and throughout the city without forgetting that the edge of the river is an important space.

It is important to create infrastructure and advertising to inform people. Following our analysis, we found some negative points to consider. To start, it would be possible to do more advertising, events and days for tourists. It is important to focus on the culinary specialty also (Kalixlöjram).

Kalix: The Hub of the Region

Kalix is located amongst many environmentally and culturally interesting areas. The Kalix river itself is a Natura 2000 Habitat Directive site, and is recognized by the Marine and Water Agency for Marine and Water Authority as precious water with cultural value for fishing (Naturvardsvkerket, 2016).

The river is an important recreational fishing place because it is a key route for migratory sea trout and salmon stock. Other fish such as grayling, crayfish, freshwater pearl mussel, and lamprey can be found here as well.

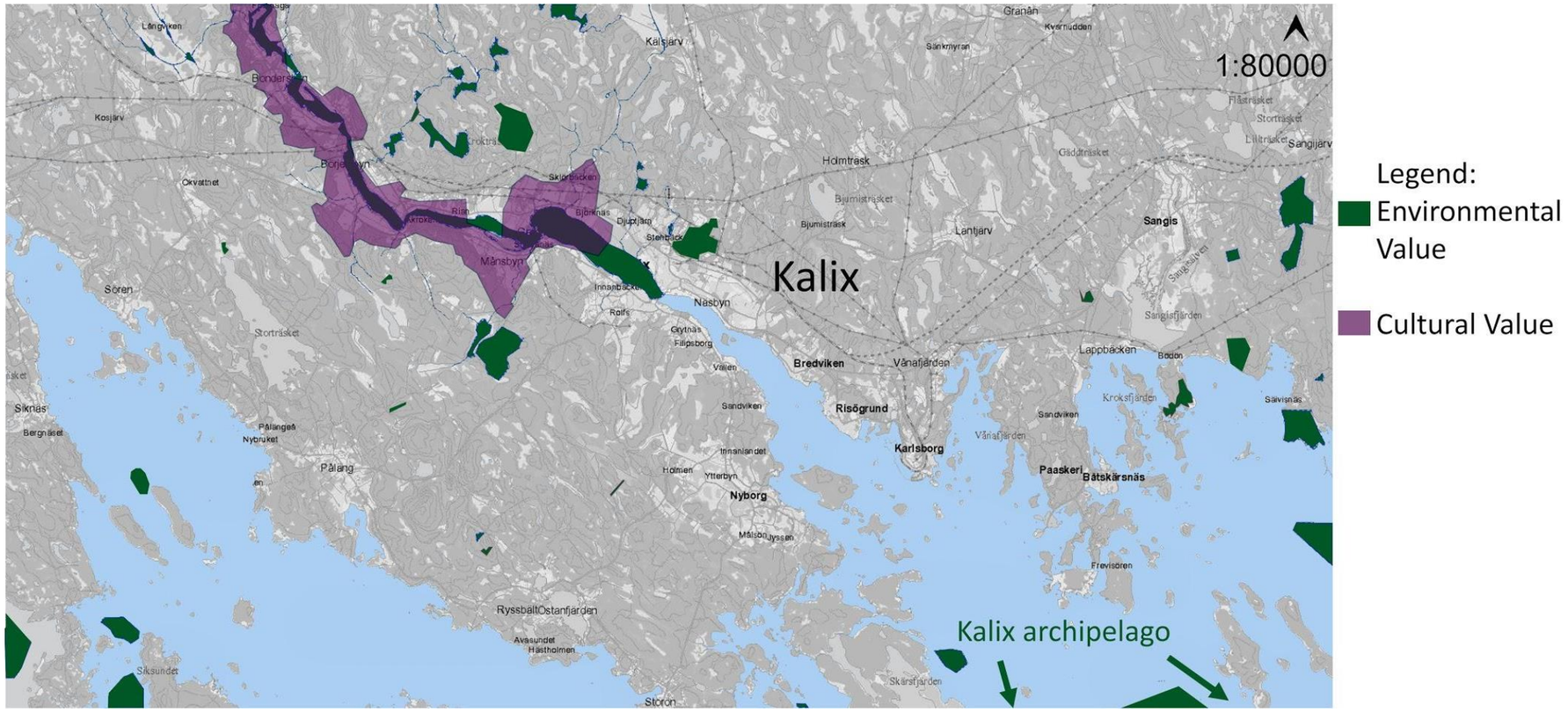

Figure 4. Environmental and cultural map of region.

Culturally this area is interesting because it is agricultural country side with medieval origins (Naturvardsvkerket, 2016). Björknäs-Gammelgården is a manor house in the agricultural countryside, and it is a place of national interest to the Cultural National Heritage Board for this reason (Naturvardsvkerket, 2016). The closest nature reserves are Stråkanäsberget and Bergträsket.

Figure X. Environmental value areas include nature reserves, forest protection agreements, and habitat directives. Cultural value areas include national interest areas and culturally valuable waters

- Proximity to natural environments is a real advantage for Kalix city centre. Additionally, Kalix is one of the larger towns in the area. Kalix appears to be the natural hub for or reference point for tourism in the surrounding areas.

Climate Change in Kalix

Climate change is having affects all over the world, and Kalix is no exception. The subarctic climate of Kalix is expected to warm on average 4-6°C in the next 100 years based on different climate scenarios (Länsstyrelsen Norrbotten, 2016, p.7). The growing season will increase by about a month to 50 days by the end of the century (Berglöv et al., 2015), and rainfall is expected to increase between 20 to 40%, depending on the climate scenario used (Länsstyrelsen Norrbotten, 2016, p. 11). Summer is the season with the highest rainfall on average, and it will continue to be.

Figure 5. Kalix citizens out on a rainy day (Kalix Kommun, 2015)

Generally snow cover will decrease on average, and it is important to note that variation between years can be large. The number of days with 20 mm or more of snow coverage will be between 100-120 from 2021 to 2050 an 80-100 by 2069-2098 (Länsstyrelsen Norrbotten, 2016, p. 17). The extreme 1-hour rainfall is expected to increase, and RCP8.5 shows greater change than RCP4.5. The increase is greatest for longer return periods, i.e. the more unusual extreme bursts. However, the calculations show even 15-25% increase in the annual storms. (Berglöv et al, 2015, p. 37).

Additionally there will be an increase in rain in the winter. The biggest change of the total inflow takes place for the winter period and the middle of the century there will be a general increase over the county. In spring seen an increase in total inflow for all streams. The increase is greatest in the northern parts of the county. This means the Kalix river could rise to higher levels, more often. This should be considered when planning in areas close to the river. During the summer season there will be a slight decrease or no change in the total inflow for most of the waterways (Berglöv et al., 2015, p. 39).

In summary, Kalix will become a warmer place with a shortened winter season, and increased rainfall. These conditions need to be taken into consideration in future urban planning.

Possible Implications

It is possible that warmer weather means that snowmobiles will be used less, and quads will be used more (Länsstyrelsen Norrbotten, 2016, p 51). Also, increased run off from increased precipitation means decreased water quality, therefore there should be a focus in treating urban runoff (Länsstyrelsen Norrbotten, 2016, p. 57). Lastly, longer summers and shorter winters with unpredictable precipitation means changes for seasonal tourism (Länsstyrelsen Norrbotten, 2016, p. 50). All of these implications should be reflected in future urban plans.

Figure 6. Most commonly avoided conditions for soft-mobility according to Chapman (2016).

Recent LTU research into weather-related soft mobility barriers reveal that rain, coldness, darkness, wind and snow precipitation (in that order) are the most commonly avoided weather conditions for soft mobility (Figure 6). Icy surfaces are more often avoided than snow covered surfaces as well (Chapman, 2016). Considering that Kalix is expected to experience increased rainfall, particularly in the winter, it could be important to create soft mobility routes that help users avoid these conditions.

Energy Analysis

Sweden is a country where renewable energies are becoming more and more important, that is why nearly 100% of the energy produced in the country is from renewable sources. This energy that later is converted to electricity or thermal energy comes from different sources: solar radiation, wind, hydro power plants and nuclear energy.

Therefore, the basic objective dealing with energies in the city of Kalix is to introduce some ideas about using renewable energies for thermal heating, district heating and the possibility of electricity generation for low consumption. This is owing to production facilities are beginning to age and more people want to start producing their own electricity and thermal energy heating.

The Swedish Energy Agency is working in four future energy systems for year 2020 depending on several factors such as industries, society, how much energy is used, available technology, climate and others. The four scenarios are named “in Forte”, “Legato”, “Espressivo” and “Vivace”. Each scenario has different parameters and routes to build a robust energy system based on that energy has various roles in society.

Trying to design a scenario just for Kalix would be difficult and take a long time, but the ideas that will be present later on, will be more associated with “Espressivo” in which the main energy policy is focused on promoting self-sufficiency, trade of services and new energy markets.

Thermal heating and district heating

Thermal heating

One of the most important uses of energy is for heating buildings. Thermal heating is a big issue considering that the winter season in Sweden is about 6 months with mean temperatures below 0 degrees, especially in Kalix. Nowadays, thermal heating for buildings in the municipality of Kalix is covered by district heating using the waste heat from the industries nearby.

This is a common option used in a lot of countries around the world. However, since society wants to produce their own energy, using renewable energy is the best idea. Also, if district-heating consumption is reduced, that will cause a reduction in the municipality costs.

Therefore, there are few options to use solar and geothermal energy for heating buildings. Two seasonal energy storages will be presented for two different situations. In the first case, the “Boreholes systems” (Figure 7), would be suitable for residential areas, buildings and suburbs. This system consists of placing solar collectors on the roofs, having a short-term storage tank and drilling deep holes (between 100-300 meters) on the ground. Thus, having a grid with water pipes connecting the solar collectors on the buildings and inside the holes, will allow heat water storage during the summer season in the ground. When winter comes, the hot water stored will be used just like a district heating loop.

During the first years, heat losses will be greater but with time, the ground would get warmer due to the hot water stored. That would mean that thermal losses are smaller, that is why this system is reliable and efficient.

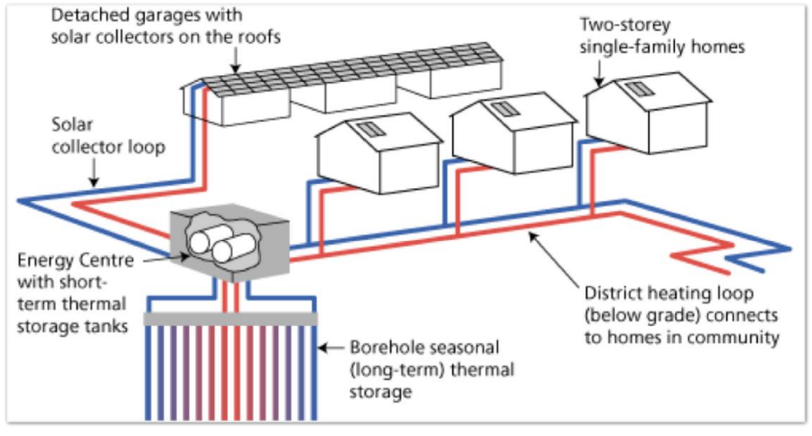

Figure 7. Borehole geothermal storage system.

However, there is also a system that would work better for single-family houses. The Active Solar Energy System (Figure 8) also uses the solar radiation by means of solar collectors on the roofs. This method is optimized for seasonal storage of solar heat. During summer, solar energy is collected and the heat is accumulated in seasonal storage underneath the building. Heat is retrieved from the storage during cold seasons using a heat pump. Also, there is an independent grid for using hot water during summer season, that is, production of hot water and storage of heat at the same time.

This technique works well to build passive houses with a low carbon footprint and reduce the CO_2 emissions to 90-100%. According to some studies and investigations, this system is able to reduce the heating consumption up to 70%, which means an important reduction in the energy costs.

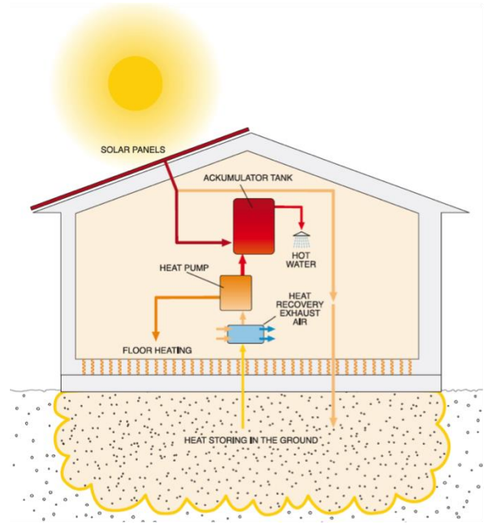

Figure 8. Active Solar Energy System for thermal heating.

District heating

A big issue that Nordic countries have to deal with is the accumulation of snow and ice in streets and roads. Moreover, considering that Kalix is located in the north of Sweden, a solution should be developed. If the snow accumulates in the roads, road transportation is affected, and if there is also ice on the sidewalks, people will avoid walking outside. Kalix should work on an efficient solution to solve this big problem. Considering the energy improvements for heating the buildings, that would reduce the district heating consumption and save money for the Kommun. Nevertheless, waste heat can still be used for heating the roads and sidewalks so then, ice will melt and it would be more comfortable to walk around the shops in Kalix.

The principle of this system is to place thin water pipes below the ground where the waste heat is produced from the nearby industries. Major cities such as New York or Stockholm (Figures 9 and 10) are installing this system in the busy public areas to keep the streets ice-free.

Figure 9. Street heating in Stockholm.

Figure 10. Street heating in New York City.

Efficient lighting

Since Kalix is a city in northern Sweden, winter months, besides being extremely cold, have very few effective sun hours. This means that the city is dark most of the day which is not very inviting for people, or far cars passing by. Therefore, more lights should be placed around the city, especially in the center and on the bridge, which is the main entrance to Kalix. More lights will involve an increase in the electricity demand, that is, an increase in the Kalix Kommun costs. However, as it was stated before, solutions using renewable energies are the main objective to be presented in this project. Thus, some energy efficient lighting systems are described.

LED Lights

The use of LED lights will require a large initial cost in the beginning because LEDs are more expensive than a classic light. Nevertheless, this initial investment will be recovered in few years. The main advantage of LEDs is that they consume much less energy-, it can reduce the electricity demand between 40-60% compared with the traditional lighting systems. Moreover, the lifetime of an LED is higher than a white-hot bulb and the luminescence is between 80 to 100 lumens/watt whereas the typical lights do not reach 60 lumens/watt. This last point is important to consider in order to eliminate the darkness of the city during the winter months.

Efficient lights using renewable energies

Nowadays, more lighting systems are being developed using renewable energies, mainly using solar and wind energy. The problem that the solar lighting systems will face in Kalix is that there are almost 4 months that the solar radiation cannot be used. Electrical batteries could be used to store electricity during summer and then reused the electricity in the winter. The issue here is that seasonal electrical batteries at low scale are really expensive and not completely reliable since electricity is difficult to store for a long period of time. As a result, using only solar energy systems are not an effective to implement in the city of Kalix.

Figure 11. Street light using wind and sun energy.

The situation will change if a system is designed combining solar energy and wind. Kalix is placed near a river and the sea, where wind plays an important role since wind speed simulations have been done. This type of lighting system will take the solar radiation during the summer season and use small batteries for storing the electricity for the nights. When the winter season comes and there are a few hours of sun this system does not work efficiently. Placing a small wind turbine then uses wind power. Generating electricity for self-consumption at low scales using wind energy is becoming more popular and new and effective systems are being investigated and developed each year.

Using wind power will be an effective solution to implement on the Kalix bridge since it is a place where wind is less obstructed and will be a perfect combination with the solar energy during the whole year. Combining solar and wind energy for generating electricity for lighting is an effective system using renewable energies which will be independent of any electrical companies and be owned by the Kalix Kommun. This will suppose an important reduction of cost in electricity over the years, so since the initial investment in the solar panel and the wind turbine will be recovered in a time between 3-7 years, depending on the materials used and the electricity demand.

In conclusion, this system opens a wide range of options for increasing the lighting of Kalix, potentially encouraging pedestrians to get out of their houses and walk the streets of Kalix, if they are better illuminated. Also, having a well-illuminated entrance to the city, people might stop and take time to visit Kalix. If a system is managed to get people walking around the gallerias and go shopping, that will transform in an income

for the city and if the self-generation of electricity is added, the Kommun will have a bigger budget for the following years.

Snow Storage and Snow Cooling

Snow removal from streets is a big problem in northern countries. Some studies and investigations have been done in order to obtain an effective solution to take advantage of the high quantities of snow that are on the streets and roads in the winter. There are some typical applications to get rid of the snow and store it in some places for future winter activities such as:

- Alpine skiing
- Ski jumping
- Snow sculptures
- Ice hotels/pubs
- Snow storage
- Snow cooling and its applications with data centers

Figure 12. Snow castle in Kemi, Finland

Figure 13. Snow sculptures in Japan.

A more common scenario in cities with big flat surfaces like Kalix is to build recreational places like ice hotels or snow sculptures around the city, as can be seen in figures 12 and 13. Ice hotels or pubs will suppose new tourism staying there because an iced hotel is something new, especially for people from South Europe and America. Also, the possibility of iced pubs is interesting and exciting. People near Kalix will come couple times during the winter to spend some money. The idea of iced hotels and pubs are growing up and being more important in Nordic countries since it will attract many people just to see a big building, which is only made of ice and it, only can be built in few countries. Similarly, snow sculptures can be created in different key places Kalix. In such a way, people who come to the city or just the one who is passing through will stop and have a look at those astonishing sculptures. Cities from Canada, Japan or China are organizing small competitions between the citizens to build the best sculptures. If Kalix could arrange some kind of

competition, that will have two main advantages. First, people will be active, working in their buildings and removing the snow from the streets since they will need it; in a second plane, people will come to see the sculptures and the Kommun can take advantage of this type of tourism and have new incomes.

A solution that can result in important revenue for the city is to obtain a big place on the outskirts of the city to leave the accumulated snow. The key is that small cities around Kalix will also need to take away the snow and lay it somewhere. Having snow storage will make these cities bring their collected snow to the storage. Therefore, if for each city that wants to deposit the snow in the storage would have to pay a tax, it will create an important income for the Kommun. Moreover, this stored snow could be reused later for winter applications as the ones explained above.

Figure 14. Indoor snow storage.

The place to store the snow can be indoor (Figure 14) or outside. In the case to store it outside, it would have to cover the outer surface with thin layers of plastic or a gravel compound to prevent snow from melting. On the other hand, storing the snow inside a building, special needs are not necessarily need because the cold air outside will keep low temperatures inside the building, in such a way, the snow will not melt.

Green Data Centers

Data centers use a lot of power, consumed by two main usages: the power required to run the actual equipment and then the power required to cool the equipment. The first category is addressed by designing computers and storage systems that are increasingly power-efficient. To bring down cooling costs data center designers try to use natural ways to cool the equipment. Many data centers are located near good fiber connectivity, power grid connections and also people-concentrations to manage the equipment, but there are also circumstances where the data center can be miles away from the users and do not need a lot of local management. Examples of this are the 'mass' data centers like Google or Facebook: these DC's are built around many standardized servers and storage-arrays and the actual users of the systems are located all around the world.

Figure 15. Green data center in port of Strasbourg.

After the initial build of a data center staff numbers required to keep it running are often relatively low: especially data centers that provide mass-storage or computing power which do not need to be near population centers. Data centers in arctic locations where outside air provides all cooling are getting more popular as cooling and electricity are the two main variable cost components.

Why install a data center in Sweden?

The cold climate in Sweden offers a natural advantage in cooling server rooms. The country has no shortage of cooling water. In Sweden, heat is actually a commodity and some data centers already sell heat to district heating networks.

Besides the electricity price in Sweden is one of the lowest prices around all Europe (0.062 e/kWh) and the power supply is 100% green, there are also other factors that supports the idea of Sweden as being one of the most effective countries to locate data centers:

- Low risk of natural disasters.
- An excellent international connectivity and bandwidth with other countries.
- A good supply of skilled labor, including scientists and engineers

For future years, companies owning or willing to have a data center have four main requisites for their installation:

1. Easy access to power. Data centers require high amounts of power
2. Cooling and climate. Data centers built in cooler climates can reduce the costs because outside air and ground temperature can be used to chill the data center.
3. Proximity to risk
4. Data security

Nowadays, there are already 250 data centers in Europe. However, technology and industry are evolving continuously leading to a need of building more buildings and data centers among them. Therefore, according to estimations from Gartner Consulting, in the following ten years, it was estimated that 50 data centers will be built. Cloud data centers seem to be moving towards extremes in terms of size, either becoming massive or very small. The ones, which are bigger, would need energy supply and therefore, more cooling. Thus, this type of data center will be built in cooler climates to reduce cooling costs.

Snow cooling for data centers

There is a new issue dealing with data centers and is the possibility to install snow cooling plants within the dwelling. In the White Data center Project (Hokkaido, Japan), has shown the viability of storing snow in winter and using it as cooling in summer. Snow cooling maintained the ambient temperature of the building at 25ºC without the need of electric air-cooling.

Companies with data centers

Alibaba, AOL, Amazon, Apple, Blackberry, Cisco, Google, Hewlett-Packard, Lenovo, Microsoft, Oracle, Schneider electric, Uber, Yahoo, eBay, Facebook, Intel, Netflix, Twitter….

Data Centers in Nordic countries

Moving towards different applications to get use of the snow, the world's cooling demand has increased considerably during the last decades due to the increase of industrialization, comfort demands and new building technologies, i.e. data centers. Conventional cooling is produced by electrically driven devices. However, there is a variety of less energy-consuming system to produce cooling. This is to use stored snow and ice for cooling during summer. This technique has been demonstrated in large parts of the world, including Sweden, where the Sundsvall Regional Hospital has been using successfully the snow cooling plant since 1999, where the plant has delivered the main part (77-93%) of the cooling, having a total coefficient of performance 2.0-6.6 times greater than that of a conventional chiller system.

Installing a cooling plant would require a high investment and would require big demands and an increase in the electricity price for the investment to be amortized in the short term. Hence, there is a scenario that is increasing and will keep increasing for future years and that is to get the data centers of companies to be located in Kalix. Data centers use a lot of power, consumed by two main usages: the power required to run the actual equipment and then the power required to cool the equipment. The first category is addressed by designing computers and storage systems that are increasingly power-efficient. To bring down cooling costs data center designers try to use natural ways to cool the equipment. Thus, companies owning data centers are looking for a solution where CO_2 emissions are reduced and that is to use only renewable energies.

Figure 16. Facebook's data center in Luleå.

Here is where Kalix plays an important role. The cold climate of Sweden offers a natural advantage in cooling server rooms. Sweden has no shortage of cooling water. In the country, heat is actually a commodity and some data centers already sell heat to district heating networks. The electricity price in Sweden is one of the lowest prices around all Europe (0.062 e/kWh) and the power supply is 100% from renewable sources. These things make the companies think about placing their data centers in Nordic countries, i.e. Google Data Center in Hamina, Finland or Facebook's Data Center in Lulea, Sweden. This last one was the first data center located in Norbotten and since the time Facebook installed their first data center in Lulea, five more companies follow the steps of Mark Zuckerberg's company.

