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How improved rail infrastructure will affect property values in northern Stockholm.

- A study in value capture and the development of public transport
in the northern regions of Stockholm.**

Authors:

Alexander Pikosz
David Tiberger

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Supervisors:

Hans Lind
Karl Kottenhoff

Bachelor of Science thesis

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| Authors: | Alexander Pikosz, David Tiberg |
| Departments: | Real Estate and Construction Management, Transport Science |
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Abstract

This report aims to determine the economical benefits of improved public transport in some of Stockholms northern suburbs that are strategic locations for further urbanization. The correlation between public transport (PT) and property values will be explored. How will the PT scenarios that are suggested here increase the value of real estate in the regional focal points? How can the financial winners by this improvement be prepared to take part in financing the PT solutions?

Denna uppsats syftar till att fastställa de ekonomiska fördelarna av förbättrad kollektivtrafik i norra Stockholmsregionen. Det kommer att undersökas i vilken utsträckning det föreligger ett samband mellan tillgänglighet till kollektivtrafik och fastighetsvärden. Hur kan de olika kollektivtrafiklösningarna komma att påverka fastighetsvärdena i de regionala kärnorna? Hur skulle nyttotagarna av en sådan investering kunna vara med att finansiera den?

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Stockholm, June 2011

Alexander Pikosz

David Tiberg

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1. Introduction

Stockholm county is populated by just over 2 million people today and growing at a quick pace, it is likely to reach 2,23 million inhabitants by 2018.¹ Urban growth puts pressure on the city's infrastructure, buildings and people. Stockholm today shows strong tendencies of being a city of monocentric model. The theory of a monocentric city is constructed on the idea that all economic transactions are made in the Central Business District (CBD). The land is homogenous and shares the same properties everywhere. Value of locational advantage is capitalized in the form of land rent, meaning close access to CBD gives higher rents and locations further away from the CBD give lower rents. However, the price of commuting increases with the distance from CBD.²

Stockholm has a strong inner-city where most of the region's economical transactions take place. Housing prices in the city are steadily increasing as not many new homes are built while there is an increase in demand. Prices in regional focal points as well as suburbs closer to the city are significantly lower than in the inner-city.³

A polycentric city structure on the other hand, builds on the theory that a city has several subcenters or focal points. This kind of city structure often makes cities less dense, but it can offer a more diverse and mixed composition of structures. Subcenters can be made more dynamic, making it possible for workplaces and workers to relocate, benefitting the region by decreasing commuting costs and commuting time⁴.

Stockholm suffers from urban sprawl and suburbanization where offices, shops and places of leisure expand in the suburbs which leads to a distance increase in peripheral commuting, mainly by motorized commuting, since public transport often is neglected and insufficient in these areas. Studies have shown that the further away the residence areas are from a city center, the higher the rate of motorization.

Today, within larger monocentric urban areas, there is a rapid increase of commuting distances and congestion on the transport axes.⁵

The lack of public transport in the outskirts of Stockholm is significant. The following can be read from a statement by Upplands-Väsby Municipality in " Yttrande över samrådsförslag till Regional Utvecklingsplan för Stockholms län RUFS 2010";

¹ SL

² Song, S. (1992) p.6

³ Stähle, A. (2011)

⁴ Dr. Aguilera, A., Dr.Mignot, D. (2004) Pp.94, 96

⁵ Ibid.

"Stockholm has a huge gap that has occurred over the past 20-30 years in terms of both initial investment and maintenance of existing infrastructure. This has slowly led to a totally unacceptable level of congestion on both road and rail infrastructure."

This paper aims to show how the city can be developed in a more polycentric way, to offer a more sustainable expansion by developing public transport, hence making the city more accessible and economically attractive. The effects of improved public transport will be measured through value capture - meaning that the economical effects of the investment will be capitalized in the increase and decrease of property values. Different financing possibilities will be presented and an investigation will show how the increase of property values can participate in financing the suggested railway, Norrortsbanan.

1.1 Hypothesis

The increase of property values generated by Norrortsbanan is greater than the project cost.

2. Method

2.1 Introduction

The method used in this report is scenario planning, within the field of futures studies. The main scenario consists of an infrastructure corridor, a preferred traffic solution and value capture, including the rail's effect on property and co-financing of rail.

Some of the key ingredients in the report are to establish; a moderate project cost, an accurate project revenue and to sum up the effects and identify the factors that contribute to the projects revenues. Trying to understand the problems and trends of the region is central.

2.2 Data collection

Data has been collected through various channels such as interviews, papers, books and academic reports and articles mainly supplied through Google scholar and local planning authorities. Geographical data has also been collected from maps and other statistical data has been collected from reference projects and Lantmäteriet - the Swedish mapping, cadastral and land registration authority.

2.3 Data selection

Data concerning property values and railway constructions has been collected from around the world, but mostly from the USA. Using qualitative methodology, data from academic papers and reports is examined in order to observe certain trends from which conclusions can be drawn. Applying figures and data to this report, however, is of greater challenge. To see which reports and statistics that are applicable to this report, concerning Stockholm, careful considerations are taken as to which of the results are most likely to occur in this project. Data

is used to find the most likely way in which the railway expansion will affect property values in the affected areas.

