CHALMERS

An Integrated Planning Approach for the Development of Bohus and its Station Area

Focus on accessibility, urban structure and safety of the traveller

Master of Science Thesis in the Master's Programme Geo and Water Engineering

JACK LU

Department of Civil and Environmental Engineering
Division of GeoEngineering

Road and Traffic Research Group

CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden 2012

Master's Thesis 2012:2

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Picture of a bicycle lane with Bohus centre in the background. The picture is taken by the author September 7, 2011.

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ABSTRACT

In December 2012, Alependeln will be opened for service and Bohus is one of the communities along the commuter line that will get a new station. This master's thesis will study how Bohus can take advantage of this opportunity and, with an integrated traffic and urban planning approach, develop its community and station area into an attractive node. The aspects of accessibility, urban structure and safety of the traveller will be focused upon. Literature studies of current trends in integrated planning and case studies of three other station communities (Norrviken, Kävlinge and Høje Taastrup) will serve as the basis for the project proposal.

The main lesson learned is that there is no specific way to plan and create an attractive node. It has to be understood that Bohus has its own conditions and limitations and therefore have other needs than other station communities. Bohus is situated close to Kungälv and with the trains in service, Göteborg and Trollhättan will be just 16 and 25 minutes away, respectively. One of Bohus' major strengths is its strategic location and it would be beneficial if Bohus could use it to attract new residents, workers, travellers and visitors. However, it is found that the small population and varying topography are the biggest barriers that need to be overcome in order for Bohus to become vibrant and increase the attractiveness of walking and biking. Effort on the pedestrian and bicycling environment along main corridors and extensive bus services are means to improve accessibility for non-driving travellers. Furthermore, a multi-functional community centre in human-scale and with wide a range of services can generate a more secure and vibrant station area.

KEY WORDS: Integrated traffic and urban planning, Bohus, public transportation, accessibility, urban structure, safety, node, sustainability, urban development and station community.

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Preface

This master's thesis has been carried out between August 2011 and January 2012 under the Department of Civil and Environmental Engineering, Division of GeoEngineering, Road and Traffic Research Group, Chalmers University of Technology, Sweden. The project idea was initiated by the Gothenburg Association of Local Authorities (GR) and after a dialogue with the municipality of Ale, the thesis purpose was shaped. Therafter, the thesis was carried out at the department of Urban Planning (Trafik-Plan-Landskap) at WSP, Göteborg, under the supervision of Henrik Yngve. The site visits took place at different times during the autumn in 2011. The examiner and main supervisor of the thesis is Gunnar Lannér, professor at the Division of GeoEngineering.

I want to thank the representatives at GR and the municipality of Ale for their involvement and project idea. I also want to thank my supervisor Gunnar Lannér for being a helping hand throughout the project and making the site visits possible. Foremost, I want to express my appreciation to all my co-workers at WSP, Urban Planning, especially Henrik Yngve, for encouraging me and providing me with constructive criticism, great ideas and professionalism.

Göteborg, January 2012

Jack Lu

1 Introduction

With the regional expansion of Göteborg and increased demand for sustainable transportation options, many large infrastructural projects will carry on in Göteborg in the coming decades. An aim is to decrease car dependency and improve conditions for public and non-motorised transportation.

One of the projects is the expansion of a double railway track on the Norway/Vänern rail route. A new commuter line will start operating along Göta Älv in the municipality of Ale by the end of year 2012. Six new commuter train stations will be added along the rail line: Gamlestaden, Surte, Bohus, Nödinge, Nol and Älvängen. Consequently, these communities will be provided with a new traffic service that they are not accustomed to.

Today, the majority of the residents in Ale travel to work by car or bus. The aim of the new stations is for people to change travel habits and commute into Göteborg and the other station communities by train instead.

Bohus is one of the communities that will get a new commuter station. There are already good connections across the river to Kungälv and there are plans on having the regional train between Trollhättan and Göteborg stopping in Bohus. This means that Bohus will attain a central role in the region and become an important node, which is a great opportunity for the community. However, Bohus is not adapted for this drastic change yet. Therefore, various means, both physical and behavioural, are needed in order for Bohus to develop and become an attractive transit-oriented node for the residents, workers, travellers and visitors.

1.1 Purpose

The purpose of this thesis is to study Bohus and suggest a proposal in how to develop its community and station area based on an integrated, effective and sustainable urban- and traffic planning approach. The thesis will look at what means, connected to *accessibility*, *urban structure* and *safety*, that are required in order to create a successful node and how they can be applied on Bohus based on its conditions and limitations.

1.2 Aim

The aim is to determine the changes and improvements needed in order for a new station community to change its behaviour from being car-oriented to transit-oriented and become attractive for all users. The results will be presented as a project proposal for Bohus.

1.3 Delimitations

This study does not deal with the traffic system itself, such as ticket system, prices, train services and so forth, but only how the station community can be developed in order to provide better conditions for increased transit ridership. Soft factors, such as human behaviour, habits and patterns are not focused on either. The emphases in the case studies and analyses are on *accessibility* for various transportation modes, design in *urban structure* and services and the *safety* and security of the traveller.

The project proposal is made within limitations of current infrastructural and urban structural conditions of Bohus and under the assumption that the regional train will stop at Bohus. A goal is to make minimal intrusion in the natural environment. It is realistic to assume that the suggested changes can be made within a ten year period of time, before year 2022.

1.4 Method

Most of the background information is gained from literature, map and field studies and by reviewing the municipalities' comprehensive and local development plans. Current trends within station planning are studied for increased knowledge and background within the subject. Thereafter, case studies of different national and international station communities are made on-site. A workshop with the department of Urban Planning at WSP is carried out in order to gain some professional insight and create a discussion. The obtained information is then analysed and compared in order to make an appropriate proposal for Bohus.

1.5 Reading instructions

Chapter 1 introduces the thesis and its purpose, aim, delimitations and method.

Chapter 2 and Chapter 3 briefly present the background of the project.

Chapter 4 gives the reader a brief insight of Bohus and its station and describes its conditions.

Chapter 5 is more of a theoretical chapter and treats some of the current trends in urban planning that are relevant for the development of Bohus.

Chapter 6 deals with other station communities that are comparable with Bohus. The results from these case studies are connected to accessibility, urban structure and safety of the traveller.

Chapter 7 are the results which are presented as a project proposal with ideas, concepts and designs.

Chapter 8 reflects upon the results and discusses the advantages and disadvantages of the proposal.

Chapter 9 concludes the thesis and summarizes the main findings.

2 Expansion of Göteborg-region

The region of Göteborg includes thirteen municipalities. With an increasing population and changes in travel habits and patterns, the society is in need of changes and improvements in transportation and infrastructure in order to meet the future travel demands. Increased accessibility, mobility and ridership in public transportation are crucial in order to create a strong and sustainable region.

2.1 Regional structure

A structural scheme has been introduced by GR with the aim to create and develop a sustainable and attractive region to visit, stay, live and work in. The general concept is that there should be a clear and strong centre, like the palm of the hand, with distinctive fingers sprawling out, which symbolize important infrastructural and communicational branches (GR, 2008). A stylistic picture of the regional structure is shown in Figure 1.

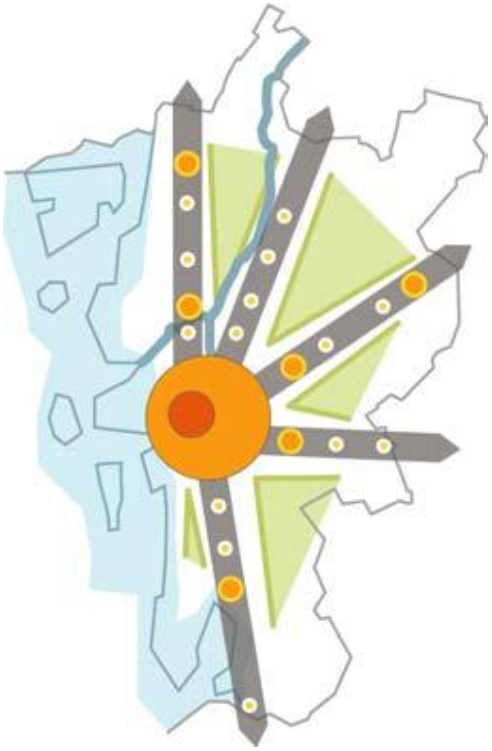


Figure 1. Regional structure of Göteborg-region.

These extensions are vital for the expansion and attractiveness of the region and its labour market. In order to increase the accessibility along these paths, it is claimed that the development of these linear corridors should occur with focus on a sustainable and attractive public transportation system, which includes both local and regional traffic. It is also specified that commuter traffic is necessary in order for the areas to grow and strengthen its role as a key corridor (GR, 2006). GR further states that good public transportation and sufficient walking and biking opportunities at station communities are essential and that new residential projects should be developed in adjacent to public transportation (GR, 2008).

2.2 K2020

As mentioned earlier, a big part in achieving the goals for GR is in investing in public transportation. K2020 is a regional program with the aim to have a market share in public transportation of at least 40 % by year 2025. Today, the ridership in public transportation is only 20 % and therefore has to be increased in relation to car traffic (K2020, 2009).

According to K2020 (2004), the short trips and daily commuting[1] trips have the biggest potential in shifting transportation mode from the car to public transportation and non-motorized traffic. The work-trips with car need to be reduced from today's 65 % to 35 % before year 2025 and rail traffic needs to be four times higher in order to reach the goal with K2020. This requires a well-developed and attractive railway system.

Commuter rail along the five main branches, see Figure 1, and nodes at strategic locations are also parts of the plan that are explicitly stated. The program further mentions commuter parking, design and structure of transportation nodes, disincentives for car-users and many other strategies as measures in increasing the competitiveness and ridership of commuter rail (K2020, 2004). The corridor between Göteborg and Trollhättan is for instance one of the five main corridors that will get commuter train from Göteborg to Älvängen in Ale municipality, as a part in achieving the goals of K2020.

[1] Trips to and from work, school or shopping

3 Project: BanaVäg i Väst

The conditions on E45 between Göteborg and Trollhättan have been poor, with heavy traffic, many bottlenecks and recurrent flooding and the single-track rail road has passed full capacity for goods traffic. In 2004, the government therefore decided that improvements of the trunk road were necessary and together with the expansion of Norway/Vänern rail route, these two huge infrastructure projects would go under the name of BanaVäg i Väst. The project includes a new and more direct double track railway line between Trollhättan and Göteborg and an upgrade of the E45 into a four-lane road with motorway standard, see Figure 2. It will undergo 16 construction stages and the entire project is planned to be completed in 2012 and open for traffic in December the same year (Trafikverket, 2011a).

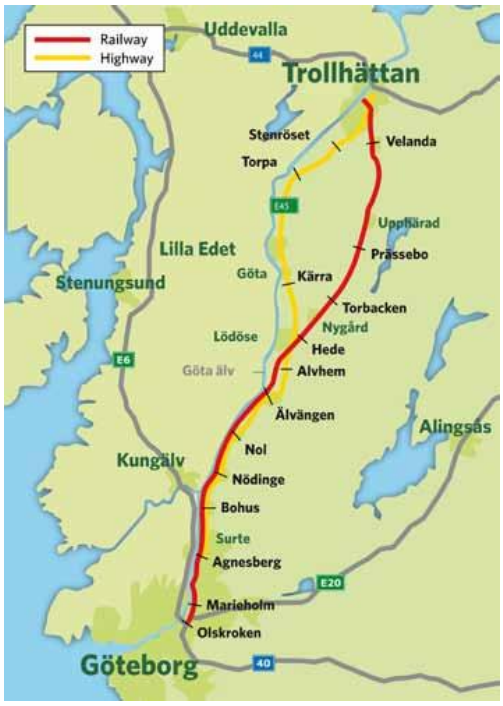


Figure 2. Map over the projected rail- and highway.

3.1 E45 – motorway standard

The project includes a four-lane road with motorway standard for E45 between Göteborg and Trollhättan, which means wider shoulders, a cable barrier and an allowance of a maximum speed of 110 km/h. In addition, several new flyover intersections will be constructed. This will increase the safety and accessibility on the road with smoother traffic, less conflicts and disturbances. The environmental gains are also huge in terms of less emission due to the smoother traffic flow (Trafikverket, 2011c).

3.2 Norway/Vänern rail route – double railway track

> The expansion with double track on the railroad will provide with conditions for more train stops in Ale. In the plan, there will be a train stop in every community, which will make it more attractive to live and work in Ale, with good communications to both Göteborg and Trollhättan. Besides, the expansion is important for the entire region.
>
> – Inga-Lill Andersson, the chairman of the municipal government in Ale. (Banverket, 2004)

Furthermore, the railway will be expanded from being single tracked to a twin railway track. This will result in the opportunity to double the railway traffic on the Norway/Vänern rail route from 60 to 120 freight- and passenger trains per day (Trafikverket, 2011b). The standard of the railway tracks will be increased and designed for 250 km/h, compared to today's 140 km/h, and all railway and road crossings will be multi-levelled as well. From an environmental standpoint, trains, as

a transportation mode, are also more environmental friendly than motor-driven road vehicles (Trafikverket, 2011c).

Due to the double track expansion on Norway/Vänern rail route, there will be enough capacity to introduce a new commuter train line between Göteborg and Älvängen, called Alependeln. This line will operate every 15-minute during peak traffic time and every 30-minute at low demand periods. Alependeln will have six new stations along the corridor: Gamlestaden, Surte, Bohus, Nödinge, Nol and Älvängen (Västtrafik, 2010).

The regional train between Göteborg and Trollhättan will operate in 30-minute traffic and stop in Lödöse södra, which also is a new station, and Älvängen. Currently, there are also discussions whether the regional train should stop in Nödinge or Bohus as well (Västtrafik, 2010). The travel-time between Göteborg and Trollhättan will thereafter be reduced from 50 minutes to 30 minutes (Trafikverket, 2011c).

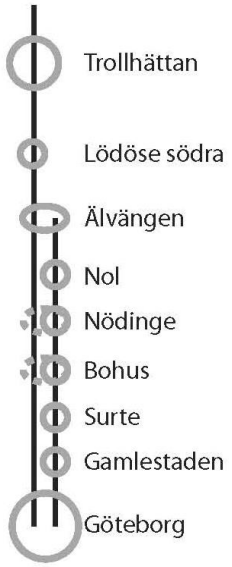


Figure 3. The regional train (left line) and Alependeln (right line) with stops.

4 Plot Study

This thesis focuses on Bohus as one of the station communities that will get a new train station. Bohus station will be the fourth of seven commuter stations along Alependeln, counting from Göteborg. A map of Bohus with marked areas of interest is illustrated in Appendix 1.

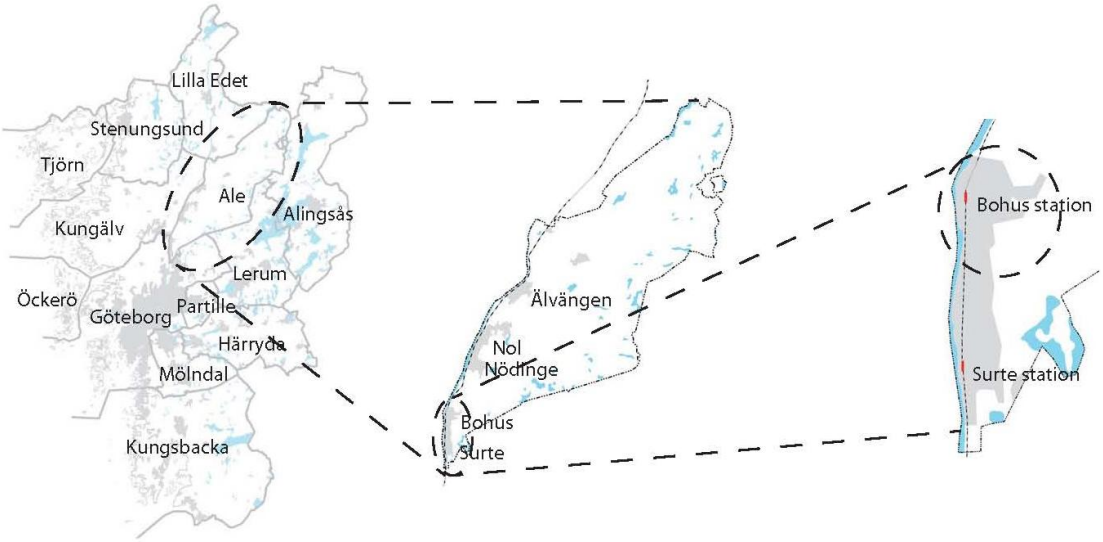


Figure 4. Relation between GR, Ale and Bohus.

4.1 Bohus – the community

Bohus has a bit over 3 000 inhabitants which makes it the fifth largest community in the municipality of Ale, which has 27 400 inhabitants (Ale kommun, 2011a). The community is situated on the east bank of the river Göta älv, 17 kilometres north of Göteborg. In a communicational point of view, it is strategically located next to E45 and the railway and it is well connected to Kungälv and E6 by the bridge Jordfallsbron. Today, it takes 20 minutes to drive by car from Bohus to the central areas of Göteborg.

4.1.1 Urban structure and services

The community was built in the beginning of the 1970s and was developed thanks to its strategic location. Göta älv and the varying topography function as barriers which have allowed the community to expand mostly in a north-southward direction. Bohus and its southern neighbouring community, Surte, are slowly growing into each other.

As it can be seen in Figure 5, the majority of the settlement is on the east side of E45 and the railway. The area between the river and the railroad is industrial and belongs to EKA Chemicals AB, which is the biggest company in the entire municipality with over 500 employees in Bohus (Ale kommun, 2007). The community centre is adjacent to Trafikplats Bohus, a traffic junction, where both river sides are connected by the bridge, which makes the centre easily accessible from the major roads. The centre, seen in Figure 6, has basic general dealers, such as a grocer's store, bakery, flower shop, bicycle store, pharmacy etc. A medical centre and dentist are also available in the central area. For bigger shopping malls and groceries, the locals have to travel to Nödinge, Kungälv or Göteborg.

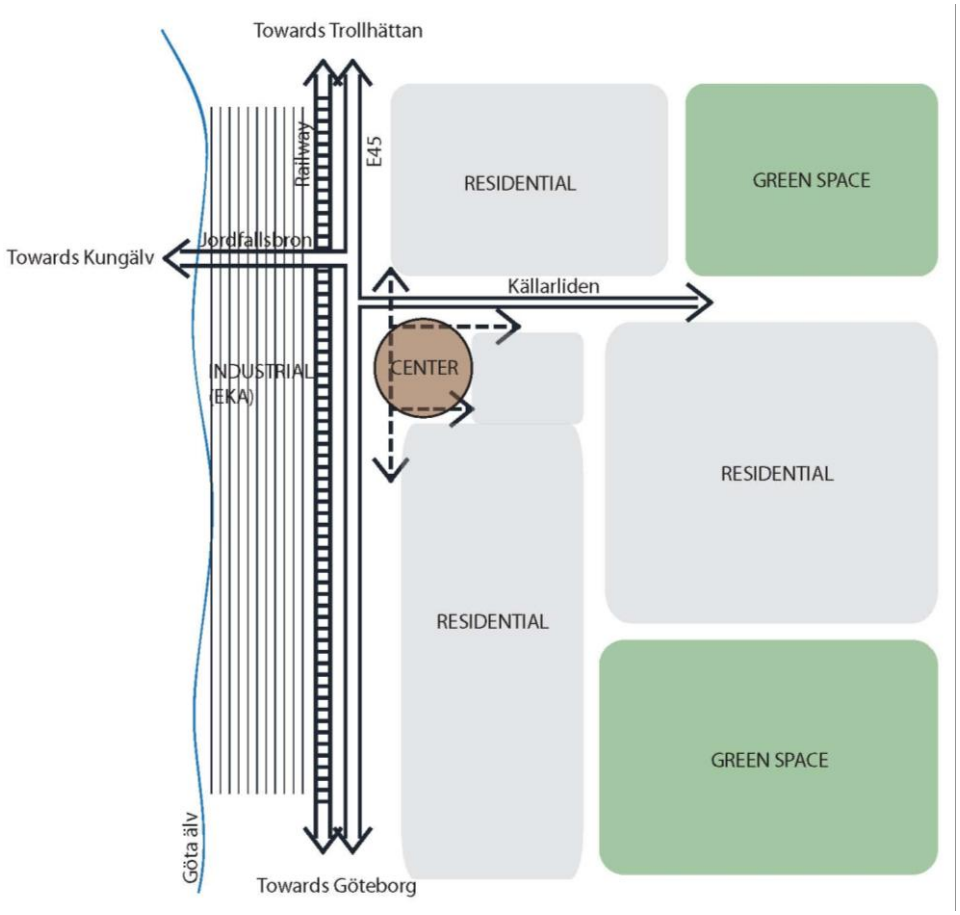


Figure 5. Conceptual structure of Bohus.

Figure 6. Bohus centre.

The centre is surrounded by apartments on the east. They vary between three to five-floor apartments. A bit further from the centre, the housings turn into single family houses. On the hill, the dominant housing features are semi-detached and row houses. These areas have been developed rather recently in 2003 (Ale kommun, 2011c). In general, it can be said that there are mixed accommodation styles in Bohus, with apartments close to the centre and main road and single-family houses further away and up the hill. Some of the housing styles can be seen in Figure 7.

Figure 7. Some of the typical housing types in Bohus.

In the outskirts of Bohus are the big green and recreational areas, such as a shooting range southeast of Bohus and Jennylund's recreational facilities, which for instance includes a football field, ice rink, riding stables and illuminated ski tracks. There are also some smaller green spaces, grass plains and a football field closer towards the community centre.

Bohus has a public elementary school and a preschool. For higher education, the students have to travel outside Bohus. The nearest upper secondary school in Ale is Ale gymnasium, which is located in Nödinge. Other public services in Bohus are the nursing home for senior citizens in the centre and a library in Bohusskolan (Ale kommun, 2007).

4.1.2 Infrastructure

The major road link through Bohus that connects Bohus with Göteborg and the other bigger communities along Göta älv is E45. Norway/Vänern rail route runs parallel with E45. These two thoroughfares are presently undergoing construction work as a part of the project BanaVäg i Väst. A new local road that runs east side along E45 and connects the neighbouring communities from Agnesberg to Älvängen is under construction as a complement to the improved E45 (Ale kommun, 2007).

Jordfallsbron is a central feature in Bohus since it is the only connection over Göta älv within the municipality. The bridge is the joining link between E6 on the west bank and E45 on the east side of the river. It also connects Ale with Kungälv municipality and Hisingen in Göteborg, which makes the bridge very important in a logistical and communicational point of view.

Within Bohus, there is one local street that is of thoroughfare character: Källarliden. The other streets are short neighbourhood streets with no through traffic. The speed limit on Källarliden is set to 50 km/h and 30 km/h on the local street. However, a traffic plan with new speed limits is currently under investigation.