According to Gartner Consulting, there are already 250 data centers in all Europe and the industry will add up to 50 more in the following ten years. Cloud data centers seem to be moving towards extremes in terms of size, either becoming massive or very small. The ones, which are bigger, would need energy supply and therefore, more cooling. Thus, this type of data center will be built in cooler climate places to reduce cooling costs. This is related to the snow cooling plants mentioned before which due to the lower electricity price in Sweden, makes it interesting to combine a snow cooling plant with a data center that can also sell district heating. In such a way, an independent heating/cooling network will be originated using only renewable energies.

Figure 17. Google's data centre in Hamina, Finland.

As an example of using snow cooling for data center, the White Data Center project in Hokkaido, Japan, has shown the viability of storing snow in winter and using it as cooling in summer. Snow cooling maintained the ambient temperature of the building at 25ºC without the need of electric air-cooling.

Therefore, Kalix could be an interesting city to locate data centers. To get a significant company's data center installed in Kalix as Facebook has done in Lulea, will suppose a really high investment, hundreds of new employees and the possibility of new industries. Some companies that are currently studying to look for places to build their new data centers are: Alibaba, AOL, Cisco, Lenovo, Oracle, IBM, Equinix, Schneider Electric, Sentinel, Intel and Netflix.

The Traffic Situation

The road network and the traffic situation in the centre of Kalix is messy and unstructured. Kalix street spaces are designed and customized for cars. Indeed, all the streets and destinations can be reached by car and often offer parking spaces directly adjacent to them. This situation leads to a large amount of cars circulating in the downtown core in search of the best parking spot, a situation that is unsustainable. (Kalix Kommun, 2012) The street network provides good connection in the east-west direction, but not in the north-south one which lead to some lack of supply in this direction. (Kalix Kommun, 2012)

Local transport in Kalix is operated on contract by Enberg haulage AB . Bus services run only Monday to Friday, no weekends. People who cannot travel by public transport have the opportunity to apply for transportation service. They can be granted an escort if necessary. Special transport services are regulated by Paratransit Act and is intended for people with significant disability and difficulties in moving on their own or take public transportation. Paratransit is a kind of special public transport adapted to the needs of disabled people. That means they can't "own" a car or travel at exactly requested times. It means they are given an opportunity for mobility and it is also an adapted form of transport.
In cooperation with the Norrbotten County traffic arranged Kalix direct buses to Luleå are available for people who commute daily from Kalix. The bus departs from Kalix Bus Station and also stop in Töre for boarding, then it goes directly to Luleå University and Stoat Park before arriving at Luleå bus station. (Kalix Kommun, 2012)

The frequency of the bus is rather low, almost 1 per hour. This means that it is easier to choose the car for trips before the bus. Car ownership in Kalix is 553 cars per 1000 inhabitants, which is slightly above the average for the county (535). This means that the car plays an important role in people's transport in Kalix despite the objectives the municipality policies states (Kalix Kommun, 2012)

Kalix has good pedestrian and cycle routes from the housing areas to the center. In the center of Kalix, however, we find only those which are existing in the road network. (Kalix Kommun, 2012)

The E4 runs south of the center of Kalix and links the city with the south Lulea and Haparanda in the east. The road is the main gateway to Kalix, its adjacent buildings and nature are very important for the city's first impression. The E4 is very busy and despite the fact that it is perceived as an access for far traffic, it is used within agglomerations. Its width and high speed rating may be questionable. The municipality plans to narrow the E4 along the route past the center, reducing the four lanes to only two lanes. Two new roundabouts are also planned along the same route, to increase access to Strandängarna. (Kalix Kommun, 2012)

Summary

	Main Issues
Road network	Traffic in the center is messy and unstructured. Many cars circulating in the downtown core looking for the best parking spot The lack of transport network is because today the parallel street is closed past the mall.
Street network	Good connection in the East-West direction, but not in the North-South direction. There is a lack of supply in this direction
Local transport	Only during weekdays (Monday-Friday) Not high frequency only one per hour, therefore it is easier for people to take the car
Car density	Higher car ownership than the average of the county (553vs535) for 1000 inhabitants
E4	Very busy Speed is too high

Figure 18. Summary table of main traffic issues.

Main Purpose

Reduce traffic in the center of Kalix and create better conditions for walking and cycling in a greener environment that encourages social meetings by promoting clearer street structure and shorter driveways in the traffic. The goal in the future would also providing for Kalix its own train station.

Vulnerable Areas

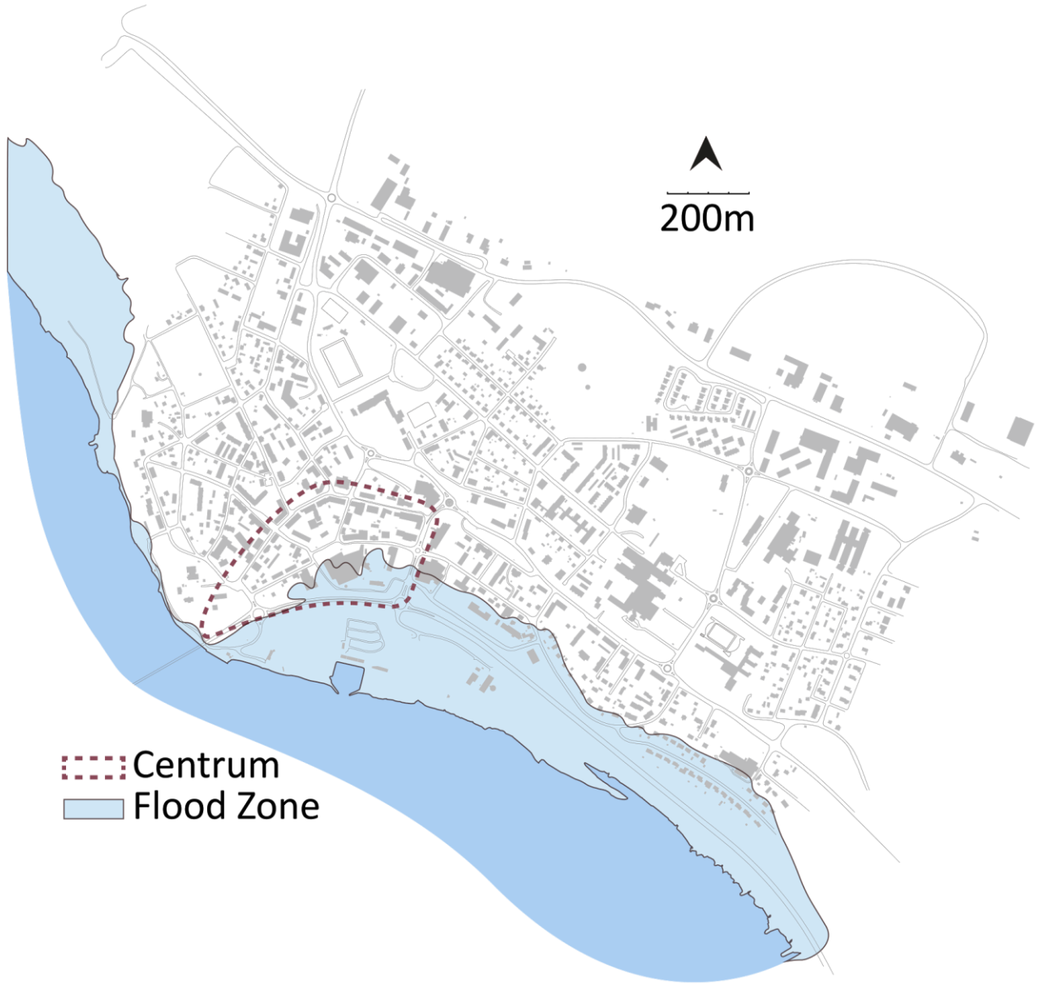

Figure 19. The flood zone is comprised of 100-year flood lines combined with maximum flow lines to depict a worst-case scenario for flooding in Kalix (Myndigheten för samhällsskydd och beredskap, 2015).

- Kalix centrum is affected both by 100 year floods and maximum flow calculations

Many cities use the 100-year flood lines to help guide urban development. From SMHI predictions, it can be seen that Strandängarna, as well as ICA would be affected by the maximum flows generated from a 100-year rain event. Development in these areas should happen with this very real risk in mind.

Population and Demographics

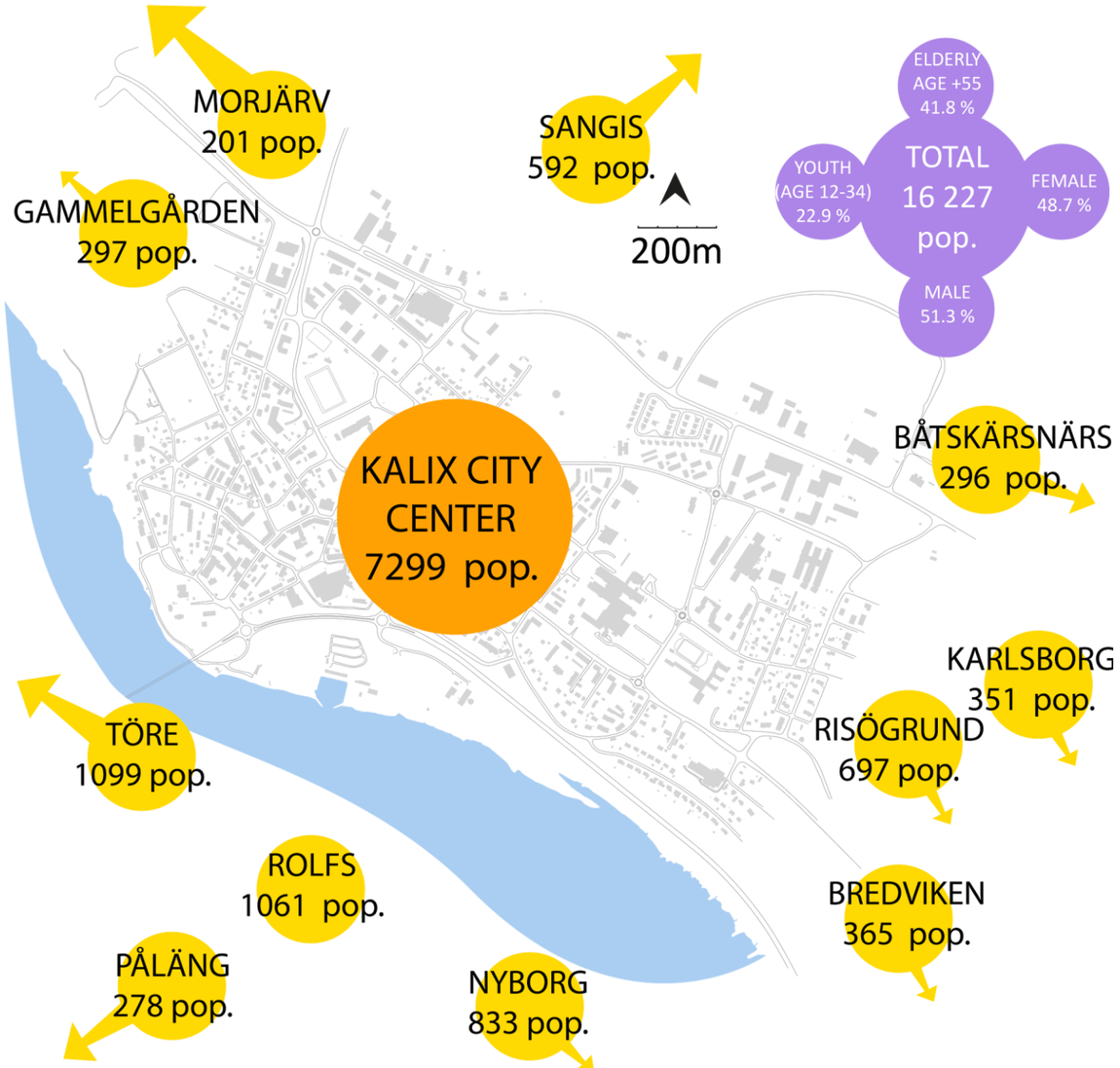

Figure 20. Population map of Kalix and surrounding towns

\+ Kalix is the centre for many surrounding towns and therefore has major institutions for the county

\- Kalix has an aging and shrinking population

Kalix has an area of 7,57 km^2 and is host to a population of 7299 people. The nearest town to it is Rolfs, located right after Kalixälven. The entire municipality has a population of 16,497 with Kalix center clearly contributing approximately half of this total number (Kalix Municipality, 2016). Thus, it is understandable that Kalix city center provides the major institutions of the county, such as the hospital and some local schools.

The demographics in Kalix displays a low percentage of youth (aged 12-34) at approximately 23%, while an disproportionally high percentage of elderly above the age of 55 at approximately 42% (City Population, 2016). This indicates an aging population that needs to be taken into account in further stages of urban design and planning.

For further demographic information refer to Appendix A.

Recreation & Attractions

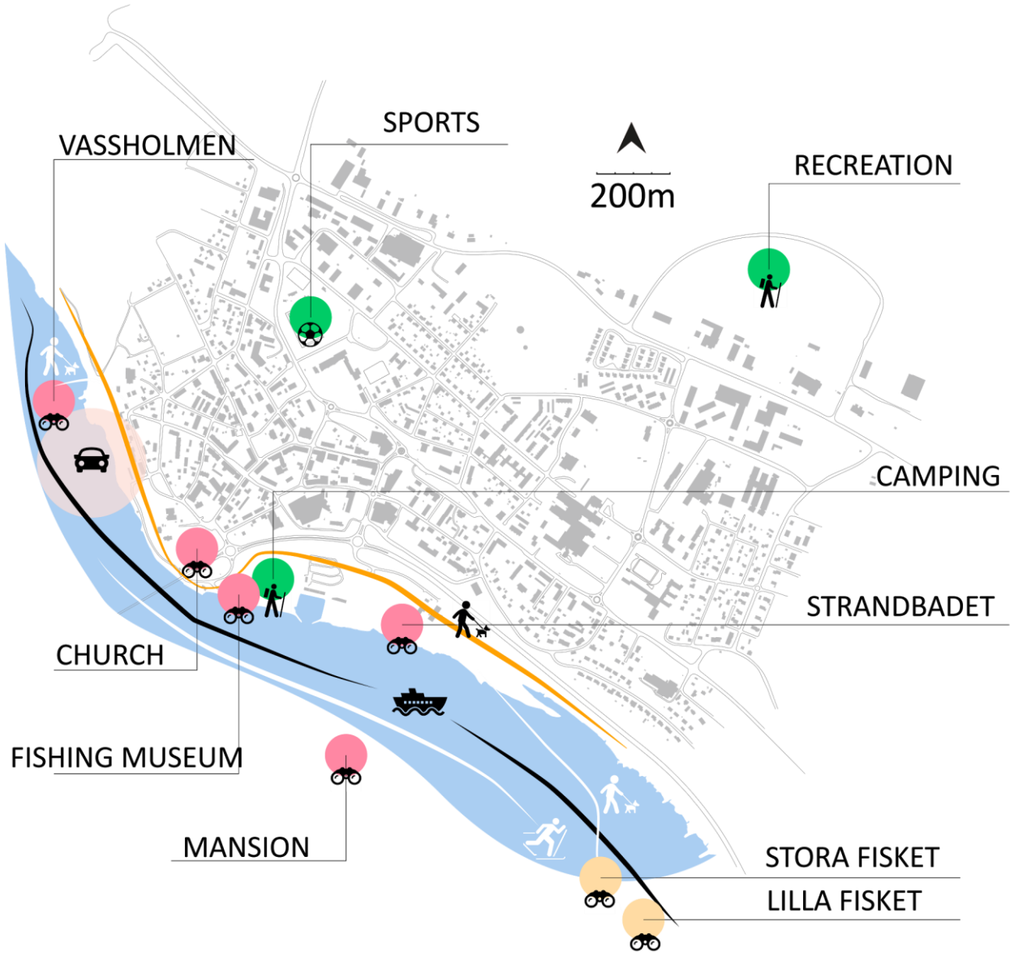

Figure 21. Recreational opportunities in Kalix

- \+ Kalix has a variety of nature-based recreation and attractions along the waterfront
- \+ Kalixälven becomes a strong recreational and connection corridor during winter
- − Lack of connection between these areas and attractions

Kalix offers for a nature and outdoor-oriented lifestyle, and many of these outdoor activities can be found in Kalix's annual guide called "Kalix Outdoor and Culture Guide" (Kalix Municipality, 2016). In the map on the left, some of these major activities are depicted. Most of these activities are found along or on Kalixälven, and it depicts both winter and summer uses of the river. Not only does the river support a plethora of recreational activities, it also acts as a transport corridor during the winter, when the river freezes through. Commonly, ice skating, cross-country skiing and using a snowmobile are modes of transport during winter. Upstream, it is even possible to drive on the ice during some winter periods.

There are some recreational activities and areas present further inland, however there is evident disconnection between them. The most convenient way to access them is via private transport (a car). The connection between these areas needs to be strengthened and better connected to the activities by the waterfront if Kalix aims to become a more accessible city for both tourists and locals.

Orientation & Movement

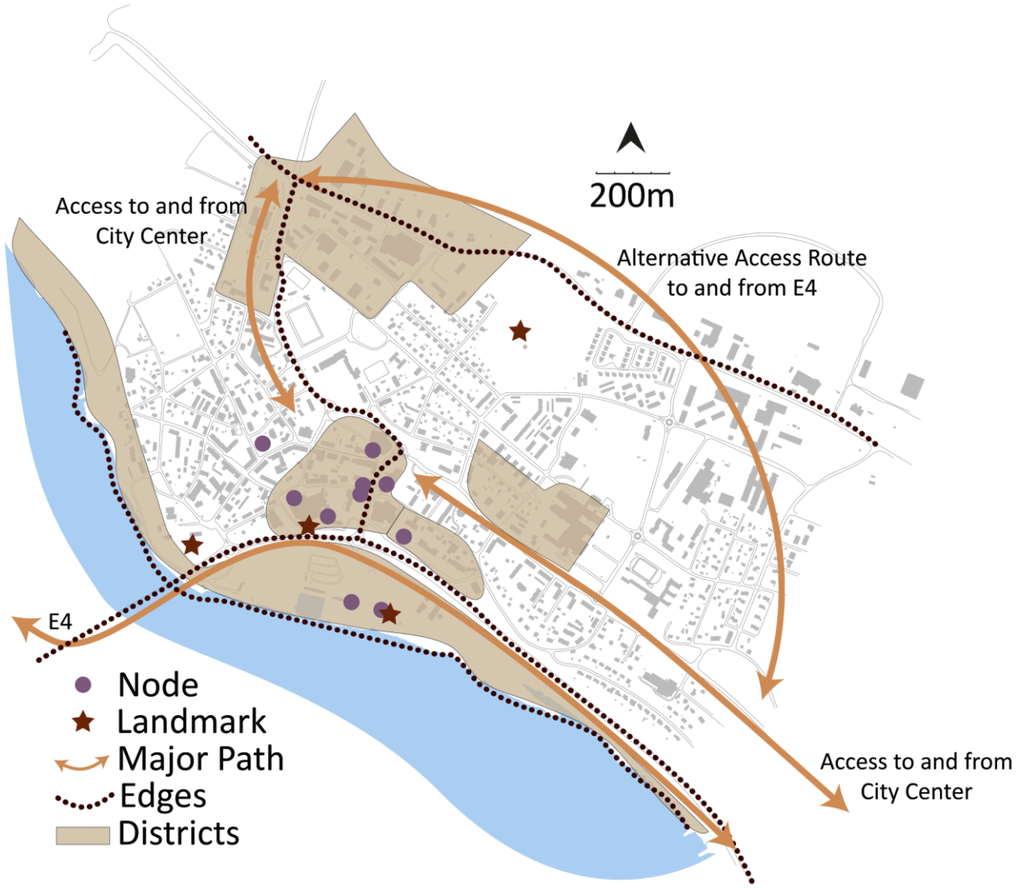

Figure 22. A Lynch analysis of Kalix

- The church, Galleria and orange ball are strong landmarks visible from the E4
- Lacks both inviting features and signage to entice E4 users to stay
- Illegible city centre

The orientation and movement analysis takes principles from the Kevin Lynch analysis, where orientation and movement is focused upon using a social perspective - what people notice (landmarks), where people congregate (node), how people move (path and barriers), and how people perceive and feel different spaces (districts). Many of the major barriers in Kalix are posed by roads, and also by Kalixälven. With such a car-dominated environment, it is justified to say that the movement of people is shaped by the movement of cars. Thus, the major paths are also characterised by roads, where major access roads are delineated (the E4, and roads accessing in and out from the E4). Some identifiable landmarks from the E4 is the Galleria, the Orange Ball, and the Church. Weaker landmarks are Strandbadet, and the water tower inside the city. Some strong nodes of Kalix is Strandängarna (the walk along Kalix Meadows), and the area outside Hotel Valhall which marks a central point for people living in different directions from the city center to meet.

Landuse

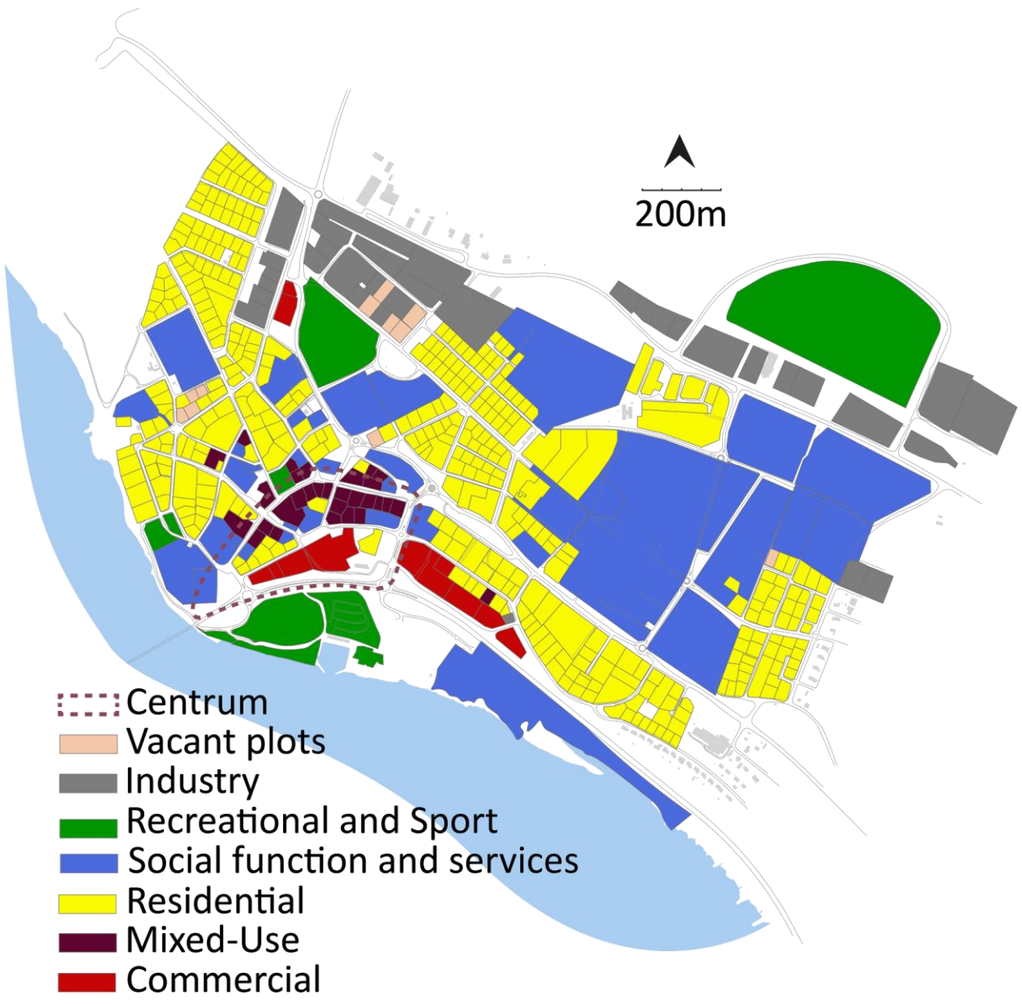

Figure 23. Landuse map of Kalix centrum.