2.4 Selection of urban centers

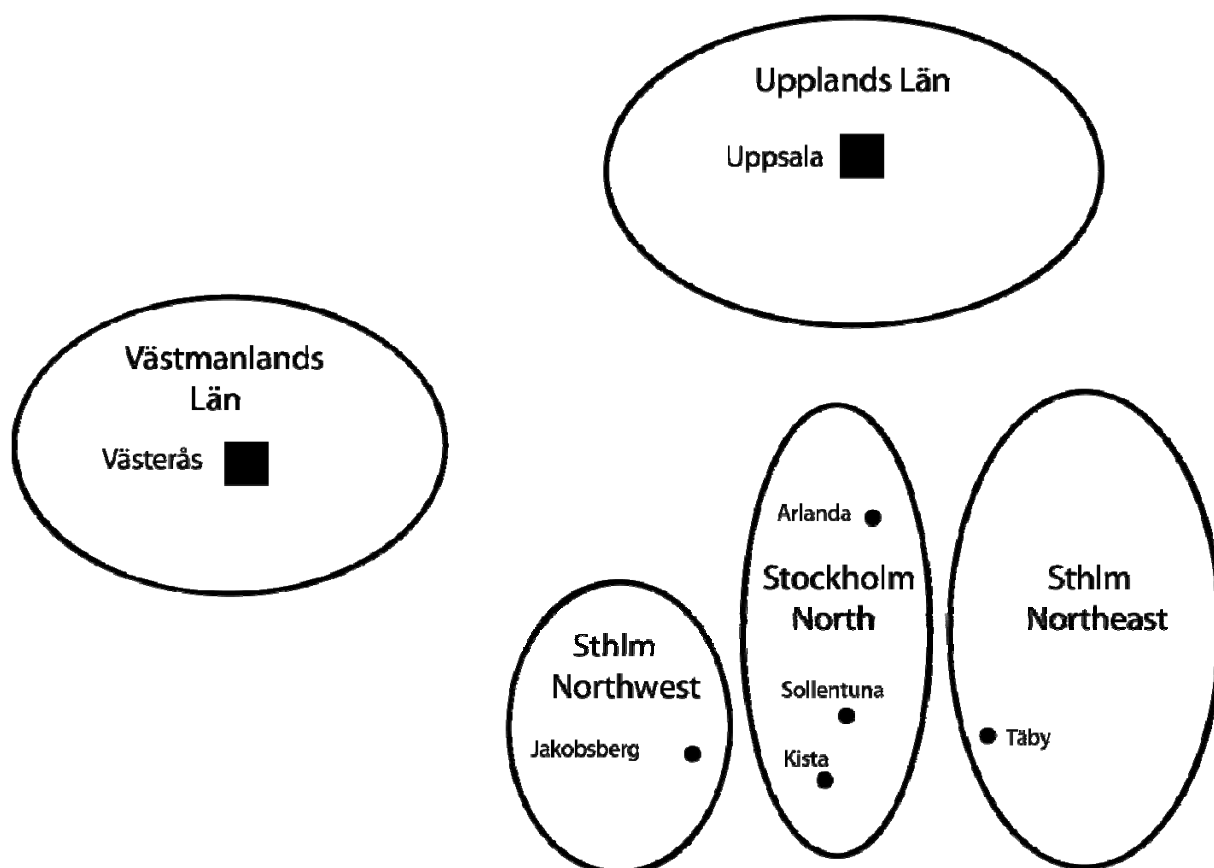
The selection of urban centers was based on the master regional plan. When revising the master regional plan it was clear that the selected region has several focal points that are adjacent, but with poor communication to one another. Consensus is that the region is neglected in terms of public transport.

3. Presentation of the region

3.1 Introduction

The location for this project has been chosen to the north of Stockholm, where public transport is far from fully expanded and where an intersecting railway could strongly benefit the region. The region is divided into three sectors, the northwestern sector, the northeastern sector and the northern sector. Expanding existing railway and connecting it to new hubs can help create new paths. Furthermore, this region consists of a mixture of real estate, light and dense; homes, offices, shops, malls and warehouses.

The region contains several potential regional focal points, such as Täby-Arninge, Kista-Sollentuna, Jakobsberg and Arlanda. The railroad expansion that is presented in this report will connect the northern suburbs of Stockholm to three other cities, Uppsala, Västerås and Enköping. The studied region contains one million people but has no internal railway system, and is therefore highly dependent on Stockholm central station. The outer cities may be of importance to the railway expansion, but the real estate market effects will mainly be studied within Stockholm County.



Picture 1: The studied region located north of Stockholm.

3.2 The sectors of Stockholm

In addition to the small presentations given below, more facts are given in appendix A and B.

3.2.1 Northwestern sector

The northwestern sector contains the municipalities of Järfälla and Upplands-Bro. Järfälla is an expanding Municipality with a lot of high density buildings. 17 713 of the total housing consist of apartments whereas the remaining 10 867 homes consist of small houses.⁶

There are many plans for developing new properties and apartment buildings in Järfälla and there is a strong political will to proceed with these. A great reason to why development is proceeding at a relatively slow pace is the lack of sufficient infrastructure in the area. Existing roads cannot cope with the current traffic situation.

Järfälla has two big shopping areas. Barkarby Handelsplats and Jakobsbergs Centrum. These areas are situated only 1500m from one another and are a part of the same regional focal point.

Barkarby Handelsplats is placed in a sparsely populated area with potential of further development. It offers job opportunities and shopping with about 50 stores including an IKEA store. The sales at Barkarby Handelsplats were 2006 estimated to about 350 million kronor, but are forecasted to increase with an annual rate of 7%, so that sales reach 1 billion kronor at the end of year 2030.

⁶ jarfalla.se (2011)

Jakobsbergs Centrum contains a mall that features over 100 stores. Sales were 2006 estimated at 400 million kronor but are annually predicted to increase by 3-4 percent, so that sales reach around 500 million kronor by the end of year 2015 and 900 million kronor by the end of 2030.

Communication-wise Järfälla can be reached either by taking the E18 freeway or the commuter train.

Upplands-Bro is a fairly small municipality with about as many apartments as there are houses. Expansion and further development in the housing market has been discussed and carried out. Upplands-bro has many green areas and it is of great interest to the public that they remain green and fairly untouched.⁷

3.2.2 Northern sector

The northern sector contains the municipalities of Sigtuna, Sollentuna, Upplands Väsby and the district of Kista.

Stockholm's international airport is situated in Sigtuna. Arlanda is the biggest employer in the Municipality with close to 12 000 job positions. In 2009 16.1 million travelers traveled either from or to Arlanda, which equals about 40 000 trips per day. A total figure of 192 500 take-offs and landings to 176 destinations were made at the airport.⁸ The biggest towns in the municipality are Märsta and Sigtuna.

The commercial center of Sollentuna is situated about 11 km north of the city center of Stockholm, immediately west of Täby Municipality and east of Barkarby-Jakobsberg. Two subcenters from this sector that will be presented and discussed in this report are Kista and Sollentuna-Häggvik. Kista is a part of Stockholm municipality but is adjacent to Sollentuna. Häggvik is a part of Sollentuna Municipality. Kista and Sollentuna do not share the same identity, but they share some infrastructural problems, for example the lack of traversing infrastructure. Sollentuna is mainly focused on housing, and offers many houses and apartments. The municipality has accepted a plan on how it can be developed in a more sustainable manner. The plan suggests that new buildings should be built densely near railways and existing constructions should be rebuilt so that they become more efficient. Kista was built to serve companies that could benefit from being in an IT-cluster. Today many IT-companies are stationed here, such as Ericsson, Nokia, Microsoft and IBM, also, KTH has a local branch here. There is a mall, Kista Galleria, in association to the nearby offices.⁹ Kistamässan - exhibition and event center is currently under construction but is opened for exhibitions. Kista science tower was constructed 2002, it is the tallest office building in Sweden with 41 000 square meters of office space.¹⁰

Upplands Väsby, has a goal to increase population by 1% per year, reaching between 44 000 to 48 000 inhabitants by 2030. The municipality is planned to expand towards a "dense,

⁷ RUFS 2010

⁸ arlanda.se (2009)

⁹ RUFS 2010

¹⁰ ncc.se (2011)

mixed and attractive focal point", "in tune with local businesses, organizations and the Arlanda-region".¹¹

3.2.3 Northeastern sector

The Northeastern sector is the biggest and most populated one of northern Stockholm's sectors. It consists of Täby, Danderyd, Norrtälje, Vaxholm, Vallentuna and Österåker municipality. This sector offers the least number of working places in comparison to its number of inhabitants. The regional focal point which this report will focus on in this sector is Täby Centrum-Arninge. Täby Centrum is located relatively near both the Stockholm CBD and Kista. Around half of the houses in Täby municipality are small family villas. The area near Täby Centrum is served by rail lines and is located near the E18 freeway. This area is a composition of big apartment blocks, constructed in the mid- 1900 as well as the big mall, "Täby Centrum". Arninge, situated just east of Täby C serves strictly as a commercial center with big stores. Arninge is sparse and has potential for further development when it comes to housing, business and infrastructure. Täby aims to better connect Täby C with Arninge, allowing the focal point to become more attractive and accessible.¹²

3.2.4 Uppsala

Uppsala is Sweden's fourth largest city, containing about 195 000 inhabitants.¹³ Uppsala has the oldest university in northern Europe with a total of 45 000 students' enrolled and 5 500 faculty members.¹⁴ A majority of homes are situated in building blocks. The E4/E20 Freeway runs through Uppsala, as well as several train lines.