The bikeway net is not very extensive in Bohus. Appendix 1 marks where there are separated bike lanes and bikeways in mixed traffic.

Parking is free on all public parking spaces in Bohus (Ale kommun, 2011b). There is a commuter parking next to the bus terminal and there are some additional public parking lots adjacent to the community centre.

4.1.3 Transportation

Ale is a car-oriented municipality with both a motor-vehicle density and share of car-usage[2] higher than regional average (Lejland, 2009). The public transportation in Ale municipality is run by Västtrafik and is presently built on a regional and local bus system. The public transit ridership in Ale is 15 % with a slightly lower percentage for work trips (11 %). The transit ridership for work trips is highest for trips to central Göteborg (24 %) and lowest within Ale municipality (5 %).[3]

Ale can be considered as a commuting municipality since the majority of all workers commute from Ale to other municipalities. The ratio between commuting to and from Ale is approximately one to four, with 2 600 commuting to and 9 000 commuting from Ale for work (SCB, 2009). The biggest commuting destination is Göteborg (70 %), followed by Kungälv (11 %), Mölndal (5 %) and Lilla Edet (2 %) (Ale ÖP 07). Approximately 4 200 people live and work within Ale (SCB, 2009).

Of the 1 360 workers living in Bohus, almost half of them commute to Göteborg and 14 % to Kungälv. 10 % live and work in Bohus, while 14 % travel to the neighbouring communities in Ale for work[4]. Table 1 and 2 show the top commuting destinations for workers living in Bohus.

Table 1. Top 10 commuting destinations (municipalities) for workers living in Bohus.

Göteborg	49,5 %
Ale	24,4 %
Kungälv	14,3 %
Mölndal	4,2 %
Härryda	1,6 %
Partille	1,1 %
Stenungssund	1,0 %
Trollhättan	0,7 %
Lilla Edet	0,5 %
Borås	0,5 %

Table 2. Top 5 commuting destinations (within Ale) for workers living in Bohus.

Bohus	10,1 %
Surte	3,0 %
Nödinge	2,9 %
Älvängen	1,9 %
Alafors	0,9 %

Bohus has five bus stops within the community: Jennylund, Bohushöjd, Bohus C, Bohus skolväg and Skårdal. The main station is Bohus C, seen in Figure 8, and there are a total of five bus lines that serve Bohus, which are the following:

[2] Martin Elofsson, Västtrafik, e-mail and excerpt from a document, 16 September 2011.
[3] Ibid
[4] Martin Elofsson, Västtrafik, e-mail and exceldocument, 16 September 2011 & Johnny Selin, SCB, complementary data, 22 September 2011.

Table 3. The bus services in Bohus.

Bus line	Destination	Frequency	# stops in Bohus	Comments
301	Ytterby - Bohus	30 min	1	-
401	Kungälv - Bohus	30 min	3	Continues to Jennylund during low traffic periods
402	Eketrägatan - Älvängen	30 min	1	Does not serve Bohus during evenings and weekends
403	Göteborg C - Nödinge	30 min	3	-
404	Göteborg C - Jennylund	30 min	5	Only operates during peak hours

Figure 8. The bus terminal in Bohus.

4.1.4 Expansion plans

According to Ale's comprehensive plan (Ale kommun, 2007), the vision is to have a municipal population of 30 000 by the year of 2020. To reach this goal, many new apartments and residential areas need to be built and it is believed that the completion of BanaVäg i Väst will have a great positive effect on the residential demand. It is explicitly stated that new exploited areas should be localised so that existing infrastructure, such as roads, water and sewage system, can be used, as well as with good access to public transportation (Ale kommun, 2007).

There are plans on expanding Bohus, where the most extensive detail plan in progress is for Skårdals Skans with 200 dwellings. In order to construct Skårsdals Skans, the shooting range may need to be relocated. There is also an investigation in exploiting Vinningsbo for 170-225 apartments further in the future. This would however implicate intrusion on the national interest of outdoor recreation (Ale kommun, 2007). For the location of the expansion areas, see Appendix 1.

The land north of the EKA industrial area needs to be sanitised before it can be used for other uses; such as industry land, nature areas and traffic sites (Ale kommun, 2010).

4.2 Bohus station

Bohus station is one of the seven new stations that will be built along Norway/Vänern rail route. It will be the fourth station counting from Göteborg on Alependeln and a trip to Göteborg will only take 16 minutes in the future and nine minutes to Älvängen[5].

The station will be situated west of E45 and south of Trafikplats Bohus, see Appendix 1. To overcome the barrier and be able to reach the platform safely, the station will be designed with three towers connected by a glass encrusted pedestrian bridge. The towers will contain stairs, an elevator and waiting areas. Several weather protections will be placed along the station platform. The overall conception of the station design is clarity and simplicity with glass walls that expose the interior. The idea applies to the bridge and both towers, as well as for the weather protection[6]. For pictures and plans of the future Bohus station, see Appendix 2.

Currently, there are discussions on whether the regional train should stop at Bohus station or in Nödinge. According to Friberg[7], the biggest advantage of having the stop in Bohus is the good connection to Kungälv and the opportunity for increased mobility and accessibility for commuters between Kungälv and the communities along Norway/Vänern rail route. Bohus, as a transportation node, will then have a larger influence area and become more important than today. The main argument for having the stop in Nödinge is that it is one of the central communities and is planned to expand and develop more than any other community in Ale. Moreover, Nödinge has Alegymnasium and a higher population.

[5] Johan Hasselqvist, Västtrafik, interview, 3 October 2011.
[6] Carl Johansson, Sjögren Arkitekter AB, e-mail and excerpt from a document 21 September 2011.
[7] Annika Friberg, Ale municipality, interview, 7 September 2011.

5 Planning Trends

Nowadays, planning urban areas in regards to public transportation has become a more and more apparent planning approach: Urban development should occur along transit lines and around nodes in order to enlarge and create a strong, attractive and sustainable area to live, work and stay in. Therefore, society cannot longer be car-oriented since there are for instance environmental, resource and safety aspects to take into consideration. Alternative transportation modes are now encouraged and we see a global trend in investments in public transportation and improved conditions for pedestrians and bicyclists.

One of the current trends is the view on traffic contra land use planning. A city cannot longer be planned with just one of the approaches in mind, but they should be integrated in the planning process in order to create the sustainable city that is needed. Hence, a more suitable planning term: urban planning.

A similar planning strategy that has been on the subject for many years internationally, foremost in North America and Australia, is TOD (Transit oriented development). TOD is a conceptual planning tool specifically applied to train stations regarding integrated public transportation and land use planning.

On a smaller scale and with a more concrete method of station planning, a guideline of creating the ideal node has been compiled. The focus is on creating an attractive meeting point that revolves around people and interaction in order to give the node a more meaningful purpose and usage than just transportation.

The following chapters will describe these three current trends in more detail: what the theories are, how it can be achieved, and the main problems that come with it.

5.1 Urban planning: integrated traffic and land use planning

According to Boverket (2002), a sustainable city is a city that:

- ✓ has functional and beautiful public spaces that encourage movement and interactions
- ✓ involves the public in the planning process
- ✓ is unique and has its own identity
- ✓ is accessible for all people and users
- ✓ has a comprehensible urban structure and is multi-functional in uses
- ✓ is esthetic, comfortable and safe
- ✓ has green spaces, healthy sound environment and access to fresh air
- ✓ has a sufficient and safe transportation system, both within and out from the city

5.1.1 What is it?

In 2002, Boverket published an inspirational book about urban planning as a combined and integrated concept: *STADSPLANERA – istället för trafikplanera och bebyggelseplanera*. The overall idea is to better integrate traffic and land use planning on the local and regional level in order to reach national goals in sustainability. The

book states that the city and traffic are not anti-poles but they presume each other. Factors such as a city's environment, traffic and peoples' everyday life are strongly connected (Boverket, 2002). The book focuses on the planning of a city, but the theories are also applicable on smaller communities and neighbourhoods.

5.1.2 How can it be achieved?

One of the main believes is that each city is unique with its own identity and people. It also has to be recognized that different aspects need to be taken into consideration when planning since each city is different. Boverket (2004) claims that a sustainable city is a city that is available for everyone and all modes of transportation, even the car. However, it should be planned with regards to the human and support walking and biking. The pedestrian system should offer short-cuts and be more accessible than the bicycle network, which in turn should be more accessible than the car. Only then can walking and biking be an attractive mode of travelling.

Pro-active public transportation planning

In addition, an efficient and accessible public transportation system is crucial in creating a sustainable society. It is clear that there needs to be a more pro-active public transportation planning approach (Svensson & Nilsson, 2004). This means that a city should be planned after the public transportation system and not vice versa. Public transportation should encourage urban growth and this can be done by concentrating new development in walking or biking distance to transit stations. Separations between residential housing, retail and office spaces are no longer needed. Instead, mixed uses are encouraged in order to create vibrancy and interaction in a community and at the same time reduce the need of travelling. This, in combination with an improved accessibility for transit, pedestrians and bicyclists, a sustainable city can be achieved (Boverket, 2004).

Svensson & Nilsson (2004) summarize that in order to reduce car traffic in short terms, direct car-affected measures are needed, such as car disincentives and a more competitive public transportation. However, in the long run, these actions have to be complemented by an urban structure and function that favors alternative travel methods than driving.

Accessibility for everyone

Boverket (2002) mentions that a sustainable city is a city that is accessible for everyone: the young, the elderly and people with mobility and functional disabilities. The city should also be accessible for all types of transportation: walking, biking, transit, cars and goods transport. It is important to remember that the path to the station also is a part of the journey. An "Entire trip" concept should be used, meaning that anyone should be able to go from door-to-door safely and fast (Berg, 2009).

Accessibility should not be misinterpreted with mobility. It is important to understand that increased mobility does not always mean increased accessibility. For instance, in a scattered community mobility is encouraged through movement between the places. However, efficient and sufficient transportation systems are vital in connecting the scattered urban developments and thereby increase accessibility for all users (Boverket, 2004).

Berg (2009) explains that there are various aspects of accessibility with regards to transportation.

- ✓ Physical – able to make his way without meeting physical obstacles
- ✓ Psychological – able to percept, understand and use transportation and its opportunities
- ✓ Social – able to interact with others and participate
- ✓ Organizational – able to have access to useful information and services before the trip
- ✓ Economical – able to afford to use transportation

5.1.3 Challenges and criticism

A big challenge in implementing this integrated planning approach is to first break the barriers of conventional and traditional planning. In the past, the planning tactics has been very normative and focused on cars but needs to become more forward-looking and sustainable-minded (Berg, 2009). Svensson and Nilsson have some criticism against the present Swedish public transportation planning system:

> The means of control and incentives are weak and too few, the national targets are difficult to interpret and translate into local action, the coordination in and between different levels and sectors in the political and planning system is weak, management by objectives demands new methodologies and description patterns which are still not fully developed, and there is a general lack of knowledge. (Svensson & Nilsson, 2004)

Public participation is also pointed out as an essential part in the planning process, which is why it is recommended that integrated urban planning should be done on the local and regional level in order to better reach out to the public. There should be a continuous communication between planners, politicians and the citizens. (Boverket, 2002)

5.2 TOD – Transit oriented development

> Transit oriented development is the exciting new fast growing trend in creating vibrant liveable communities. […] it is the creation of compact, walkable communities centered around high quality train systems. This makes it possible to live higher quality life without complete dependence on a car for mobility or survival. (TransitOrientedDevelopment)

5.2.1 What is it?

The concept of TOD was introduced in the early 90s where the issue about transit oriented planning was brought up and how it can counteract suburban sprawl that is occurring in the American cities and the problems that comes with it, for instance car-dependency and traffic congestion (Berg, 2009). TOD considers the integration of transport and land use planning and development around station areas. The overall idea is to concentrate dense and mixed urban development around railway stations in order to encourage the use of public transit and non-motorised modes (Curtis, Renne, & Bertolini, 2009).

TOD should be treated as a conceptual planning tool and framework when developing or redeveloping urban areas rather than as a design checklist. Each neighbourhood is individual and have its unique needs and potential, which the goals and visions of TOD need to be adjusted to (Anderson & Zimbabwe, 2011). However, some aspects that need to be taken into consideration in the planning of TOD are for example designing in human scale; in accordance to pedestrian and bicyclists' accessibility and safety. The station area needs to be a central feature and the surrounding areas, typically within 800 meters, should contain high density and multi-functional development (CTOD, 2008b). Figure 9 illustrates a conceptual model of a TOD.

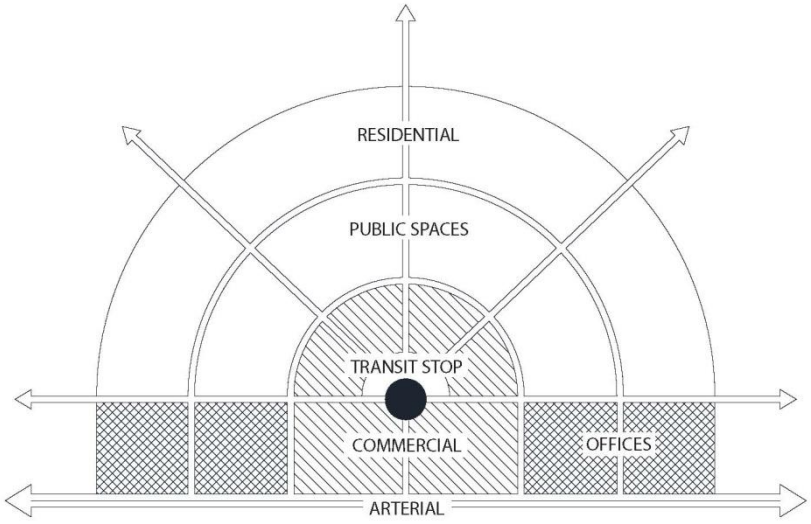


Figure 9. A conceptual model of a TOD, with commercial uses closest to the station and residential areas in the outskirts.

5.2.2 How can it be achieved?

Cars are fast and flexible, but lacks in capacity. Public transit has high capacity and travel speed but needs to increase its flexibility, while non-motorised transportation has both high capacity and flexibility, but lacks in speed, see Figure 10. The strengths and advantages of public transit and non-motorised transportation need to be combined in order to compete with the car. At the same time, means to reduce the flexibility and speed of the car needs to be introduced. Curtis et al (2009) suggest that this only can be achieved in dense areas with short distances, which TOD promotes.

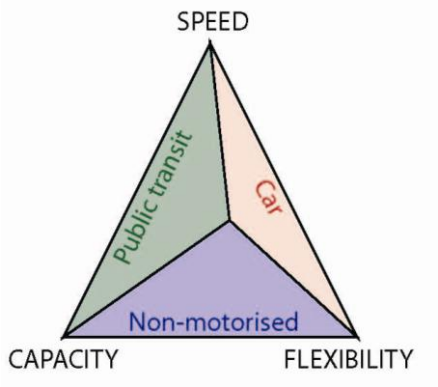


Figure 10. Relation between speed, capacity and flexibility for different transportation modes.

Another significant aspect in TOD-planning is the urban structure around the transit node. It is stated that a centre cannot stay viable as long as the houses and jobs are scattered and there is not a decent public transportation system; no matter how many services and amenities that are provided (Curtis, Renne, & Bertolini, 2009). In order to increase transit ridership, the station area therefore needs to be considered as a place to reside in and not just for transportation. A dense and functional mix of services and office spaces is advocated for, which will increase the attractiveness of the area. Furthermore, households with lower income and single-person households are generally more frequent transit users (CTOD, 2008a). Therefore, creating a rich mix of accommodation styles for people of all ages and incomes is vital in a TOD. According to CTOD (2008b) it can stimulate private investments in development and real estate and provide value for the entire community.

Other important aspects to be considered in a successful TOD are (CTOD, 2008a):

- ✓ Pedestrian and bicycle friendly streets. This means that intersections and sidewalks should be designed after the needs of pedestrians, bicyclists and transit users and not the cars. Clear and easy orientation, adequate space and good street connections are important in order to encourage walking and biking.
- ✓ Public spaces, which need to be pedestrian-friendly and multi-functional in a way that it is welcoming to transit riders, workers, residents and visitors.
- ✓ Parking, which need to be thoughtfully planned and well integrated into the station area. Poorly managed parking can make the station area unfriendly and create a barrier for by-passers while well-planned parking may induce ridership and improve station accessibility. Sufficient bicycle parking should also be provided at strategic locations.
- ✓ Politics. TOD cannot just be a conceptual planning method but needs to be a statuary principle in regional planning which requires density and mix in centres and good access to transit in newly developed areas. Also, public participation early in the planning process can be very helpful in creating a successful TOD.

5.2.3 Challenges and criticism

The concept of TOD is still under acceptance in many countries, but already widespread and recognized in Scandinavia. One typical example is the *Finger Plan* of Copenhagen, where a rail system promotes urban growth along the linear corridors. The plan encourages a mix in land uses and has produced a sustainable travel pattern amongst the population (Curtis, Renne, & Bertolini, 2009).

However, there is still some problems and criticism with TOD-planning:

> […] although transit-oriented development is now starting to be recognized as a viable type of development, there is still a widespread lack of understanding of its nature, its potential, the challenges it faces and the tools needed to overcome these challenges. (Autler & Belzer, 2002)

As Berg (2009) states in her report, one of the major concerns with concrete TOD is the absence of expected synergy effects that is supposed to occur with the mix of residential housing, offices and retail. A functional mix has proven to be harder to accomplish than what TOD advocates for. Additionally, studies have shown that mixed accommodation styles do not always generate a mixed population, which originally is the purpose. It is believed that the main reason is that there often is no unified vision amongst the decision-makers and that the interests of each involved stake-holder differ. They do not necessarily support TOD and they do not always understand its potential and benefits. First and foremost, the attitude therefore needs to be changed: Without a unified goal, it will not be easy to translate the vision of TOD into reality.

5.3 Traffic node as a meeting point

Gehl Architects has worked on various projects about modern station development with emphasis on the traveller's physical and social needs and restrictions. Focus is on the interaction amongst people and between people and the physical environment. Gehl believes that if social, cultural and physical values of the humans are taken into consideration in station planning, it can strengthen the role of a station area (Gehl Architects, 2011a).

5.3.1 What is it?

A station should not only be a place for transportation. Gehl makes the differentiation between an interchange and a node: An interchange is a place where public transportation meets and where people can change between transportation modes. A node is more than that: it offers services, has a more dense development and encourages interactions (Gehl Architects, 2007). In order for a station to become attractive and obtain a central role in the community, the station should be planned as a node.

As for the previous planning trends, the shaping of a node is also about integrating public transportation with other functions of the community. It is assumed that a node, a place for both people and transportation, can act as a generator for urban development and that thoughtfully planned nodes can create attractive communities. With the traveller in mind, it can create better conditions for walking, biking and public transportation (Gehl Architects, 2011a). Therefore, this planning approach should act as an inspiration and vision towards creating the ideal node.

5.3.2 How can it be achieved?

In *Den ideala bytespunkten* (2007), nine qualities are mentioned that can act as a guideline in developing the ideal node. These nine qualities can be narrowed down to five basic requirements for an attractive node, see Figure 11. Accessibility and security are fundamental for all stations, but in order to separate a node from an interchange, three more basic requirements need to be regarded (Gehl Architects, 2011a).

Figure 11. The ideal node can be broken down to five fundamental criteria.

Accessible for everyone

Probably the most important and obvious assumption is that the public transportation is efficient and reliable. Otherwise it will not be able to compete with the car, no matter how successful the node is designed. Furthermore, the station needs to be easily-oriented and accessible for all users, no matter age or functional ability or disability. Anyone should be able to use and change between the transportation modes and use the services that are offered at the station.

The local environment around the node should also be considered since most trips with public transportation start or end with walking or biking. It is essential that the station is connected to the local pedestrian and bicycle network and accessibility can be improved if work places and residential areas are in close proximity. A dense urban structure and sufficient network for walking and biking mean that more people have better access to the node. In addition, thoughtfully planned car and bicycle parking can attract more potential public transportation users.

Safe and secure during all times

Another basic requirement is that the node should be safe and secure to reside in at all times. Sufficient lighting, a perspicuous station area and staffing are some aspects that can enhance the feeling of safety. In addition, restrictions in motorized traffic and safe crossings are means to improve traffic safety, which also is an important part in shaping the ideal node.

Feeling safe socially can be equally as important as physical safety. Social safety can be achieved by striving after mixed use of groups at the node in order for everyone to feel welcome. Activities that enable life and movement during all times of the day, such as retail, housing, restaurants or a gym are encouraged. More eyes on the street and surveillance will make the node feel more secure.

Encourage interactions and meetings

Another aspect that separates a node from an interchange is the possibility for interaction between people. A node that can inspire and encourage interactions and meetings is a vibrant node. In order for it to become vibrant, there need to be dense development with spaces and different activities, such as markets, events, cafés or shops. Ground floors can for instance be open and active for mixed uses and thereby attract movement and life.

Well-designed public spaces with places to sit and rest are also important. It can encourage meetings and conversations and it can also offer secure spaces for individuals who just want to observe. Furthermore, there are often central and natural meeting points in a node, which could be a specific sign, fountain, statue or similar.

Distinctive with own identity

Gehl points out that it is significant that a node has its own identity and has a distinctive place and meaning in the community. It is preferably the hub of the community. The design should be easily recognizable and clearly state to the traveller that they have arrived to an important node. In addition, there should be sufficient information about the station area and its services that the traveller and visitor easily can use and understand its functions.

The node has a greater attraction potential if it somehow can be associated with the community and its people. It can for instance be reflected in a cultural or historical heritage. It is also beneficial if the community can feel affiliation and pride over the node in order to create an accustomed place that welcomes everyone.

Attractive and aesthetically pleasing

The last of the five fundamentals is the aspect of attractiveness in terms of aesthetics and design. Choice of furniture and material should be attentive to the human scale and mind that different users have different needs and behaviour. An elderly or parent with a baby carriage is likely to have different travel patterns and functional needs than a student that arrives to the station on a bike.

Other necessary features are weather protections and elements of nature, which often are appreciated and can result in a more welcoming place to be in. Moreover, the sustainable aspect in energy efficiency and ecological solutions becomes more and more prominent: The society need a design that lasts. The node should obviously also be clean, intact and well-maintained in order for it to stay attractive.

5.3.3 Challenges and criticism

There are many requirements in developing a node and most are not that easy to implement. Due to regional enlargement and changed travel patterns amongst the citizens, there are many challenges that need to be overcome before the vision of an ideal node can be reached.

Cities are expanding and people tend to move further away from the city centres. With a concentrated labour market in the cities and people living in the outskirts, people have to travel more. If alternative transportation modes are not encouraged or available, car-dependency becomes the only option. Furthermore, with everything being concentrated in the cities, services and activities flee from the smaller communities and so does the vibrancy. This makes it difficult to create attractive nodes in smaller communities outside larger cities.