+ Centrum has an appropriate mix of landuse functions to support a vibrant city centre

− Lack of density in the centrum

Land use map can illustrate different dimensions of land use information. Most common dimensions of a land use map are activity, function, structure type, site development character, and ownership (The Land Based Classification Standards, 2001).

In this study, we define seven-category multidimensional legend to understand and learn the most of the Kalix city. The ownership and property boundaries helped us to distinguish land pieces. (Kartor Eniro, 2016)

While developing this map, we notice the central part of the city is quite sparse. There are vacant plots close to city center. Mixed-use functions in central part lend Kalix a great foundation to a live and vibrant city center. Industrial plots are located farther north of the centrum and close to the railroad. Social functions and buildings are well integrated throughout the residential areas.

Parking

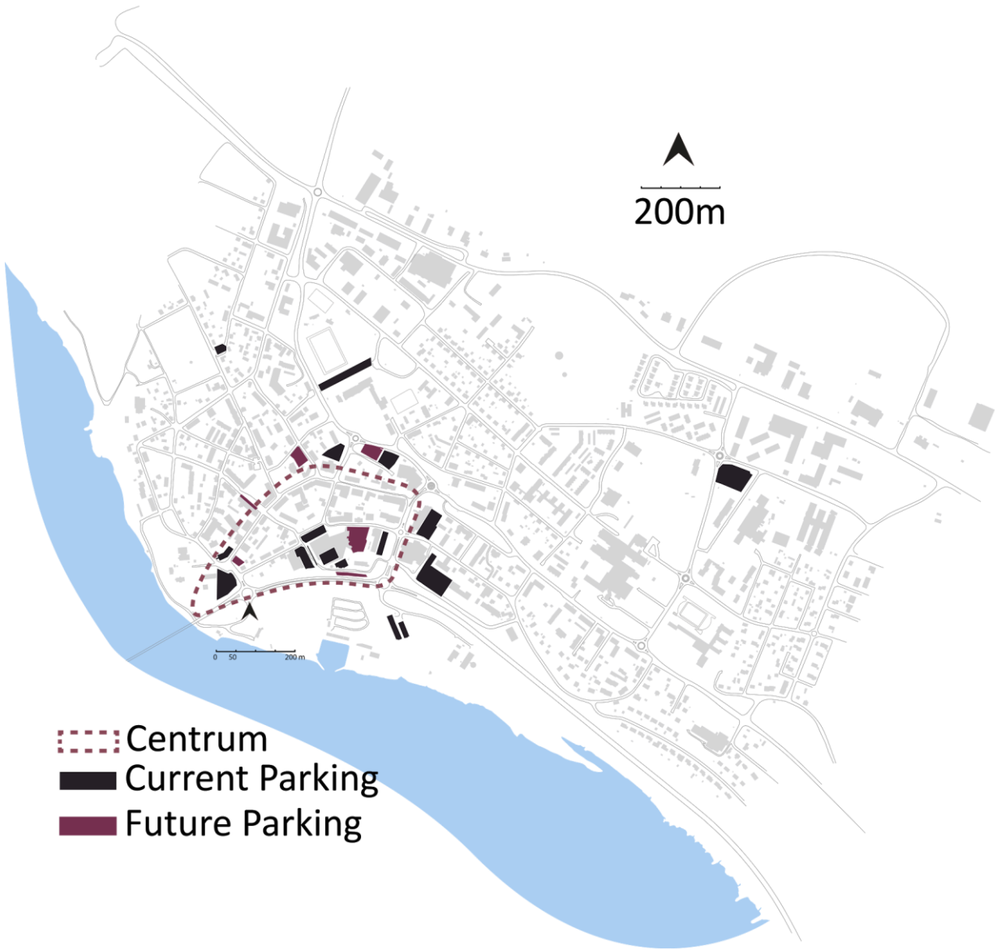

Figure 24. This map highlights how some valuable plots have been dedicated to current and future parking lots.

- Car-dominated centrum
- Future parking proposals will take up more valuable land in city centre

"Galleria Kalix" is located in the central part of the city and it serves not only the residents of Kalix but the entire county's inhabitants, hence there is a great demand for parking spaces around Kalix centrum. The following map shows the distribution of current parking lots and planned parking lots for future Kalix (Kalix Kommun, 2012).

Everywhere there are parking lots; along streets, in residential entrances, at the square formations etc. Car parks tend to get prime real estate, stealing attractive and valuable land that could instead be used for pleasant activities. However, parking spaces should still be offered because trading activities in the center rely on easy car accessibility. The proximity to Haparanda and Luleå and the bigger shopping centres means Kalix centrum has to compete for trade with these other areas.

Today 1/3 of the parking spaces are reached from the mall from Nygatan and Parallelgatan, and the rest from Strandgatan.

Greenery and Asphalt

Figure 25. Trees and green space of Kalix centrum.

+ Strandängarna is valuable green space park that allows interaction with the Kalix river

− Lack of greenery in the city centre

In Figure 25. Kalix greenery and trees are illustrated. The large amount of greenery at the waterfront allows a higher level of interaction with the Kalix river both in summer and winter. Lack of greenery in the city center is visible. In addition, large asphalt areas are observed in the city center (Blom Web Viewer, 2014).

Soft Mobility Routes

- Disconnected and sparse soft mobility routes
- Lack of connection to the waterfront

Official soft mobility routes in Kalix are limited. They consist of dedicated lanes, trails, and bicycle friendly roads. These paths are approximately less than 3 km long. These paths are not connecting the central part of Kalix (Google maps, 2016).

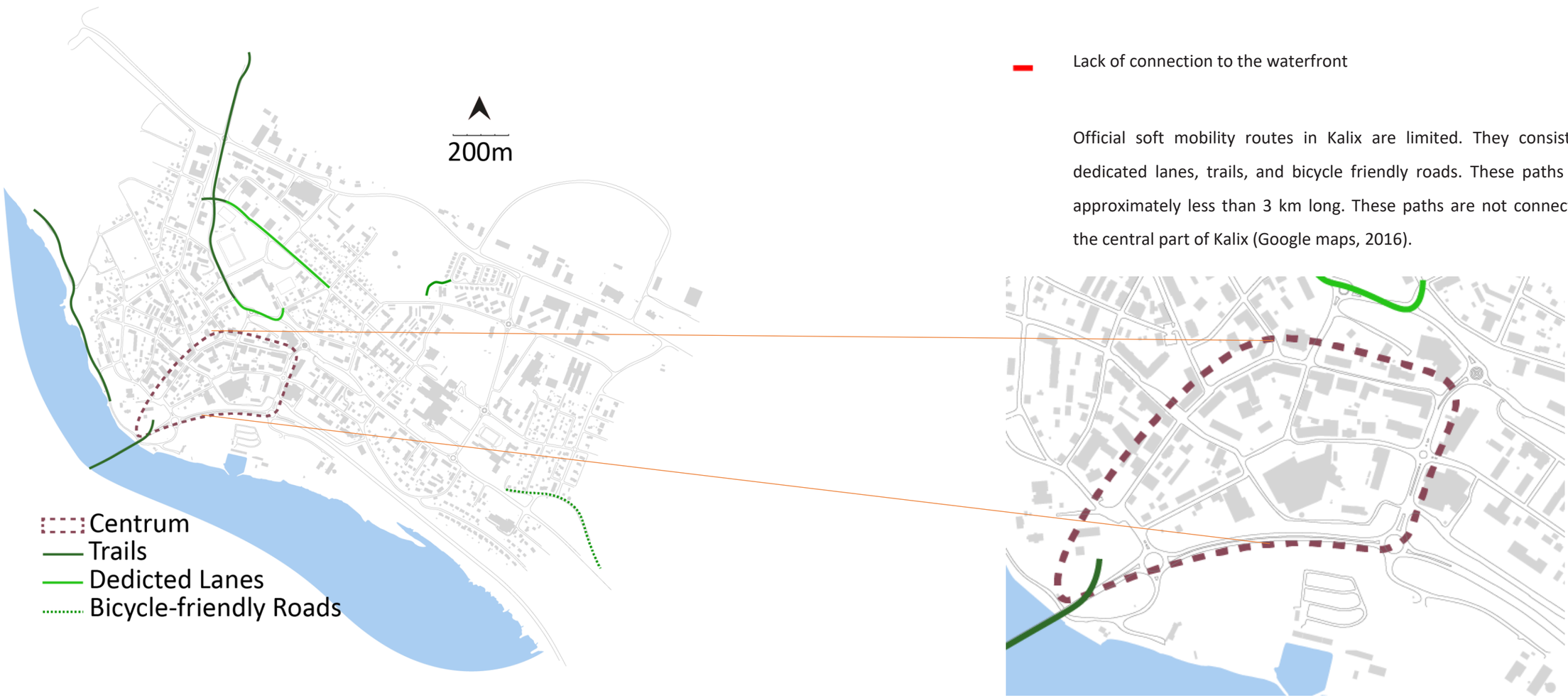

Figure 26. Soft mobility paths of Kalix centrum.

Bus Stops

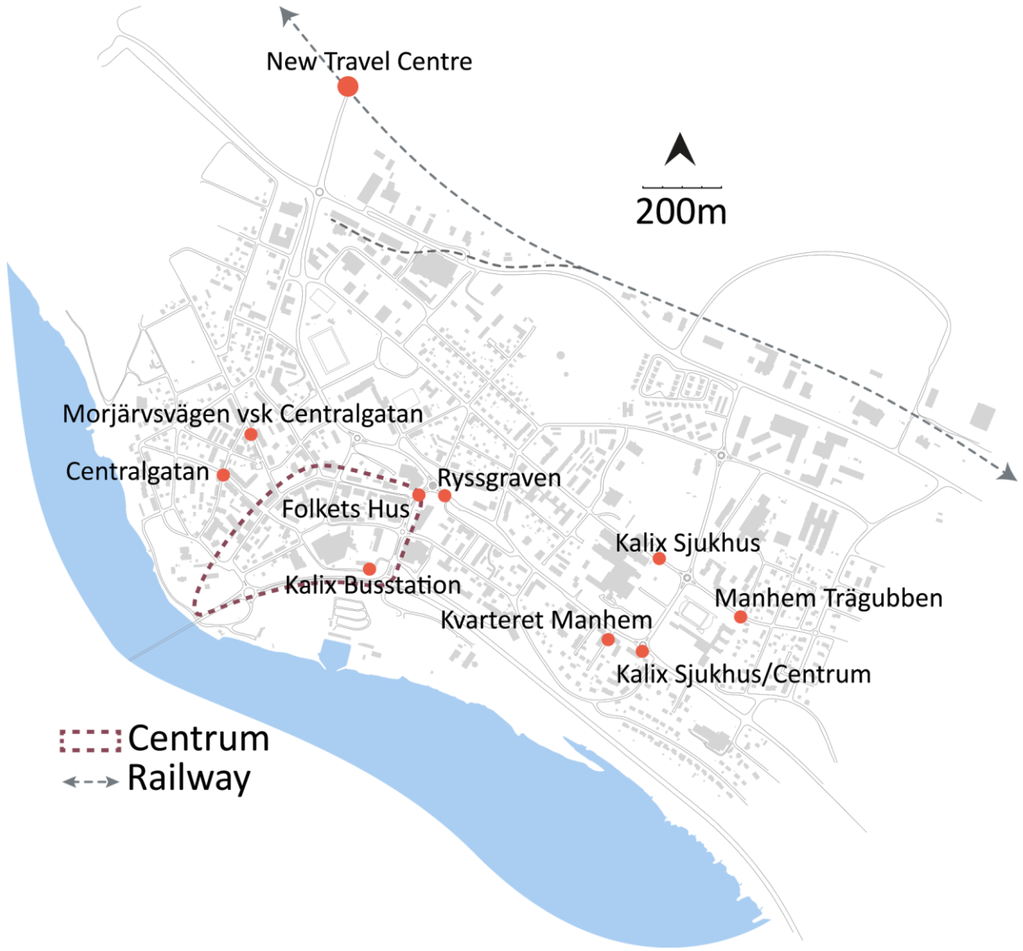

Figure 27. Bus stops of Kalix.

- Buses are not a very convenient form of travel within Kalix

Three nearby bus stops are connecting Kalix centrum to the rest of the town and the neighboring towns. This makes most of the social services in the city accessible (Kalix Kommun, 2016).

The new travel center/train station in northern part of Kalix are slightly disconnected and separated from the rest of the stations (Trafikverket, 2014).

Preservation Interests

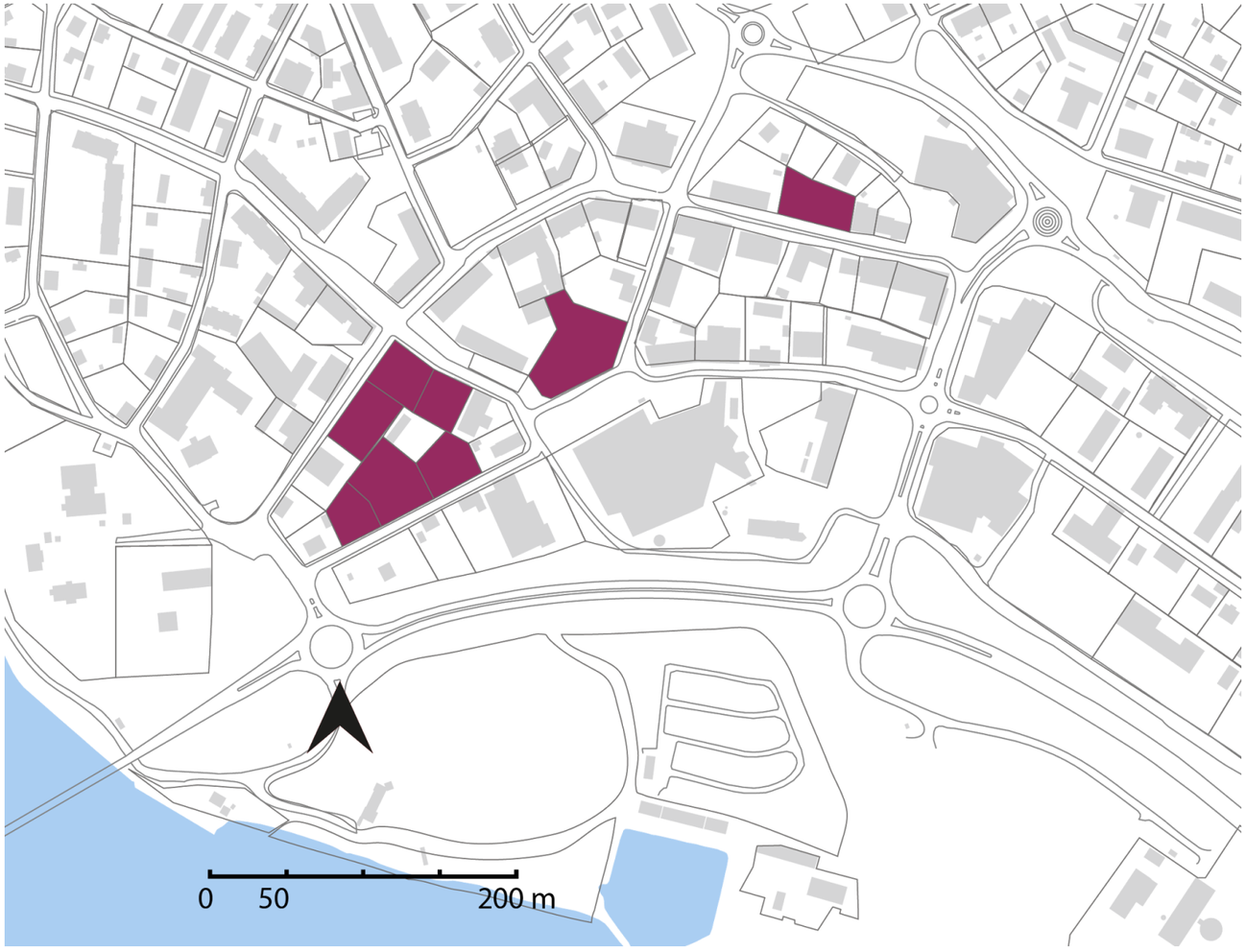

Figure 28. Conservation-worthy buildings and plots of land within or immediately adjacent to the project area are shown in purple. These buildings do not have formal heritage protection, but have identified by the Kommun as conservation-worthy (Kalix Kommun, 2012).

+ Buildings and plots with heritage value exist in the city centre

It is an asset that buildings and plots with heritage value exist in the city centre. Preserving these buildings can help create a strengthened identity of the city centre, one which is rooted in history. As seen in Figure 28 these buildings are mostly concentrated in the Handeln quarter, making this quarter less attractive for development.

Accessible Entrances

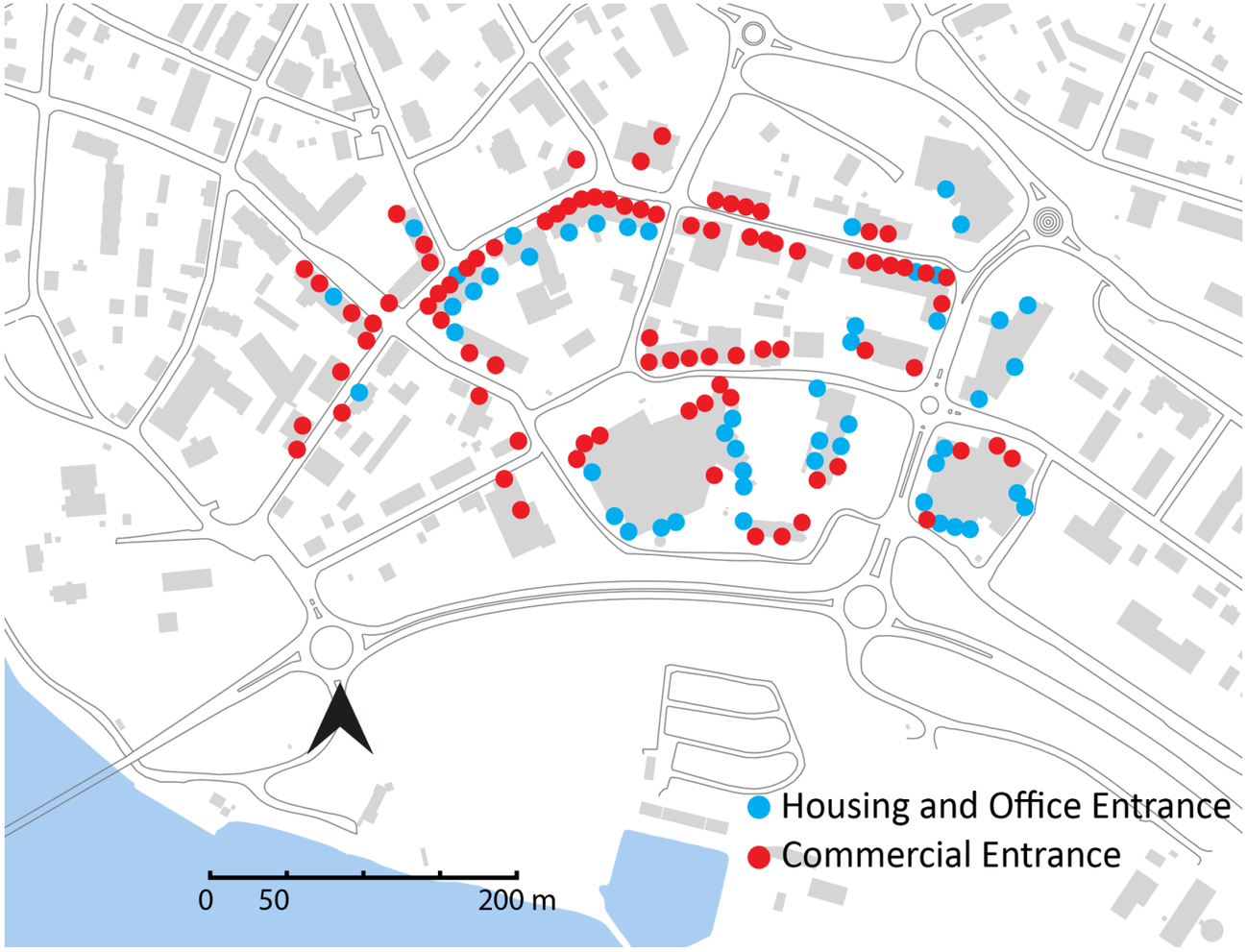

Figure 29. Accessible entrances in Kalix centrum.

- Commercial entrance areas are disconnected from each other
- Köpmannagatan entrances are north-facing
- Few entrances from the inner yards

The current accessible entrances to commercial spaces are shown in figure 29. The blue dots represent entrances to residential units and offices, and the red, commercial entrances. Most of the entrances into commercial activities are located along Köpmannagatan and Strandgatan. Hardly any entrances are to be found along Ny-, Post- or Torggatan. This clearly shows the strong disconnectivity between Köpmannagatan and Strandgatan. There is also a great lack of activities in the inner yards that are resulting in long distances between the two shopping streets.