3.2.5 Västerås

Västerås has a total of about 137 000 inhabitants and is located about 90 km northwest of Stockholm. The city is known as an industrial city with some activity within retail and logistics¹⁵. Mälardalens university college, with about 13 000 enrolled student is located here. Västerås has easy access to both railways and E18.¹⁶ Västerås also has a small international airport.

3.2.6 Enköping¹⁷

Enköping is a mid-sized city in the vicinity of Stockholm. It is a growing town, oriented to the north west of Stockholm CBD. The number of residents is approximately 39000. The town has a big share of commuters to Stockholm County.

3.2.7 Bålsta

Bålsta, situated in Håbo municipality, is today the ending station for the commuter train going north. This small town could be made to serve as an interchange point for railway traffic going further west.

¹¹ Upplands Väsby kommun (2011)

¹² RUFS 2010

¹³ uppsala.se(2011)

¹⁴ uu.se(2011)

¹⁵ vasteras.se (2011)

¹⁶ mdh.se (2011)

¹⁷ enkoping.se (2011)

3.3 Table showing the property values in the studied regions

The table below shows how the average prices on condominiums vary within the region and that prices on properties close to Stockholm CBD carry a significantly higher value than properties located further away¹⁸.

| Municipality | Price (kr/sqm) |
|------------------|------------------|
| Enköping | 11 885 kr |
| Håbo | 11 847 kr |
| Järfälla | 20 040 kr |
| Norrtälje | 15 575 kr |
| Sigtuna | 13 108 kr |
| Sollentuna | 23 468 kr |
| Stockholm | 45 297 kr |
| Täby | 25 294 kr |
| Upplands-Bro | 15 245 kr |
| Upplands-Väsby | 18 337 kr |
| Uppsala | 26 023 kr |
| Vallentuna | 17 315 kr |
| Västerås | 11 540 kr |
| Österåker | 16 729 kr |

Table 1: Monthly average sales prices on condominiums in the region (2011-06-12)

¹⁸ Mäklarstatistik (2011-06-12)

3.4 Railway's and trains

National railways in the Stockholm region are oriented around Stockholm central station. Distance trains from Stockholm city center run north along Ostkustbanan towards Arlanda and Uppsala and northwest along Mälarbanan towards Enköping and Västerås. Trains which serve the regional and long-distance travel market are sharing some of the space on these tracks with Stockholm County's commuter trains, which mainly operates within the county.

The national authority Trafikverket, which controls the nationwide infrastructure system, creates the timetable and distributes slots to the different train operators, such as SL, SJ and A-train. Trafikverket are also responsible for maintenance and investments along the transport corridors.

The Stockholm region's internal public transport system is clearly dominated by SL, which is the proprietor of local infrastructure networks and operator of public transport. The traffic can easily be categorized in four separated networks.

- commuter trains
- light rail / tramways
- underground
- bus traffic

The commuter train runs with an average running speed between 60 and 70 km/h on two branches towards the northern suburbs, and two southern branches. The central station is by far the most used station within the commuter net.

The tramways of Stockholm are mostly found in the area surrounding Stockholm's inner city. Operating speeds are normally just around 25 km per hour which makes it attractive on fairly short distances. However, Roslagsbanan is an exception that resembles a commuter rail line. It is a thin gauge light rail service faster than the average tramway, and it has skip-stop traffic. It is directed from the city towards the northeastern suburbs.

The underground is running with an average speed of 40-50 km/h on three separated line systems: the red, blue and green one. The underground network consists of several branches, making up seven different line routes in total, which all converge in the city by the central train station.

Public transport by bus is slow but flexible compared to rail bound traffic. Stockholm has an extensive bus network that covers all parts of the city, typically on non-direct routes. However, some bus routes have been made reminiscent of rail lines along some popular transport corridors.

4. Problematization

4.1 Urban Sprawl and lack of suburban city planning

The expansion of Stockholm is taking place throughout the Stockholm County, to a big degree in suburban municipalities. Proximity to public transport, commerce and other service is a value that could generate dense development in the major hubs of suburban Stockholm. When new suburban development occurs far away from existing centers and transport hubs it generates car dependency and makes public transport hard to implement. The urbanization of undeveloped land may be a threat to both the local and the global environment. Lack of concentrated suburban city-like planning will eventually lead to a shortage of land within some suburban municipalities. There is also question about how the vision of Stockholm 2030, with strengthened regional focal points, can be realized with the urban sprawl problem of today.

4.2 Monocentrism and over-heated real estate market in the inner city

The dense Stockholm inner city is highly popular for living, working and visiting as a tourist. Nowhere does the property value per squaremeter come close to that of the inner city in other parts of the Stockholm region. Tourists are lodging on inner-city hotels to spend the days visiting Stockholm's top attractions, all located in the inner-city or just south thereof. The residential rent market does not work well: Public housing queues are extremely long and second or third hand lodging is quite common. The suburb of Sollentuna has been planning for development around rail lines that run diagonally to the innercity links, which were first supposed to be built in the 70's, and is now hardened over the lost opportunities.¹⁹

4.3 Social aspects

Public transport is vital for equity in society, since all people cannot drive a car. The suburbanization causes equity problems since it is boosting the dependence of transport by car. In the best case this simply means that people that are prevented from driving are delayed in time. More importantly, suburbanization is a source of segregation. Northern Stockholm is the location for some of Sweden's most secluded and segregated areas. The magnitude of these issues is hard to overlook since suburbanization is a relatively new phenomenon in Stockholm's history. There is no question; however, that good public transport coverage is an important factor in relation to integration and urban planning.

¹⁹ Hallmén, A.(2011)

4.4 Long travel times

Accessibility is a key factor in all regional development, for Stockholm city as much as its suburbs. More specifically, travel times must be short and trustworthy between places of interest. A location in Stockholm city center is superior to a location in the suburbs, simply because the connections are vastly better. Transforming Stockholm from a monocentric city to a polycentric city means that the hierarchical structure within the transport system will change, to allow smooth traveling directly between the suburban centers. It is not possible to be competitive in an urban arena without accessibility, both in terms of private transport and public transport.