Gehl (2011a) brings up an interesting point about how distances can be perceived differently depending on the physical environment. Much is mental, meaning that the willingness to walk or bike is affected by whether the road or spaces are designed in human scale or promote interaction with the physical environment. Spaces with variation and movement tend to encourage people to walk or bike a longer distance.

5.4 Summary of the trends

The three trends that have been mentioned in this report have many similarities. They all advocate:

1. an integrated traffic- and urban planning approach
2. a station design that considers the traveller and recognizes that each community is unique and have different needs and opportunities
3. prioritization of walking, biking and public transportation
4. public participation in planning process

However, the focus and applicability of each theory is different. Below is a table that summarizes the main characteristics of each planning trend.

Table 4. A brief summary of the main ideas of each planning trend.

	Urban planning	**TOD**	**Traffic node**
Conceptual/ concreteness	Inspirational planning concept	Conceptual planning tool	Guidelines
Applicability/scale	Cities and towns	Railways station communities	Station and station area
Main focuses	1. Integrate traffic and land-use planning on local and regional level. 2. Pro-active public transportation planning. 3. Accessible for all people and all modes of transportation.	1. Concentration of development around train stations. 2. Creating a functional mix in structure and services. 3. Design in accordance to the safety and accessibility of pedestrians and bicyclists.	1. Station as a meeting point and that encourages interactions. 2. Distinctive with own identity. 3. Design in regards to the needs and limitations of the traveller.
Main problems	1. Break barriers of car-oriented planning. 2. Better coordination between different levels in the political system.	1. Still not a fully accepted or understood theory world-wide. 2. Difficult to achieve synergies between the functions.	1. Difficult to implement in smaller communities.

6 Case Studies

This chapter will look into three examples of station communities, two of them which are located in Sweden and one international example in Denmark, see Figure 12. All stations are approximately 15-20 kilometres outside of a larger CBD[8] and have a population that does not exceed 10 000. This is in order to have similar characteristics with Bohus, thus allowing reasonable comparisons.

The first case study is Norrviken, a residential community outside Stockholm which has a commuter station of a simple kind. Kävlinge, the second station community, is located northeast of Malmö and is served by both regional and commuter train. There are current plans in expanding and redeveloping the station area. The last example is Høje Taastrup, which is located outside Copenhagen and has a more modern train station. This station functions as a regional and important traffic junction and is under the development of becoming a node.

With lessons from the planning trends in mind, the sites were visited in order to gain a realistic and fair view of the accessibility, urban structure and safety of the community and station area. The case studies took place during different autumn days in 2011.

There are maps of each community in Appendix 3, 4 and 5 where important structural and infrastructural features are highlighted.

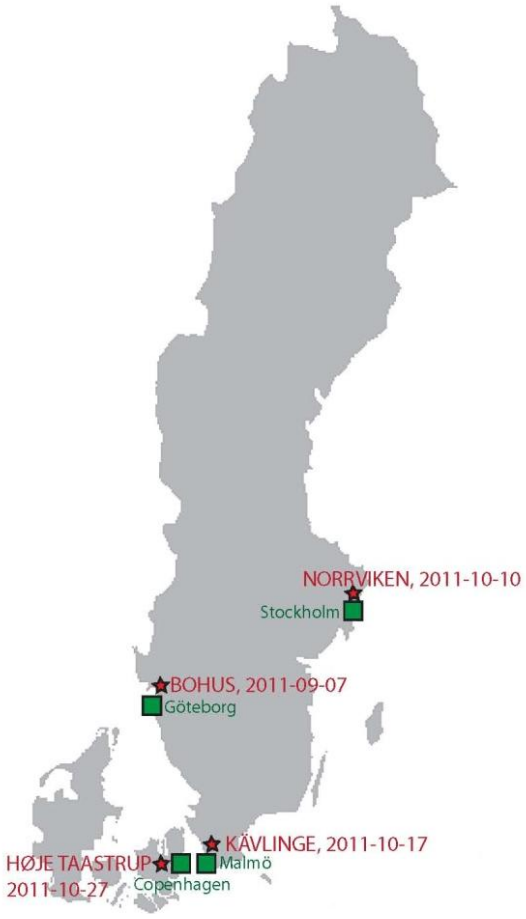


Figure 12. Map with the location of case studies marked.

6.1 Norrviken - the station from 1907

Norrviken has 3 300 inhabitants and is a residential community in the municipality of Sollentuna, 64 600 inhabitants (Sollentuna kommun, 2011). Norrviken is located 17 kilometres north of Stockholm and is situated south of Rotebro and bounded by E4 and lake Norrviken. The community is characterized by its lavish and preserved villas from the early 1900s and was not really starting to develop until after the opening of the train station in 1907 (Stockholms läns museum). It takes approximately 16 minutes to travel to central Stockholm by car.

[8] Central business district, usually referred to the centre of a large city where commercial activities occur. Stockholm, Göteborg, Malmö and Copenhagen are considered as CBDs in this context.

6.1.1 Urban structure and services

The community mainly consists of residential housing; mostly villas but also some blocks with row-houses. The centre, which is sited directly west of the commuter station, consists of apartment houses. North and south of the centre, along Norrvikenleden, are offices and work places for several small companies. The only retail and commerce are located in the small community centre and is simple and limited in services. See Figure 13, for a conceptual urban structure of Norrviken. For larger commercial areas, the residents have to travel to its neighbouring communities: Häggvik or Rotebro.

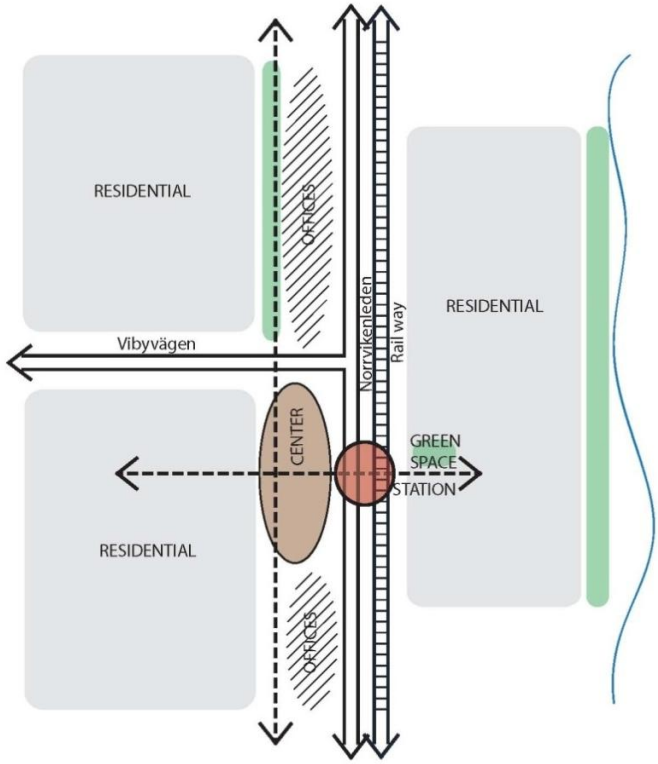


Figure 13. Conceptual structure of Norrviken

Even though there are many large single-family houses with private gardens, the development is quite dense and has no large topographical differences. There are not many open public spaces in between the habitats and also no room for local expansions since almost all plots already have been built on.

6.1.2 Infrastructure

As seen in Appendix 3, Norrviken is bordered by E4 on the west side. The rail road runs through the community in a south-northern direction. The main thoroughfares in the community are Norrvikenleden, which goes parallel to the rail road, and Vibyvägen, which stretches perpendicular from Norrvikenleden. The other streets are of local character with no through traffic. Many of those streets do not have sidewalks, but are directly bounded by property fences.

However, the conditions for pedestrian and bicyclists are better on the main routes closer to the centre. There are some separated pedestrian and bicycle paths in the community, see Figure 13. These paths are usually shortcuts that go through a block or function as an extension of a road, but only for non-motorized traffic.

Figure 14. Foot- and bicycle paths in Norrviken, through neighbourhoods and along thoroughfares.

6.1.3 Transportation

The public transportation in Norrviken is operated by SL and the system consists of a commuter line that runs through the community and is complemented by seven bus routes. The transit ridership is 25 % in the municipality of Sollentuna and there are 1 600 boarding and embarking at Norrviken station during a normal weekday, which is a high number in relation to its population (SL, 2011a).

There are 1 600 workers living in Norrviken and 83 % of them work outside the community. Approximately 800 people commute to and 1 300 commute from Norrviken for work. 160 people live and work within the community (Stockholms läns landsting, 2007).

Norrviken is located along the commuter line that runs between Södertälje and Märsta, see Appendix 6. It is the sixth station north of Stockholm C and a trip to the central station takes 21 minutes and 15 minutes to Märsta. The commuter train operates every 15 minutes during most times, except in the evenings when the frequency is 30 minutes. A few additional departures are added during peak hours.

Norrviken has six bus stops within the community, marked in Appendix 3. Most of them have weather protection. The main bus station is Norrviken station, which is in connection to the commuter station.

6.1.4 The station area

The range of services in Norrviken centre is limited. The centre consists of a small and empty square surrounded by a daily grocery store, private dentist, meat market, tobacco shop, grill bar and a pizza restaurant. There are some seats and lighting along the edges of the square.

The central area is car free and the car parking is located behind the centre. There are two parking lots on the west side of the station where most spaces are leased by companies or residents. However, there are approximately 40 public parking spaces, which are intended for grocery shoppers, visitors and commuters. The first two hours are free and thereafter there is an hourly fee. These parking lots are also used for lay-bys and taxis. There is also a small commuter parking on the immediate east side of the station with 14 spaces, which are free of charge.

For bicyclists, there are plenty of bicycle stands, mostly on the west side of the station. They are conveniently located between the car parking and the station. However, only the bicycle parking on the east side has weather protection.

The station is located almost centrally in the community where the two thoroughfares Norrvikenleden and Vibyvägen meets, which makes it easy to orient to the station. There are clear signs on how to get to the commuter station, both for drivers and non-drivers, and one can already spot the station sign before coming to the centre. It is also displayed how to get to the buses and the centre, coming from the commuter station. However, the information about car and bicycle parking is poor. There are no signs of where the parking spaces are. Furthermore, the public parking is mixed with leased parking which makes it more difficult to find a parking spot.

Norrviken station

Norrviken station is situated in direct proximity to the community centre, only separated by Norrvikenleden. In order to get to the station platform, one therefore has to go under the road and the rail tracks through two tunnels. The entrance to the station is in one of the tunnels and the platform is reached by a flight of stairs or elevator. There is an indoor waiting hall with a few seats and a WC. The platform is roofed halfway, and there are plenty of seats with weather protection. The waiting hall is well lit and staffed during operation hours. Only the part of the tunnel where the station entrance is has lighting. A conceptual picture of the station area can be seen in Figure 15.

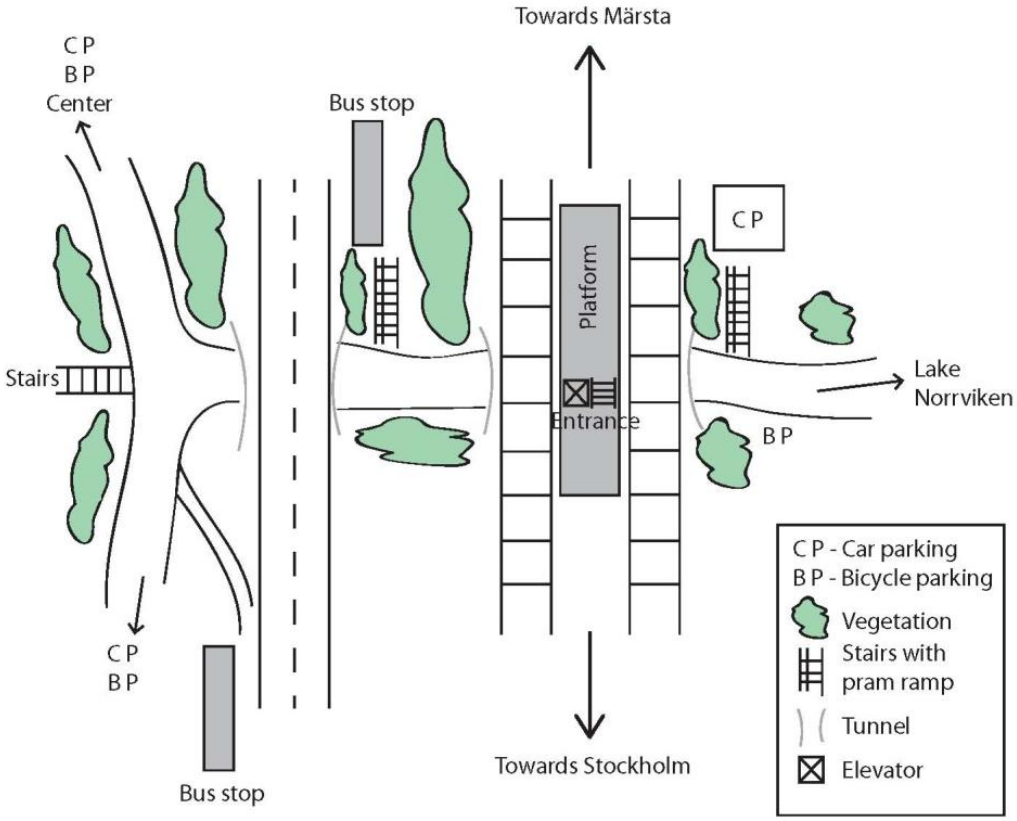


Figure 15. Overview of Norrviken station and its surrounding areas.

The station also has a connecting bus stop on Norrvikenleden and can be reached when coming out from the train station. To catch the bus that goes towards Märsta, one has to climb a flight of stairs which is located between the tunnels. The other bus stop in the other direction is further away from the train station, but has a ramp which makes it more accessible for people with baby carriages or elderly who have difficulties to walk in stairs. Both bus stops have weather protection.

6.1.5 General reflections

From an accessibility point of view, the station area is well adapted for pedestrians and bicyclists. There are good connections on the main corridors and with separated paths and shortcuts it is easy to get around in Norrviken by foot or bike. There is also plenty of bicycle parking. However, for the convenience of the bicyclists, weather protection is preferred. It seems that many commuters walk or bike to the station, instead of driving. This is probably because of the concentrated development that implies short distances, but also that most of the parking spaces are feed. For drivers coming further outside of Norrviken, SL refers to the commuter parking in neighbouring communities Häggvik or Rotebro (SL, 2011b).

For the elderly and mobile disabled, it is difficult to get to the bus stop on Norrvikenleden towards Märsta. There is only stairs and a pram ramp leading to the bus stop from the tunnel, which makes it very difficult for them to reach the bus stop. Crossing Norrvikenleden is not an option since it is not safe. It is also difficult to spot the bus stop from the tunnel when coming out from the train station because of the level difference. Therefore, the connection to the bus and accessibility aspect is lost. A picture of the pram ramp and visibility problem can be seen in Figure 16.

Figure 16. Picture of the stairs and pram ramp that leads up to the bus stop. The visibility is poor.

The concentrated urban structure promotes walking and biking within the community and to the station, even though many local streets do not have bikeways or even sidewalks. There are clear main routes where the pedestrian and bicycle infrastructure is sufficient. The pedestrian and bicycle crossings over the main thoroughfares in central Norrviken are grade separated, which is traffic safe. In addition, the car free centre adds to the safety aspect.

Even though the station area is traffic safe, it does not necessarily mean it is secure in a social perspective. The tunnel, for instance, feels unsafe since it is partly unlit and goes under a heavily trafficked road and railway which can cause a lot of noise. Sharp turns from the tunnel, high vegetation and the level difference up to the bus stop mean poor visibility: A clear overview is favourable from a security point of view.

Furthermore, Norrviken is mainly a residential community, which means that there is an absence of vibrancy and movement during mid-days and in the evenings, especially when the shops are closed. This also contributes to the social insecurity. However, due to the offices, there still is some movement in the central area during day times.

Norrviken station lacks clear information of departures for train and buses. It would be beneficial if the information for train departures could be seen from further away, and not just in the waiting hall at the station. At many other commuter stations in Stockholm, a large digital board with a clock and information about the next arrival and departure has been used, see Figure 17. These boards are approximately five meters high, show real time information, usually placed close to the station entrance and easy to recognize. Moreover, bus information could also be shown digitally at the train station. This would give the travellers the option to wait for the bus indoors instead of going outside to the bus stop in order to see the time table.

Figure 17. A digital information board that could be used.

6.2 Kävlinge – community under development

Kävlinge is a community in the region of Skåne, with approximately 9 000 inhabitants. The municipality, with the same name, has a population of 29 000 (Kävlinge kommun, 2011a). Kävlinge is characterized by its 1800s architecture and old industrial areas and has slowly grown into its neighbouring community, Furulund (Kävlinge kommun, 2010). It is strategically located where road 108 from Lund and 104 from Landskrona intersects and where the rail road diverges towards Lund and Malmö. With both regional and commuter trains stopping in Kävlinge, it functions as an important hub for rail traffic. Lund and Malmö are located 11, respectively 23 kilometres south of Kävlinge. It takes approximately 15 minutes to drive to Lund and 30 minutes to Malmö.

6.2.1 Urban structure and services

The urban structure in Kävlinge is clear; principally mixed public and commercial activities in the central areas and residential further out, see Figure 18. There are also some industrial plots here and there. The housings are of various styles and types: apartments close to the centre and primarily old single-family brick and stucco houses in the outskirts. Some of the public services that are offered in the central area are a church, museum, town hall, health care centre and community centre for senior citizens.

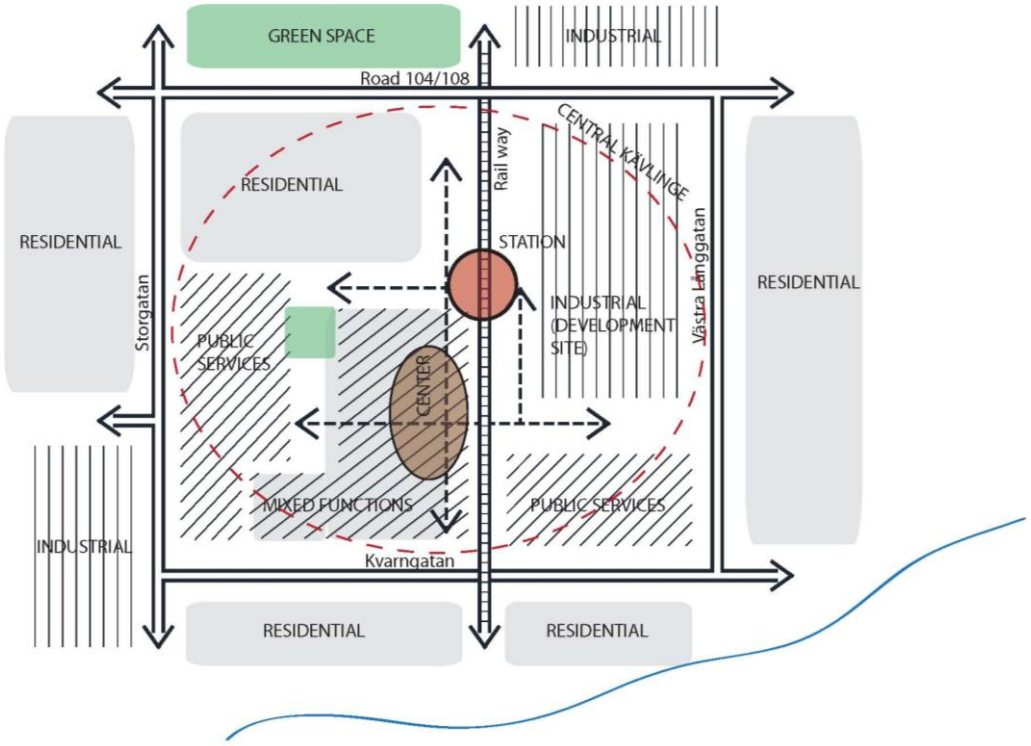


Figure 18. Conceptual structure of Kävlinge. The red circle marks the central areas of the community.

Kävlinge train station is the transportation hub of the community. However the community centre is located approximately 400 meters southwest of the train station. Most of the houses are mixed in function: Commercial on the bottom floor and residential on the floors above. The range of local services is broad, varying from grocery stores, cafés and clothing stores to banks, hair salons and florists. There is a pedestrian street and a market square in the centre, which can be considered as the central point of the community centre.

6.2.2 Infrastructure

Central Kävlinge is enclosed by four main roads: road 104/108, which functions as a bypass, and Storgatan, Kvarngatan and Västra Långgatan, which are the main thoroughfares. The other streets are more of a local character with narrower roads and lower speed limits.

The rail road runs through the central areas of Kävlinge, separating the community into a western and eastern part. The western part consists of the community centre and commercial areas, while the eastern part mainly is characterized by old industrials. The connections over the railroad are grade separated.

The pedestrian and bicycle network is extensive in Kävlinge. There are both wide sidewalks for pedestrians and bicyclists along the thoroughfares and separated walk- and bikeways through residential and public spaces. Certain neighbourhoods are car free, meaning that cars are limited within the area and instead have to park a bit outside. However, those areas have sufficient walk- and bikeways which facilitate and encourage non-motorized traffic. This generally applies to the entire community.

6.2.3 Transportation

The public transportation system in Kävlinge is operated by Skånetrafiken. The community is served by buses, commuter train and a regional train, which is operated by Öresundstågen. Rail map of the commuter train and regional train are shown in Appendix 7. Kävlinge station is the transportation hub of the community where three regional bus lines and four complementary local lines diverge from.

A survey from 2007[9] shows that, of all trips with starting point in the town of Kävlinge, 30 % are made with public transportation (24% train, 6 % bus). If just looking at the destinations that are served with commuter trains, and not the entire market in Skåne, the train ridership is much higher than the average, 41 %. The largest commuting destination is Lund, where the market share for public transportation is 62 % (45 % train, 17 % bus).

Kävlinge station is located along two commuter lines: Ängelholm – Malmö and Helsingborg – Ystad. It is the second station north of Lund and sixth station from Malmö. At peak hours, there are four train departures hourly. The regional train (Öresundstågen) also stops at Kävlinge, but only during five times per day. It takes approximately 26 minutes to Malmö and ten minutes to Lund with commuter train. Trips with the regional train are generally a bit faster since it stops at fewer stations.

Three regional bus lines serve Kävlinge with at most a frequency of 60 minutes. They all depart from Kävlinge station and thereafter run in three different directions: west, south and east. There are eleven bus stops in the community and most of them are located along two streets, seen in Appendix 4.

Except for the regional buses, there are also four local lines that serve the outskirts of Kävlinge. These routes are operated by taxis and are intended for areas that lack support for regular bus service and have more than two kilometres to the nearest bus stop. There are only a limited amount of departures per day at fixed times. In order to catch one of these rides, it is necessary to book at least two hours in advance.