Wind Analysis

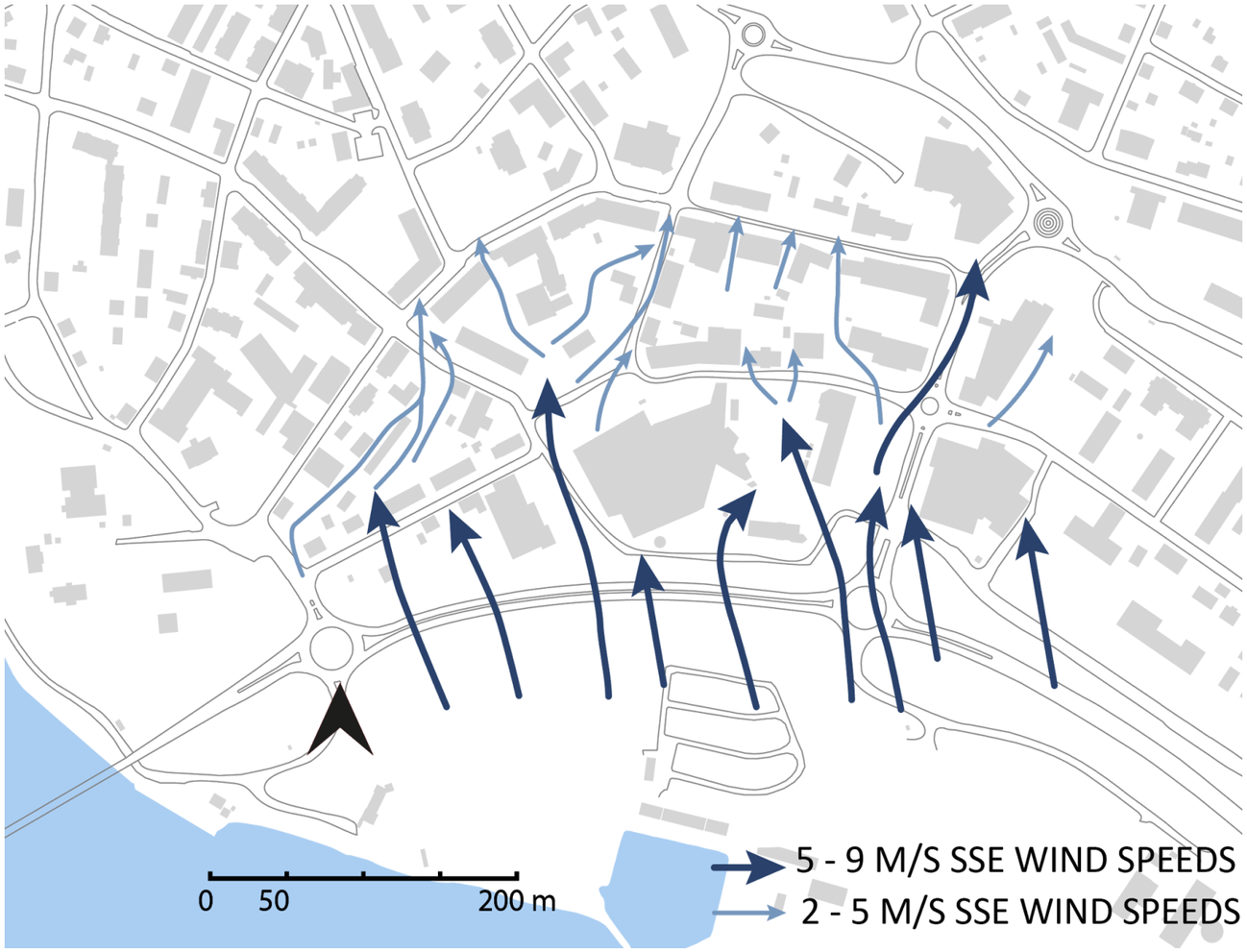

Figure 30. Wind analysis using predominant wind speed and direction for Kalix.

\+ Low building heights in the centre allow wind to pass over buildings

\- Köpmannagatan, Strandgatan and galleria plaza relatively are wind-protected

\- Some areas of the city centre are quite exposed to predominant SSE winds

The predominant winds in Kalix come from SSE at 9.2 m/s (Windfinder, 2016). This wind analysis shows higher wind speeds in dark blue arrows, and lower speed winds in light blue. It can be seen that the south side of the city centre experiences higher wind exposure, and that the higher speed winds enter the city centre through the large open spaces between the most southern buildings. The original CFD analysis can be found in Appendix B.

Shadow Analysis

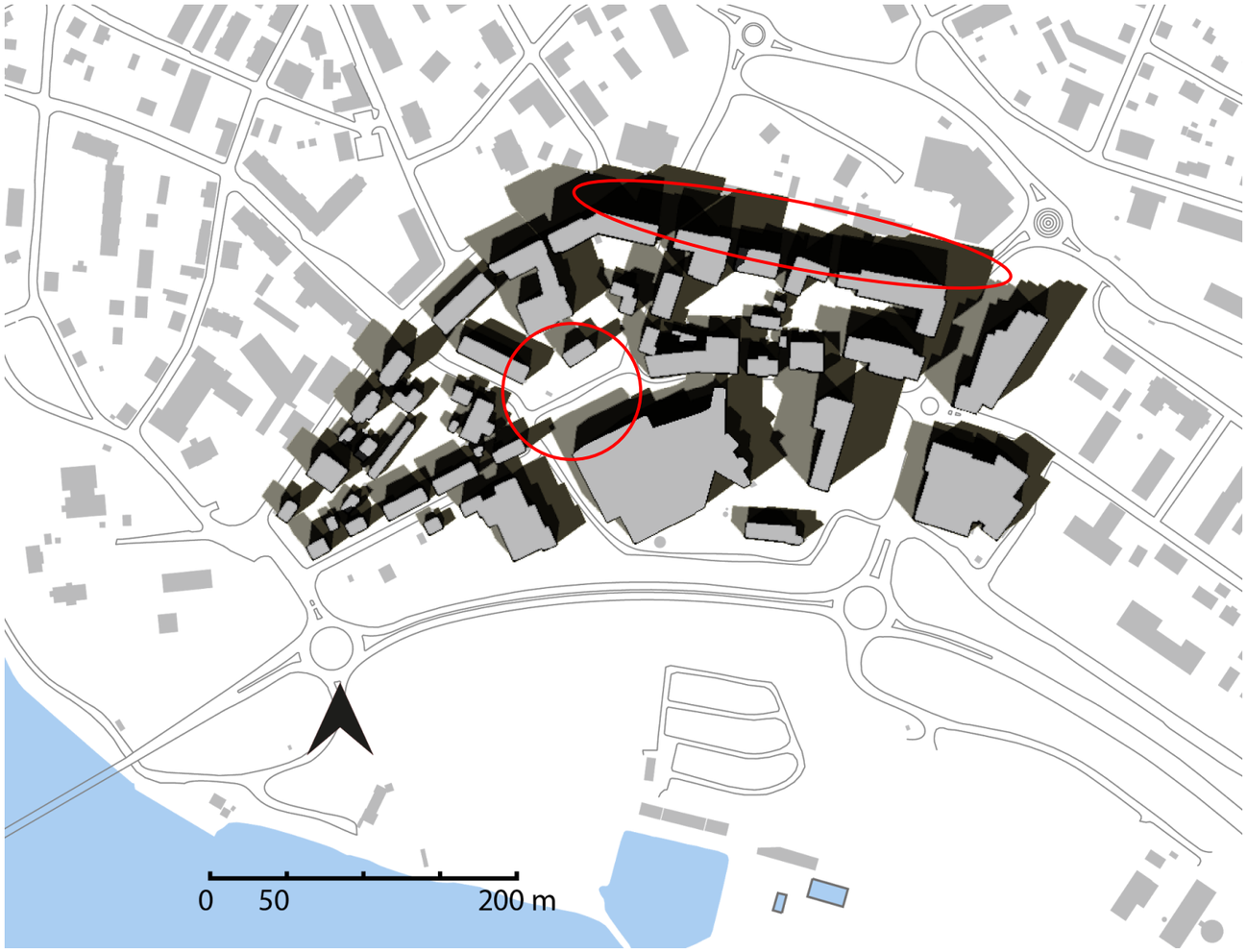

Figure 31. Overlaid shadow analysis for Mar 20.9:00,12:00,15:00.

\+ Low building heights and distribution allow sun into the city centre

\- Sun-exposed areas do not align with pedestrian areas (Köpmannagatan)

Shadow analyses are usually done at the summer and winter solstice, as well as one of the equinoxes. This March 20 shadow study was conducted at the autumnal equinox, a day where day and night are equal lengths. Shadows are overlaid for the hours of 9:00, 12:00 and 15:00.

The relatively low density of buildings in the allows sun to penetrate the city centre, however, the sunny areas do not align with pedestrian focused zones. One of the sunniest areas is currently a parking lot, and one of the most shadowed places is the main pedestrian shopping area (Köpmannagatan).

Shadow Analysis

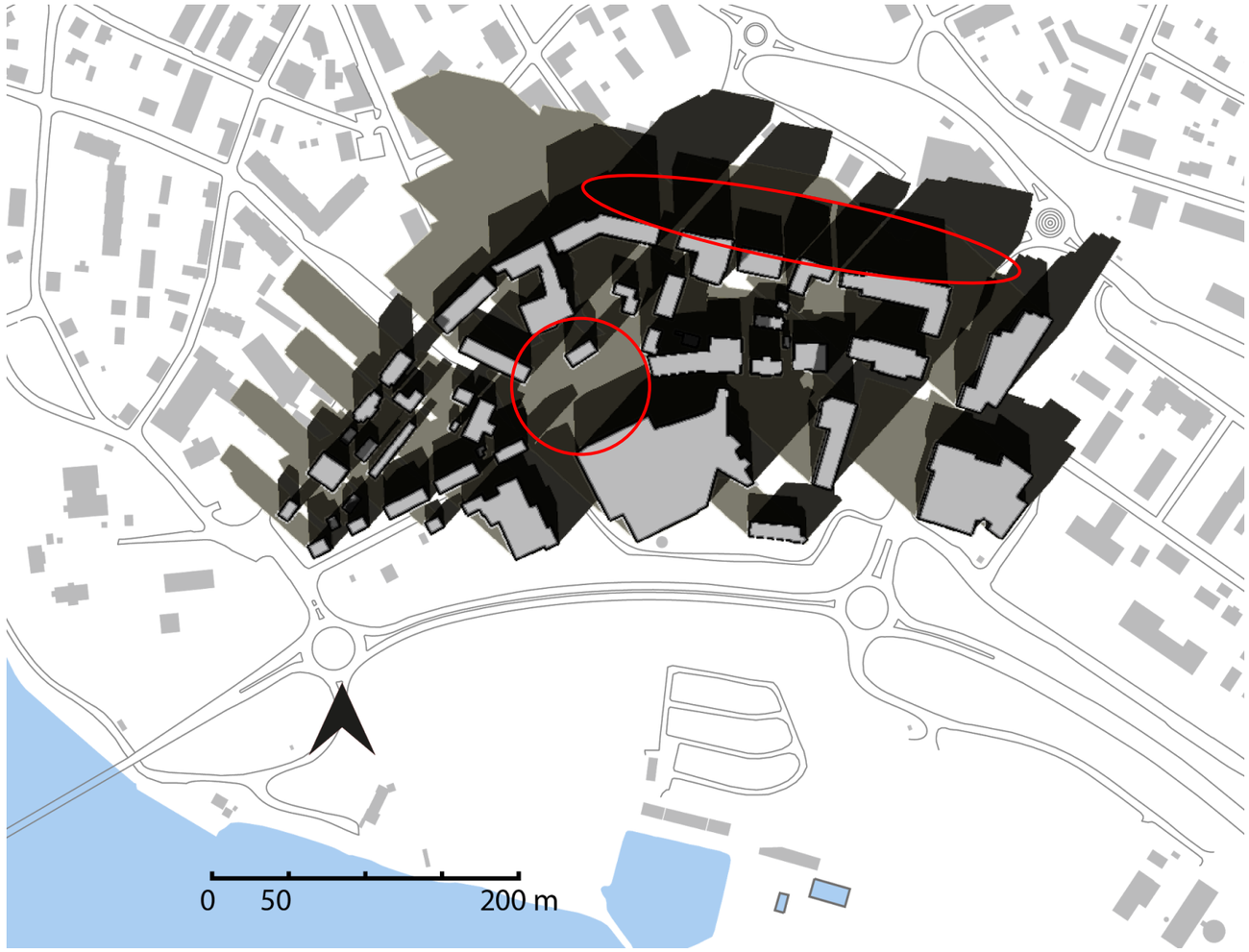

Figure 32. Overlaid shadow analysis for Oct 20. 9:00,12:00,15:00

\+ Low building heights and distribution allow sun into the city centre, even with low sun angles

\- Sun-exposed areas do not align with pedestrian areas (Köpmannagatan)

As previously mentioned, shadow analyses are usually done at the summer and winter solstice, as well as one of the equinoxes. For Kalix however, the summer solstice will show total sun exposure, and the winter solstice will show virtually no sun exposure due to the extremely low sun angles. For these reasons, the date of October 20 was chosen, as it is approximately halfway between the fall equinox and summer solstice. At this time of year there is some sun but at low angles. This is a time of year when people welcome the presence of any sun.

Köpmannagatan has very few spaces in the city centre receive with sun access all day long, but the areas in light grey receive some sunlight. Again, Köpmannagatan is a very shadowed street, and long shadows are cast by the buildings on the south side of Köpmannagatan. Some sun reaches the open space/parking lot behind ICA is again the sunniest area in the city centre.

SWOT Analysis

STRENGTHS	WEAKNESSES
➢ Kalix is located in a culturally and naturally interesting landscape • Developed waterfront close to city centre ➢ Church is a strong cultural heritage landmark ➢ Very close to transit corridor (E4) ➢ Has major institutions of Kalix Iän ➢ Sunny exist within the city centre	➢ Lack of greenery in centrum ➢ Disconnected city centre • Waterfront • Church ➢ Lack of true “centre” ➢ Unclear signage ➢ Wind-exposed city centre ➢ Disjointed cycling and pedestrian infrastructure ➢ Parking-dominated centre ➢ Large block size makes it difficult for pedestrians to navigate ➢ Lack of senior housing ➢ Köpmannagatan is a shadowed street
OPPORTUNITIES	**THREATS**
➢ Improvement of winter life ➢ Connection of future travel centre to city centre ➢ Encourage E4 users to stop in Kalix ➢ Open spaces (including parking) in centre allows for easy development ➢ Well-positioned to attract data centre	➢ 100-year flood and max flow levels ➢ Changing climate ➢ Shrinking population ➢ Aging population

Figure 33. SWOT table.

VISION FOR THE FUTURE KALIX

Analysis and creativity sessions done during this project make it possible to have a clear vision for the future Kalix, divided into five main goals for the future. Creativity sessions are explained in detail in Appendix B.

1. A vibrant, northern hub for outdoor activity.

The plan is to develop an active winter tourism sector, and new solutions to new challenges by taking advantage of more efficient technologies. Making Kalix an attractive point will be done through creative and unique activities (Local specialities fast Food, Ice Statue...).

2. An accessible and connected Kalix.

Kalix will be a climate-smart city that encourages cycling, walking and public transportation. The train between Luleå, Kalix and Haparanda will also contribute to this, as well as aid in developing larger communication in the region and increase the attractiveness of the city.

3. Financially prosperous Kalix.

This will be done by developing a bustling city center and an active economy through an enticing shopping area and urban streets morphology. The prospect of a data center is also another way to contribute to the economical prosperity of Kalix.

4. Celebration of cultural heritage.

Kalix has an interesting cultural heritage such as the church and the special local food (caviar), which need to be emphasized through activities and used as means to attract people.

5. Natural and sustainable Kalix.

Green areas will be connected, protected and will provide opportunities for recreation and support biodiversity. Greater consumption of renewable energy with a data center and energy eco facilities (eg, district and thermal heating) will contribute also to a sustainable future Kalix.

A vibrant, northern hub for outdoor activity

Figure 34. WInter sauna (Source: Seefeld Sports).

Figure 35. Jumping into the lake in winter (Source: Wikiwand).

The plan is to create a vibrant northern hub for outdoor activity, especially in front of Kalix river. The first idea is to create a winter sauna to complete the current swimming pool complex. A suggestion is to add a jacuzzi and *'hamman',* in order to develop a real relaxing complex like a spa. The complex could be located nearest the river to offer the opportunity to the customers to go out and swim in the cold river after sauna.

Another innovative concept is to organize the biggest sauna of the world to attract many people in Kalix. This concept could be also the biggest barbecue or concert in an ice building or cultural festival. These ideas have to be developed in a more realistic manner, but could be a good way to make the city more known and frequented.

Figure 36. An example of a protected public space (Source: Tengbom Arkitekter).

Figure 37. Example of seasonal market (Source: room-suggestion).

Another concept is developing a social and economic space, protected of outside wind and cold. Maybe a seasonal market where people can sell or purchase local products and regional specialities like Kalix caviar. Products would vary across seasons and availability. It could energize the local economy and create jobs. These areas would attract locals and tourists to have a good time.

An accessible and connected Kalix

Figure 38. Umbrella provision (Source: Umbracity, Richard Seah).

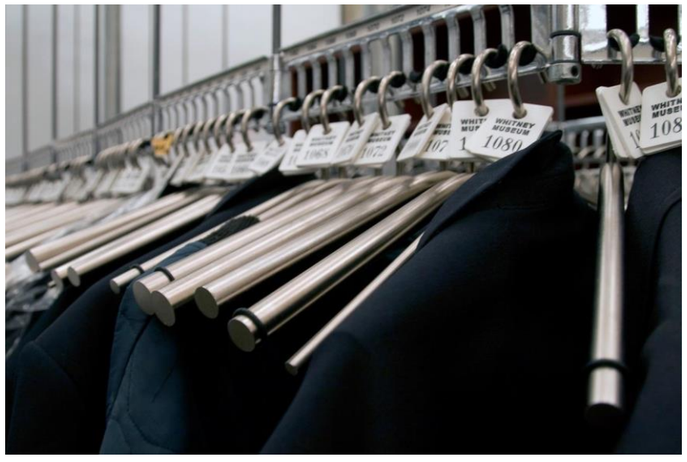

Figure 39. Coat check (Source: Sheldon Collins).

Figure 40. Indoor loafers provision (Source: Maison Thuret).

About an accessible and connected Kalix, concepts were considered that could help people to enjoy spending time in the city centre, and have a more comfortable shopping experience. Kalix's northern location means that bulky winter clothing is required in the colder months. This can be uncomfortable to carry or wear when you transition to an indoor environment. Coats checks (Figure 39) could be created at the entrances of stores or public buildings where people can easily leave their outdoor clothes, and possibly rent slippers to make themselves comfortable (Figure 40). Climate change information reveals that Kalix will become a rainier place in coming years. In cities like Vancouver, Canada, umbrella rental services exist in busy pedestrian areas, so going outside in inclement weather is a bit easier. Perhaps Kalix could have a free umbrella rental service, and brand the umbrellas to strengthen the Kalix image, or promote local business or tourism (Figure 38).

Figure 41. Bicycle racks (Source: Tool Design tool).

Figure 42. Covered bicycle transport (Source: Organic Transit).

Kalix will be a more sustainable city that encourages sustainable modes of transportation such as cycling, walking and public transportation. This can be achieved through different propositions such as free covered bike stations (Figure 41) near the drop off station, the centrum, the waterfront and the bus station, green corridors, pedestrian zones. For example, biking can be an enjoyable form of transportation year-round as well. With protected bike storage, bikes stay dry and snow free. Kalix could encourage people to get out biking all year round with free covered "Kalix cabs" (Figure 42) that people can rent free of cost. These colourful bikes could provide some climate protection, and be an eye-catching way to encourage people to use active transportation year-round.

This can also be managed through innovative ideas adapted to the climate in Kalix such as heated sidewalks.

Figure 43. Heated sidewalks (Source: MontrealGazette).

A financially prosperous Kalix

Always concerned with the financial prosperity of Kalix, we think about an outdoor galleria. It consists of covering the shopping street with a glass roof. It allows light to pass through during the day and see the stars during the night. We want to add light decorations to create a nice and warm place.

Figure 44. Glass covered walkway (Source: By Fozr).

Celebrating cultural heritage

Figure 45. Example of burger with caviar (Source: Nookrestaurang).

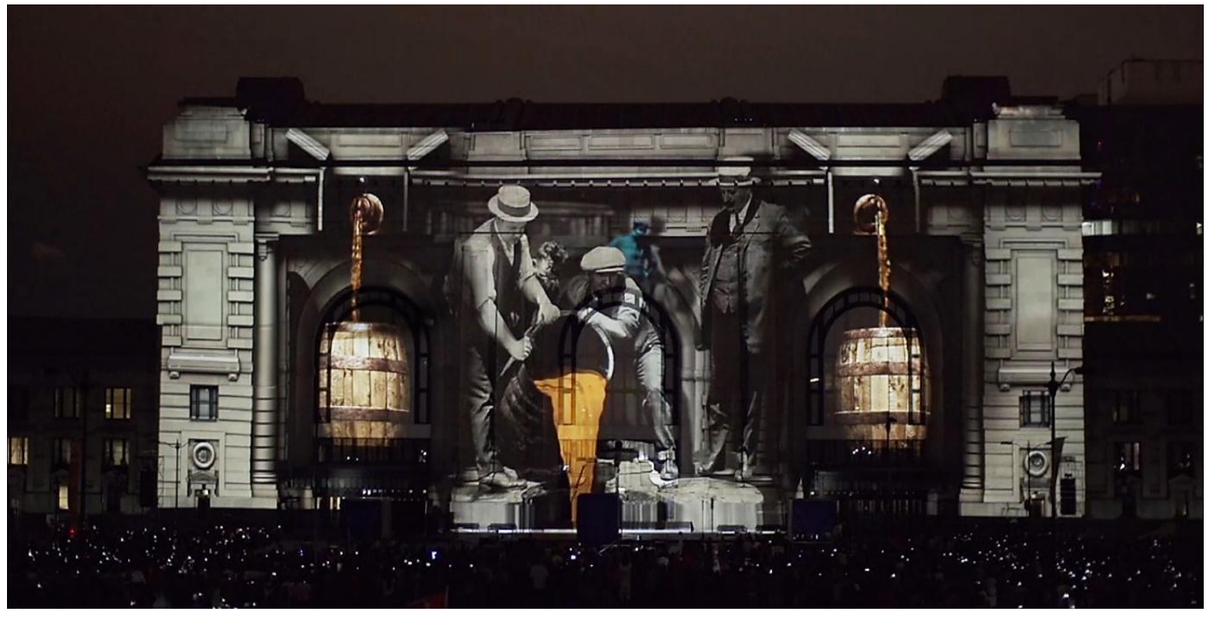

Figure 46. Projection onto a wall (Source: Digitalmedianet).

Figure 47. Depiction of new Kalix tourist office.

About celebrating cultural heritage, we want to implant a little restaurant or a fast food near the fishing museum market. The aim is to propose local food like the *lojrom* of Kalix. This social and friendly place could attract people and show the culture of Kalix. Another idea is the projection of a movie of history and culture of Kalix onto the wall of the parking garage with a video projector. It is a new activity in the city center to attract people, both locals and tourists.

We can also introduce a tourist office, like a little cabin, in the entrance of the city, just after the bridge. A guide can advise tourists about all types of activities, events, museums, shopping. The goal is to entice tourists to stay in the city.

A natural and sustainable Kalix

Figure 48. Data center (Source: Daily Mail).

Figure 49. Street lighting energised by wind and sun (Source: Barcelona University).