4.5 The cost of the transport sector's environmental goals

Environmental sustainability is a national political goal that is far from realized. For the transport sector this is a great challenge, which lies heavily on having more people use public transport instead of private transport. This issue is ever-present at Arlanda airport, which has a limitation given by the government on the quantity of emissions that is allowed to be let out on the account of the airport's passenger traffic - ground travels to the airport included. On Arlanda and in the region as well the slow implementation of new public transport routes is threatening sustainable growth.

4.6 Punctuality

Malfunctioning infrastructure is causing poor punctuality for all modes of transportation in the Stockholm region. Delayed trips are to a great extent caused by overcrowded trip corridors in direction of Stockholm CBD in the morning and out from Stockholm CBD in the afternoon. Congestion taxes to reduce car traffic have increased the pressure on public transport in these relations. Still, the commuting links to work places in the city suffer from congestion. Both roads and trains to work places in the city are jammed in the morning and equivalently on the way back in the afternoon. The low punctuality of public transport is seen as the biggest problem, in the suburban municipality of Sollentuna.²⁰ The punctuality of the region's public transport was decreasing in 2010.²¹

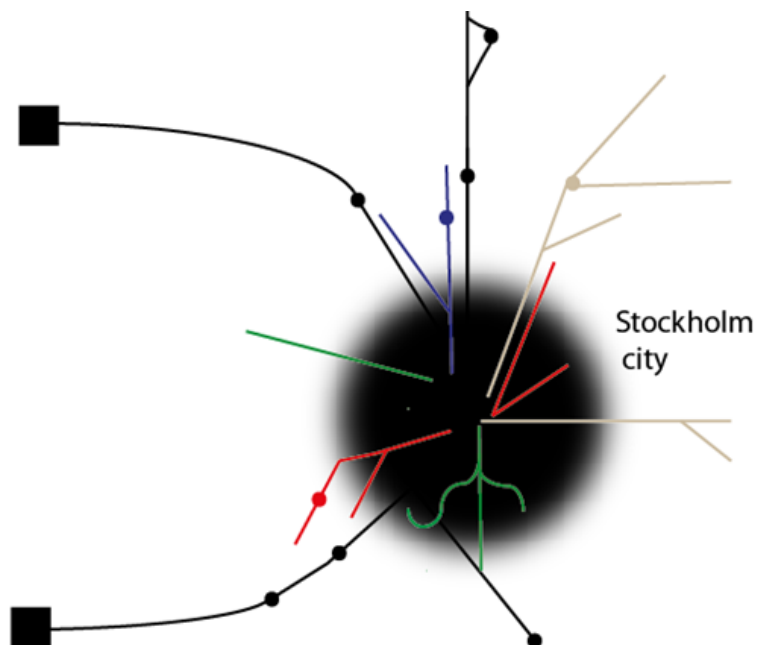
²⁰ Ibid.

²¹TV4 (2011)

4.7 Few and unilateral improvements of public transport

The expansion of rail-based traffic networks in Stockholm has been small and light since the 1970's when the blue metro line opened. The opening of Tvärbanan in the late 1990's at last showed some positive tendencies again for rail traffic. Tvärbanan has led way for more light rail lines that currently are being either planned or constructed close to the city center. However, the region's biggest growth in the decades to come is expected to take place in the suburban areas, where the rail expansions aren't being planned.

In suburban Stockholm it is hard to find comfortable public transportation in high-speed straight lines, unless you're going in the direction of the city centre. The rail network that offers these services are directed towards Stockholm city and thereby creating a monocentric structure.



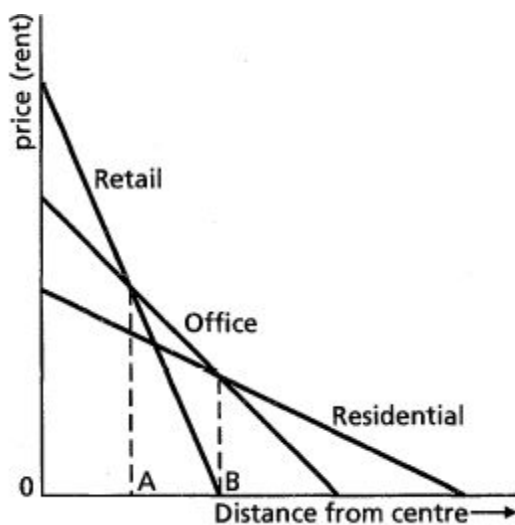
Picture 2: Monocentric blur caused by the unilateral public transport system

5. A meta study of previous reports

5.1 Property Values

5.1.1 International reports

Most reports build on the theories discovered by von Thünen(1863), who was a pioneer when describing the relation between farmland values and accessibility. He found that accessibility to the marketplace from farmlands explained the variation in land rent, on the premises that all land is homogenous. Shorter distance (easier access) to the marketplace showed higher rents and longer distance to the marketplace showed lower rents. Von Thünen's findings were later improved by Alonso(1964) and Muth(1967) resulting in a bid-rent model leading to a rent-gradient that declines with the distance to CBD.



Picture 3: The bid-rent model

The general approach amongst today's authors is to categorize the factors concerning property values as physical, environmental and accessibility.²² Bowes and Ihlanfeldt (2001), when analyzing the effect on property values generated by MARTA (Metropolitan Atlanta Rapid Transit Authority) point out two factors that are said to have positive impact on property values and two negative ones. One of the positive factors is identified to be the access advantage provided by the railway station. If the railway provides a less stressful way of commuting and reduces commuting time, commuters should be willing to pay more for properties close to railway stations. The second positive factor is that retail establishments show strong tendencies to be attracted to these areas.²³

²² Debrezion, G. & Pels, E. & Rietveld, P. (2007) p.162

²³ Cervero, R., Duncan, M. (2002) Pp. 26-28

Two negative factors that are presented is the increase of crime, due to easier access from outside the area and the unsightliness of the railway station and factors such as pollution and noise.²⁴ The same negative factors are also pointed out by R. B. Diaz and B. Allen²⁵. In some studies however, no negative effects are found.²⁶

Railway stations' impact may also be of demographic nature. Income and social divisions are common. Some reports emphasize that accessibility of public transport is of higher value to low-income households than to high income households.²⁷ The reason for this is claimed to be that low-income households rely on public transport to a greater extent. However, this statement is contradicted by Bowes and Ihlanfeldt whose results claim that high-income neighborhoods are more likely to benefit from railway access.

The way of reaching the railway station mostly consists of slow modes (walking and cycling), consensus is that distances further away from the railway station experience less economical and accessibility impacts.

In a great majority of reports, when calculating property values, authors use a hedonic price model. The hedonic price model, originating from the property evaluation methods by Rosen, (1974) takes different properties' features into consideration. The integration of such data may for example include physical, accessibility and environmental characteristics to explain property value variation.²⁸

Apart from using the Hedonic model, Bowes & Ihlanfeldt also include neighborhoods crime and retail employment equations to determine the indirect effects that railway stations may have.