6.2.4 The station area

In Kävlinge, the train station is not in direct adjacency to the community centre, which instead is located a few blocks southwest. However, both are well connected by a local street. The street is lined with cobblestone and two-story houses, which give a sense of human scale. There is a parking lot and mixed residential and commercial services along the street, such as a tavern, grill stand and hostel. More services can be found in the community centre around Mårtensgatan and Unionsgatan, seen in Figure 19.

[9] Ingemar Bryman, Skånetrafiken, excel document *Pendling från Kävlinge kommun*, 4 November 2011.

Figure 19. The community centre, with its mixed functions, services and cobblestone street: Mårtensgatan to the left and Unionsgatan to the right.

The connection to the station from other parts of the community is good for bicyclists and pedestrians. Since there is limited car traffic, low speed limits and no major thoroughfares to cross, it is traffic safe at the station area. No matter coming from which direction, there are walk- and bikeways that all converge at the station. The walk- and bikeways are at many places separated from car traffic and the sidewalks are broad, which clearly shows that the design of the station has taken the safety and needs of the traveller into consideration, see Figure 20.

There is principally no retail at the station but it is clearly an interchange. The bicycle parking is located closest to the station entrance and the car parking is a bit further away, on both sides of the station. The bicycle parking consists of bicycle stands without weather protection, see Figure 20. Even though there are designated spaces for bicycle parking, many chose to lock their bike onto railings and lampposts since it is closer to the station entrance and that most of the closest parking stands already are occupied.

Figure 20. The picture on the left shows bicycle parking and bus stop in the background. The right picture shows a pedestrian and bicycle path that leads to the station.

The bus terminal, where all three regional bus lines depart from, is located in connection to the train station. They are lined up that each bus line has its own sheltered stop, which makes it easy to find a particular bus. Right in front of the station building are 30-minute-parking areas for lay-bys and taxis.

Kävlinge station

Kävlinge station consists of three platforms which are connected by a dusky concrete tunnel. The tunnel has two entrances, one on each side of the rail tracks, which can be reached by stairs or elevator on the west side and stairs and a ramp on the east side of the tracks. The two middle platforms can only be reached by stairs or elevator from the tunnel. Both platforms have seats with weather protection, ticket machines and traffic information.

Immediately coming down into the tunnel, from the platform, are directions to the buses and community centre. The bicycle parking is just by the tunnel entrance and a bit further away is the car parking, with handicap parking closest to the entrance. There is also traffic information on each side of the station. The station house, a WC, bus terminal and lay-by-zones are all on the west side of the tracks. The station hall is very limited in service and has a simple café and a small ticket hall that is only staffed during work hours. There is no designated waiting hall. A conceptual overview of the station area is illustrated in Figure 21.

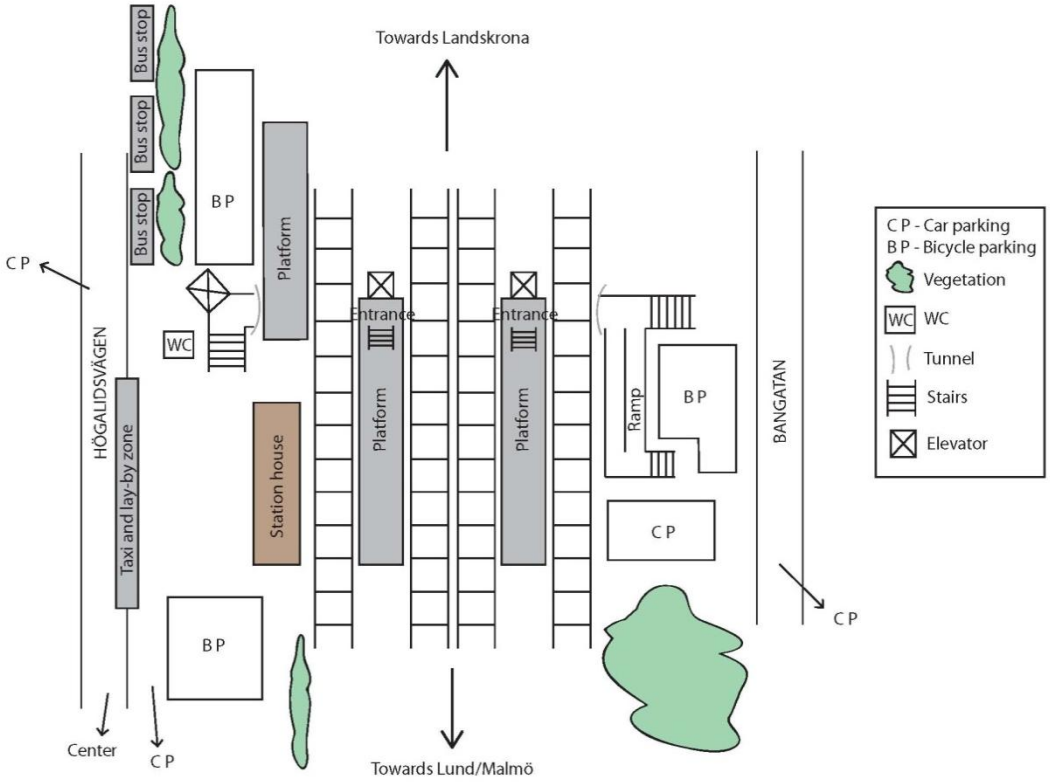


Figure 21. Overview of Kävlinge station and its surrounding areas

6.2.5 Redevelopment – Östra Centrum

The big industrial plot on the east side of the rail tracks was previously a slaughterhouse but is since 2008 not in use and a site for redevelopment plans. The plan is to develop an entirely new district, called Östra Centrum, with mixed uses in direct connection to the railway station. The site, as seen in Figure 22, will contain approximately 1300 new apartments, 35 000 m^2 commercial spaces and take 15 years to build (Kävlinge kommun, 2011b). The aim is to combine residential housings with retail, services, green areas and other activities in order to create a vibrant, dense and attractive neighbourhood. It is believed that this will attract new residents, visitors and enhance Kävlinge's role in the region of Öresund (Gehl Architects, 2011b).

Figure 22. A sketch over Östra Centrum. The descriptions are in Swedish.

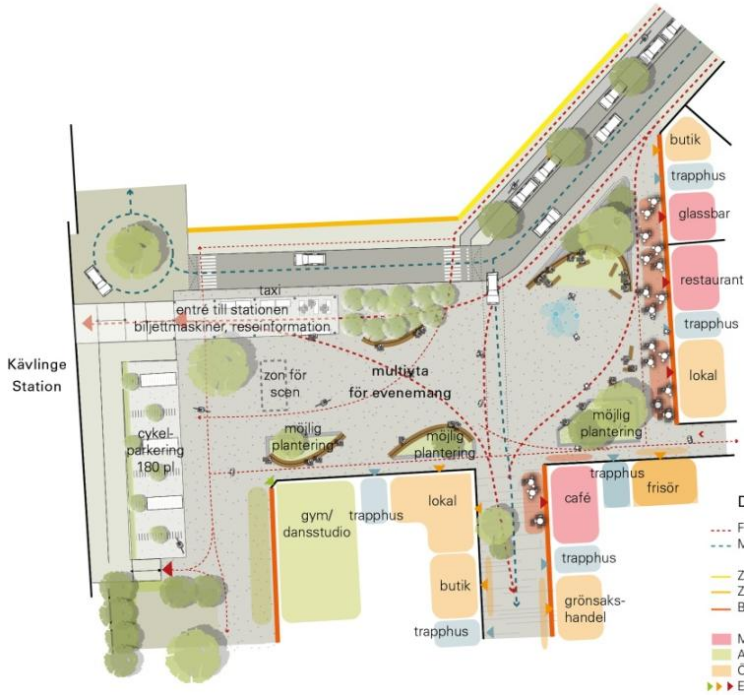


Figure 23. A conceptual sketch over the station plaza with its different services and open spaces. The descriptions are in Swedish.

Much of Östra Centrum is planned after the guidelines of *Bytespunkten som mötesplats i Skåne*, where the focus is on the forthcoming users and their needs. The neighbourhood will be designed in human scale with a coherent and clear street and urban structure that prioritize walking and biking in order to create attractive meeting points and a stimulating environment for both residents and visitors (Gehl Architects, 2011b).

Meeting points will be at strategic places, such as important destinations and connections between thoroughfares. The new planned station plaza, seen in Figure 23, will be the most prominent meeting place in Östra Centrum and should encourage recreation and longer stays. It will be situated in direct adjacency to the eastern station entrance and consist of a square and a commercial street with shops, groceries and other services. The eastern part of the station plaza, where the sunlight is most advantageous, will be intended for restaurants, cafés and other activities that encourage meetings, such as sculptures, fountains and seating (Gehl Architects, 2011b).

It is suggested that the entrance is clearly marked with a roof where ticket machines and traffic information will be provided (Gehl Architects, 2011b). There will also be spaces for bicycle parking, lay-bys and taxis for easy transfers to the train. Additional car and bicycle parking will be necessary. The plan is to add 200 extra spaces for bicycles and 160 spaces for cars, whereof 70 are curbside parking (Kävlinge kommun, 2011b).

6.2.6 General reflections

Even though the train station is not in direct adjacency to the community centre, there is a natural orientation between the two areas due to the cobblestone streets and an environment in human scale. The functional mix between residential and commercial services promotes life and movement and adds to the feeling of security since there are more eyes on the street, even at evening hours. This applies to the centre in general, where there is a functional mix, both between and within the houses.

There is not much vibrancy and movement at the station itself, but more towards the centre. There are neither green spaces nor a waiting hall at the station that function as a natural meeting point and the station house is not used to its full capacity. An idea would be to have a waiting hall that could be used for both bus and train riders. Today, the train station does not feel like an attractive place to be or stay in, but only a mean of changing transportation mode. After the completion of Östra Centrum, the station will probably obtain a more important role in the community and attract not only travellers, but also people that just want to socialize and use the services that will be offered in the area.

Pedestrians and bicyclists are clearly prioritized, not only at the station area, but also generally in the community. At the station, it is obvious that the bicycle parking is closest to the station entrance, thereafter the bus stops and furthest away, the car parking. The walk- and bikeways are at many places separated from car traffic, offer short-cuts through neighbourhoods and lead to the station entrance from all directions. Cars usually have to drive detours and through streets with traffic calming measures to get to the same destination. To summarize, it is relatively easy and convenient to get to the station by foot or bike, compared to driving.

However, public transportation does not seem to be as prioritized within Kävlinge. The buses have low frequency and only serve a limited part of the community and most areas do not have a bus stop. Many of the bus stops around the community do not have weather protection.

An interesting point is the parking issue in Kävlinge: There are plenty of commuter parking for cars and bicycles, but they are almost fully occupied during working hours. Many extra spaces will be added in the coming years, but it is believed that the more that is added, the more people will drive to the train station. This is a dilemma that needs to be considered in station planning. Bike stands with weather protection, car-free zones or feed commuter parking could be measures to encourage travellers to drive less and use more alternative transportation modes.

Billingshäll is a home for senior citizens that is located a few hundred meters northeast of the station. The location is strategically good for the elderly, since it is close to many of the important destinations in the community. It is clear that the aspect of accessibility has been taken into consideration since it is easy, quick and safe for them to walk between their homes and the train station, bus stop, centre or church.

6.3 Høje Taastrup – a regional node

Høje Taastrup is a relatively new and modern district in the municipality of Høje-Taastrup[10]. It has within the past 40 years developed to become a regional hub for train traffic in the greater Copenhagen area and a popular location for businesses and industries (DesignGroup Architects, 2011a). Today, the community has a population of more than 9 000 and the entire municipality has 47 000 inhabitants (Høje-Taastrup Kommune, 2006). As illustrated in Figure 24, Høje Taastrup is located along one of the main linear corridors of the *Finger plan*, 20 kilometres west from Copenhagen and 10 kilometres east of Roskilde. It takes approximately 25 and 15 minutes to drive to central Copenhagen and Roskilde, respectively.

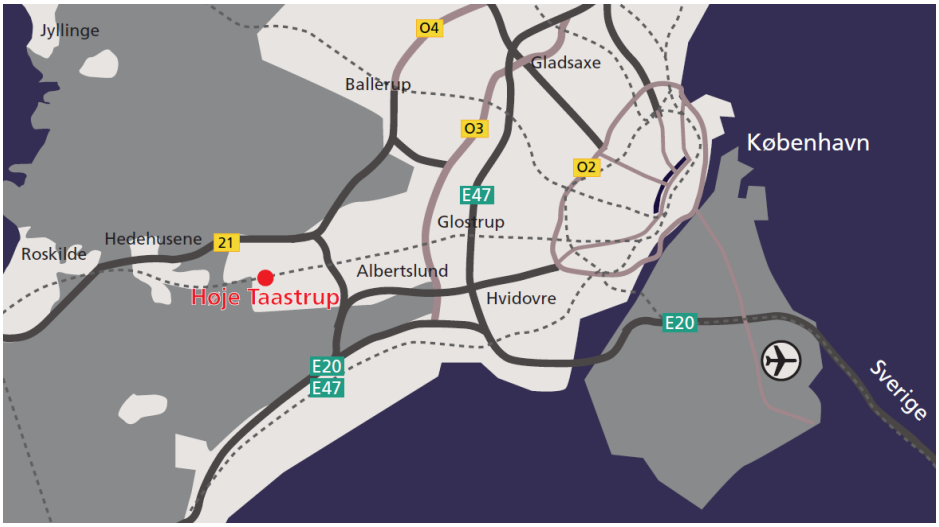


Figure 24. Map of the Copenhagen region with the location of Høje Taastrup.

[10] Høje-Taastrup is the municipality and Høje Taastrup is the district/community.

6.3.1 Urban structure and services

Due to its good connection to the rail road and main arterials, Høje Taastrup is a perfect location for transport and logistics centres, business parks and large commercial centres. The urban structure is clear and comprehensible, with the train station in the centre and distinctive and mono-functional plots stretching out in a north-southward direction from the station, each separated by wide boulevards. The areas closest to the station are mainly public and commercial, while the residential neighbourhoods are further out. Figure 25 illustrates the conceptual structure of Høje Taastrup. The community is airy in the sense that there are a lot of open spaces, some occupied by parking lots and some by public green landscapes. The wide boulevards and the islands of neighbourhoods also contribute to the feeling of openness.

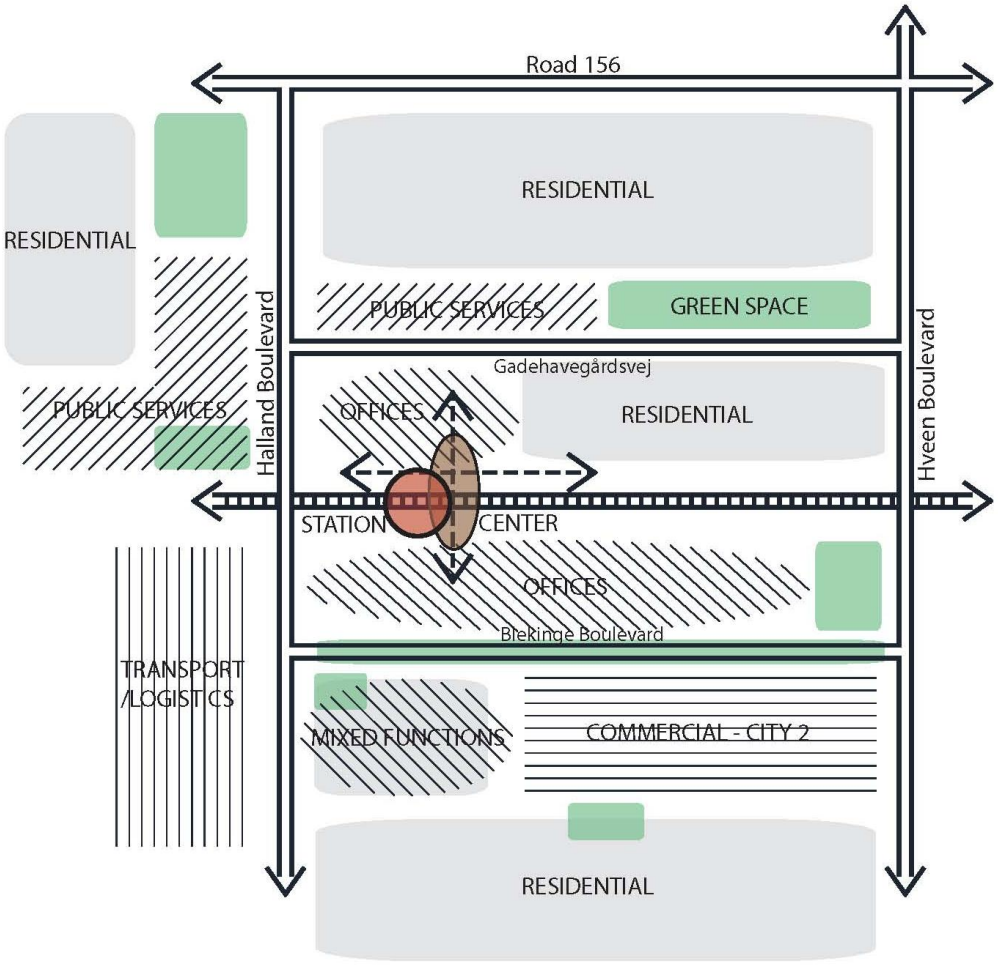


Figure 25. Conceptual structure of Høje Taastrup with the mono-functional areas and main streets.

The centre is in close proximity to the train station, where the services are basic and limited in range: a pharmacy, hair dresser and a couple of small grocery stores and restaurants. For more shops and services people usually go to City 2, which is one of the largest shopping centres in Denmark, or to the outdoor shopping mall in the neighbouring town of Taastrup.

South of the railway station is a business park with a neoclassical and postmodern architecture. The buildings are uniform with straight lines and high walls. There are plots of public services on the north side of the railway tracks, where the library, city hall, homes for senior citizens, elementary and upper secondary schools are situated. The logistical and transport centres, an amusement park and the Institute of Technology are a bit further out in connection to the arterial roads. There are three major residential areas in Høje Taastrup that vary in style: from old agricultural single-family homes to large blocks of public housing.

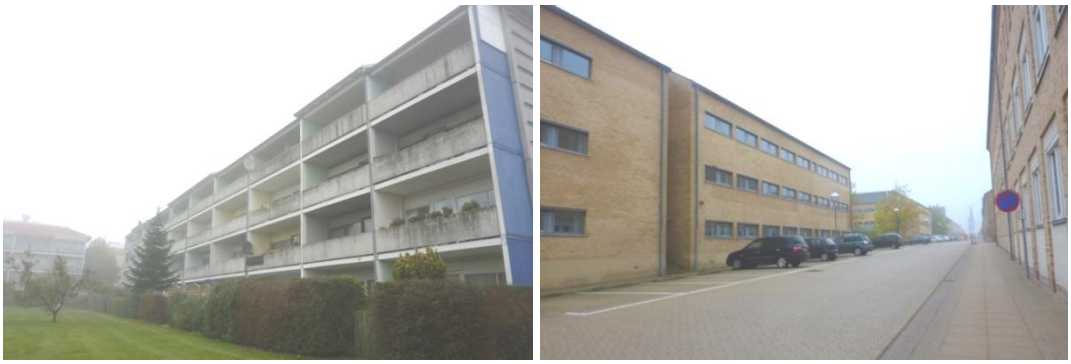


Figure 26. The picture to the left shows one of the residential buildings in functional style. The right picture shows the postmodern business park.

6.3.2 Infrastructure

Høje Taastrup is located with good connections to main arterials, such as road 21, 156, O4 and E20. In addition, the railway provides good services to both Copenhagen and the rest of the country. These are good conditions for car, cargo and public transportation.

The main thoroughfares in the town are Halland Boulevard, Gadehavegårdsvej and Blekinge Boulevard. The roads are all quite wide and adapted for cars, which also is a tendency for most other roads in the community. This creates barriers and separates the different neighbourhoods into islands. A solution to overcome these obstacles has been many grade separated crossings for pedestrians and bicyclists. The pedestrian and bicycle network is very comprehensive, extensive and mostly separated from car traffic, meaning that they either go through neighbourhoods or that there is a certain distance between the paths and the road, often separated by vegetation. Close to the train station, where car and non-motorized traffic is mixed, the sidewalks and bike paths are as broad as the driveways and some streets do not even have curbsides.

6.3.3 Transportation

Because of the many working opportunities in Høje-Taastrup, more people commute in than out from the municipality: 22 000 commute in and 16 000 commute out (Høje-Taastrup kommune, 2010). This makes Høje Taastrup station one of the stations with the highest ridership in the entire country. Of all people coming from outside the municipality, 20-30 % chose to take the train instead of driving to work (DesignGroup Architects, 2011a). Of all commuting in Høje Taastrup, 44 % is done within the municipality of Høje-Taastrup, 32 % radially along the corridor and 24 % to and from another corridor (Høje-Taastrup kommune, 2010). These relations are explained in Figure 27.

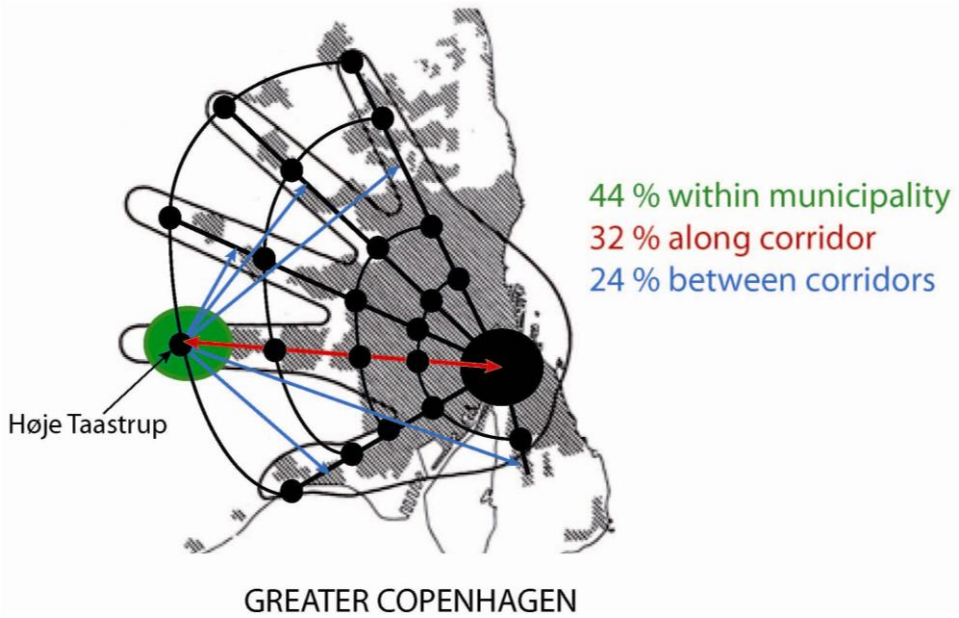


Figure 27. Finger plan of greater Copenhagen showing the relations between different commuting patterns.