As mentioned before, Kalix is placed near a river and the sea, where wind plays an important role since wind speed simulations have been done. Thus, a lighting system running on wind energy will generate electricity for self-consumption at low scales. Using wind power will be an effective solution to implement on the Kalix bridge since it is a place where wind is less obstructed and will be a perfect combination with the solar energy during the whole year. Combining solar and wind energy for generating electricity for lighting is an effective system using renewable energies which will be independent of any electrical companies and be owned by the Kalix Kommun.

Also, as mentioned earlier, Kalix is a potential place for a data center. To get a significant company's data center installed in Kalix as Facebook has done in Luleå, will suppose a really high investment, hundreds of new employees and the possibility of new industries.

Expanding and improving district heating and thermal systems (described on page 13 and 14) also contribute to Kalix's future sustainability.

MAJOR CONCEPTS

Concept 1: Strengthening Historical Connections

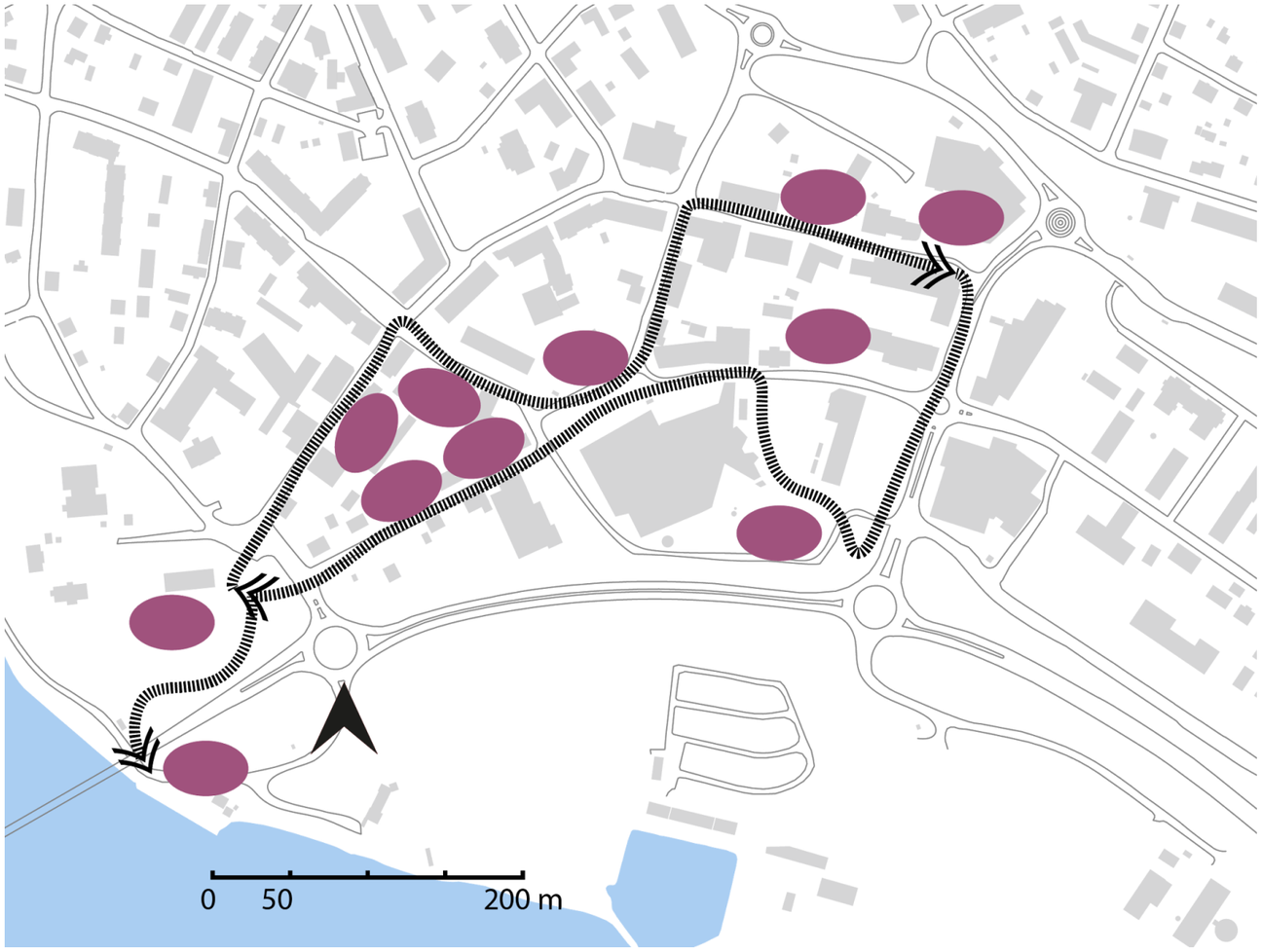

Figure 50. Map of cultural and historical spots. The journey begins with the church, then goes on to preserved historical buildings and plots, continuing to Folket Hus and the seasonal market, and then onto the Tourist information office and lastly, the Fishing Museum.

- Rich history and heritage to be celebrated
- Stronger connections promote better cultural understanding of the area - to both locals and tourists

As described previously, Kalix has a strong cultural heritage and rich history that deserves to be celebrated. In present day, the lack of legibility within the city centre and the lack of clear signage has led to much of this culture and history to be lost and unexplored. Thus, strengthening the connections between places that represent and celebrate Kalix's history is an important gesture in making culture and history more accessible to not only tourists, but to the locals too. This strengthened connection is based on walkability, such that all the places can be reached by walking and with either a tourist map or clear signage along the route. In turn, this strengthened connection will strengthen the identity of Kalix over the years, as locals and tourists become increasingly more associated with the city's culture and history.

Concept 2: Strengthening Public Spaces

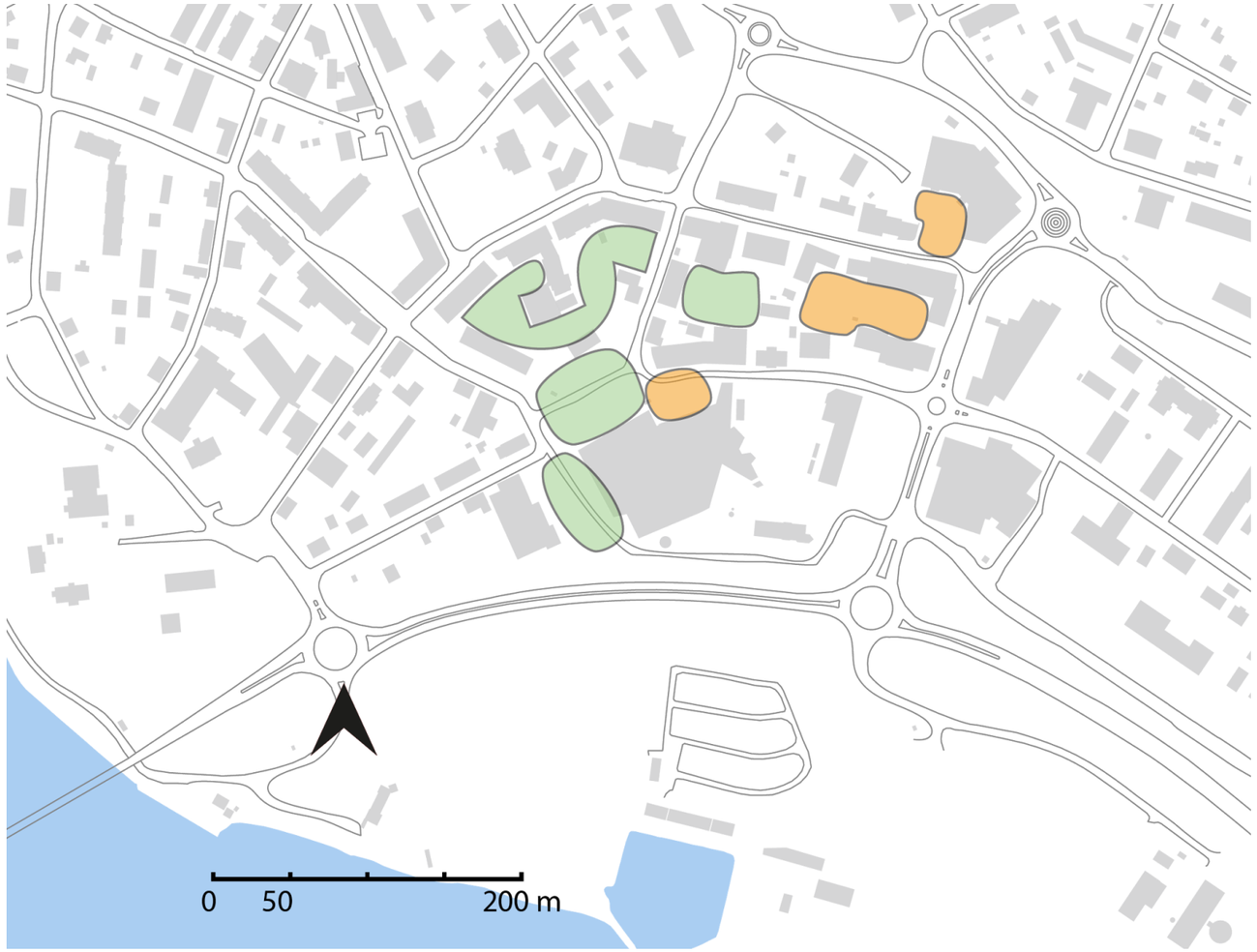

Figure 51. Map of new public spaces. Green formations indicate green public spaces such as the inner yards, new green corridor, and the central park. Orange areas indicate new open spaces such as public plazas.

- Create areas for people to stay
- Encourages walking as main form of transport within the city center

In the analysis, it was stated that over 50% of Kalix city center is covered by asphalt. This indicates some prior heavy preference for a car-dominated city center than a green, walkable city center. In an overall attempt to shift the urban design paradigm to the latter, the creation of new public spaces is important in drawing people out of their cars and buildings, on to the streets. Exciting new public spaces would encourage people to stay in these places and activate the space. This in turn, will interest other people and encourage even more activity; as Jan Gehl so succinctly expresses, “something happens because something happens because something happens,” (Gehl, 2011). These public spaces would be located close by one another, so as to promote walking between these spaces as the main form of movement. The idea of creating a more pedestrian-friendly environment is expounded on below.

Concept 3: Strengthening Pedestrian Movement

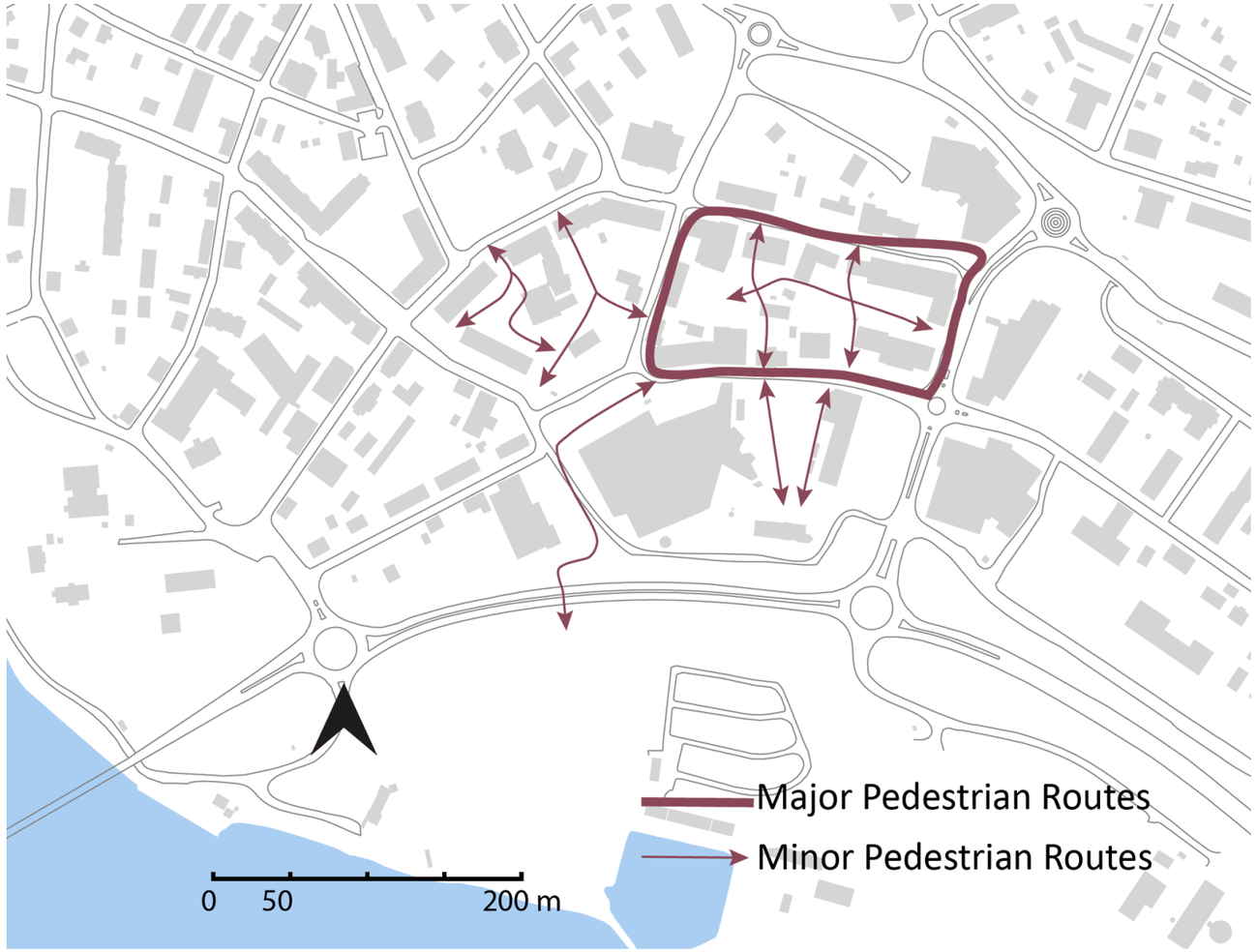

Figure 52. Map of pedestrian streets and hierarchy.

- Improving conditions in inner yards to become more accessible to pedestrian movement
- Create a more enticing pedestrian experience with interesting shop facades

Currently, there is a major disjoint between Köpmannagatan and Strandgatan in the form of pedestrian accessibility. To access these streets, one would have to use the road network (for example, Postgatan) instead of crossing through the inner yards. This makes walking inconvenient and uninteresting within the city center. For this reason, it is believed that improving the conditions in the inner yards would facilitate pedestrian thoroughfare, and also create protected microclimates for the passersby and residents of the apartments to enjoy. This type of movement is depicted on the map as the minor pedestrian routes that appear more organic.

By developing the inner yards, and repurposing the ground levels of apartment buildings to serve commercial activities, the pedestrian experience within the city would be more enticing because of these interesting shop facades along the edges of buildings. This in turn contributes to the major pedestrian routes of the city center, which provide as a forefront to more minor, organic routes within the inner yards.

Concept 4: Densification

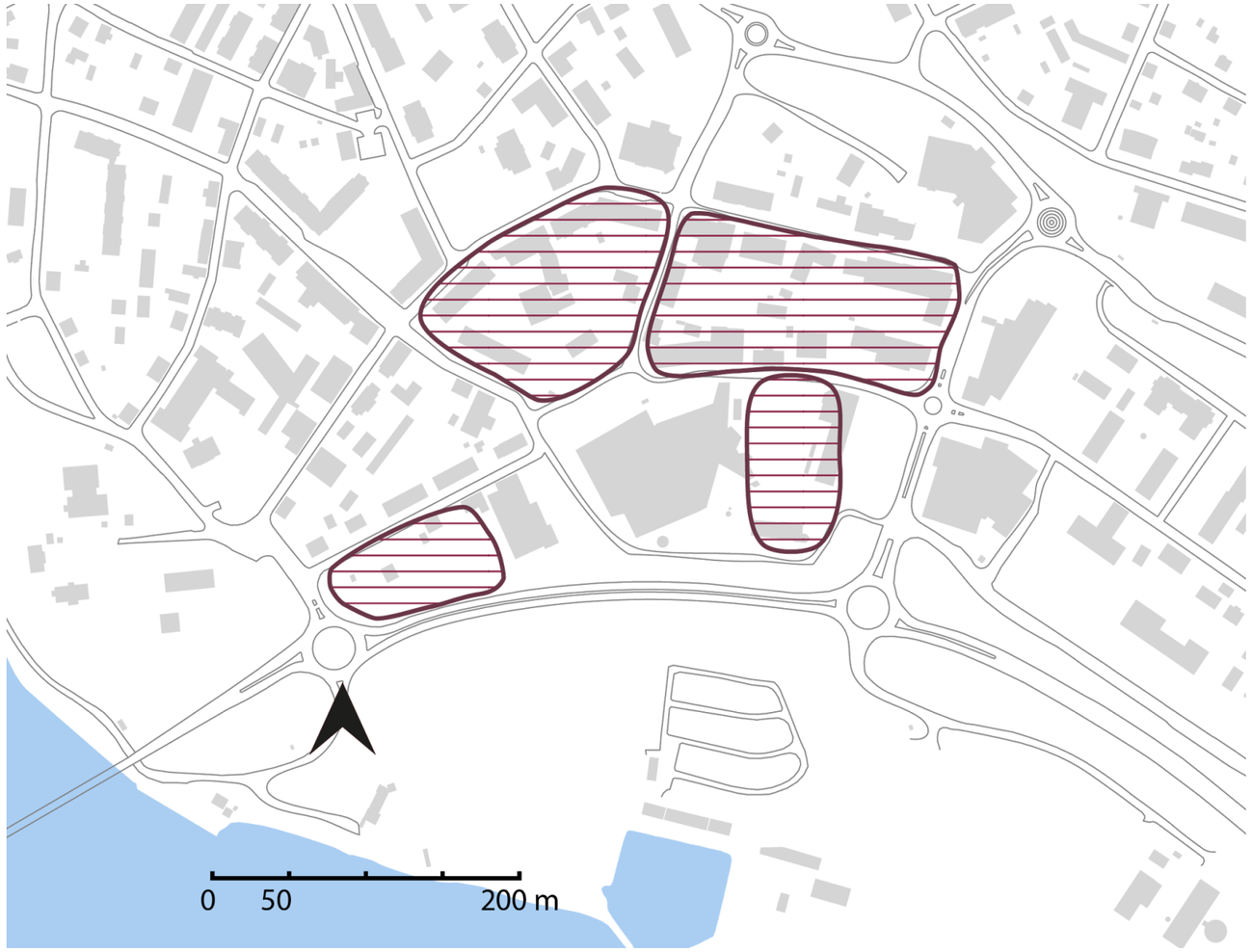

Figure 53. Map of intended densification areas.

- Aiming for a more condensed spatial feeling
- New buildings can fulfill housing need

According to discussions with the municipality, Kalix has a housing need that needs to be fulfilled. Kalix also experiences a minor urban sprawl and a lack of characterisation of the city center. These issues can be solved with the densification of some areas, depicted on the map. The areas not planned for densification contain preserved cultural plots of land, that the team deems important to protect, in line with Concept 1. Densification will aid in wind protection for the windy city center, that is currently unprotected and subject to windy conditions. Densification will also aid in condensing the current spatial feeling within the city center, providing for a more legible urban room.

Concept 5: Strengthening Axes

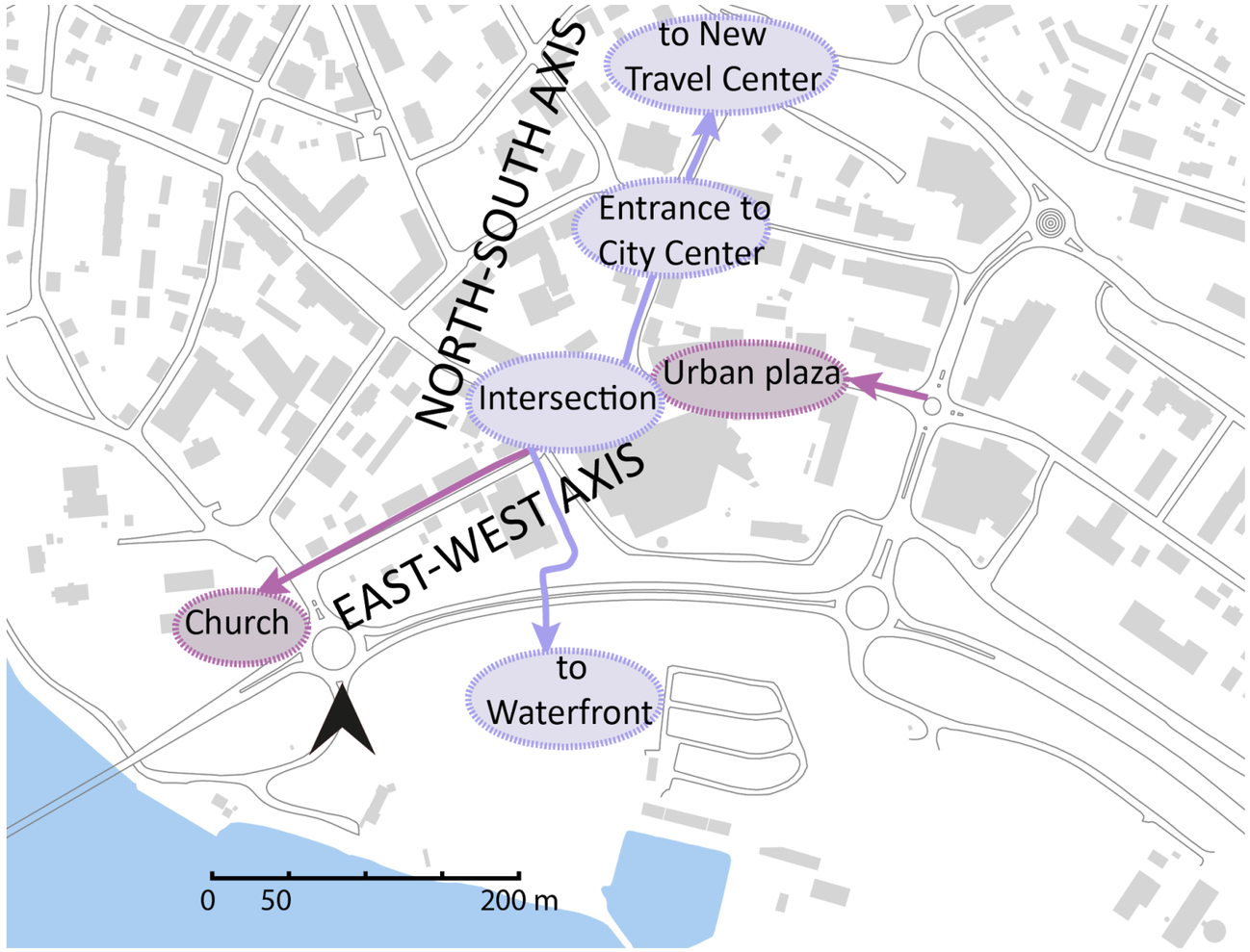

Figure 54. Map indicating new axes of the city center.