Results on the matter from contemporary reports from across the world vary in results. One of the earliest studies performed by Dewes (1976) show that residential properties within a distance of 1/3 mile of a metro station yielded higher rents; later Grass (1992) found a direct relationship between property values and accessibility to new built railway stations. Studies performed regarding some of the US-metro systems show different values when calculating property values near stations, however, there seems to be a general agreement in these studies regarding the fact that closer proximity to a station yield a greater impact on property values. In the US there are cases suggesting that commuter rail have a greater positive impact on property values on properties surrounding a station, than light rail or other forms of heavy rail.²⁹ No, or insignificant relation between railway accessibility and property values are also shown in some studies.³⁰

²⁴ Bowes, D., Ihlanfeldt, K. (2001) p. 2

²⁵ Diaz, R. B., Allen, B. (1999) p.3

²⁶ Burkhardt, R.(1976)

²⁷ Nelson, A.C.(1998)

²⁸ Debrezion, G., Pels, E., Rietveld, P. (2007) p.164

²⁹ Debrezion G., Pels E., Rietveld, P.(2006)

³⁰ Lee, D. B (1973)

Negative values generated by the proximity to railway stations are also presented in a few reports.³¹ Bowes and Ihlanfeldt conclude in their report that property value effects are negative in within a distance of ¼ mile to a railway station, however, the properties within a 1 and 3 mile radius of the railway station carried a significantly higher value than those farther away.

Other factors that come into play when examining the relationship between railway stations and property values are: the access to a parking lot³², which has a positive impact on property values; and the network structure of the rail way, in general, the vicinity of hub-stations are more attractive and show greater property value increase than stations standing alone.

The value impact of commercial properties in connection to railway stations has also been examined. Results vary to a large extent in this case as well. Bollinger and Ihlanfeldt (1997) find no significant value impacts when examining MARTA's impact on commercial properties. Studies conducted by Dvett et al. and Cervero et al. find small positive impacts generated from San Francisco's public Bay Area Rapid Transit (BART).

A study performed on Washingtons METRO system by Green and James (1993)³³, and the Dallas Area Rapid Transit (DART) metro system by Weinstein and Clower (1999) however shows large impacts on commercial property values. This is in line with the general opinion and the theory that railway stations attract commercial activities, bringing people and businesses together, resulting in an increase of commercial property values.³⁴ Weak value impacts can likely be explained with a quote from Knight and Trygg (1977), who examined the relationship between property values and public transport in the 70's: “modern urban transit systems rarely, if ever, provide a major effective increase in accessibility, because the areas

served tend to be already more accessible by auto.”³⁵ Bollinger and Ihlanfeldt come to the conclusion that this might be the case in their report, when examining the specific case of MARTA. In Stockholm however, motorization is not as widespread as the case is in the US, furthermore, public transport is less stigmatized in Sweden and not associated with the same social aspects as the case may be in parts of the US. Increased urban density over the past years, especially in Stockholm, requires an alternative to motorized commuting. Hence the effect on commercial properties is likely to be more significant than presented in some of the North American studies.

³¹ Landis, J., Cervero, R., et al. (1995)

³² Bowes, D., Ihlanfeldt, K. (2001)

³³ Ibid. p.5

³⁴ Debrezion, G., Pels, E., Rietveld, P. (2007)

³⁵ Knight, R.L., Trygg, L. L. (1977) p.232

5.1.2 Swedish reports

There are few Swedish reports concerning the relation between property values and public transport. Two reports however, have been of interest.

One made in Lunds tekniska högskola where the author Jonsson L (2007) has performed a study regarding property values in relation to Väst kustbanan.

The report was performed using hedonic evaluation methods with regression models to generate property values using different attributes. The analysis was carried out on the railroad constructed in 2000 running between Landskrona and Helsingborg concerning 8 railway stations. The conclusion presented in the report shows no indication of the railways effect on property values in any of the stations apart from one which shows tendencies of slight increase of property values within a radius of 2 km from the station.³⁶

The second report "Värdering av stadskvaliteter" by Ståhle A (2011) was conducted in Stockholm. Using regression with both "urban construction analysis" and "statistical analysis" the report shows how different attributes affect property values. It is pointed out that access to urban activities such as restaurants, stores, and cultural activities have a large positive effect on apartment buildings' property values. If access to urban activities increase by 100% the market value per square meter in apartment buildings rise by 1760kr. Access to urban activities depend on the density of homes, workplaces and the number of outward-facing entrances from buildings. Concerning access to railway stations, the study shows that residential properties farther than 500 meters away from a railway station show a value decrease of 1370kr/sqm.³⁷

³⁶ Jonsson, L (2007)

³⁷ Ståhle, A (2011)

5.1.3 Results

Results from some of the previous reports are presented in the tables below.³⁸

| Author | Distance from Railway Station | Value impact on properties |
|--|-------------------------------|---------------------------------------|
| | | |
| Bowes and Ihlanfeldt (2001) Atlanta, GA | 0–1/4 mile | –18.7% (residential properties) |
| | 1/4–1/2 mile | 2.4% (residential properties) |
| | 1/2–1 mile | 0.9% (residential properties) |
| | 1–2 miles | 3.5% (residential properties) |
| | 2–3 miles | 3.5% (residential properties) |
| | | |
| Cervero (1996) San Francisco bay area, CA | 0-1/4 mile | +10–15% in rent for rental units |
| | | |
| Weinberger (2001) Santa Clara, CA | 0–1/4 mile | +13 cent per square foot |
| | 1/4–1/2 mile | +7 cent per square foot |
| | 1/2 - 3/4 mile | +1 cent per square foot |
| | 3/4 - 1 mile | No effects |
| | | |
| Ståhle (2011) Stockholm | 0-500 meters | +1 370kr/sqm (residential properties) |

Table 2: Sample of railway station effects on property value based on distance category measures

³⁸ Debrezion, G., Pels, E., Rietveld, P. (2007)

| Author | Results |
|---------------------------|--|
| Weinstein & Clower (1999) | Effect of station on property value within 1/4 mile of the station (percentage change) |
| Retail | 36.75% |
| Office | 13.85% |
| Residential | 5.97% |
| Industrial | 7.68% |
| | |
| Dueker and Bianco (1999) | Property value declines \$1,593 for every 200 ft out of the station |
| | |
| Fejarang (1994) | Properties within 1/4 mile of the station enjoy a premium of \$31 per square foot |

Table 3: Sample of railway station effects on property values

5.2 Planning public transport networks

5.2.1 The network planning method

The network planning approach to public transport planning is to consider the interconnectivity of the entire network rather than a set of origin-destination pairs single-handedly. It is about meeting many objectives and taking on the challenges that public transportation is faced with today.³⁹

5.2.2 Radial and dispersed planning strategies

The radial and the dispersed network can be seen as two different strategies for network planning. The Stockholm region is one example of the radial planning strategy, which often risks generating only limited connections between the radial clusters. A dispersed network, on the other hand, with its high proportion of non-radial routes support multi-directional travel. Dispersed networks have the appearance of a grid rather than spokes of a wheel, although it has to overcome uneven geographies and distribution of land-uses.⁴⁰

Thompson (1977) estimated that radially organized public transport systems in dispersed suburbanized cities only can cater to around 10% of the regional trips. The basic idea of network planning, according to P Mees et al. (2010), is to transform a traditional public transport system, consisting mainly, or entirely, of low-quality routes, into an integrated network of high-quality services.