The main public transportation service to and from Høje Taastrup are with train. The train system is then complemented with a bus system that serves local destinations. In order to offer good connections and interchanges between regional and local trips, all bus lines that serve the community stop at Høje Taastrup station. The trains are operated by DSB while the bus system is under the management of Movia.

Since Høje Taastrup is such a large traffic junction, it is served by many train lines: two commuter lines (S-tog), four regional lines (Re-tog) and five intercity lines. This means that there are very frequent services between central Copenhagen and Høje Taastrup. It is the terminus for both commuter lines and takes between 23 and 26 minutes to central Copenhagen. For the other train services, it is the second station from Copenhagen central station, which is why it is faster to take the regional or intercity trains to Høje Taastrup (12-15 minutes).

There are a total of 14 bus lines that serve the community of Høje Taastrup and all of the lines stop at the Høje Taastrup station. A few of them serve the residential neighbourhoods, while others the neighbouring communities. Some of the lines are intended for City 2, the shopping mall.

6.3.4 The station area

There is no strong and distinctive town centre in Høje Taastrup. Instead, the train station is considered as the central spot and meeting point and is complemented by public squares on the south and north side of the station, where the limited range of services revolves around. The squares are surrounded by three-story tall office buildings which partially cover the streets with vaults, like a colonnade. On the ground floor, in the colonnades, are a few restaurants and cafés and some retail and other services, see Figure 28.

Høje Taastrup Boulevard, which goes through the squares, has no through traffic for cars. This ensures a lot of space for pedestrians and bicyclists where the sidewalks and bike lanes are nearly as broad as the bus lanes, which can be seen in Figure 28. It is easy and safe to get to the station by foot or bike, since either you arrive from the car-

free street or from separate walk and bike ways in an eastern-western direction. The contact with car traffic is therefore limited at the station area. However, even though the lanes are wide and the connections to the station are good, there are not many marked crossings and no curbsides which can make it feel unsafe to walk or bike in mixed traffic.

Figure 28. The left picture shows the square with its wide street and bicycle path. The right picture shows some of the services under the colonnade.

The station building has entrances on each long-side of the building. All buses arrive from Høje Taastrup Boulevard and stops in a line-up on the east side while the drop off and pick up zones for cars and taxis are on the western side. The bus stops are in direct connection to the train station, which means that the waiting hall in the station can be used for both train and bus riders. Figure 29 illustrates the overview of the station area.

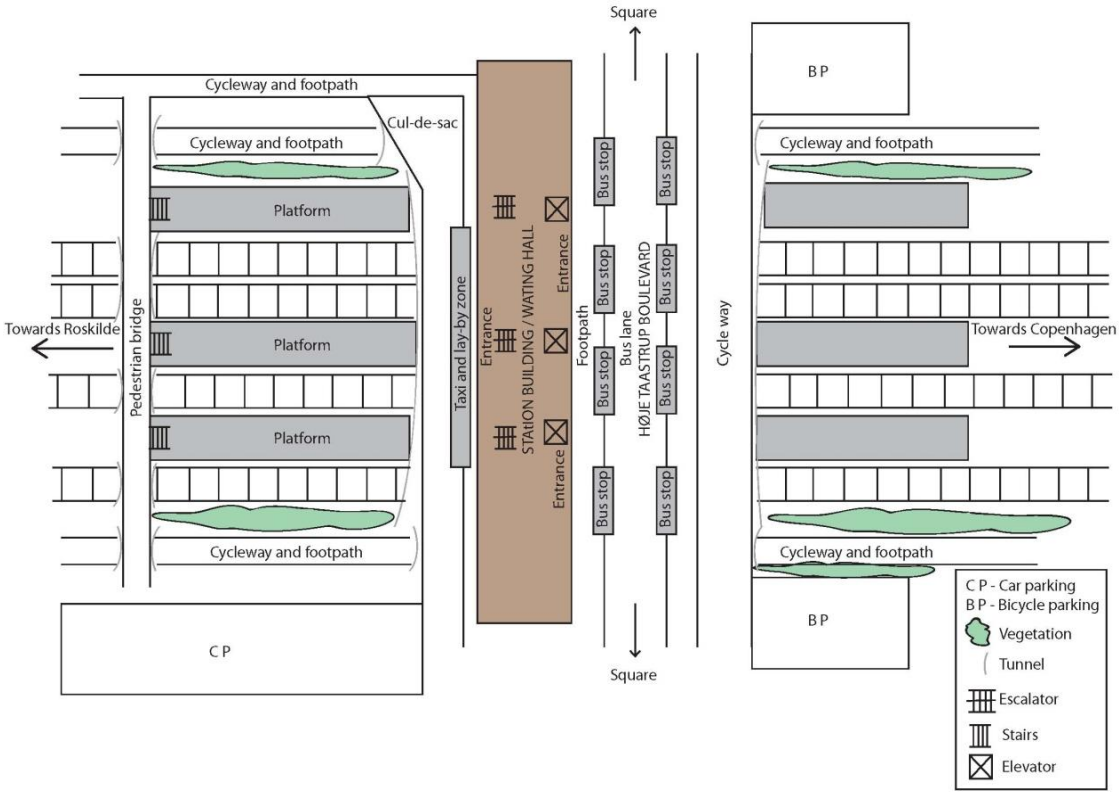


Figure 29. Overview of Høje Taastrup station and its surrounding areas.

The bicycle parking spaces are spread out and can be found around the station area. The majority are however located behind the bus stops, meaning that bicyclists have to cross the bus lanes in order to get from the parking to the train station. The car parking is located southwest of the station. There are 200 free parking spaces for municipal residents and 185 feed spaces for other commuters. There are good pedestrian connections to the station building from both sides. Therefore, it is natural for people coming from a western direction to use the west entrance and vice versa.

There are different types of arranged bicycle parking, as seen in Figure 30: bicycle stands with no weather protection, with weather protection, with saddle protection and a parking garage in which the bicyclist can rent a spot. There are also plenty spaces for bicycles on the streets along railings and such.

Figure 30. Pictures of the various types of bicycle parking at the train station.

Høje Taastrup station

The main feature of the train station is the station building with its glass façade and three distinctive steel arches, seen in Figure 31, which has become the symbol of the municipality. The station building has an illuminated and heated waiting hall that contains seats, information boards, ticket machines and a convenience store. A café will be opened soon. There are also some local services, such as a pharmacy and greengrocery right outside the station entrance.

Figure 31. The Høje Taastrup station building with its glass façade and steel arches.

There are three island platforms that can be reached by escalators or elevators. Each platform has weather protection, travel information and WC. Another accessibility adaption is the marked paths for the blind, which leads them around the waiting hall and to the platform, shown in Figure 32.

Figure 32. The light and open waiting hall with seating, information board and the marked path for blind.

The trains can also be reached from the other end of the platforms, where there is a pedestrian bridge that connects the platforms with the streets, see Figure 33. This bridge is only accessible by stairs and is not weather protected.

Figure 33. A pedestrian bridge that also function as an entrance to the train platforms.

6.3.5 Redevelopment – Downtown Høje Taastrup

Since 1978, there have been continuous plans on connecting the shopping centre, City 2, with the nearby residential neighbourhoods. The plans also involved improving the traffic situation. The infrastructure in Høje Taastrup has generally been considered sufficient. However, the infrastructure has also created barriers in the community and impaired the mobility for pedestrians and bicyclists. This has prevented the town from having a rich and vibrant urban life (DesignGroup Architects, 2011a). As a result, Downtown Høje Taastrup has been initiated; an urban development project which aims to connect the train station with City 2 by creating an entirely new district that offers a variety of services and activities. It will be the new town centre and by connecting the two major destinations in Høje Taastrup, the station and the shopping mall, it will hopefully strengthen Høje Taastrup's role as a regional node (DesignGroup Architects, 2011b). Figure 34 illustrates the projected area of Downtown Høje Taastrup.

Figure 34. The pink border shows the large project area. The orange-marked area will be the new district while the blue area contains the areas that will be improved in order to connect the station with City 2.

The vision is to create active, varying, safe and attractive spaces for all users: workers, residents and visitors. Walking and biking will be encourages by designing the area in human scale and with a lot of public spaces. The vision of the project can be described in six important points (DesignGroup Architects, 2011a):

1) **Connection** – creating a new connection for pedestrians and bicyclists between the train station and City 2. This thoroughfare will focus on traffic safety, inspiring landscapes and accessibility and mobility for all users.
2) **Active and attractive urban space** – the new district should be attractive in a way that is inviting for people to stay, interact and encourage sports and recreational activities.
3) **Trade and commerce** – mainly retail, offices and other commercial businesses will be in place. Downtown Høje Taastrup will be the new center of the town.
4) **Densification** – the urban space should be concentrated and focus on multifunctional uses and synergies. Activities and services should be diverse but still be able to function side by side.
5) **Sustainability** – the project should act as an example in sustainable solutions and innovation in urban planning and consider the social, economic and environmental aspect.
6) **Accessibility** – the urban space should be designed in a way that provides optimized accessibility for all users, especially pedestrians and bicyclists.

There is a great focus on diversity, both in function and in activities. The area should have a mix in retail, work places, housings and green spaces. The offered activities and services must also be in high density in order to attract as many users as possible to the downtown location. After project completion, there will hopefully be a vibrant and attractive urban environment that complements City 2 and acts as a natural connection to Høje Taastrup station (DesignGroup Architects, 2011b). See Figure 35 for a sketch of the winning proposal by COBE.

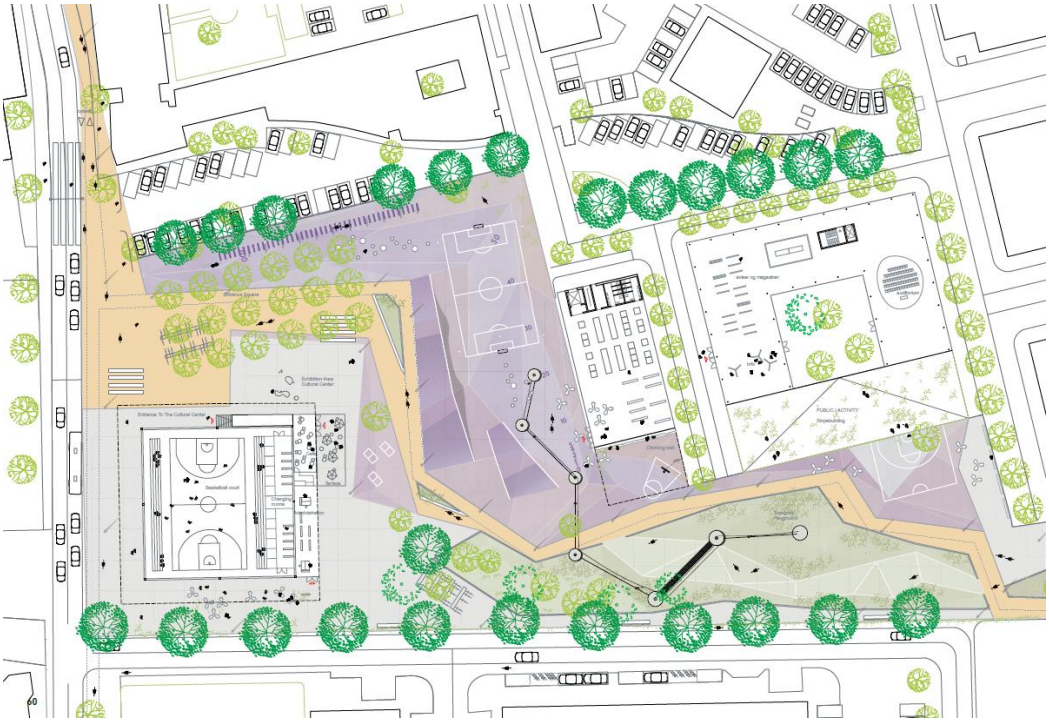


Figure 35. Plan over Downtown Høje Taastrup according to COBE architects, the winning suggestion of the architect competition, where the main theme is connection and focuses on active urban space.

6.3.6 General reflections

In the 70s, the planning approach was to create a modern town with wide boulevards and dense neighbourhoods with small local streets. This has led to mono-functional uses and long distances between the areas which are not encouraged in today's ways of planning. The big boulevards are adapted for cars and have become barriers in the landscape, creating islands and hinder the mobility of other travellers. This is the main problem in Høje Taastrup. Downtown Høje Taastrup is a step towards connecting and integrating the islands.

There is a variety in functions in Høje Taastrup: retail, offices, housing and commercial activities. However, these functions are not mixed but scattered around as single blocks in the community. The different districts are then separated by either wide boulevards or open green spaces and parking lots. The accessibility is good for pedestrians and bicyclists within the islands. However, it is not as easy to travel between the islands: one has to cross the wide thoroughfares and there are only a few places where the crossings are grade separated. The infrastructural barriers are therefore not only physical obstacles, but also affect the mental perception of distances.

The squares around the station are considered as the central area of Høje Taastrup. However, there is a short range of services and a lack of vibrancy. The area is mostly occupied by parking and the streets and bicycle lanes are wide. This gives the impression that the street mostly is for movement and function as a transport distance, rather than a destination and a place to stay at. The only time of the day when there is some movement, is when students and workers start and finish school and work.

The squares and streets also provide a sense of openness, which in this case can be intimidating since there is not many activities that occupies the space. Instead, the sharp and colossal buildings and dark colonnades can be intrusive. Consequently, the buildings and squares do not feel human scale and give the feeling of social insecurity.

Even though the community is quite car-oriented in its structure, the community has tried to consider the accessibility and safety of pedestrians and bicyclists. The pedestrian and bicycle network is extensive and most foot and bike paths are separated from car traffic. Where it is not separated, the sidewalks and bike lanes often take up a lot of road space. It is evident that bicycles and buses are prioritized, especially in the station area. This is shown in the availability in parking, bus lanes and connection to the bus stops and bicycle parking at the station.

At the train station, the accessibility for the blind and mobile disabled has been considered by having escalators instead of stairs, and marked paths that lead to important spots around the station. Furthermore, for the convenience of the travellers, there are many indoor seats and the entire waiting hall is heated during cold days. There are only automatic ticket machines, meaning that the only staffing in the waiting hall is at the convenience store. However, since there is more vibrancy in the waiting hall than outside, there is a constant surveillance from the fellow travellers.

6.4 Summary of the case studies

The three station communities that were visited all have its strengths and weaknesses. They are different in its size, urban structure and station design. But still, they are all station communities that rely on commuter traffic and have a high transit ridership. The table below lists the main characteristics of each community and station.

Basic community facts

	NORRVIKEN	KÄVLINGE	HØJE TAASTRUP
Population	3 300	9 000	9 000
Distance to CBD	17 km	11 km	20 km
Time to CBD with: car/train	16/21 min	15/10 min	25/25 min
Train frequency	15 min	~15 min	10 min
Regional train	No	Yes: one line	Yes: nine lines
Commuting ratio (in/out)	2/3	1/4	5/4
Transit ridership	~25 %	~30 %	~20-30 %

Station

	NORRVIKEN	KÄVLINGE	HØJE TAASTRUP
Services at station	A small waiting hall in connection to the platform.	A station building with a small ticket hall and simple café.	A large heated waiting hall with a convenience store and café.
Staffing	A ticket booth during train services.	A ticket hall during working hours.	Surveillance from store and travellers.
Car parking	Limited designated commuter parking.	Three almost fully occupied lots.	Plenty of spaces
Bicycle parking	Mostly no weather protection.	No weather protection.	Many different types around the station.
Public transportation	No bus terminal. Connection to the bus is poor.	A bus terminal where all buses depart from.	A bus terminal just outside the station hall.
Lay-over and taxi	By the car parking.	In front of the station building.	Directly outside the waiting hall.

Community

	NORRVIKEN	KÄVLINGE	HØJE TAASTRUP
Main use	Residential	Mixed: residential, industrial and public.	Mixed: office and commercial.
Main type of housing	Single-family housing	Mixed	Apartments
Thoroughfares	A few through the community.	A few around the central area.	Many around and through the central area.
Barriers	Railway and Norrvikenleden	Railway	Railway and the wide boulevards
Services in centre	Limited around a small square.	Many on two local streets.	Limited around two squares.
Location of train station	Almost centrally	Centrally	Centrally
Connection between station and centre	~60m: under a tunnel.	~400m: local street in human scale.	~100m: at both ends of the station building.
Bicycle infrastructure	Good on main routes.	Extensive with many separated bikeways.	Extensive with many separated bikeways.
Orientation	Easy to orientate. Main corridors lead to the station.	Easy to orientate. Main corridors lead to the station.	Easy to orientate. Main corridors lead to the station.
Development plans	No	Östra Centrum	Downtown Høje Taastrup

Pros and cons

	NORRVIKEN	KÄVLINGE	HØJE TAASTRUP
Accessibility			
+	1. Main corridors to the station that are well adapted for pedestrians and bicyclists. 2. Limited commuter parking, which encourages walking and biking.	1. Clear prioritization of bicyclists and pedestrians at the station and community. 2. Senior citizens home in good connection to important points.	1. Extensive bicycle network and sufficient parking. 2. A waiting hall with escalators, elevators and marked paths for the convenience of the traveller.
-	1. The bus stop is located with poor accessibility. 2. Poor traffic information.	1. Poor public transportation within the community. 2. Fully occupied commuter parking. The more spaces that are added, the more will drive to the station.	1. Wide boulevards and empty lots that become barriers. 2. City2 is located with poor natural connection to the station.
Urban structure			
+	1. A concentrated development which implies short distances. 2. Office parks which increases in-commuting.	1. Multi-functional center with both retail and residential. 2. Many public services in the community.	1. Multi-functional community. 2. City2 and work opportunities that induce an even commuting ratio.
-	1. Primarily single-family residential. 2. Limited services in the community and center.	1. Distance between the station and center. 2. Barely no services at the station.	1. Mono-functional islands. 2. Limited services in the center.

	NORRVIKEN	KÄVLINGE	HØJE TAASTRUP
Safety and security			
+	1. Grade separated crossings under main thoroughfares. 2. Many separated bikeways.	1. A center in human scale, which makes it feel more secure. 2. Limited car traffic in the center.	1. Grade separated crossings under main thoroughfares. 2. A waiting hall which provides with eyes on the street.
-	1. Dark tunnel and high vegetation. 2. Lack of vibrancy: no eyes on the street.	1. Limited staffing at the station. 2. No vibrancy at the station.	1. No vibrancy in the community or center. 2. Community and buildings are not in human scale, which makes it feel insecure

7 Project Proposal

Many conclusions can be drawn from the trends and case studies. Each planning theory has its relevancy and each station community has its strengths that can be applied on Bohus.

- From the planning trends, it can be learned that in order for a station community to become attractive and vibrant, there needs to be a mix of functions and a variety within the functions. Høje Taastrup has a high transit ridership, much thanks to its functional mix with working places, shopping and apartment housing.
- An accessible station can be achieved by a safe and sufficient pedestrian and bicycle network that naturally leads to the station. Walking and biking should be clearly prioritised. This has been achieved in all studied station communities and should also be the case for Bohus. Furthermore, an adequate bus service and easy transfers between trains and buses are important in order to include all users.
- As experienced in Høje Taastrup and Kävlinge, human-scale is significant in terms of security. Also, with no staffing at the station, achieving a through-flow can be equally as efficient since it provides with eyes on the street. Therefore, the station area should be designed in a way that encourages movement and activities. An open and perspicuous station area is also preferable. In Norrviken, where there are a lot of sight obstacles in terms of edges and vegetation, it may appear unsafe.
- In Kävlinge and mentioned in TOD, the public services, such as the senior citizens home, are located in close connection to the station. This is something Bohus also can take advantage of: using its location to attract groups that are dependent on public transportation.
- However, the main lesson learned is that there is no specific way or checklist to plan and develop a station community. Instead, it must be understood that Bohus is unique and has to be planned after its own conditions, needs and possibilities. A solution that works for one station community, might not work for a different community.

This chapter will firstly present a SWOT-analysis, which is necessary in order to understand the current condition and future potential of Bohus. Thereafter, a proposal for Bohus and its station area will be composed, wherefrom various ideas from the previous studies will be analysed and applied. The physical design will be presented in maps and illustrations.

7.1 SWOT-analysis

A SWOT-analysis is a planning method for different projects and a strategic way to find factors that somehow affect the outcome of the project (Haugney, 2011). The analysis involves an evaluation of the project's Strengths, Weaknesses, Opportunities and Threats. In this context, the SWOT-analysis will show what aspects that are important to take into consideration in order to create an attractive station community in Bohus and the abilities for it to grow as a node.

Strengths are characteristics that somehow benefits Bohus while weaknesses are features that are disadvantageous for the community. Opportunities are external chances that can improve Bohus' condition and status. Threats are however factors in the environment or society that can cause trouble and impair the situation. A SWOT-matrix for Bohus can be seen in Figure 36.

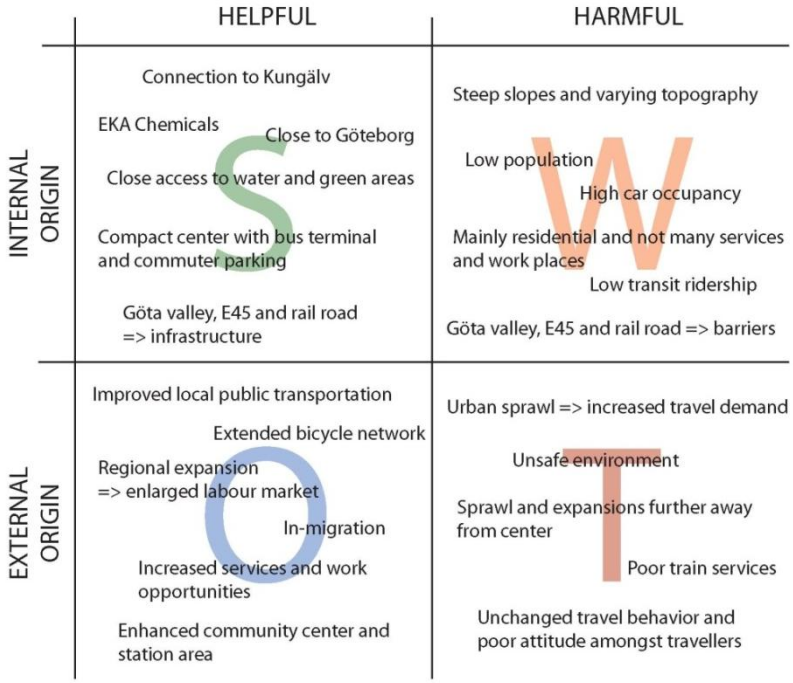


Figure 36. A simple SWOT-analysis of Bohus.

From the SWOT-analysis it is evident that there are some central questions that need to be considered in this analysis:

1. What role will Bohus have in the future and what role does it aim to have? How can it use its *strategic location* to favour growth of the community?
2. Where are the *main corridors* and how can walking and biking be promoted along them?
3. The varying *topography* is a huge barrier in the community. How can the barrier effect be reduced for pedestrians? For bicyclists? For the elderly? How can the outskirts be served and how can the accessibility be improved for those areas?
4. The *centre* is not vibrant today. How can it become more vibrant and accommodate the needs of Bohus?