✚ Axes form a well-connected core

Considering the newly confirmed travel center and other planned developments mentioned in this project, strong axes would be formed across the city center. The North-South axis would become the main axis of the city, connecting the new travel center to the waterfront development. A green corridor is planned for the entirety of the axis, in support of the concept for a stronger pedestrian environment within the city center. This stretches from Postgatan, to the central park at the point called the “Intersection”, and then into the green corridor leading from Galleria out towards the waterfront. Postgatan would become the new main entrance of the city center for both cars and pedestrians, relieving the current traffic burden on Nygatan. The East-West axis is formed on the strong visual connection between the Church and the space outside Galleria. This visual connection is intended to be preserved, as it influences pedestrian orientation and movement within the city center. In the proposal, this strong sightline remains unhindered even with the development of the park and the urban plaza, as a straight pedestrian corridor is created between the urban plaza to the church.

Concept 6: Reducing Impermeable Areas

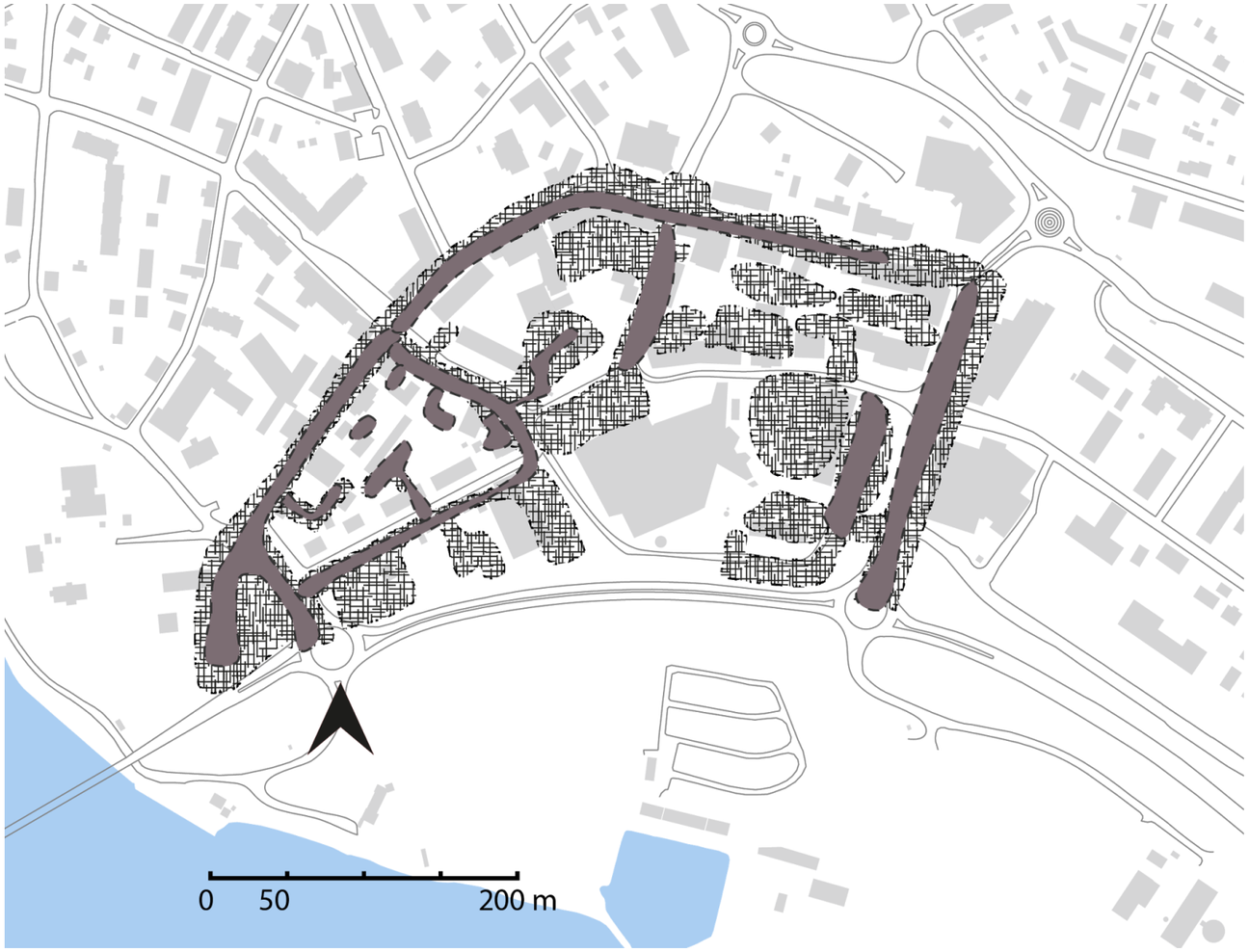

Figure 55. Map of impermeable areas. Brown areas indicate new impermeable areas, hatched black areas indicated current impermeable areas.

- Aim of at least 50% reduction of current asphalt

With climate change and reported increasing rainfall instead of snowfall in the near future for Kalix, it is important that impermeable areas are reduced in order to reduce surface runoff and the risk of flooding within the city center. Moreover, from a perspective of city identity and character, it is important that these impermeable areas (often referring to asphalted areas) are reduced to minimise the dark and gloomy feel of the present-day city center. More greenery will be a celebrated change, as greenery promotes the infiltration of rainfall and therefore, will aid urban drainage within the city center to some extent. Greenery will also contribute to the vibrancy of city center, and will complement the pedestrian experience by providing for a more comfortable and enjoyable outdoor experience. The new greenery also takes on a dual role, serving as the public spaces mentioned in Concept 2 - meaning that the new greenery will not only support pedestrian movement, but also promote outdoor activity.

URBAN DESIGN

Urban design is the design of towns and cities, streets and spaces.

It is the collaborative and multi-disciplinary process of shaping the physical setting for life in cities, towns and villages; the art of making places; design in an urban context. Urban design involves the design of buildings, groups of buildings, spaces and landscapes, and the establishment of frameworks and processes that facilitate successful development (Urban design group, 2011).

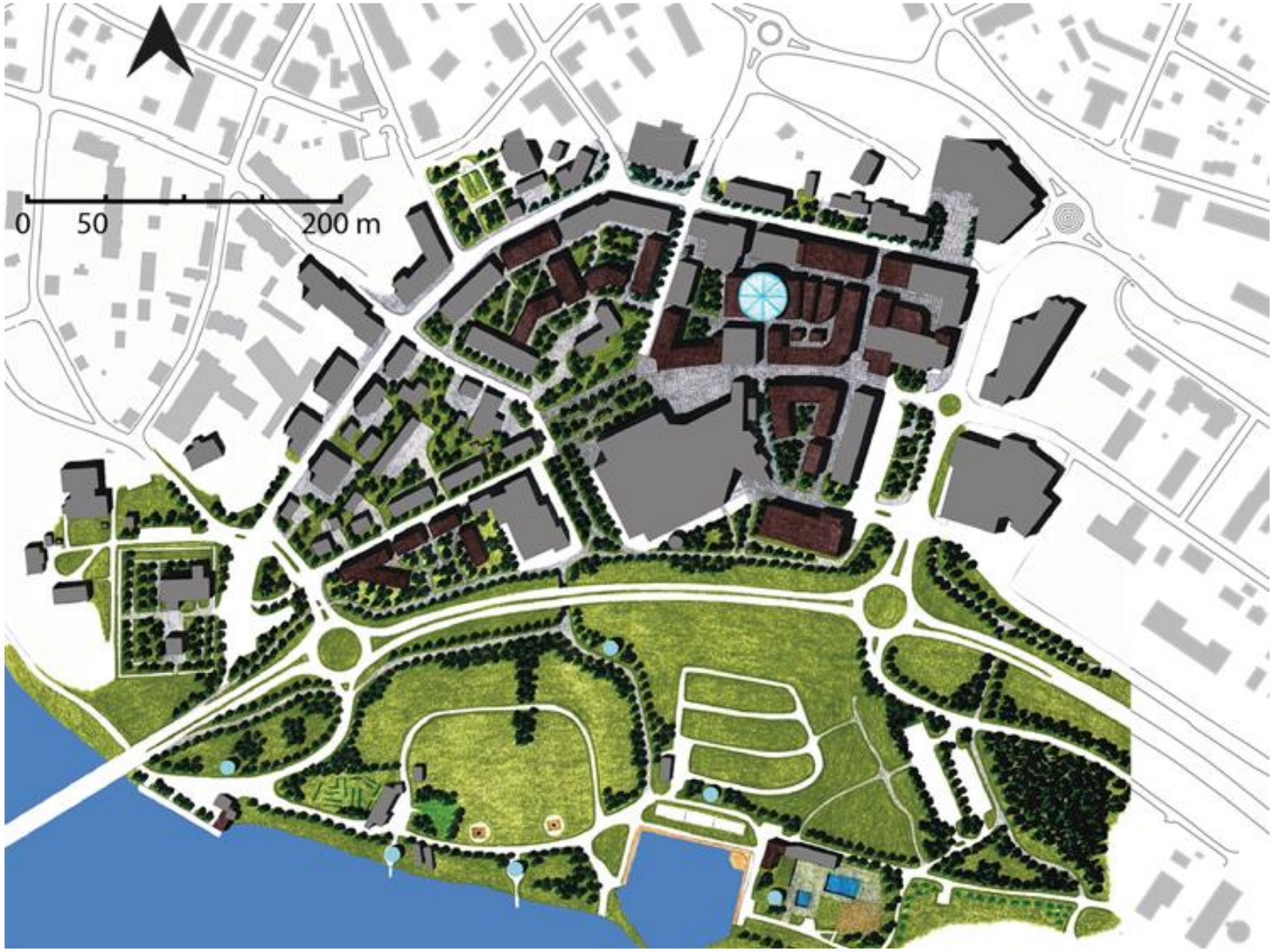

Figure 56. New design of Kalix city center.

Centrum design

In order to achieve a more vibrant, interesting, eventful and especially a more sheltered centrum area, proposals were primarily set on densification of the center area as well as developing inefficiently used areas. More specifically, the area of concentration was bounded by the church in west, Köpmannagatan in north, Nygatan in east and the Kalix river in south. Among other things, the inner yards were items for measures, especially the quarter of Örnen, Posthornet and the Slaktaren/Utsikten/Triangeln. Partly because of the lack of a true center the main focus was put on measures to be done in a relatively narrow area in the city center.

The aim was to develop pedestrian traffic in relation to car traffic in a way that would lead to pedestrians getting preference in most traffic situations in the center area. It was most necessary to improve the connections between all the quarters in the center, where there was a wish to simultaneously improve the connection between the center and the green area towards the Kalix river. Generally, the proposal aims to create environments with significantly improved conditions for pedestrian traffic.

A building's entrance fulfils an important role in providing activity for the street and creating an identity for the building (Auckland Design Manual,

2016). Most of the entrances along the most active streets in the center today are poorly connected to each other, therefore there was a need to improve the situation by increasing the number of entrances and also to create shorter distances between them. The inner yards were objects for creating multiple entrances that would result in a more active street at shorter distances than today.

With a densification of buildings in the center more apartments for seniors are created, which this is a shortage of today, but also small apartments for younger people. New planned spaces for offices are 2500 square meters and approximately 245 apartments for at least 600 people are suggested.

More green area was implemented into the city center while grey asphalt surfaces and outdoor parking areas for cars were reduced. A large building for car parking, about 500 parking spots, was suggested to be built in the immediate proximity to the center.

Handeln

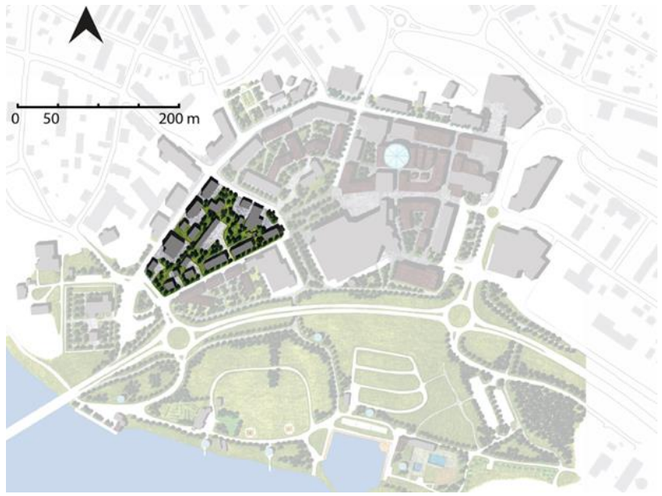

Figure 57. Handeln section of new plan.

The quarter of Handeln was not an object for any large development or densification at this stage. From the SWOT analysis no conclusions were made due to any major weaknesses or opportunities or threats that could result in a necessary development or densification. In addition, several of the existing buildings in this quarter are of heritage value, and therefore not preferable objects for modification or demolition.

The view from city center and the square, along Strandgatan, towards the church is really magnificent. It was decided to strengthen this view by planting a row of trees along the north side of Strandgatan, from the square to Kungsviksgatan.

Posthornet

In essence, a proposal for densification of housing is done in the form of new flats in the middle of the Posthornet quarter. The commercial activity is to be maintained and strengthened at least in the first floor along Köpmannagatan. The whole inner yard is shaped so that new buildings, mainly apartments for senior housing, are built in a relatively dense structure. When planning the new buildings in the quarter there is also a need to take parking spaces for cars into account. The new, smaller areas that are formed between the new buildings in the inner yards are for green spaces, mainly for the neighborhood's residents, but also for the public. It is important that new pedestrian paths are created by the new quarter planning in order to get the pedestrian network inside the inner yard as smooth as possible, but also to create more alternative routes between Köpmannagatan and Strandgatan. New walkways in the inner yards will give pedestrians a better option to move outdoors, with the protection of the surrounding buildings, in harsh

weather conditions. The new buildings that are constructed along Köpmannagatan and Postgatan contain in the first floor, at the street level, spaces for commercial use. The fact that opportunities are created for new stores and shops to be established along Postgatan will result in a stronger connection in the activities between Strandgatan and Köpmansgatan. In this way the center area will be perceived more as a whole. Above the first floors, in the new buildings, there are apartments of varying sizes.

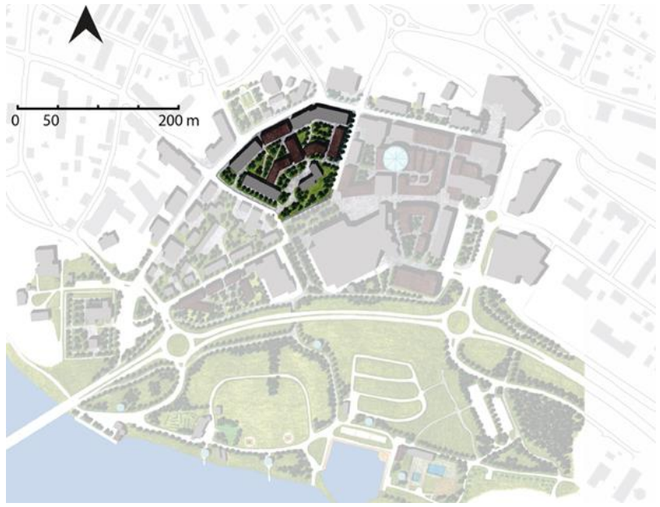

Figure 58. Posthornet section of new plan.

Örnen

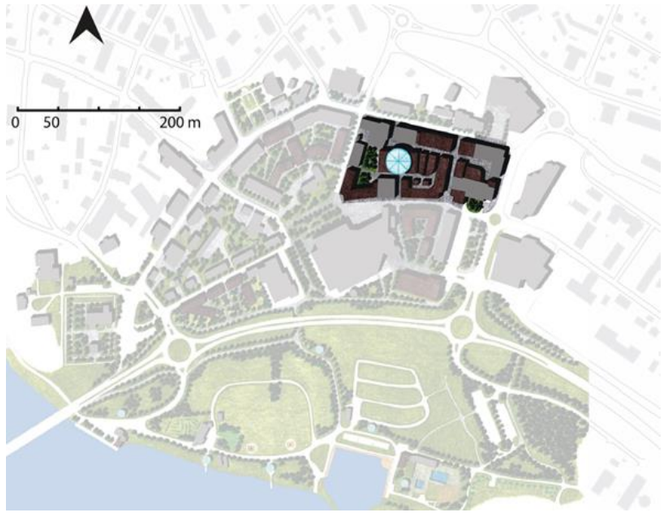

Figure 59. Örnen section of new plan.

The quarter of Örnen is closest to the current most active commercial area in Kalix city, which is the main reason why the most and the largest measures in the planning process has been focused to this quarter. This existing inner yard, located between Strandgatan and Köpmannagatan, is proposed to have a vigorous densification with mainly commercial activities, but also for new residential spaces. The aim for the planning and for the densification of this inner yard is to create an outdoor galleria in addition to the internal galleria which is located on the opposite side of Strandgatan. An outside galleria is created including a wide range of diverse commercial activities combined with apartments in the top floors of the tower blocks. The surrounding building structure of the inner yard, in the form of existing and new tower blocks, effectively form a sheltered outdoor environment for pleasant stays in all seasons. The first floor, and occasionally second floor as well, of all the buildings in the quarter shall contain spaces for commercial activities. New well-placed entrances from all surrounding streets (Strand-, Köpman-, Post- and Nygatan) to the inner yard will allow very good accessibility both from inside the inner yard, but also to the other streets in the center and to other quarters. Strandgatan, between Nygatan and Postgatan, and all traffic routes inside the inner yard are only for pedestrians. These measures will result in a strong interconnection between other commercial activities that exist along Köpmannagatan and between the current center around Strandgatan and the existing indoor galleria.

Cross section of Inner yard

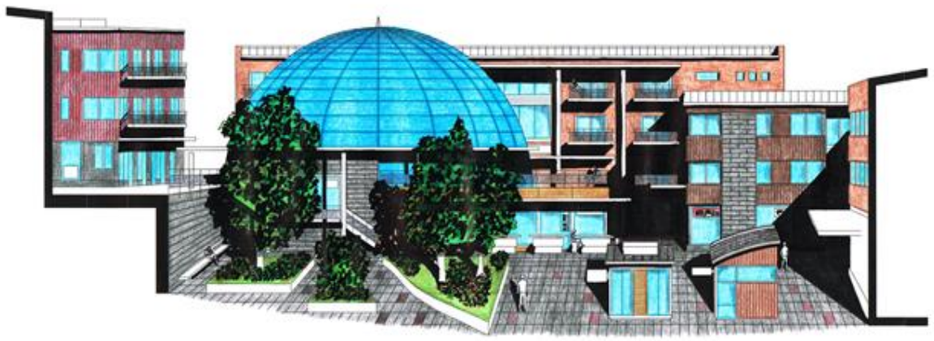

Figure 60. Depiction of the cross-section of the inner yard.

The inner yard of the quarter Örnen is, as mentioned earlier, of great importance in regard to achieve a more active, lively center. As it is inefficiently used today with all kinds of different minor activities, it will in the future have a large potential of positive development. The figure below is showing some possibilities of development that could especially function as a strong connection between the commercial activities along Köpmannagatan and Strandgatan, but also between Nygatan and Postgatan. In addition to the attractive location in the center it has also a quality of differences in elevations. In the suggestion of the inner yard it consists for example of a larger glass dome where a variation of shops, stores and cafes can be established. The entrance into the dome from the north side is approximately 3-4 meters higher than the entrance from the south side. This design of the inner yard will also allow existing and new commercial spaces to have entrances both from the surrounding streets as well as from the inside of the inner yard. The inner yard will be a excellent space for establishing other small shops and stores as a complement to the bigger glass dome. The inside area of the quarter is for pedestrians only, with a great amount of alternative routes in all directions towards the surrounding streets. Residential spaces in the higher floors have the opportunity to place balconies towards the inner yard if requested. For senior living it would be considered as a positive aspect to be able to follow all kinds of activities from higher located balconies. Small green spaces are also suggested to be implemented inside the quarter. Because of the really sheltered space inside the inner yard it will be a popular place for arranging different kinds of events and happenings (Christmas market, music events etc.). A dense arrangement of buildings inside the inner yard would even make it possible to add additional glass roofs between the most appropriate buildings to create more sheltered spaces.

Slaktaren/Utsikten/Triangeln

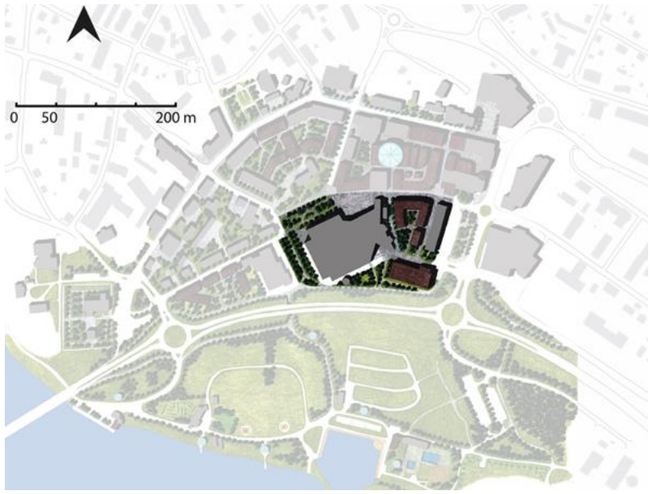

Figure 61. Central section of new plan.

The land use at the large asphalt parking area between the inside galleria, Strandgatan and the existing bus station is changed to a quarter area of green spaces and new buildings, which will consist of spaces for commercial and residential activities. In order to replace the loss of parking, a new parking structure is proposed. The new parking building, which consists of several floors with about 500 parking spots, replaces the existing bus station that is located closest to the E4. The new car park will also serve as an effective wind shelter for the city center. Visitors to the city are offered this option to park their car indoors close by the center, with possibilities to smoothly go by foot to nearby activities. New walkways are planned from the parking building with direct connection to Strandgatan, the internal galleria as well as the outside galleria in the quarter of Örnen. There is also an opportunity for this building to communicate the identity of Kalix to E4 users, seeing as the building is very visible from the E4.

In the parking areas outside the internal galleria´s northwest side and southwest side new green spaces are planned - the gray asphalt gives way to green areas. The new green park on the galleria´s northwest side is connected with the existing square and the existing green area on the other side of Strandgatan. The new green space on the galleria´s southwest side will function as a sheltered, green walkway that seamlessly connects the city centre to the green waterfront. Most of the measures proposed in this quarter is very much climate-related, and in a great way due to the strong winds mainly with a direction from south-southeast. The aim is also to try to achieve an almost car-free center where pedestrians have priority.

Winter perspective of square

Figure 62. Depiction of newly pedestrianised Strandgatan from the edge of the new park towards the galleria plaza.

Increased building height enhances the spatial feeling of the plaza and restaurants and shops contribute to the lively feeling of the place. A man pulls two children on toboggans through the park after taking an afternoon walk along Standängarna. The intersection of the park, the galleria and Strandgatan make the plaza feel like a node, and the natural town centre (Figure 62).