5.2.3 Design principles

Jago Dodson et al. (2011) have designed following key planning principles for public transport networks:

Simple and direct network strategies. Direct routes are generally quicker and shorter than circuitous ones, which helps the efficiency for both travelers and operators. Line networks should seek to consolidate and concentrate similar lines.

Plan a hierarchy into a network. The hierarchy can be described as high-speed high-capacity cross-town links; inter-suburban connecting links; and local feeder lines. The former category, when planned into low density contexts is unlikely to attract sufficient patronage to justify investment unless they are connected to a highly integrated web of connecting links.

Plan for speed, consistency and reliability. Public transport planning should aim at offering travel times that are similar to, or faster than door-to-door travel time that can be achieved by car. Lines should operate at consistent timetables and stopping patterns that apply across wider periods.

Coordinate convenient transfers. The need to transfers for most trips means that journey speeds also depend on quick transfers. Coordination can be relaxed where the service frequency of the interconnecting lines are at least every 8 minutes.

³⁹ Mees, P., et al. (2010)

⁴⁰ Ibid.

Provide clear, ubiquitous and consistent information and marking. Clear and accessible information is vital for all public transport.

5.3 Accessibility

5.3.1 Introduction

Accessibility is a term that may be used in a broad meaning. It has a social aspect as well as a fundamental economic aspect. Essential for public transport is of course its user-friendliness and accessibility for all people, which separates public transport from private transport (i. e. car driving). Essential is also the connecting of sought after places, regions and markets to support sustainability and growth. Commonly sought after destinations, according to Pitot et al. (2006) are health, education, retail, banking and employment.

5.3.2 Accessibility – a political goal in Sweden

The Swedish government has lately manifested increased interest for accessibility by forming a new authority named “Tillväxtanalys”, to lighten the field of regional accessibility. The issue of accessibility and region enlargement are also analyzed by other planning authorities in large. RAp is a commonly used diverse tool that can be used to analyze changes on a local and regional scale. PiPos is another tool that is being used to analyze accessibility on a larger scale and provides indexed maps of the accessibility in Sweden.⁴¹

In 2009 the Swedish government formed new policies for the transport sector. The primary function stated for the transport sector is to provide accessibility for travels and transports. The ultimate goal is stated to be effectiveness and long-term sustainability. Or in Swedish: “att säkerställa en samhällsekonomiskt effektiv och långsiktigt hållbar transportförsörjning för medborgare och näringsliv i hela landet”.

5.3.3 International examples of assessing accessibility

Methods to measure accessibility vary from country to country. Australian planning authorities has developed the LUPTAI tool to evaluate land use and public transport accessibility⁴², where accessibility is seen as mobility in combination with the effect of how land use is arranged. English regional authorities of London have accepted the PTAL (Public transport accessibility level) methodology, which is based on scheduling of the land area that can be reached from a point in the Public Transport network, within a certain time frame. The PTAL suggests that commuters accept 60 minutes duration for work trips, and also that longer walking distances are accepted at the origin for such trips than at the destination. PTAL consists of an 8 degree scale to rank accessibility.⁴³ The time frame of 40 minutes is a breaking point for what people in Sweden seem look upon as a reasonable commuting time.⁴⁴

⁴¹ Tillvaxtanalys.se

⁴² Pitot, M. (2006)

⁴³ Gent, C. (2005)

⁴⁴ Sandow, E., Westin, K. (2006)

5.3.4 Railway accessibility for the Stockholm region

The accessibility level to regional focal points in northern Stockholm is lower than in many other similarly populated areas in Sweden. Although relatively close to the city of Stockholm the number of railway services is low. Railway stations in cities entirely separate from Stockholm tend to enjoy numerous train services that operate faster and reach a variety of destinations. Train stations even closer to Stockholm, however, are more often covered by multiple line routes, creating interchange points and thus stimulate higher patronage. The service level to the regional focal points is summarized, in the table below by seven indicators:

- Railway standard – categorized as either being light rail or heavy rail.
- Type of train stopping
- Number of rail line routes – offered by SL, SJ, A-train or UL
- Transfer – indicates if interchange between rail lines is possible or not.
- Number of passenger [per day 2009] (the station's ranking within SL's network)
- Number of departures per hour – the mid-day average
- Other municipalities within 40 minutes commuting distance by rail (total number of municipalities with correspondence by rail)

| Regional focal point | Täby C | Kista | Sollentuna C | Järfälla C | Arlanda |
|---------------------------------------|------------|-------------|----------------|----------------|---------------------|
| Railway standard | Light rail | Heavy rail | Heavy rail | Heavy rail | Heavy rail |
| Type of trains stopping | tramway | Underground | Commuter train | Commuter train | Distance traffic |
| Number of line routes | 2 | 1 | 1 | 1 | 6 |
| Transfer | Yes | Buses only | Buses only | Buses only | Airport |
| Number of railway passengers | 2 400 (77) | 16 600 (17) | 6 900 (35) | 10 100 (27) | No number available |
| Number of departures per hour | 16 | 12 | 8 | 8 | About 14 |
| Municipalities in rail correspondence | 4 | 2 | 5 (8) | 5 (7) | 5 (30) |