7.2 Proposed design

Before suggesting a development plan for Bohus, the specific characteristics of Bohus needs to be understood and what role it aims to have after the opening of the train station. Bohus is not a vibrant node and does not have a big labour market. It is a residential community with many elderly and families. Therefore, it is important to consider the needs of the residents and adapt the community after their habits and limitations. It is important to respect its identity and at the same time use its strategic location to enhance the community as an attractive place to live and reside in.

7.2.1 Strategic location

As it can be concluded in Table 1 and 2 in Chapter 4.1.3, nearly 75 % of Bohus' working population has access to their workplace by rail or bus. More than half of the work places are located along Alependeln. Göteborg is situated only 16 minutes with commuter train from Bohus and it takes less than 30 minutes with regional train to Trollhättan. Kungälv is only five bus stops away. This gives Bohus a favourable position in Ale where the majority of the largest commuting destinations can be reached within 16 minutes and most likely within one transit. Figure 37 shows the distance and time-distance to Göteborg, Kungälv and Trollhättan.

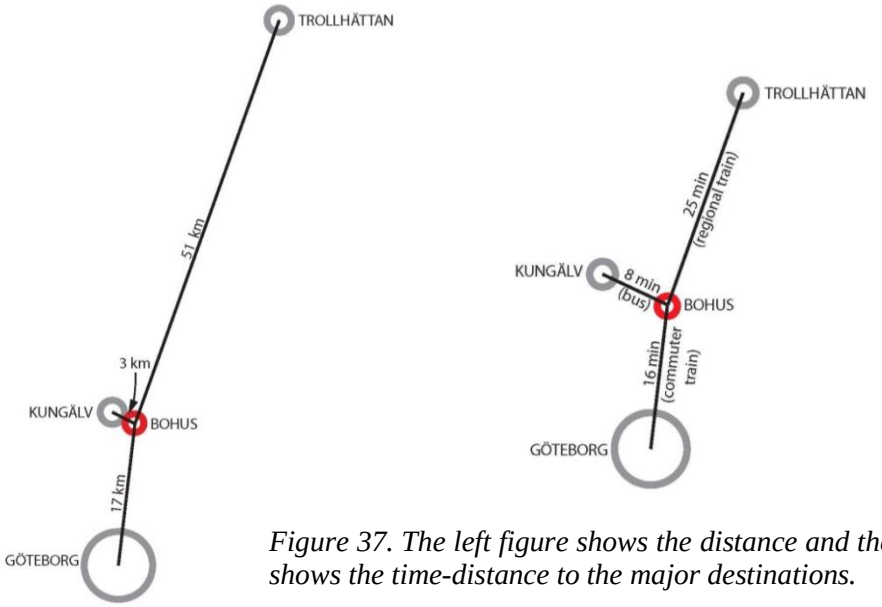


Figure 37. The left figure shows the distance and the right figure shows the time-distance to the major destinations.

After the completion of Västlänken in 2035, the two lines, Alependeln and Götalandsbanan, will be connected. This will allow the labour market in Mölndal, Härryda and Borås to become even more accessible to Bohus, which is illustrated in Figure 38.

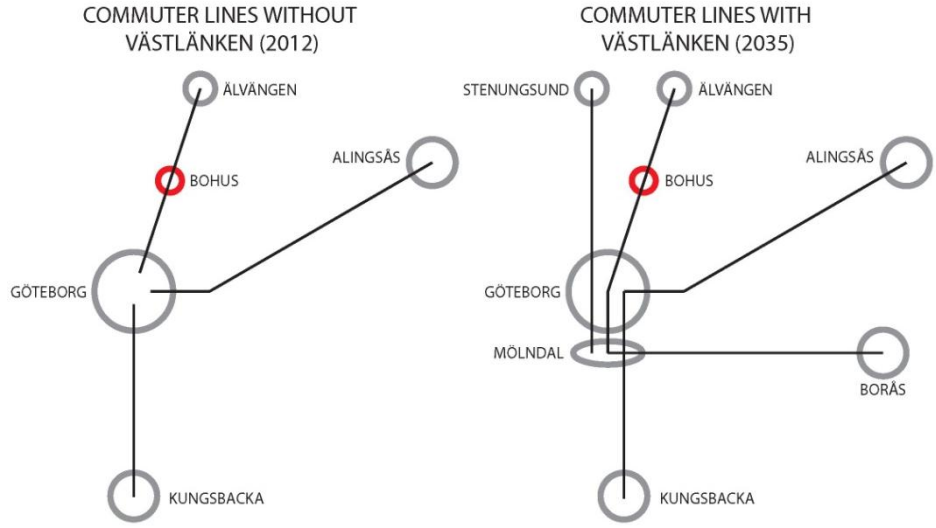


Figure 38. The left figure shows the commuter line network in Göteborg-region in 2012, where all lines terminate in Göteborg. The right figure shows the network after the completion of Västlänken in 2035, where Alependeln is connected to Götalandsbanan that continues to Borås.

In 2013, when the congestion tax is introduced in Göteborg, Alpendeln will probably gain a larger role and become even more important for the residents that travel into Göteborg. Bohus has then a great opportunity to take advantage of its strategic geographical location and the new train station. The areas closest to the train station should be the main focus for redevelopment, where more work opportunities can be created. This can be achieved by expanding the centre with more services and offer office spaces for smaller companies to rent. Bohus is a good location for those companies who for instance are active in Ale and the neighbouring areas.

Another way to use the closeness and easy access to Göteborg is to invest in apartments for the elderly, young families and students who work or study somewhere along the railway. It is relatively cheap to buy and rent housing in Bohus compared to many neighbourhoods or suburbs in Göteborg and students and elderly tend to use public transportation in a larger extend than driving. 16 minutes to central Göteborg is very fast and can be compared with the time it takes to get to central Göteborg from Kortedala, Biskopsgården or Högsbo with tram (17-20 minutes).

7.2.2 Main corridors

A goal is to make walking and biking to the station a more attractive option than driving. For a small community like Bohus, where the train station will be the primary destination, it is important to identify the main corridors that lead to other important points in the community and put effort on making these corridors attractive for pedestrians and bicyclists. Secondary destinations in Bohus are the centre, school, sports hall and Jennylund. The residential areas can also be considered as secondary destinations, as well as the neighbouring community, Surte.

The main corridors can be identified by evaluating peoples travel routes. It is assumed that people chose the shortest and quickest possible ways. The main corridors are obtained by identifying where the movements converge, in this case somewhere along the four radial corridors, seen in Figure 40. Effort should be on obtaining a safe and attractive pedestrian and bicycle environment on these corridors. Handrails, lighting, resting places, playgrounds along the corridor are for instance measures to increase safety and attractiveness. It should also be clear and easy to orient oneself to the station, no matter where you are in Bohus. A more or less accessible path can affect one's choice of route.

Walking and biking should have priority over the car and this could be done by having wide side-walks, separated bicycle lanes or offer short-cuts for pedestrians and bicyclists. Little disturbances with car traffic are preferable. The paths should naturally guide the way and this could be done by marked pavements, leading vegetation or activities situated along the way. Ultimately, we want to achieve short distances, an easily oriented network and an interactive environment in human scale to stimulate walking or biking to the station.

7.2.3 Overcoming topographical barriers

All the greater local expansion plans for Bohus are in the outskirts and on the hills. Those new developments need to be served by a decent public transportation system and a sufficient pedestrian and bicycle infrastructure. However, the topography in Bohus does not allow an attractive bicycle environment at all places. It is fast and easy to bike to the station but it can be very challenging and exhausting to bike the other way due to the steep hills. See Appendix 9 for a topographical map of Bohus.

Bus services

This is especially a large obstacle for the elderly population, mobile disabled and young families. Therefore, it is important that there is a good local bus system that serves important destinations and places that are not as easily accessible for all. The bus stops should be sheltered and the bus services must be trustworthy and have an acceptable frequency. For Bohus, which has a low ridership, a frequency of 30 minutes will be adequate and with a higher frequency during peak hours. All routes stop by Bohus station for interchange thus picking up travellers coming with the commuter trains. Furthermore, the time table of the buses should be coordinated and adjusted after the train services. Otherwise, it will lose its competitiveness and people might chose to travel by car instead.

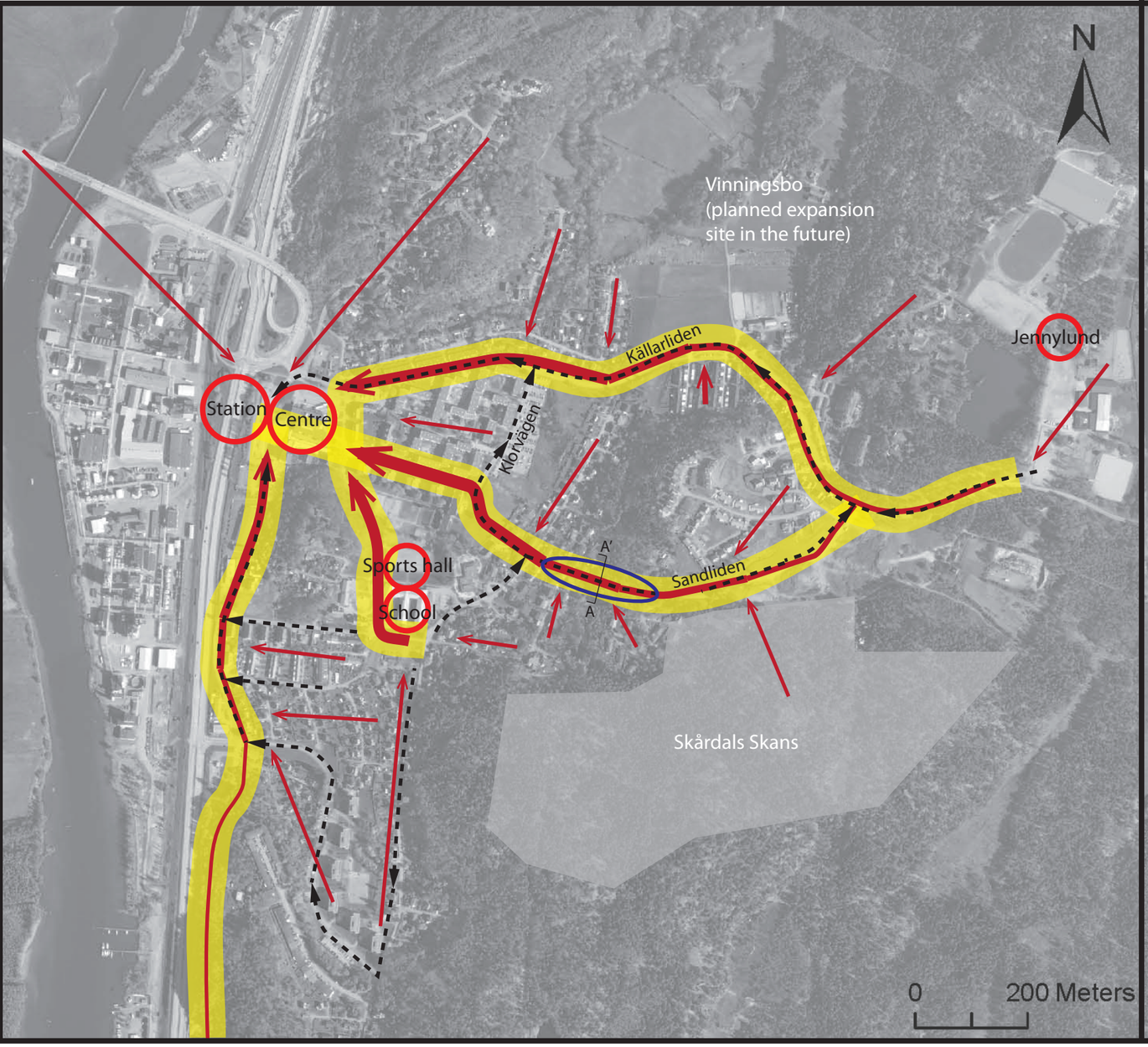
Figure 40 shows suggestions of bus routes and location of bus stops. Compare to Appendix 1 to see the proposed relocations, removal and addition of bus stops. There should also be a possibility to extend the bus service to Skårdal skans when it is completed. The aim is to serve areas that are not easily reached by foot or bike and obtain a network with a large coverage area. A walking distance of 400 meters to the nearest bus stop is considered as a good standard (Göteborgs stad, 2004).

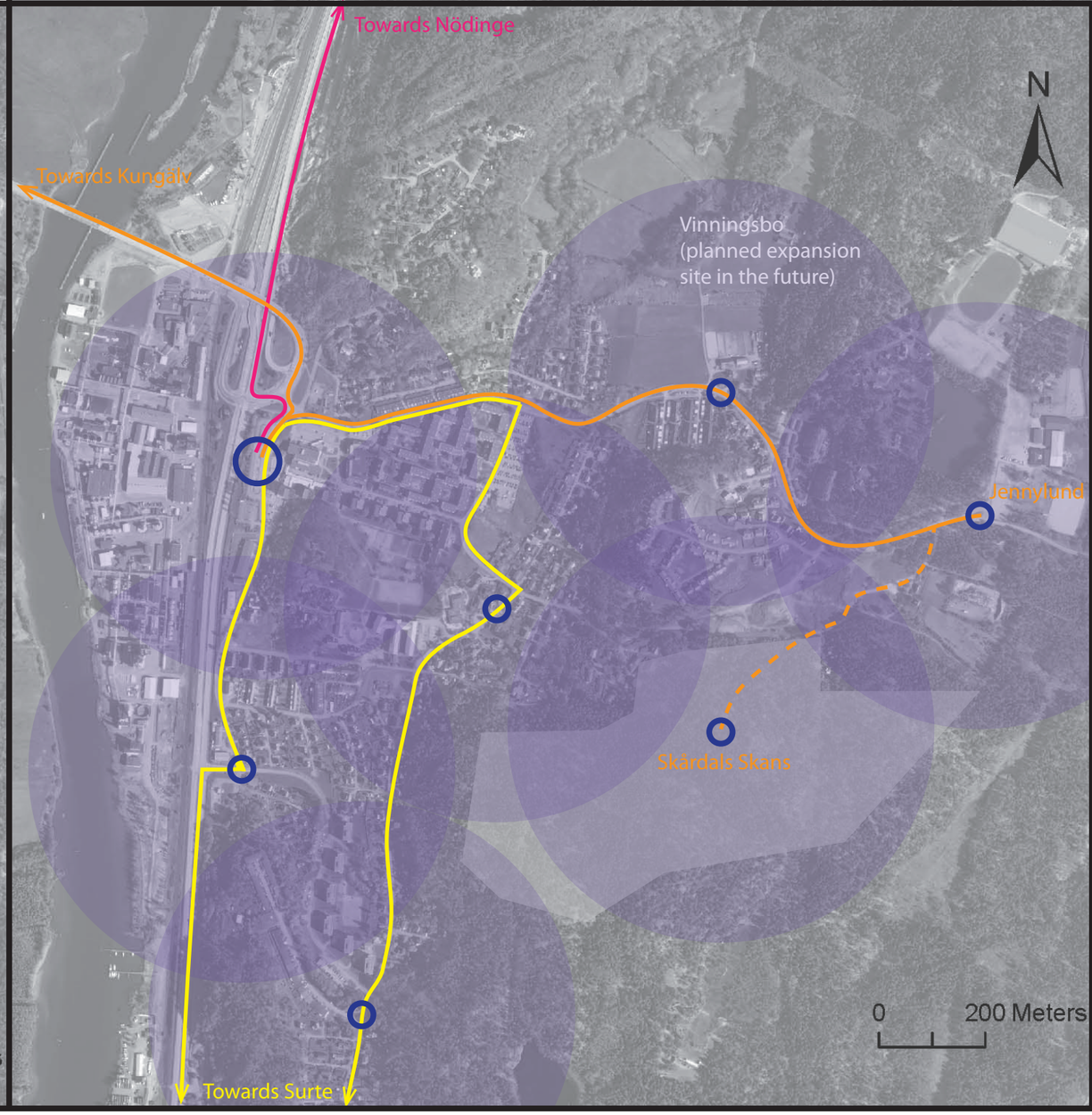
Bicycle lift

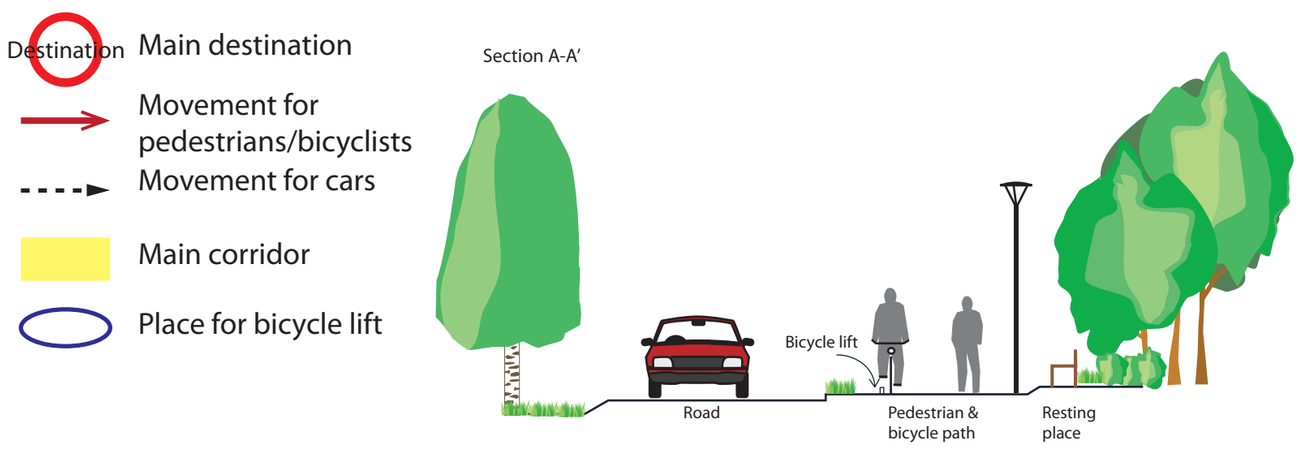
Another solution to reduce the barrier effect of the hills is to install cycle lifts at steep slopes. It could be a rail or a platform in the ground that pushes the bicyclists up the hill, like a moving walkway. Complementary solutions would be to allow bikes on the buses or have rentals or subsidies for electrical bikes.

In Trondheim, the bicycle lift TRAMPE, has been installed and runs on a 130 meter long hill side with a maximum inclination of 1:5 (20 %). The construction consists of an accelerator and motor at the ends of the lift that are connected by an underground steel rail with footplates attached to it, as modelled in Figure 39. When using the lift, the bicycle is positioned a few centimetres parallel to the lift. While straddling the bike, with the left foot on the left pedal, the right foot should be positioned on a footplate that appears on the steel rail. It is important that the body weight is on the footplate and not on the bicycle. Thereafter, the footplate will push the bicyclists up the hill at a speed of 1.5-2 m/s, which is a normal walking speed. The lift can be exited at any time during the ride by stepping off the footplate and then continue biking. (Design Management, a)

Figure 39. A model of TRAMPE in Trondheim, which operates on a steel rail with a footplate that pushes the bicyclists up the hill.







Bus stop

400 m radius

Bus routes

Figure 40. Identified main corridors and coverage of bus services.

The TRAMPE bicycle lift is patented and allows a maximum capacity of six cyclists per minute. The distance between each footplate is at least 20 meters, as a safe distance, and the footplate does not appear unless the bicyclist asks for it. In Trondheim, a start station is used where the bicyclist inserts a key card in order to start the lift. The maximum length of this kind of bicycle lift is approximately 400 meters and is ideally operated on a hill with steepness between 10-20 % and a radius no less than 25 meters. The lift does not operate during winter times and since the opening in 1993, there has not been a single injury reported. (Design Management, b)

In Bohus, the slope of the hill can be up to 17 %. Some of the critical sections are marked in Appendix 9. A bicycle lift would be appropriate on the slope along one of the main corridors, marked in Figure 40. This section is 14 % steep, approximately 220 meters long and is currently a narrow road with no sidewalk and densely bounded by woods and property boundaries. The gradient and section length is within the criteria for an optimal bicycle lift. The lift could be installed along the curbside, but with a safety distance of one meter to the road. Therefore, the road needs to be broadened to fit a sidewalk and the bicycle lift, see Figure 41. Thinning out the woods and adding sufficient lighting is also necessary to ensure the sense of security.

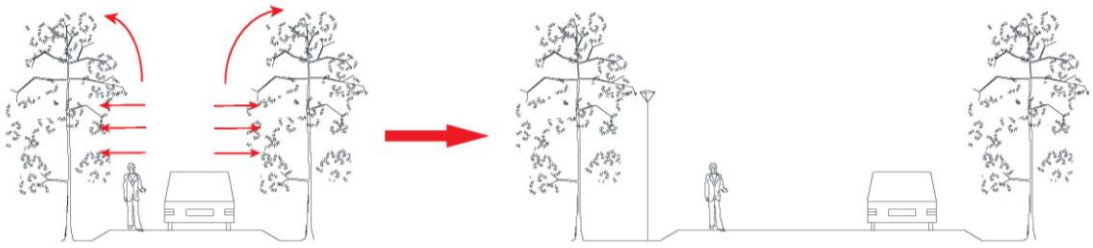


Figure 41. The figures show how the current road (to the left) can be more open and safe by broadening the road and adding sufficient lighting.

7.2.4 Bohus centre

In order to create an attractive station area, Bohus has to upgrade and enlarge its centre in size and in services. There should be a variety of services and mixed functions in the same building, for instance shops, hair dressers, cafés and other commercial services on the bottom floors and offices, apartments and healthcare on the top floors. The aim is to not only offer a wide range of services to the citizens, but also generate movement during all times of the day. Offices would for instance generate a through-flow during days while a restaurant and gym would encourage movement in the evenings. There should also be a convenience store by the station entrance that is open while the trains are in service.

The buildings

There are not many centrally located plots for the centre to expand on. In addition, Bohus has a very industrial feel so every large green space in the central area is worth keeping. Instead, Bohus should use its current location to expand closer towards the station and vertically so the buildings can contain more premises.

The current centre consists of two buildings that are connected by an enclosed indoor hall, see Figure 6 Chapter 4.1.1. In order for it to become more spacious, the hallway could be replaced by an open pedestrian street, lined with cobblestone, trees and benches, see Figure 42. It should be in human-scale and an attractive and comfortable space to reside in. Elements of water could add to an interactive environment.