Söråkern

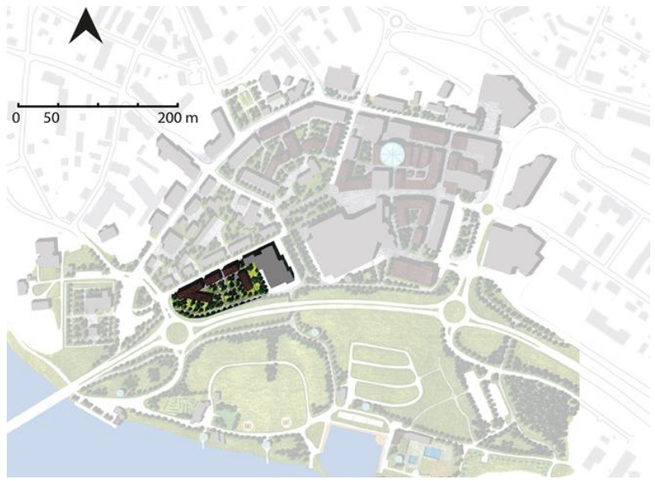

Figure 63. Söråkern section of new plan.

While the quarter of Söråkern is located slightly outside the immediate center of the city it is not of most importance to bring commercial activities into this area. Therefore the suggestion is to create a quarter of residential use only, combined with a green space inside the quarter. The new structure of buildings will form a wind shelter to the quarter on the other side of Strandgatan, while the green vegetation will be sheltered objects inside the quarter. Similar to the new parking building it is essential in designing the environment in the quarter being so close to the road of E4. When planning and designing the quarter with its content one has to also take into consideration the clear and excellent view from the city square towards the church.

Waterfront

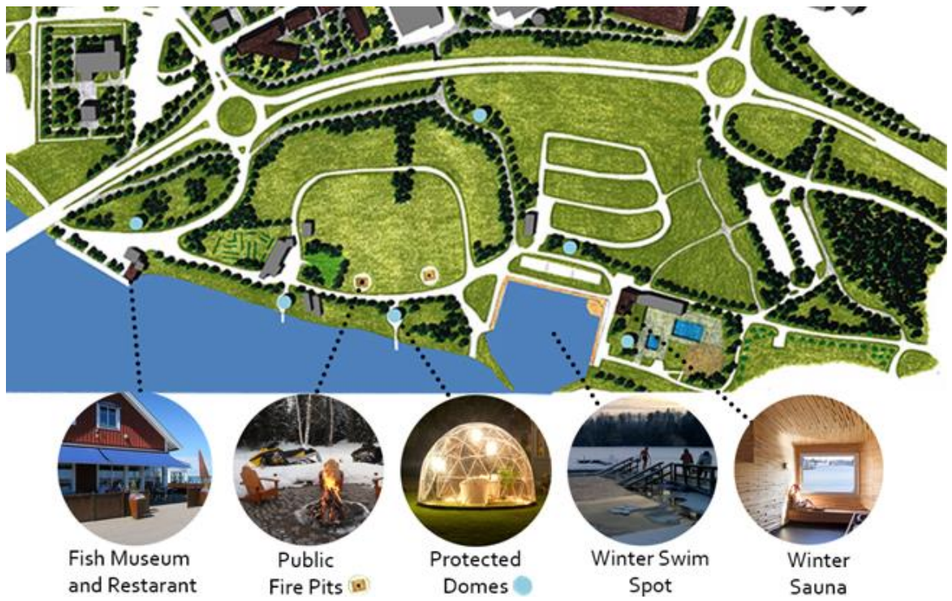

Figure 64. Specifics of waterfront design.

The waterfront design is fairly simplistic in that it adds several new elements to the current plan without changing the current layout very drastically. The waterfront is a jewel of Kalix, as it can be seen from the E4, and it is a place where people have an opportunity to interact with the river. The suggested proposal aims to increase this interaction, and make it easier and more enjoyable.

Fish Museum and Restaurant

A fish museum/restaurant would be visible from the E4, and create another type of experience along the waterfront that could be enjoyed in all seasons. Combining food and history in one location would create an enriched dining experience that could allow visitors to taste Kalix (where the river meets the sea) and provide a small introduction to the history of Kalix. Creating a destination like this at the waterfront would give visitors and Kalix residents another reason to visit the beautiful waterfront.

Public Fire Pits

The Kalix campground is a lively place in the summer, but in the winter there are few opportunities to stay as the campground shuts down for the season. Creating fIre pits with seating could be a way to create places for people to stay along the waterfront even in the winter. The Kalix river is a frozen asset in the winter, and invites snowmobiles, cross country skiers etc. to the shores of Kalix. Creating warm places to stay is an important part of creating life on the waterfront in the winter.

Winter Swim Spot/Sauna

Kalix has a beautiful new public swimming pool, and an addition to the pool could create a winter sauna/spa area so that the swimming facility is used year round. The location at the waterfront allows people to interact with nature, and the contrast of the warm sauna with the beautiful frozen river is a real opportunity for Kalix. A swimming hole in the ice could be created close to the pool and would definitely provide excitement and human activity along the waterfront in the winter.

Protected Domes

Several protected domes along the waterfront could create spaces with protection from the wind. There are many opportunities for the domes: they could provide sheltered seating areas with lounge chairs, picnic tables, or playing areas. They could be lit at night to warmly invite people to visit them, and to attract visitors from the E4 to explore the inviting Kalix waterfront. The colours could change with the seasons...orange to represent the Kalix bandy ball, red and green at Christmas time...the possibilities are endless.

Figure 65. Riverside terrace next to Kalix river in the summer (Source: Kalix Camping).

Figure 66. Depiction of new glass-covered dome.

With some protection and light, the dome has potential to become another place to stay and gather in the winter. This could be a serviced area where food and hot drinks are served at certain times, or simply a sheltered area where people walking by can stop for a rest, or enjoy a winter picnic after an afternoon of snowmobiling.

Walking Routes

Current Walking Routes

The current network of walking routes in the city center is quite limited (Figure 67). There are sidewalks along most of the streets in the center, for example along Köpmanna-, Strand-, Post-, Ny- and Torggatan, but purely pedestrian walkways are not to be found.

Added Walking Routes

According to the suggested plan for the city center the accessibility for pedestrians is favoured over car traffic. Strandgatan is to be changed into a pedestrian only street, between Nygatan and Postgatan. Alternative routes for pedestrians are created through the development of the inner yards. Paths from the new parking building lead directly to the pedestrian street of Strandgatan, the internal galleria, the square, the outside galleria and to the new green inner yard of quarter Posthornet. Along most of the new paths, sheltered spaces have been created to create more comfortable places to stay, especially along the pedestrian path from the square and the new park leading towards the Kalix river (Figure 68).

Combined Walking Routes

Combining the existing and the new walking routes will form a network that undoubtedly favours pedestrians in the center (Figure 69). With a well functioning pedestrian network, the car traffic will decrease, resulting in a more secure and more enjoyable stay in the center. The only place where interaction between inside and the outside environments can happen is at street level. With more car free zones it will make street areas more useful for all kinds of outdoor activities.

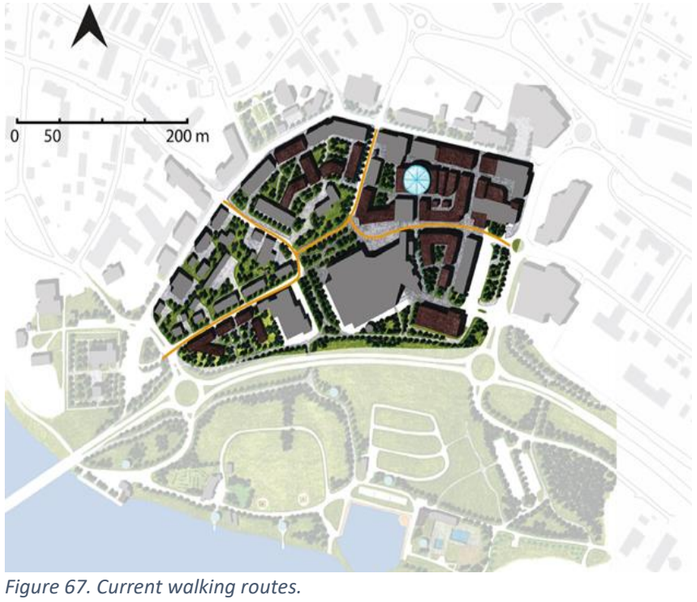

Figure 67. Current walking routes.

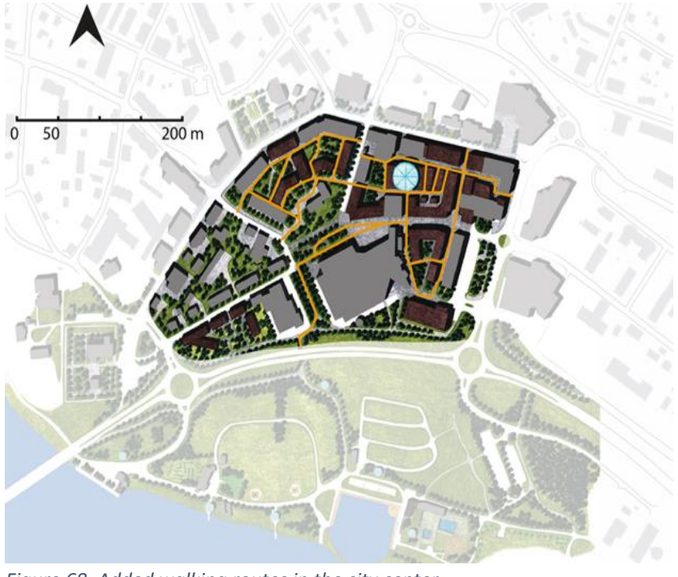

Figure 68. Added walking routes in the city center.

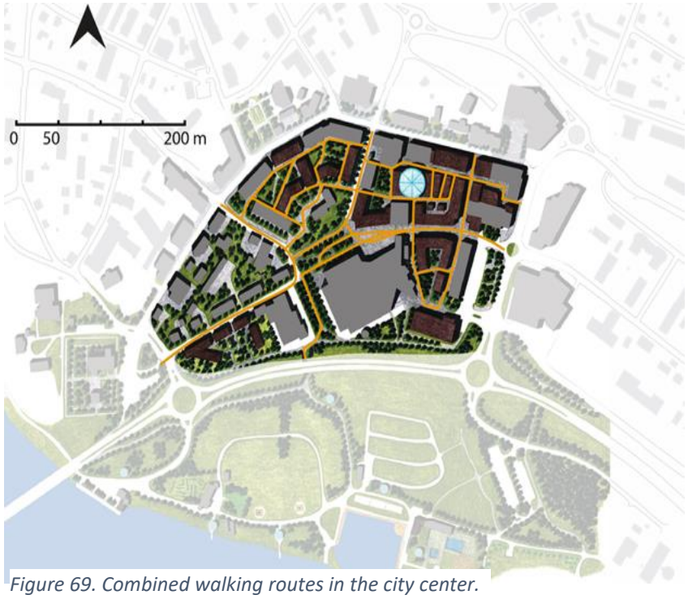

Figure 69. Combined walking routes in the city center.

Accessible Entrances

Current Accessible Entrances

As outlined in the analysis, the current accessible entrances to commercial spaces are shown in the figure below with red dots (Figure 70). The blue dots represent entrances to residential units and offices. Most of the entrances into commercial activities are located along Köpmannagatan and Strandgatan. Hardly any entrances are to be found along Ny-, Post- or Torggatan. This clearly shows quite a strong disconnect between Köpmannagatan and Strandgatan. There is also a great lack of activities in the inner yards that are resulting in long distances between the two shopping streets.

Added Accessible Entrances

When developing the inner yards of the quarters of Posthornet and Örnen the amount of entrances into commercial spaces as well as into residential units will increase a great deal. Distances between different kinds of activities will become shorter, which makes the area more pedestrian friendly. From the figure below one can see that the entrances into commercial spaces will increase strongly inside the quarter of Örnen (Figure 71).

Combined Accessible Entrances

As mentioned earlier it is very important in a city center to try to create entrances into all kinds of commercial spaces in order to provide activity for the street, but also to create an identity for the building. When combining the existing and the new entrances one can immediately notice that streets and inner yards are connected to each other. The possibilities for movement between all of the entrances, through public spaces and along pedestrian routes in the center are greatly increased. Figure 72 also clearly shows the possibilities for stores and shops to add entrances from the inner yard of Örnen in addition to having just one entrance from the streets outside the inner yard.

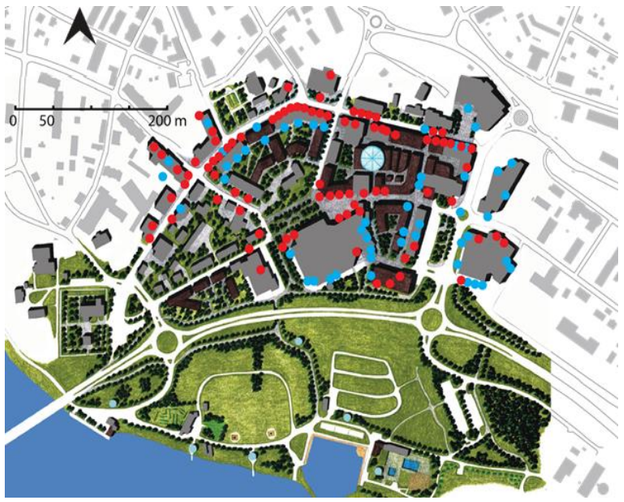

Figure 70. Current accessible entrances in the city center (similar to analysis, red dots signify commercial entrances, blue dots signify residential and office entrances).

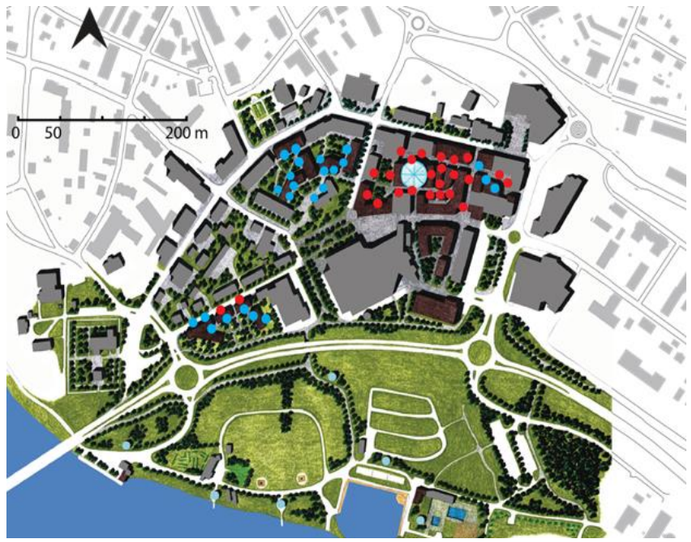

Figure 71. Added accessible entrances in the city center.

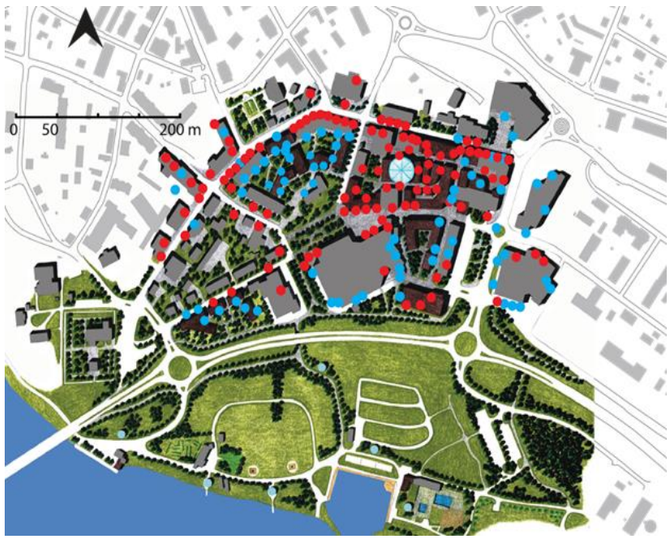

Figure 72. Combined accessible entrances in the city center.

Parking Structure

The parking structure would be placed east of the Galleria where the building is marked on the map. At a height of 20 m, this structure will create wind protection for the city centre. By offering almost 500 parking spots, the need of new parking in the city will be fulfilled, and spaces that were taken for development are replaced.

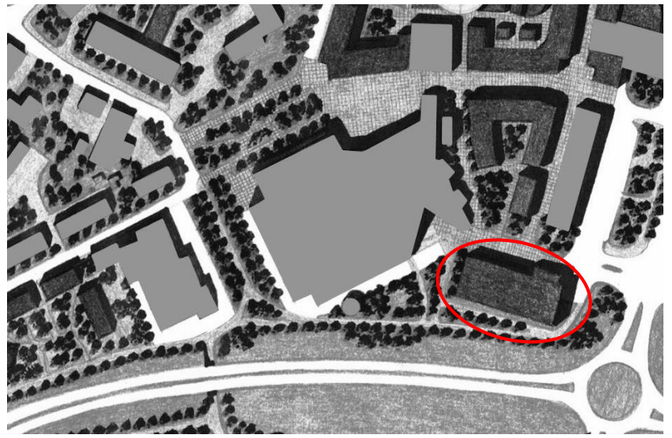

Figure 73. Location of new parking structure.

The main idea of the design of this structure is to represent the identity of the city of Kalix. On the south facade towards and parallel to the E4, the rusted metal exterior celebrates Kalix's history of iron ore mining. The metal facade should also be carved with shapes and history of Kalix to invite new visitors to the city. This face of the building will not allow much sunlight to lower the cooling need of the building. The west facade represents the production, need and importance of timber and wood in Kalix and the region. This facade will also block out sunlight during warmer periods so the inner temperature would not rise too much. Windows are placed on the two other facades of the building to allow the sunlight and lower the energy use of the building.

Figure 74. Parking structure, West and South facades.

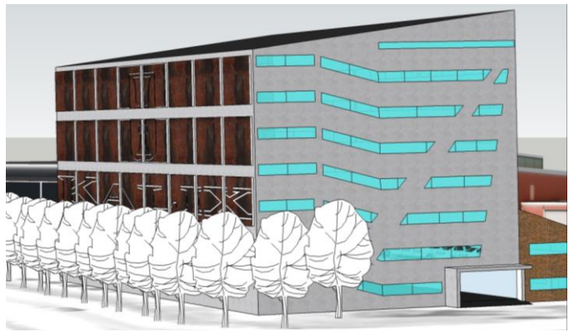

Figure 75. Parking structure, South and east facades.

Figure 76. East and North facades.

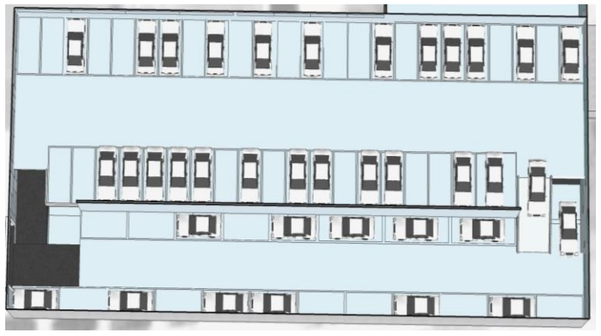

Figure 77. Plan of parking structure.

Since the parking structure will be positioned to welcome new visitors to the city, a new tourist office could be placed alongside it. When entering Kalix from the E4 this will be very visible. The tourist office could be combined with a shop or café to minimize the cost for the Kommun, and to increase opening hours.

New Housing

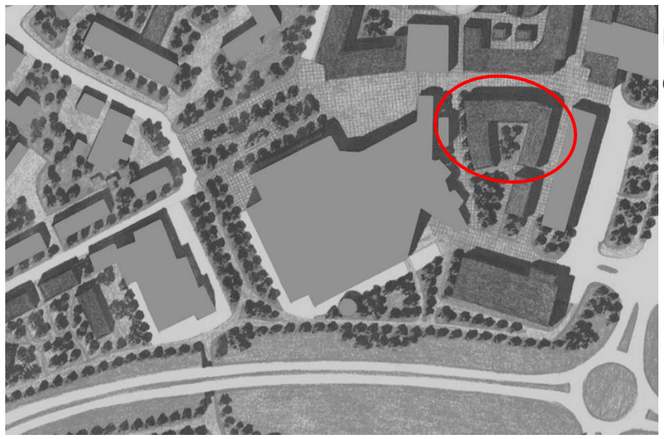

Figure 78. Location of suggested new housing.

New Housing in the city centre aims to solve lack of homes in Kalix. The U-shaped building is placed north of the Parking building and east of the Galleria as shown on the map. Having such a central location and being in the shopping area allows to have the first floor commercial.

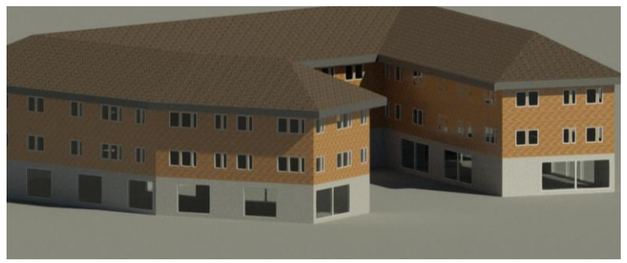

Figure 79. Illustration of new housing.

Figure 80. South faced of new housing.

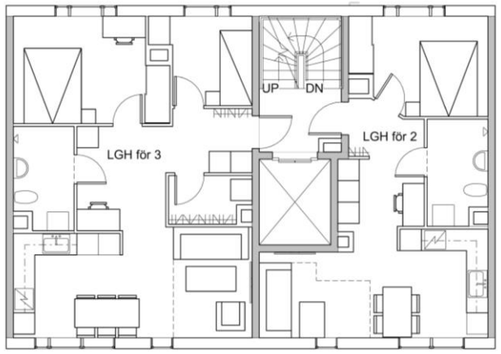

Figure 81. Plan design and new housing.

The upside-down U-shape creates an inner yard maximizing the ability to catch the evening sunlight while also providing wind protection from the parking building. Facades of the buildings are dressed with wood and have a warmer color to give a warm feeling to the area. Apartments in these houses are compact and are meant to be used by two or three people. Design of the flats is well planned, space efficient and offers accessibility and comfortability at a great central location. Apartments and housing outside of this central area will be bigger in size and have a mix of apartments for one, two and more.

Wind Analysis after Development

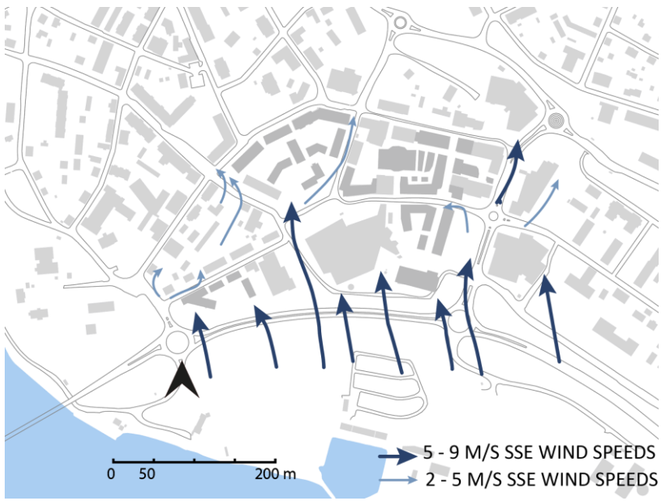

Figure 82. Wind analysis after suggested developments.