Table 4: Accessibility to train stations in the regional focal points

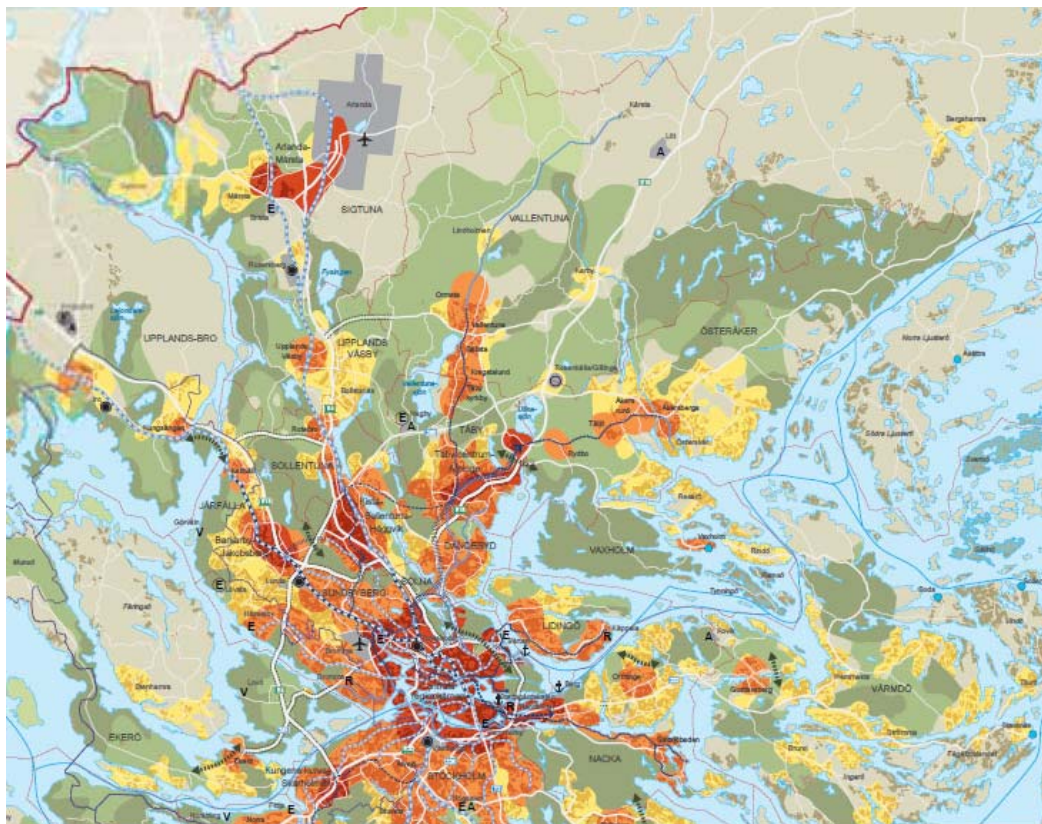
6. Planning the future Stockholm region

6.1 Stockholm's head planning institute

The most recent regional development plan for Stockholm was finalized last year, by the region's head planning institute, RTK. It is a predicting document, in which the future shape and struggle to create a better region is described. The purpose of the plan is to work for an attractive and sustainable region, which is meant to be achieved through seven different strategies, regarding a diverse range of aspects in the future city, such as ecology and urban form. There are also certain commitments attached with these strategies.⁴⁵ RTK are working with the plan along these commitments and strategies together with the municipalities of the region, giving it status of a credible lead document.

6.2 Rufs 2010

In Rufs 2010 Stockholm's developed urban areas are divided into categories; urban core, urban area with growing potential and other urban area. Urban core is defined as a node in the transport system (s. 156). It is also said that the main core of Stockholm city is of great importance for the regions collective strength, and that the peripheral regional cores should have the aim of being attractive localization spots, supporting the central core.



Picture 4: Map of the urban areas in the Stockholm region

⁴⁵ RUFs (2010)

6.2.1 Urban core

The approach to an urban core that is held by the regional planning organ is to work for dense environment and innovative investments that strengthens the urban cores. The accessibility is important as well as the area around the stations, which should be densely used. The built environment should be rich and all-round, including service, commerce, businesses and residences. These urban cores areas are presented under chapter 3.1 of this report.

6.2.2 Urban area with growing potential

This category is referring to areas and corridors with high accessibility. The area should be within 1200 meters from a railway station or a major bus terminal. The approach held by the regional planning organ is to stimulate the location of new residences and businesses within these areas and to have strong public transport connectivity to the urban cores. Urban qualities and a variety of functions are meant to be found there. Examples of this type of area are the center of Upplands Väsby, and many areas surrounding Täby Centrum.

6.2.3 Other urban area

Other urban area refers to areas with low accessibility to public transport, including areas around distance stations and areas with seasonal residences. The approach to this types of area is to hold back new developments to constitute a minor part of the total increase in built area. New development within these areas should be given the denseness and expenditure that is required to support public transport coverage. Big parts of Österåker and Upplands Väsby municipality are defined as other urban area.

6.2.4 Public transport investment proposed by RTK

In Rufs 2010 it is suggested that public transport investments in the Stockholm region may serve three different goals. The first goal is to expand the region and increase capacity in the radially oriented rail net towards the Stockholm city central core. The second goal is to improve the traffic system in the central core. The third goal is to develop the diagonal connections between the urban cores, which they hope reaching by promoting several new traversing railway investments, such as an expansion of light rail. Their list of new railway proposals are including regional plans by SL, national plans by Trafikverket, but also some further visions. This shows that there is, from an urban planning perspective, a great interest in public transport, supporting the regional development plan.

6.3 The political situation for public transport in Stockholm

The public transport rail network in Stockholm is primarily maintained by the regional authorities (SL), that own and operate the underground, tramway and local train systems. The national authority (Trafikverket) is in charge of the national railways that make up the heavy rail network through Stockholm.

RTK's status of involvement in regional planning has recently been withdrawn from the field of public transportation. However being the leading planning institute for the region, makes RTK inseparable from public transport issues. The influence of RUFS 2010, however, may be undermined by lack of coordination in between RTK and the infrastructure planning organs at national and regional level.

6.3.1 Regional politics – The SL organization

SL is short for Greater Stockholm's local traffic. It is a regional politically run organization, managed by the County of Stockholm. Every year SL makes investigations to see what the customer satisfaction is like. In the autumn 2010 customer satisfaction was 74 %, which is 10 points higher than five years before. During the last few years SL has taken over the responsibility from RTK as the Stockholm region's leading institute for traffic planning. SL disposes of the entire underground, tramway and local train infrastructure systems, and a huge fleet of vehicles. The yearly expenses are in one part operating costs and in one part investments. Many of the recent investments have been related to light rail expansions. In 2010 the production cost of the trips were 10,6 (see table) billion kronor of which SL received 48 % of the funding through tax money.⁴⁶

| | Year | Metro | Tramways | Buses | Commuter trains | Other | Total |
|------------------------------|------|-------|----------|-------|-----------------|-------|---------------|
| Operation Costs (Msek) | 2007 | 2 713 | 555 | 3 741 | 1 395 | 318 | 8 722 |
| | 2008 | 2 669 | 586 | 4 051 | 1 492 | 376 | 9 174 |
| | 2009 | 2 760 | 668 | 4 234 | 1 567 | 418 | 9 647 |
| | 2010 | 2 866 | 807 | 4 636 | 1 615 | 631 | 10 555 |
| Investments (Msek) | 2007 | 812 | 447 | 387 | 1 104 | 360 | 3 110 |
| | 2008 | 1 046 | 520 | 431 | 1 083 | 453 | 3 533 |
| | 2009 | 890 | 1 101 | 521 | 492 | 858 | 3 862 |
| | 2010 | 790 | 1 900 | 886 | 671 | 416 | 4 663 |

Table 5: SL's Investments and Operating costs 2007 - 2010

⁴⁶ SL (2011)

As the table indicates an increasing proportion of SL's yearly expenses are spent on investments rather than operating. 2007 the investments were just 36 % of the operating cost, four years later the investments were 44 % in relation to operating costs. The whole increase is explained by the growing interest in tramways, whereas heavy rail networks such as the metro and commuter train networks enjoy less investment money now than four years ago.