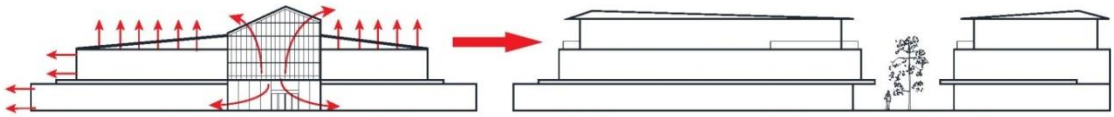


Figure 42. The figures show how the current centre (to the left) can expand by adding one floor and become more spacious by removing the glassed hallway.

The bottom floors are occupied by various retail and services, such as a super-market, green grocery, café, hair dresser and so forth. The premises on the second floor will be for dentist, health care and offices while apartments occupy the top floor, see Figure 43.

There is a residential building south of the centre that also could be developed into student housing, which in close connection to the station also would contribute to a functional mix and increased vibrancy in the centre. In addition, a mix of ages and types of users will increase the sense of security of the station area. A gym on the bottom floor would not only contribute to an additional service for the community, but also movement after business hours. Large windows will also provide with eyes on the street, which adds to the security of the centre.

The square

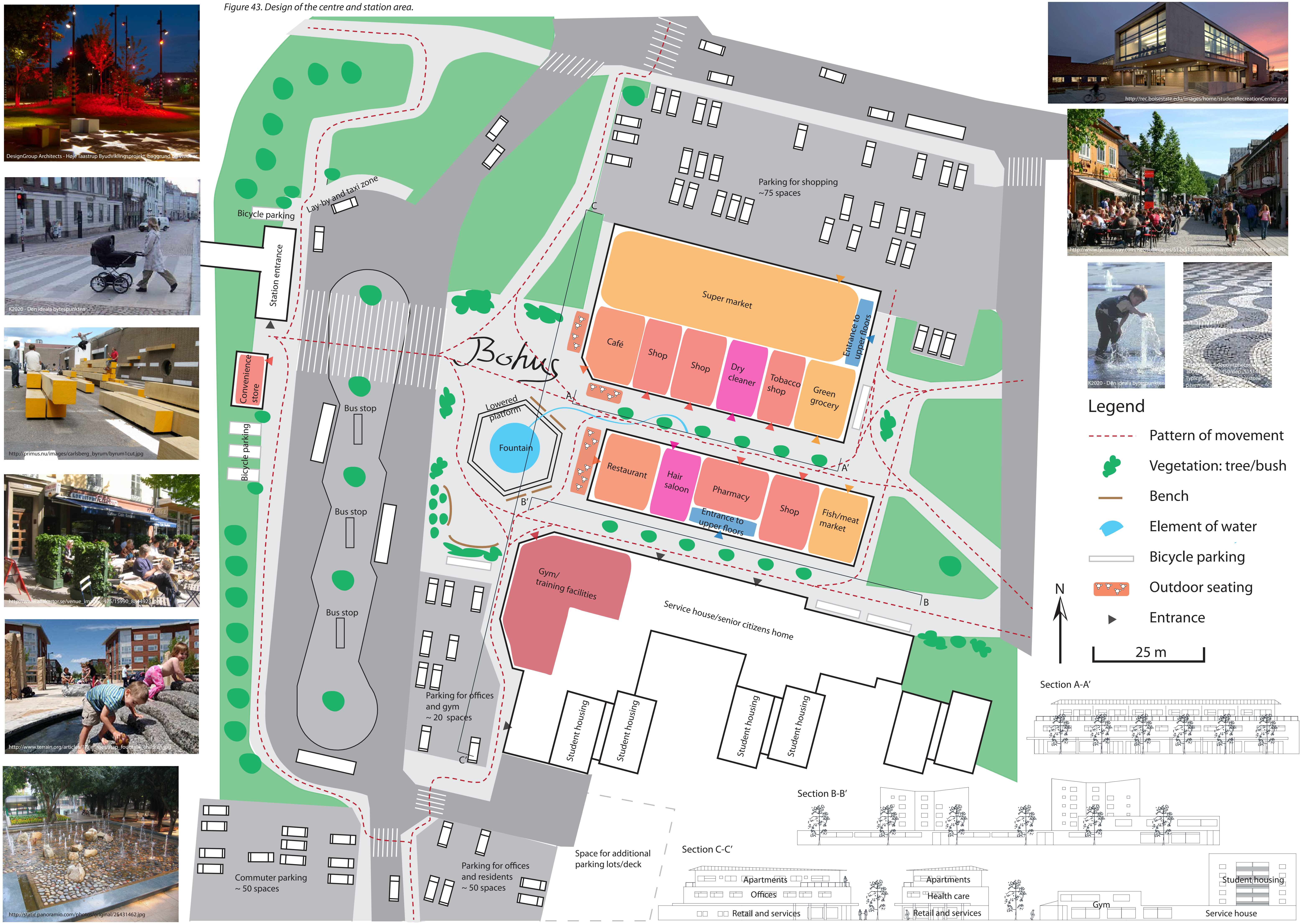
An open square with a fountain and outdoor seating would encourage activities and interaction. The square would be intermediate the station and centre, so a lot of movement will occur across it. Innovative furnishing and design of the square could inspire play and interactions. It should be open and perspicuous to ensure air and sunlight. For instance, the outdoor seating for the café and restaurant are placed where the sunlight is most advantageous for afternoon and evening sun. Trees along the edges of the square will provide with shade. Furthermore, it is important to consider lighting and the human scale when designing the centre so the buildings and spaces do not become intruding or perceived unsafe. The square could also be used for other purposes, for instance hold markets or other events.

The station

At the station, pedestrians and bicyclists should be clearly prioritised over the bus and lastly the car. This can be done by giving pedestrians and bicyclists precedence in crossings by using marked pathways and having traffic calming measures for buses and cars. The local pedestrian and bicycle network should be clearly connected to the station and, to the largest extent, avoid interruption with car and bus traffic. The bicycle parking should be visibly located in direct adjacency to the station entrance and preferably be weather protected. A lay-by and taxi zone by the station entrance would also improve accessibility for the travellers.

Clear real-time traffic information for buses and trains at other locations than just at the station is preferable. For instance, it can be convenient and accessible to have an information board at the square so the traveller does not need to wait on the train platform or bus terminal. Instead, they can use their waiting time to use the services that are offered at the mall or square, which also will contribute to an increased through-flow. Since there will be no staffing at the station, achieving a vibrant square and centre is vital so that the fellow travellers contribute to the safety of the area. It is important that there are no sight obstacles to the station entrance, such as vegetation or objects that can cause poor overview. In addition, sufficient lighting is essential for the security of the traveller.

Figure 43. Design of the centre and station area.



7.2.5 Summary of proposed changes

Below follows a summary of the changes and improvement that can be done in regards to accessibility, urban structure and safety.

Accessibility	Urban structure	Safety and security
Bicycle lift	Student housing and senior citizen's home	Openness and overview of the square and station
Extended bus services with higher coverage	Enlarged centre	Gym on bottom floor
Attractive pedestrian and bicycle environment along main corridors	More services in centre	Limited car traffic
Bicycle parking by the station entrance	Mixed functions in centre: Retail, offices and apartments	Separated and broadened pedestrian and bicycle lanes
Good connection to local network and main corridors from station	Square as a meeting point	Safe crossing to the station
Real-time traffic information at strategic spots	Pedestrian street	Lighting

8 Discussion and Reflections

From the analysis there are several points that can be discussed. This chapter will reflect on advantages and disadvantages of the proposed solutions and what additional measures that can be taken into consideration in order to improve the design.

Small community with topographical barriers

Bohus is a small residential community with only 3 000 inhabitants and has a very hilly landscape. These are the two most significant obstacles for Bohus to grow and become a vibrant node where walking and biking are attractive transportation options. One way to overcome the obstacles is to concentrate new development projects around the centre. However, a small community needs a small centre so it is preferable to keep it in human-scale and not too intrusive. If not, the risk is that it will add to the industrial feeling of Bohus and make it an unsafe environment to reside in. Instead, aiming for a mixed functional centre with little intrusion in the natural environment seems more appropriate for the character of Bohus.

Favourable strategic location for growth

The main advantage of Bohus is that it is situated in close connection and with good public transportation services to some of the major labour markets in the region and therefore has a large catchment area. Central Göteborg is only 16 minutes away with train. With that in mind, and with the poor housing situation in Göteborg, Bohus can be an attractive place to live in for young families and students. However, the community does not offer a lot of student-oriented services which will make it difficult to attract that target group. Nonetheless, if the rentals are low and the train services are good and reliable, Bohus can use its strategic location to offer affordable housing and attract new residents and workers.

EKA Chemicals and mobility management

EKA Chemicals contributes to the industrial feel of Bohus. It can be discussed whether to move the industry to another location, but with the decontaminated soil and its close location along the road and railroad, it is practically no good for other uses. However, the industry is good for Bohus since it is the largest company in Ale. With the train station just outside the industry fences, it would be a perfect opportunity for the company to introduce mobility management in order to attract the workers to commute to work by train. Mobility management is a concept which aims to change people's travel patterns and increase ridership of other transportation modes than the car. This is achieved through soft factors, such as car pools, reduced tickets in public transportation and other incentives and minimal changes in infrastructure. Since EKA is the largest employer, it can make a big impression and act as a good example for the commercial and industrial life in the municipality.

Affecting people's travel choices: route

It is difficult to evaluate what paths people chose without making a thorough survey about their travel patterns. In the analysis, it is estimated that people converge along one of the four main corridors towards the centre, no matter where in Bohus their journey is begun. This is under the assumption that people chose the shortest, fastest and most convenient possible path. By making a road more or less accessible, it can affect people's route choices. Some factors could for instance be if the road is well lit,

if it is slippery, if it has resting places alongside, if there are intermediate stops on the way or if there are certain areas or people that want to be avoided (for instance dark forests or group of intimidating people). All roads should be safe, but it is especially important to make sure that the four identified main corridors are safe, attractive and convenient to use.

Affecting people's travel choices: transportation mode

Generally, walking and biking can become more competitive against driving if the car is under-prioritized in the infrastructure. This could for instance be shown in speed-calming measures and few thoroughfares for cars, in combination with short-cuts and separated paths for pedestrians and bicyclists. From a traffic safety point of view, minimal contact between the traffic modes is preferable. However, mixed traffic could also enhance the sense of security, especially in the evening, since it provides light, movement and more eyes on the street. In this case, people might prefer to take the longer road with more traffic rather than the shortcut and bike-lift in the evening. Therefore, providing several possible route options will increase the accessibility for all users at all times.

Viability of a cable car

For Bohus, the expansion plans will be primarily done in the outskirts where the larger empty plots are. Skårdals skans and Vinningsbo are two of them. This is favourable since it is the high locations with views and far away from the noise that often are considered attractive places to live in. The problem is that the distance to the station becomes longer and promotes driving instead of walking and biking. A discussion of having a cable car between the station and hill-top has been made. It would certainly overcome the topographical barrier and improve accessibility for all residents. It would also increase the ridership of public transportation. However, it is not viable for a small community like Bohus. The travel demand would be too low and the cars would often run empty. In addition there will be an uneven flow since most people arrive with the train, which is at regular intervals.

Bikes on buses

By allowing bicycles on the buses, it would be a more convenient alternative to bike to the station knowing that it is possible to bring it back on the bus. Hence, it will add to the attractiveness of both biking and public transportation. The drawback is that there might not be enough space for bikes on the bus and it might not be appreciated by the other travellers having to be crowded with large, heavy and sometimes dirty bikes. It could also make boarding and alighting of buses inflexible.

Real coverage area and perceived distances

With the suggested location of bus stops, most of the residential areas have less than 400 meters to the nearest bus stop. However, the figure shows the radius as a circle around the bus stop, which assumes that everything's flat. In reality, the coverage area depends on the topography. Conversely, the standard of 400 meters is in walking distance and not the air distance. Depending on the terrain and urban structure, the walking distance is somewhat shorter than the air distance on the map. Furthermore, the perception of distances can be affected by the design of the road and safety. On a very dark road with poor standards, or in a hilly landscape like Bohus, it can be expected that the distance is perceived longer than it physically is.

Safety of the bicycle lift

The bicycle lift might appear unsafe for a lot of bicyclists. Relying on a pedal pushing the bicyclist, while controlling the bike and one's balance, does not seem the easiest. According to TRAMPE, it is mostly about technique and therefore it could be necessary to have an introduction course with the opportunity to test before users are allowed on the bicycle lift.

Best location of the bicycle lift

A discussion could be made on whether a bicycle lift is most appropriate on Sandliden or Källarliden, the other main corridor towards Jennylund. A bicycle lift on any of those corridors would connect lower with upper Bohus and improve accessibility for all bicyclists living on the hill. However, a bicycle lift on the suggested section along Sandliden would offload Källarliden, which has a longer slope to climb, and ensure a shorter distance to the station for the residents on the hill, especially for Skårdals skans. The cars are expected to choose Källarliden, which is a thoroughfare and has a speed limit of 50 km/h and fewer traffic interruptions than Sandliden-Klorvägen, while bicyclists and pedestrians expects to take the shorter corridor to the station. However, in order for people to take Sandliden, it has to be re-designed to become more secure and accessible.

Centre with a broad clientele

When developing the centre and deliberating in what services that are needed, it is important to investigate what Bohus can offer that the residents and workers in Surte also will use, and vice versa. Bohus and Surte should complement each other and not be competitors. For instance, the gym or a pizzeria would have a clientele that extends to the neighbouring community. Bohus centre will not only serve the residents in the communities, but also workers, visitors and travellers who transfer in Bohus. If a mix in functions and services is not achieved, the centre might lose important groups of costumers. Single groups tend to create social insecurity, where other groups feel that they are not welcome.

Traffic noise

The east façade of the main building in the centre lies only 85 metres from E45 and is therefore in a very vulnerable position in terms of traffic noise and pollution, especially for the apartments on the top floor. Measurements of noise need to be made to make sure that they meet the acceptable levels for residential housing. Otherwise noise reduction measures are needed. One way is to make sure that the bedrooms do not face the road. Another option is to have offices on both floors, but only on the side that faces E45, while the other side is used for apartments.

9 Conclusions

It can be concluded that an important condition for an interchange to become an attractive node, is if whether or not it is designed after the needs and limitations of the user. It has to become more of a destination rather than just a place to change transportation modes. There are many aspects to take into consideration in creating this ideal node, but these have to be applied on Bohus based on its specific conditions, opportunities and limitations.

One of the biggest advantages with Bohus is its geographical location. With the commuter and regional train services, it has the opportunity to become an important node in the region. Cheap housing and office spaces are for example means to use the strategic location to attract a larger mix of users to Bohus. From the planning trends, it is apparent that they promote concentration of developments around the station area. This is however more applicable to a larger station community that has a high transit ridership. For Bohus, a small community with an industrial feel, it could be more effective to keep the centre small and in human-scale. A too heavy transformation could give the opposite effect and reduce vibrancy and remove the aspect of safety.

To improve accessibility for pedestrians and bicyclists, it is necessary to identify the main corridors to the station area and make sure that the environment is safe and attractive along them. In order for walking and biking to become an attractive choice, the routes have to be easily oriented, short, fast, interactive and safe for all road users.

The steep slopes and small population are two of Bohus' main weaknesses. These two barriers limit the community a lot in terms of accessibility and safety. Due to the varying topography, it is challenging for people to get around in Bohus. Therefore, the buses need to provide with adequate services and cover a large area in order to reduce the barrier effect. To make it easier for the bicyclists, a bicycle lift along the slope of Sandliden can also be considered, as well as allowing bikes on buses.

With a small population, it is important to have a centre that is for everyone. When deliberating what services that are needed, it is important to have a larger clientele in mind; the centre is going to be used by residents, workers, travellers and visitors. A small and multi-functional centre in human-scale and a perspicuous square and station area will promote interaction and thereby induce vibrancy and security.

An integrated traffic and urban planning approach is necessary in order to create a community and station area that is attractive, accessible and safe for everyone. The built environment, traffic and people's everyday life are strongly connected. With a pro-active public transportation planning and an urban structure that promotes accessibility and safety for all users, Bohus can become an attractive transit-oriented community that is attractive to live, work and reside in.

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10.2 Figure references

All figures are made by the author unless else is stated in figure references.

Figure 1. http://www.gr.to/download/18.2fe1b41a11c70e6248a80009341/ Folder+strukturbilden.pdf [2012-01-02]

Figure 2. http://www.trafikverket.se/PageFiles/35205/110630_banavagivast _eng_webb.pdf [2012-01-02]

Figure 9. Modified after Berg, K. (2009). *Planeringsfrågan väg till hållplats.* Göteborg: Chalmers tekniska högskola.(pp. 144)

Figure 12. Modified after http://upload.wikimedia.org/wikipedia/commons/7/75/ Denmark_Sweden_Locator.png [2011-11-03]

Figure 17. http://lt.se/image_processor/1.1355297.1315832036!/image/1772025074 .jpg_gen/derivatives/wide/1772025074.jpg?maxWidth=200 [2012-01-02]

Figure 22. Kävlinge kommun (2011b). *Plan- och genomförandebeskrivning.* Kävlinge: Kävlinge kommun. (pp. 5)

Figure 23. Gehl Architects. (2011b). *Kvalitetsprogram.* Kävlinge: Kävlinge kommun. (pp. 37)

Figure 24. DesignGroup Architects. (2011a). *Downtown Høje Taastrup byudviklingsprojekt – baggrund og visioner.* Høje Taastrup: Høje-Taastrup kommune. (pp. 9)

Figure 27. Modified after http://brandavenue.typepad.com/.a/ 6a00d8341c12a453ef013488a3e536970c-pi [2011-11-09]

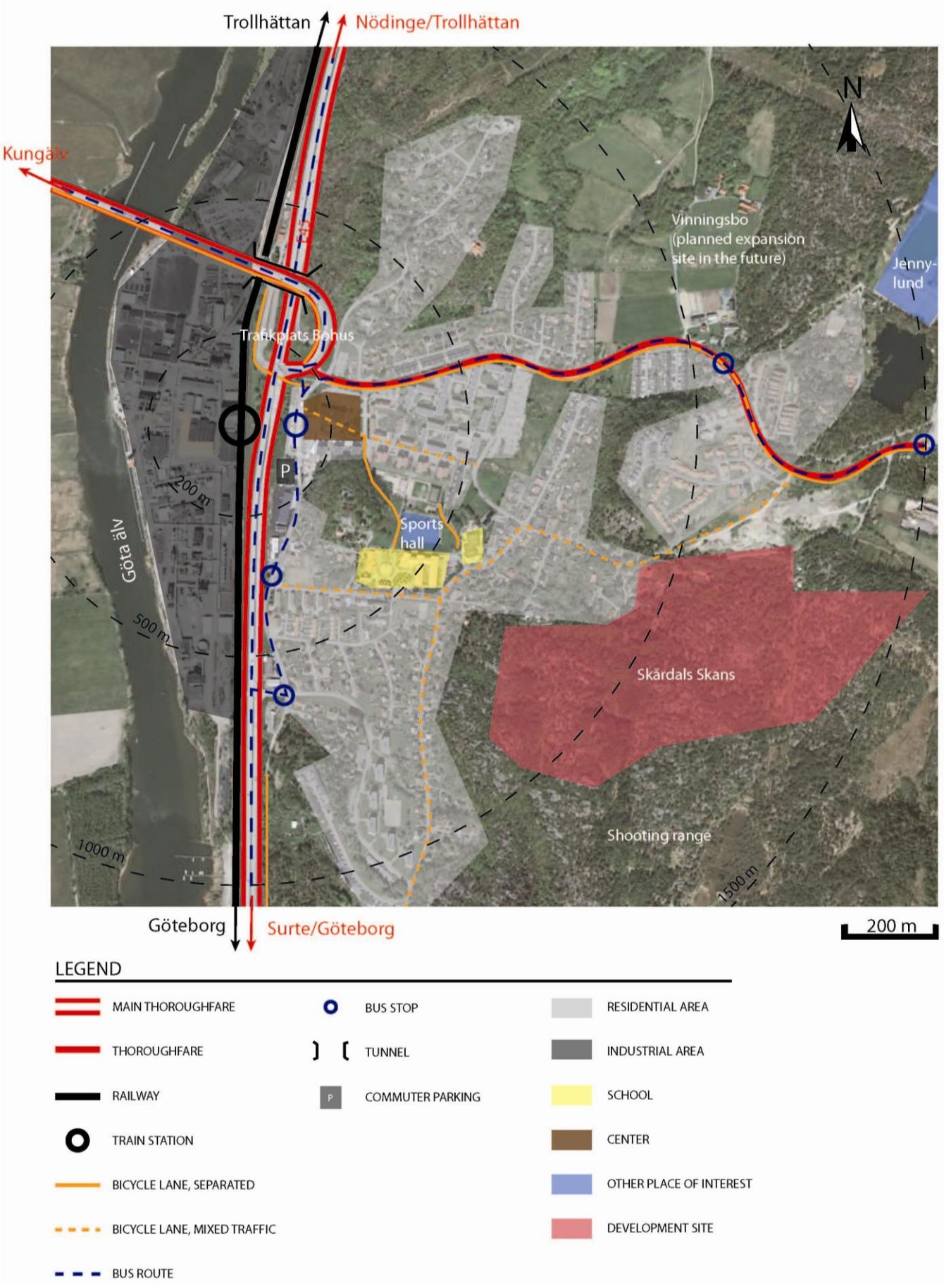
Figure 31. http://www.panoramio.com/photo/3891481[2012-11-09]

Figure 34. DesignGroup Architects. (2011b). *Downtown Høje Taastrup byudviklingsprojekt – program.* Høje Taastrup: Høje-Taastrup kommune. (pp. 12-13)

Figure 35. COBE. (2011). *Koblingen - en modig og aktiv bydel i Høje Taastrup.* http://www2.htk.dk/Byraadscenter/Down%20Town/COBE.pdf (pp 31) [2012-01-09]

Figure 39. http://trampe.no/downloads/pamphlet.pdf & http://www.trampe.no/english/ [2012-12-12]