After design of the area the new model was tested for the SSE wind with a speed of 9.2 m/s (Figure 82).

The parking structure blocks the major winds into the city centre and create a wind-free zone behind the building. Improvements are also seen by the new housing in the west close to the church. Taken into consideration that vegetation is not included in this analysis the results are good but will improve even more when dense vegetation is added.

This improvement of the microclimates allows higher activity in the area.

Shadow Analysis after Development

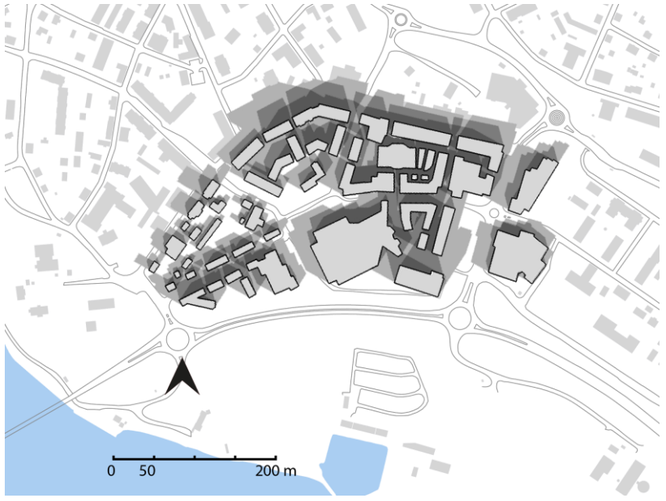

Figure 83. Overlaid shadow analysis for March 20. 9:00, 12:00, 15:00.

Figure 84. Overlaid shadow analysis for October 20. 9:00,12:00, 15:00.

As shown in the analysis of sun and shadow after the improvements in the area, no major shadowed areas are created in the centrum area where the activity takes place (Figure 83 and 84). Of course higher buildings will create longer shadows but the most active and central areas are not affected by this design. Analysis is done at the same dates and time as the earlier shadow analysis of the area.

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APPENDIX A

Demographics

Kalix, Year 2014

Inhabitants (N.)	Familias (N.)	Males (%)	Females (%)	Foreigners (%)	Average age (years)	Population density (Inhabitants/Km2)
16,307	7,821	51.3	48.7	4.9	53.6	8.5

Figure A-1. Demographics data for Kalix, year 2014.

Rankings:

> 21st largest among 54 municipalities in region by demographic size

> 159th place among 312 municipalities in SWEDEN by demographic size

> 52nd place among 312 municipalities in SWEDEN per average age

Demographic status:

Civil Status	(n.)	%
Bachelors	4,483	27.49
Bachelorette	3,448	21.14
Married Males	2,877	17.64
Married Females	2,866	17.58
Divorced males	773	4.75
Divorced Females	814	4.99
Widowers	234	1.43
Widows	812	4.98
Total Residents	16,307	100.0

Figure A-2. Demographics Detailed status data for Kalix, year 2014.

Classes	Males		Females		Total	
(age)	(n)	%	(n)	%	(n)	%
0-2	205	2.45	190	2.39	395	2.42
3-5	225	2.69	214	2.70	439	2.69
6-11	526	6.29	463	5.8	989	6.06
12-17	533	6.37	506	6.37	1,039	6.37
18-24	691	8.25	495	6.23	1,186	7.27
25-34	810	9.68	648	8.16	1,458	8.94
35-44	867	10.36	866	10.91	1,733	10.63
45-54	1,164	13.91	1,096	13.80	2,260	13.86
55-64	1,219	14.57	1,140	14.36	2,359	14.47
65-74	1,252	14.96	1,210	15.24	2,462	15.10
75 and above	875	10.46	1,112	14.01	1,987	12.18
Total	8,367	100.00	7,940	100.00	16,307	100.00

Figure A-3. Demographics Age data for Kalix, year 2014.

-Decline of the demography

-The average age increases

-70% of population are between 25-80 years

-Equal percentage of females and males

APPENDIX B

CFD Analysis

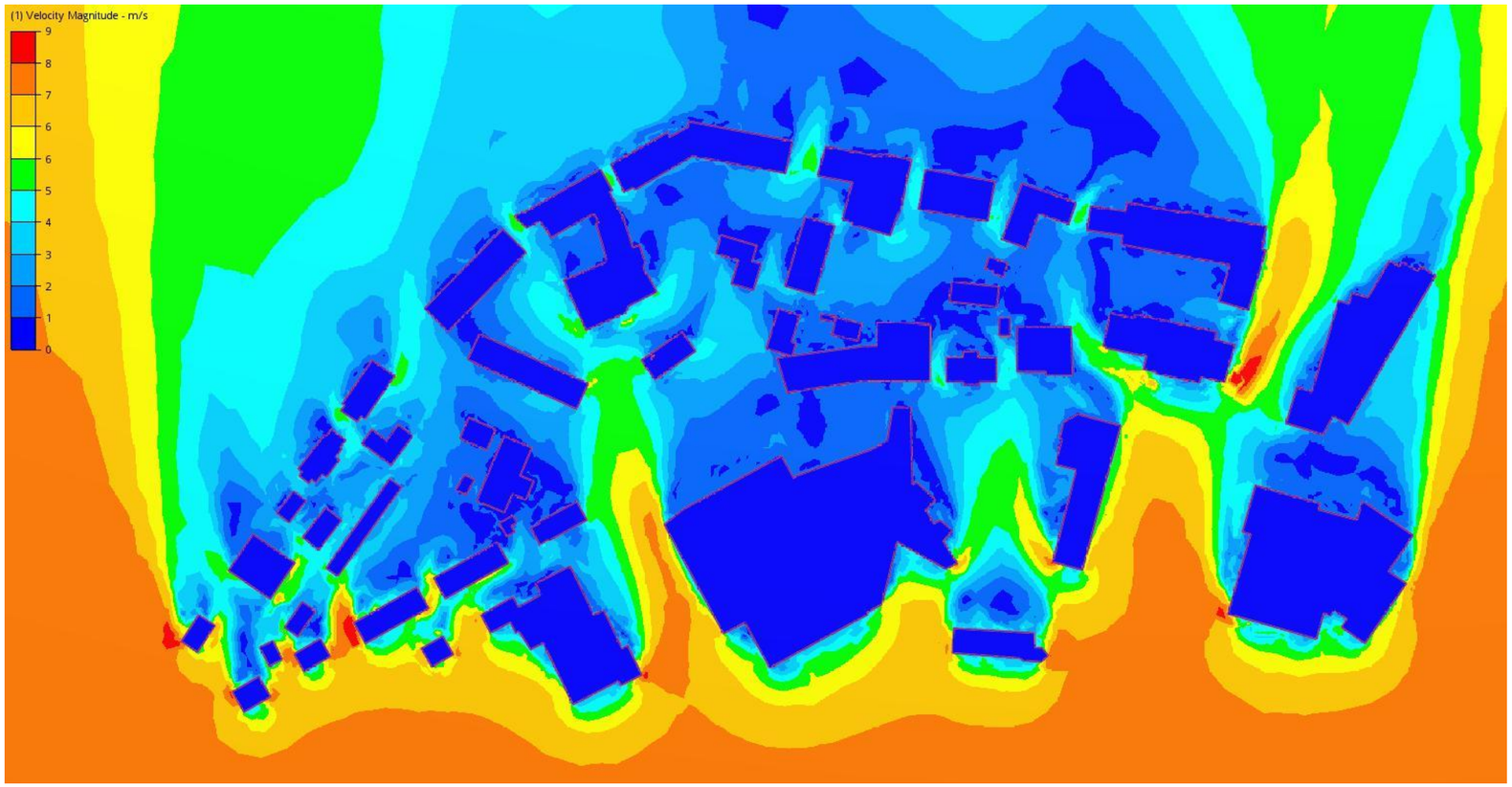

Figure B-1. CFD result for current situation, 9.2 m/s, SSE wind.

First wind analysis showing SSE wind with a speed of 9.2 m/s at a level of 1 meter above ground.

-Areas with warmer colors have a high speed wind where the wind have a direct impact on the activity on the area.

-Spots with red color has almost the same wind (9.2 m/s) or more cause by the wind tunnel effect.

-Areas with dark blue color have a much lower wind speed (under 1 m/s) which is comfortable areas to plan outdoor activities.

Important to notice that vegetation and minor object that affects the wind are not taken into the model which could have changed the outcome slightly.

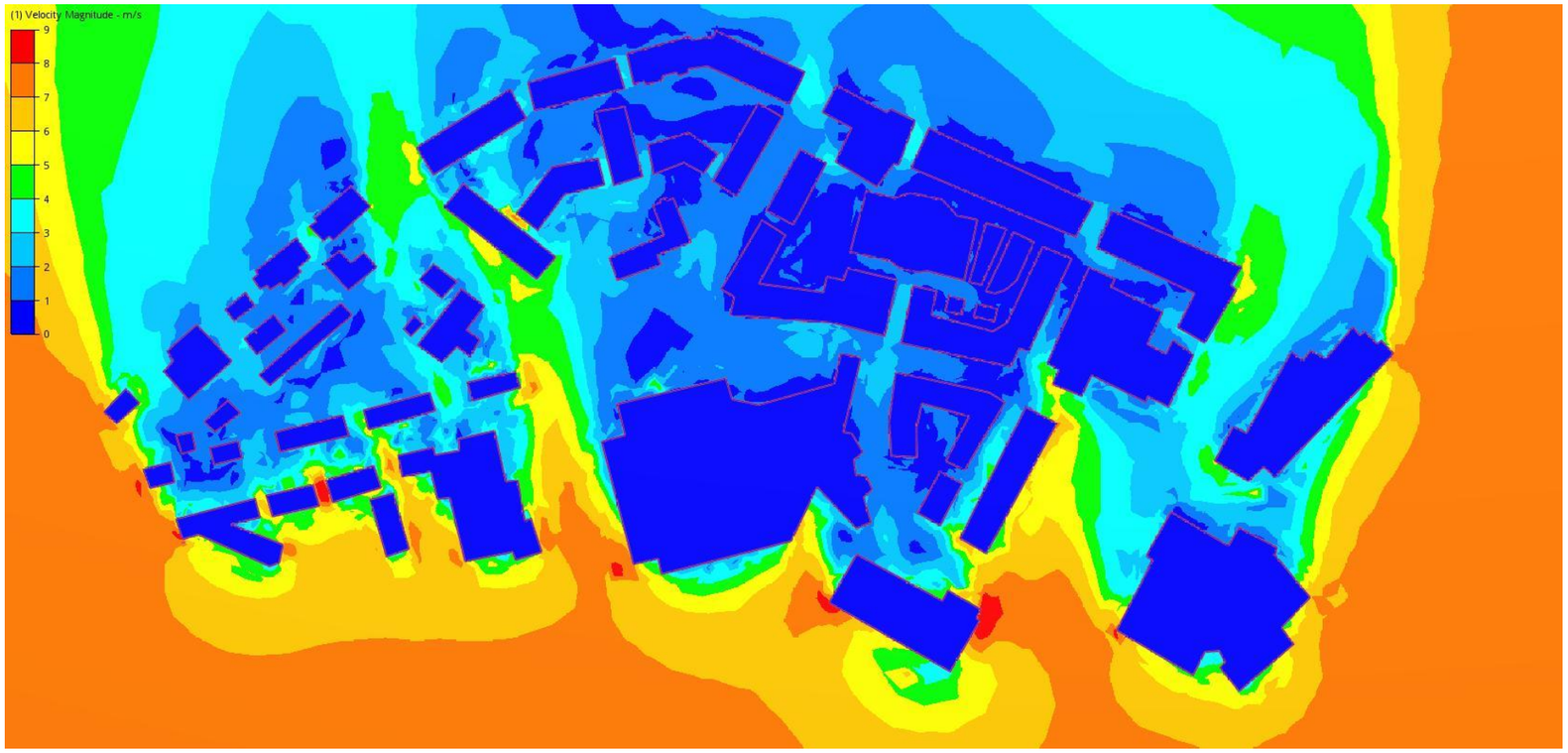

Figure B-1. CFD result after suggested developments, 9.2 m/s, SSE wind.

Second wind analyses showing wind at 1 meter above the ground. The wind is the same as the analysis before, SSE with a speed of 9.2 m/s. Also here the vegetation and minor objects are not taken into the model which would have improved the results slightly. As shown in the picture, the parking structure with its height blocks the winds coming into the city centre. On the sides of the parking structure where the entrance and exit are, we see red areas where the wind is very high but this leads to less snow gathering in those areas because of the high wind.

-Dark blue color presenting low wind areas (under 1 m/s) are now much more in the city centre. This allows more activity in this area during windy days.

-Red spots in the southwest part in the housing area where the wind is very high will be solved by dense vegetation in the area.

APPENDIX C

Creativity sessions explained

A creativity session aims to create new concepts and ideas about a subject with the aid of different tools. A session is divided in four steps. The first phase is named “team building” and consists of getting to know each other to create group cohesion. The second phase is the “divergence” which aims to go away the subject and leave preconceptions about the subject behind. The next phase is the creative phase, that’s to say the emergence of the new ideas. Finally we have to select the best ideas and write idea cards. To carry out a session, some rules have to be respected. Group members have to sign a kind of “contract” with the others.

-Everything is good to say

-Censorship and self-censorship are abolished on pain of punishment : no good or bad ideas, everything is possible, we can't say something is not possible to do

-Quantity : with creativity in mind, the more we have the better it is

-Crazy, wacky, fancy...let go of constraints

-Diversion : it’s OK to get off track and away from the subject

A creativity session should occur in a big room to make everybody comfortable, but also to hang poster on walls to write on them. We did it in a classroom in Lulea Tekniska Universitet.

We only need chairs, paper, a board, tape, pens, post-it, paper and the good mood of people! For the Kalix project we chose to do three creativity sessions to browse three different topics, which are important to make Kalix more attractive for tourists and residents:

- Energize the city's shops (infrastructure, concept etc.)
- Wayfinding and lighting of a city (panel, light etc.)
- The concept that makes Kalix a unique town (event, monument, activity etc.)

An ideal group is composed of 8 people. The session is directed by an animator. We decided to do each session with different groups to diversify and obtain a larger number of new ideas.

For the first session, only the four engineering girls participated. In the second session, all the members of the Kalix project participated. And for the last session other exchange students participated.

Integrating external persons of the project allowed us to obtain another point of view, the point of view of tourists for example. The other exchange students tell us what they imagine in any city, why they want to go to a city etc. For each session we used different tools and activities to complement the topic.

CREATIVITY SESSION 1

Theme: ENERGIZE THE CITY'S SHOPS

Place: A room in Nordkalotten Hotel, Lulea

Date: Friday November 25th 2016 from 9:30 to 11:30 am

People: Four engineering students (one animator and three participants)

STEP 1: TEAM BUILDING

- TITANIC

Each participant stands up and puts on socks. The animator puts a towel on the ground and explains this towel represents a boat. The aim is the group of participants must position themselves in equilibrium on the boat/towel. Each time the group achieves this goal, the animator explains the boat is sinking; the size of towel is divided by two (the animator folds in half the towel). The game stops when the space where participants must position themselves is so little.

During this game, participants use their team skills, their bodies and their brains. They must discuss, reflect and coordinate between them to achieve the goal. Moreover, participants come close physically, which allows to break the barriers between them. In addition of a moment of laughter, participants see themselves further as a team at the end of this game.

-FIVE BALLS

Each participant stands up and creates a ball with paper. All of the balls must be the same size. Then the animator takes back the balls, and the participants position themselves in to form a circle. Each participant also chooses to whom he will give the ball during the game.

The goal is: people must throw a ball without the ball falling on the ground. The game begins with a ball, then two, etc... until the number of balls in the game is equal to the number of participants.

During this game, participants concentrate, and like the previous game, they use their bodies, their brains and their team skills to succeed. They must not work individually but as a team.

STEP 2: DIVERGENCE AND CREATIVITY

-BRAINSTORMING (purge and mind map)

Participants position themselves in front of an empty space (ex: a empty wall or blackboard). The animator distributes post-its and pens to participants. They have five minutes to write all words or ideas that they think, when they read the theme of the creativity session. An idea/word/expression per post-it. Then; each participant stands up and positions themselves close to the empty wall, one after another. He reads his post-its by explaining what he thought through these words. At the same time, together the participants assemble the post-its that represent a similar idea/concept. After that, people give a title for each group of post-its, and they choose a group to work on that. This activity allows the participants' minds to refresh their minds. This step is necessary to allow people to become creative.

-HOT POTATO

People create a big ball with paper. This ball can be associated to a hot potato. Each time a participant has the ball in his hands, he must say the first word that he thinks, after hearing the last word given. Then he throws the ball to another participant. The first word must be the title of the group of post-its selected in the previous activity (brainstorming). During this game, the animator writes the words on a paperboard. He also decides when the ball throw stops. After that, people look all the words and purpose ideas by gathering a word with the initial word. The ideas must be explained and drawn so that everyone understands the new idea/concept. Everyone can add an idea or improve the idea of another. The goal is to emerge new and creative ideas, and make links with different words that not appear be linked at first sight.

-DAYDREAM

Participants choose a comfortable position (ex: on the bed, on the sofa), and close their eyes until the end of the activity. It is better if the light of the room is subdued, and if there is no noise. The animator narrates a story and the participants must imagine the story (the space/environment; imagine the story). The participants must also say what they imagine; the animator writes it at the same time. For example (explained

faster), the story is: imagine you walk outside, then you enter in a store. How do you imagine the inside of this store? This activity allows ideas and concepts to emerge by using imagination and subconscious.

STEP 3: SORTING

-WEIGHTING

People select and organize the (better) ideas. And people resume each idea on a idea sheet. It allows ideas that appeared during the creativity session to be organized and made more concrete. Thereby a professional and real trace of the ideas exists. In the future, these idea sheets can be used and understood by external people (people who have not participated to the creativity session).

ESTIMATION OF TIME

TITANIC: 5 min

FIVE BALLS: 10 min

BRAINSTORMING: 45 min

HOT POTATO: 20 min

DAYDREAM: 20 min

WEIGHTING: 20 min

During the brainstorming

Figure C-1. Creativity session one.

CREATIVITY SESSION 2

We did a second session of creativity with the project group. For this session, we wanted to have the point of view of people who knows the town and the project. Furthermore, they have different backgrounds and their knowledges in urban design and architecture were a big asset for this session. The subject was : « Wayfinding and lighting of a city ». This topic was about creating an attractive centre, how to make the city more attractive by adding light elements, creating new activities and information resources for tourists.

We have proposed different activities of team building and creativity in order to answer this question: "how to make the city of Kalix more attractive?". The ideas resulting from this session were grouped into 4 themes : Lights, Tourists, commercial and waterfront.

Waterfront : For the waterfront of Kalix, we imagine different concepts. First, we wanted to make this zone more dynamic because it has a big potential for development. We proposed to enlarge the swimming pool to create a big, relaxing complex complete with sauna and hammam. We wanted also to imagine something which allows people to be protected from the cold weather. Glass domes were suggested over public areas that are accessible to anyone at any time. The could also be a place to relax and watch the northern lights.

Lights: Lights are essential for a city especially in Sweden because of the early sunset. For this, we imagine different concepts like using the urban elements (benches, flower pots,) for lighting. These objects can be totally luminous in addition of decoration and lights on the trees and the walls. We thought about a concept in tandem with GPS which guides the tourists to different places in the city with the help of the lights. All the streets would be equipped with lights on the ground which could be of different colors according to the place that they indicate. The tourist would only have to follow the corresponding color to the place he is looking for. Another light element that we propose are lighting pedestrian crossing and using the headlights of cars to illuminate a structure, using reflection of mirrors. This idea wasn't explored much further however.

- Tourists: We thought that the cultural heritage was very important for the city of Kalix. To transmit this heritage, we proposed a new tourist centre at the entrance of the city. We thought also about projection of a movie/images, which explains the story of the city on a building. To advertise the local products, we imagine a restaurant near the fishing museum, which sells the caviar of Kalix and also a seasonal market in the centre.

-Commercial: We proposed to cover the principal shopping street with a glass roof to protect the pedestrians from the wind, the rain and the snow. We imagine a big pedestrian street under a glass dome, which creates a protected environment in the city. The streets can be more vibrant by adding smells, lights, vegetation and music.

All these ideas we imagine have to be developed further to be realistic, here we have only proposed the general concepts.

Figure C-2. Creativity session two, participants.

Figure C-3. Creativity session two,result.

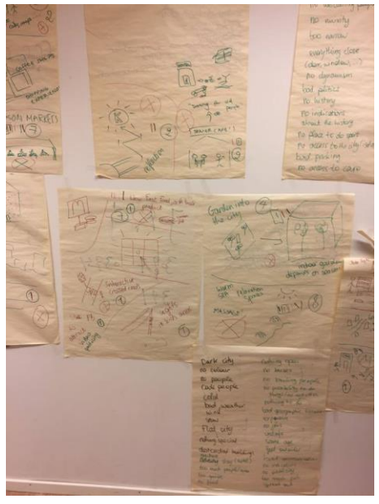

Figure C-4. Creativity session two.

CREATIVITY SESSION 3

Finally, we decided to carry out a creativity session with Erasmus students. We chose these participants because they are outside the project, they had no influence on the subject and the ideas obtained are not influenced by certain constraints or barriers that the people knowing the city and the project might consider. It is also interesting for us to have people of different nationalities with a different point of view than Swedish people. Different cultures allow different ideas. Moreover, it is important for Kalix to attract tourists also, so this is a possible demographic these students represent. No special information from Kalix was shared with these students, so any confidentiality problems were avoided in this way.

During this session, the topic was "a concept that makes a Swedish city unique". With this subject, we wanted to find an idea, activities ... which would make of the city of Kalix a unique city and thus attract tourists to this city so that it becomes better known. We did not restrict people to find a solution for both locals and tourists. We thought of things like the Ice Hotel in Jukkasrjarvi but something that does not exist yet. During the session, we did various activities to find ideas. We will present the one that seems to us the best and especially those which are realistic.

The first idea is a traditional festival that offers different activities. To begin with, there would be demonstrations of different Swedish activities, with the possibility for people to participate. For example, learn to fish, cut wood, etc. Other activities could be ice-skating, reindeer ... An idea that also appeared is to create a reindeer race championship. There would also be traditional menus. This would make it possible to introduce Swedish traditions in addition to the city. A second idea is to create the largest sauna in the world, either the most saunas in the world, or largest by the size of the building. This would allow the city to be known for a record. In the same concept, it is possible to carry out a giant barbecue. The last idea that appeared interesting to us was to present is a concert in an igloo. It is true that this requires a large organization but it may be interesting to think more in detail about this idea. The different ideas can be realized in summer as in winter or it is possible to make them permanent throughout the year.

Figure C-5. Creativity session three, participants.

Figure C-6. Creativity session three, Results.