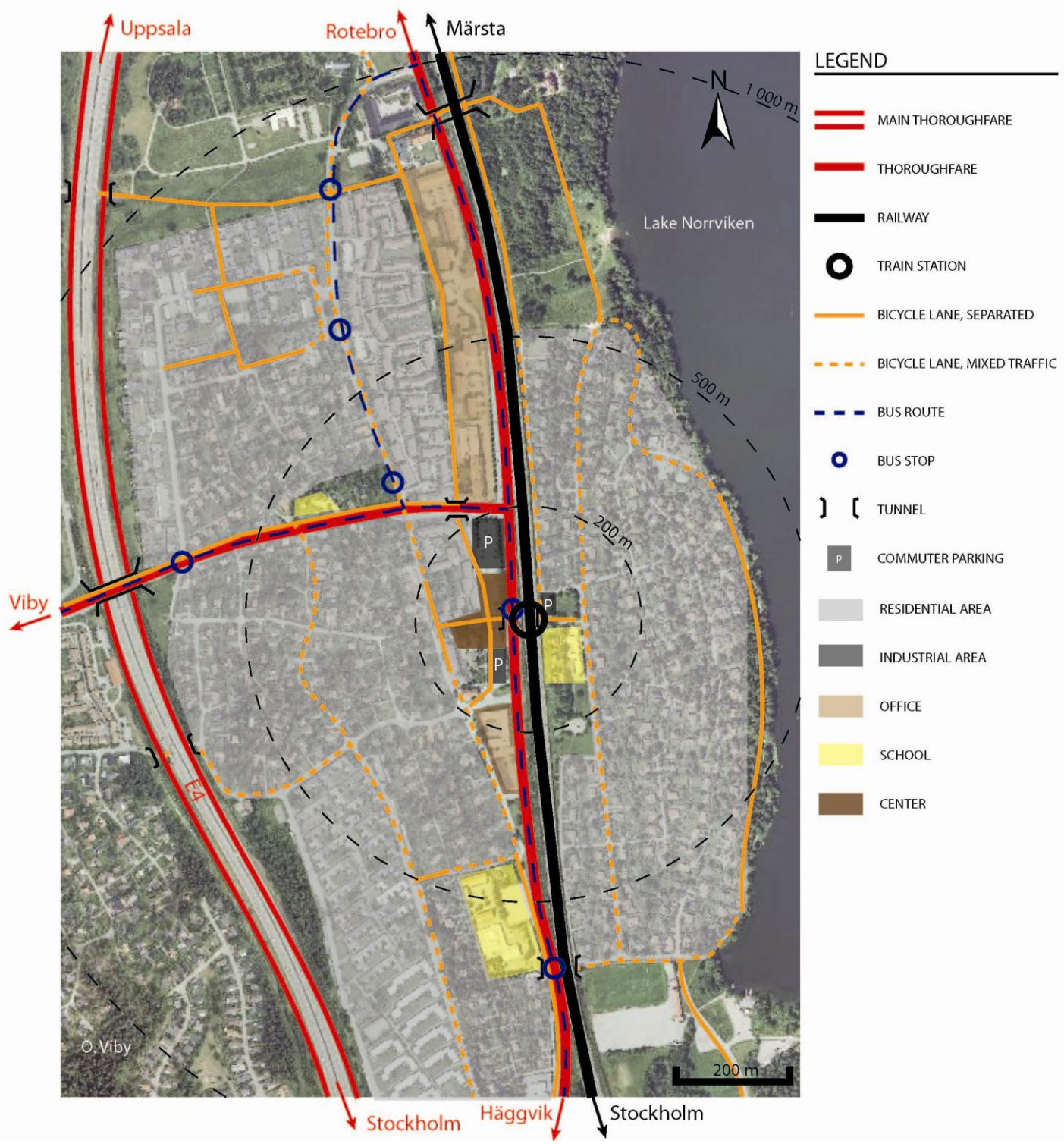
Appendix 1. Map of Bohus



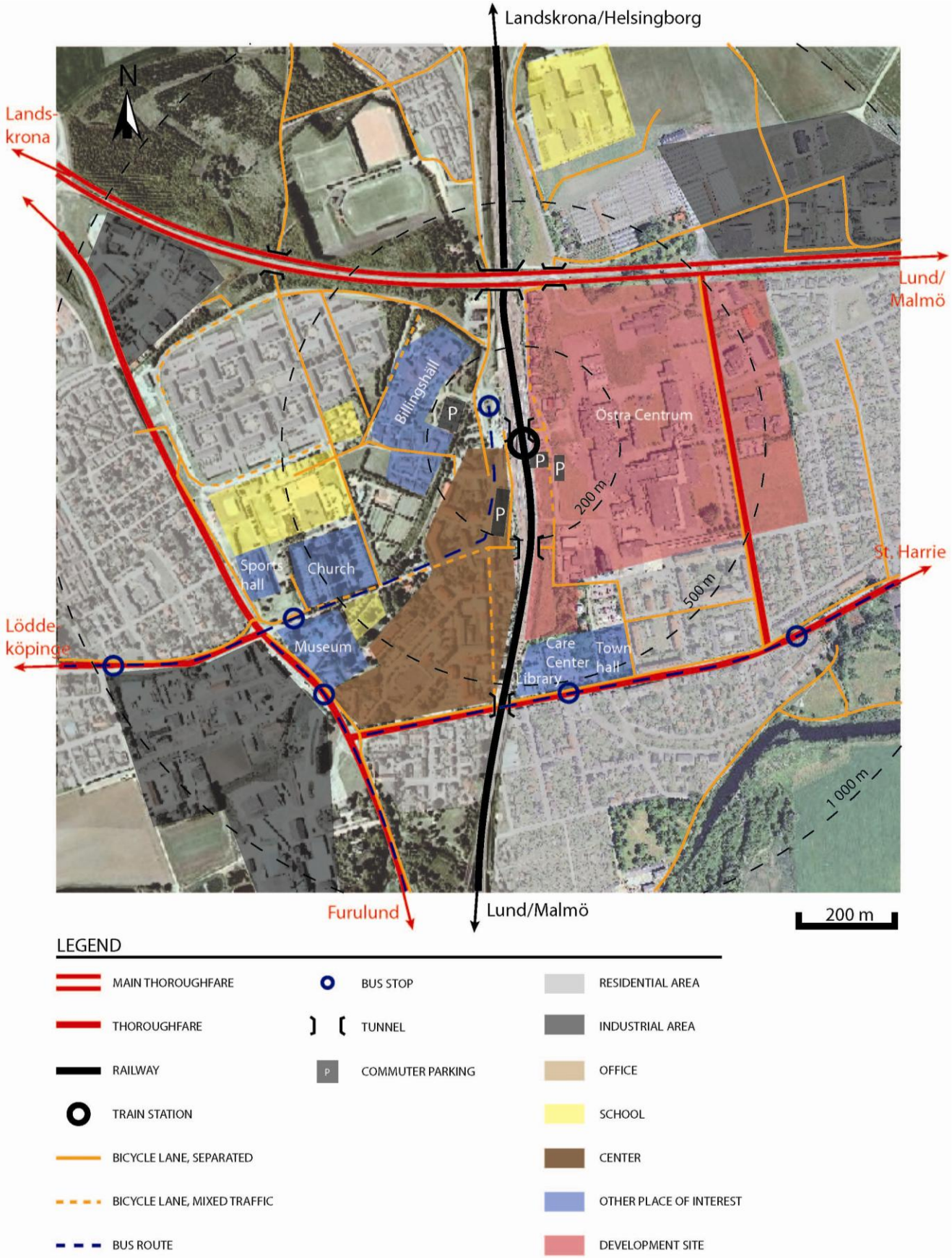
Appendix 2. Illustrations of Bohus Station

Carl Johansson, Sjögren Arkitekter AB, 21 September 2011

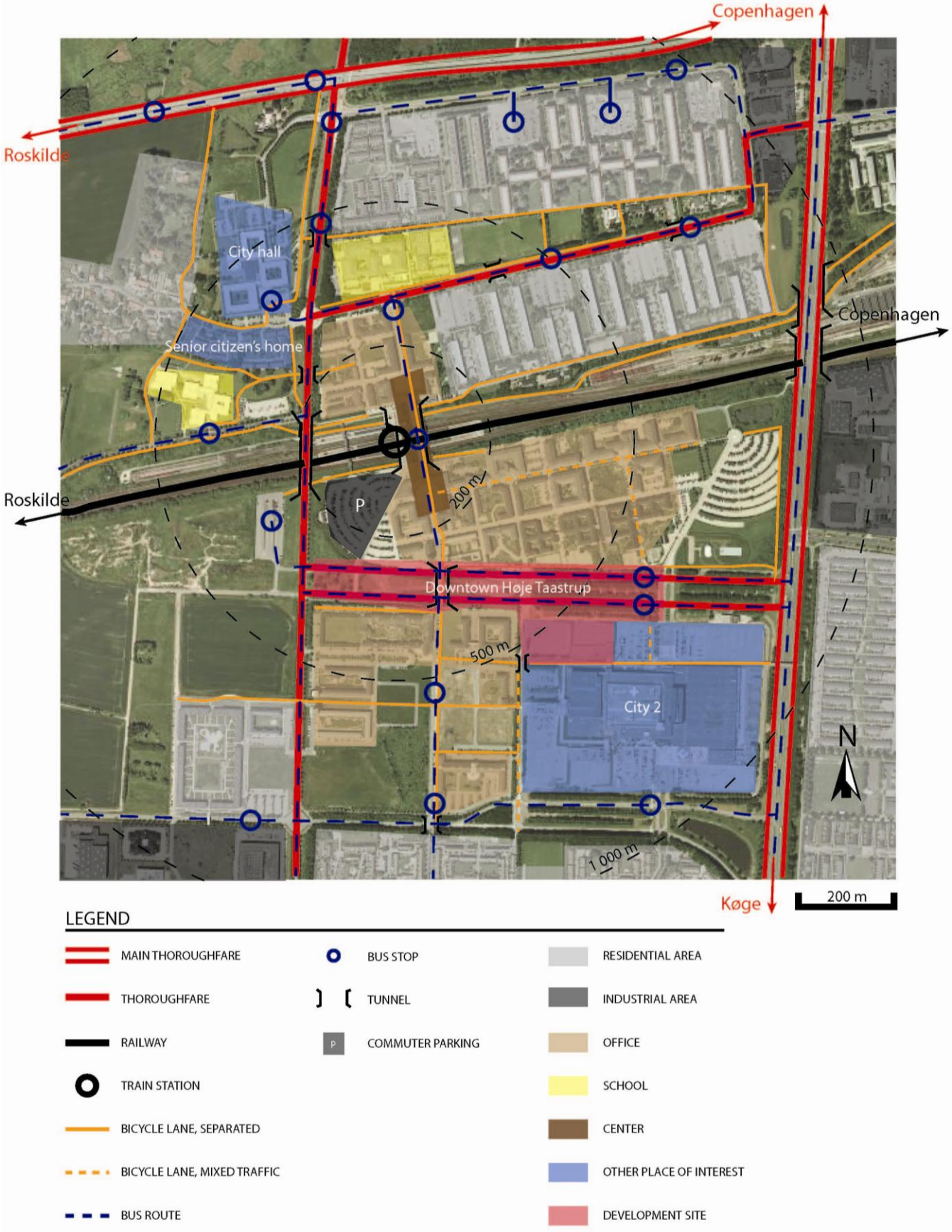
Appendix 3. Map of Norrviken



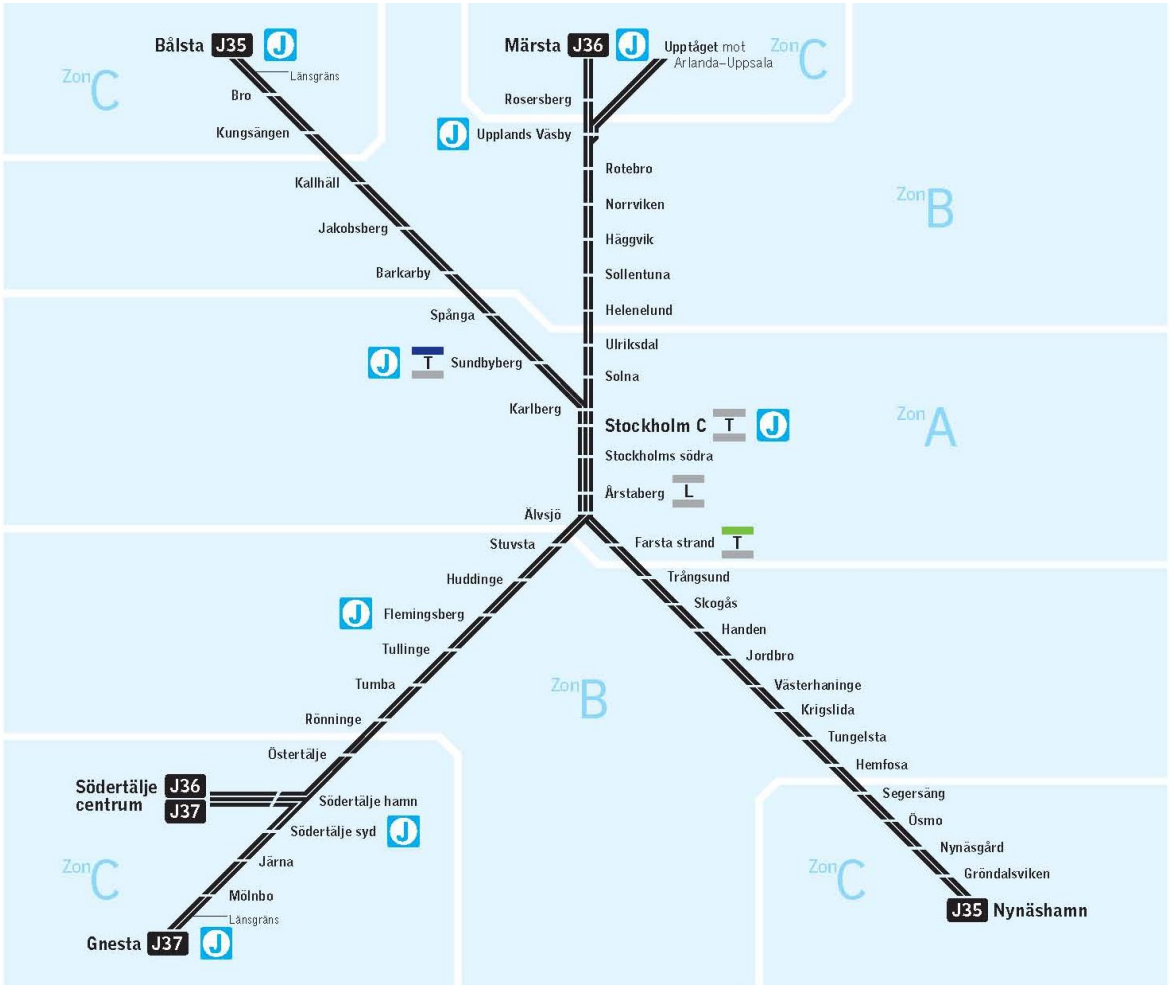
Appendix 4. Map of Kävlinge



Appendix 5. Map of Høje Taastrup

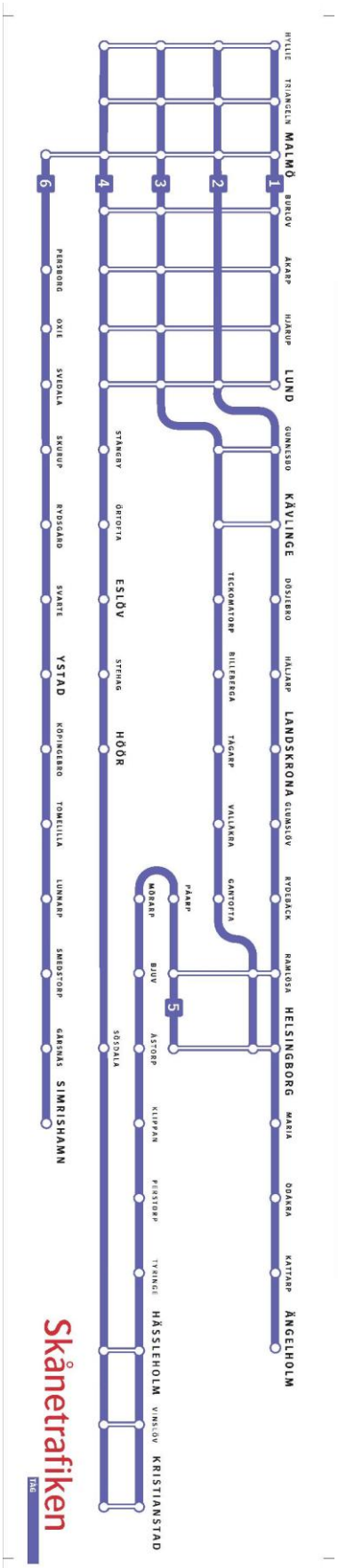


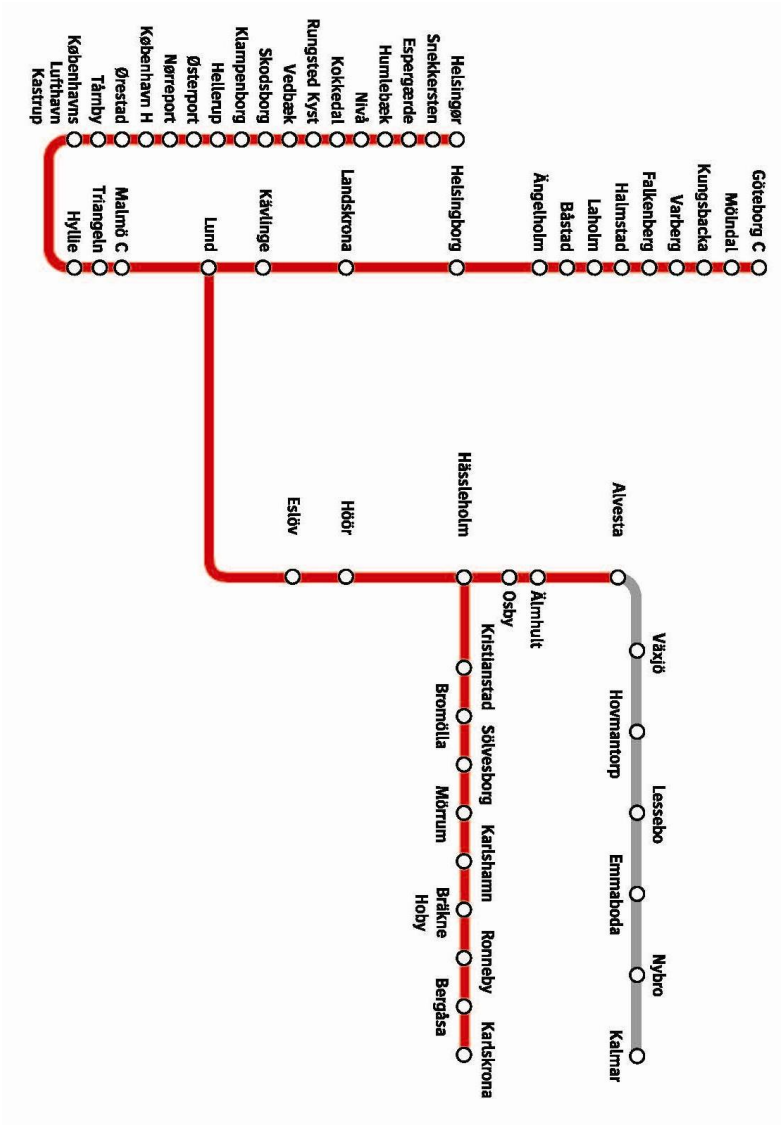
Appendix 6. Commuter Rail Map – SL



http://sl.se/ Kartor / Spårtrafik / Pendeltåg [2011-11-15]

Appendix 7. Rail Map – Pågatåg & Öresundståg



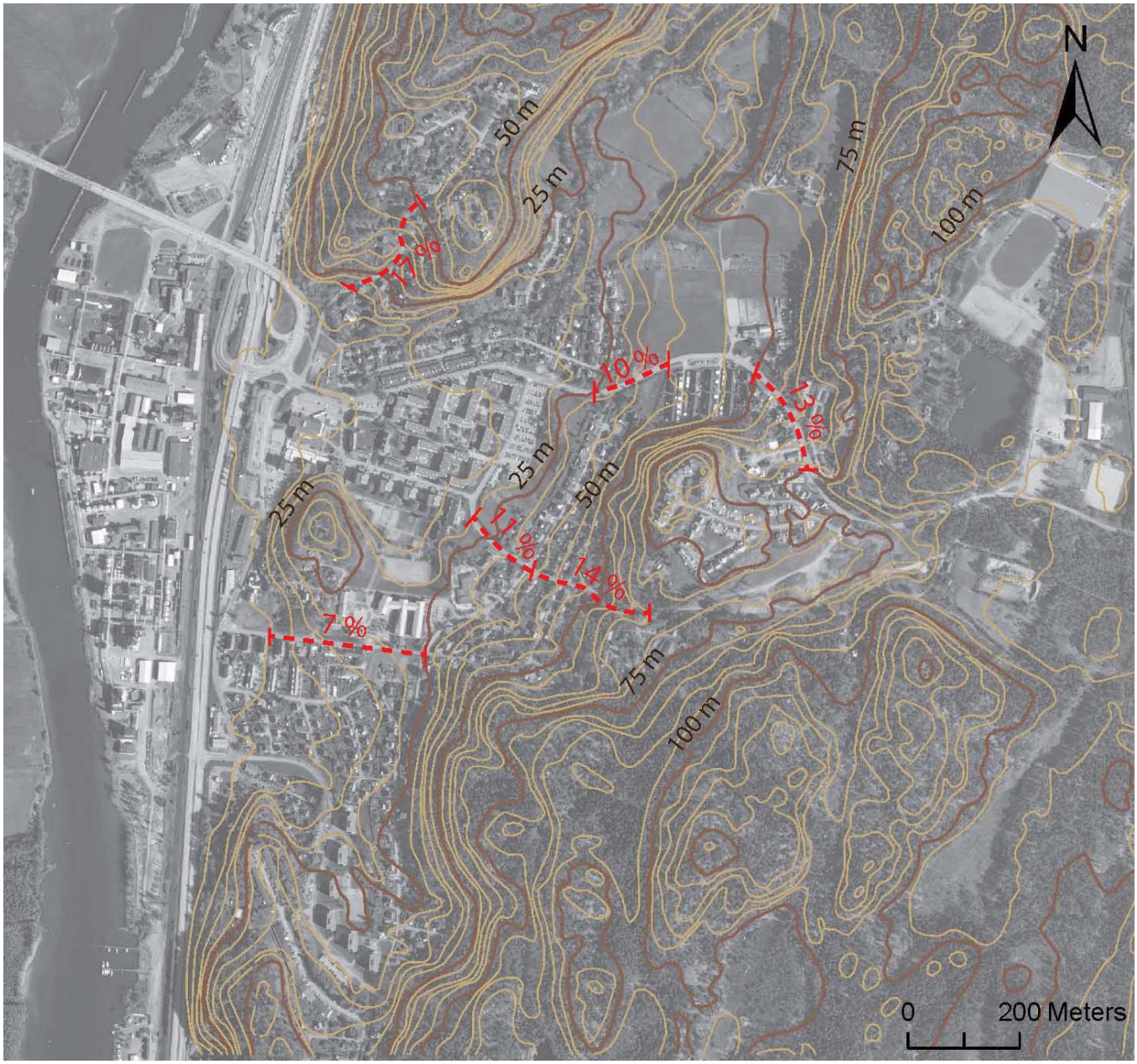


http://www.skanetrafiken.se/ Att resa / Kartor [2011-11-15]

Appendix 8. Commuter Rail Map – S-tog

http://www.dsb.dk/ S-tog / Køreplaner – Alle linjer [2012-01-10]

Appendix 9. Topographical Map of Bohus



Some of the identified critical slopes are marked in red.