6.3.2 National politics - The Trafikverket organization

Trafikverket is an authority under governmental influence. Their job description is received by Näringsdepartementet. Trafikverket is in charge of maintenance and expansion of the country's entire transport system, of which railroads constitute a significant part. Any organization or company with a license can operate traffic on the national railroads, but it is only just recently that the former governmental monopoly was discarded. In order to operate traffic on the national rail network the company needs to apply to Trafikverket for capacity. Trafikverket conducts a yearly process to establish a timetable, where capacity is distributed between the applicants on the basis of a social economic analysis.

6.3.3 Institutional changes under way

The Stockholm region has been suffering from slow urban rail expansions for nearly half a century. This is an experienced problem⁴⁷ that may be explained by too many changes in the governing structure. On a regional level there has been a long tradition of one-term social democratic governance followed by one-term right-wing governance, causing a problematic situation for long sighted infrastructure planning. National politics attempts to rearrange the institutional form is omnipresent, causing a structural ambiguity. Last year (2010) Trafikverket was created as four authorities where joint together. The complex organization structure and slow expansion of public transport infrastructure, has led to yet another reorganization on a regional level. All regions shall soon have its own local transport authority, with the responsibility of the level of public transport offered in the region.

7. The regional traffic plan 2020 - Our Zero scenario

This chapter demonstrates what the transport system to support northern Stockholm will look like in year 2020, if no further intensions are being realized to improve the situation.

7.1 Introduction

SL's traffic plan consists mainly of and light rail expansions close to the inner city. Although it consists of a few heavy rail investments, which are described in 7.3, those investments are simply brought from the national plan. The plan's general assumption is that the running costs of the public transport will increase heavily while the PT market share will be slightly reduced. It is also stated in the plan that travelling across county borders will increase at a

⁴⁷ Hallmén, A.(2011)

greater pace than other travelling, but the plan offers no explanation of how to meet this shifting travel pattern.

7.2 Contents of the traffic plan

SL's traffic plan 2020 was published in Stockholm 2010. There, the expansion of public transport are divided in three levels, governmental plans (agreed upon in 2010), agreements within the Stockholm county (agreement 2007) and SL's own plans (2007 -2010). All investments are tied either one of four different subgroups:

- commuter trains
- light rail / tramways
- underground
- bus traffic

7.2.1 Light rail extensions

Roslagsbanan is a local train system that is unique for the northeastern sector of Stockholm. The system contains three branches which all connect to Stockholm East train station in the city center. The traffic service includes a peak hour service of skip-stop traffic and average speed varies between 35 and 50 km/h. The trains run on thin gauge tracks. Until 2020 significant improvements are under way, reducing the amount of delays and the generalized travel times.

The expansion of the Tvärbanan light rail branch to Kista is being prioritized in SL's traffic plan 2020. Tvärbanan is traversing the medium dense semi-central zone of Stockholm. The expansion will likely be connected to Ostkustbanan and its commuter rail line somewhere within Sollentuna municipality. This will create a transfer point on the local scale.

7.2.2 Maintained service level on the underground

The blue Metro line of Stockholm has two branches in north and northwestern Stockholm, of which one ends in Hjulsta just before Järfälla and the Stockholm northwestern focal point. The other branch passes Kista and ends in Akalla. The median departure frequency is every ten minutes.

7.2.3 Small extensions of the trunk bus net

The concept of trunk buses has been introduced to the northern Stockholm region in the recent years. Line 178 connects Barkarby and Järfälla with Kista and Helenelund before going south towards Mörby Centrum. Line 179 operates between Sollentuna C and Vällingby in the western part of Stockholm. It is an extremely curvy line that runs via Kista and Rinkeby as well as Tensta. A new trunk bus will run between Sollentuna and Täby C by 2020.

7.2.4 The commuter train (pendeltåg)

The commuter train line J36 is running through the northern suburbs of Stockholm on the branch towards Märsta . The commuter train has two dedicated tracks and is separated from distance traffic. The average frequency of the commuter train today is one train per direction every 15 minutes. An extension of this branch to Uppsala is scheduled within a few years, which is likely to result in two commuter lines, one of which will continue following the existing line route.

The commuter train line J 35 is running through Stockholm's northwestern suburbs towards Bålsta, see 3.2.7. As of today, the commuter line is sharing tracks with a mix of distance traffic, which is constraining the departure frequencies and operation speeds on the track. An extra pair of tracks is being planned, to have the situation improved, see 7.3.2 . It seems probable that the frequency of the commuter trains, then, will be increased.

7.3 Initiated heavy rail projects

7.3.1 The citybanan project

Citybanan is an enormous project within the compounds of Stockholm inner city. The project consists of 6 kilometer new tunnel and 3 train stations that will be served by commuter train. Trafikverket is the proprietor of this multi-billion project that will benefit the entire region by roughly doubling the north-to-south going capacity through Stockholm and thus leading to an increased stream of railway traffic through the city.

7.3.2 The Mälarbanan Tomtebodav-Kallhäll project

The occupancy rate along Mälarbanan between Stockholm city and the northwestern sector is very high, with timetabling and sensitivity issues as a consequence. The ongoing project to deal with these issues is to double the number of tracks between Tomtebodav, in Stockholm city, and Kallhäll, in the northwest. The project is called Mälarbanan Tomtebodav-Kallhäll and has been going on for nearly a decade.

Initially the project contained a few alternatives regarding different corridors to develop the new double track. Two main alternatives were established: to expand within the existing corridor or develop a new route via Kista and southwards parallel to Ostkustbanan. The Kista alternative was not set out to take advantage of the existing four track system of Ostkustbanan and therefore, slightly longer, it turned out to be the more costly alternative. The entire Mälarbanan expansion are now being planned to follow the existing corridor. There will be a new platform to allow regional trains to stop in either Jakobsberg or Barkarby.

The completion of the project is divided in two phases, the first one being between Barkarby and Kallhäll. This piece of the railway is 7,5 kilometer of railway was is scheduled to open in 2017. Trafikverket states in a public report that the four tracks of the future Mälarbanan will be operated commuter trains on the middle tracks and distance trains on the outside, similarly to Ostkustbanan. According to forecasts the occupancy rate on the outside tracks will be only 34 % of capacity, leaving plenty of space for additional train services to be granted slots.

7.4 Summary of the zero scenario

The zero scenario offers small improvements for each regional focal point, but not in terms of higher railway standard. The focal point in Jakobsberg/Barkarby will be affected by the Mälarbanan expansion, which is likely to make way for future distance traffic stop. Arlanda and Sollentuna will be affected by the commuter train extension to Uppsala, which will provide connectivity increase within the corridor. Täby will merely experience bus traffic increase, and some efficiency increase in light rail. Kista will gain a new light rail connection within in the semi-urban zone of Stockholm.

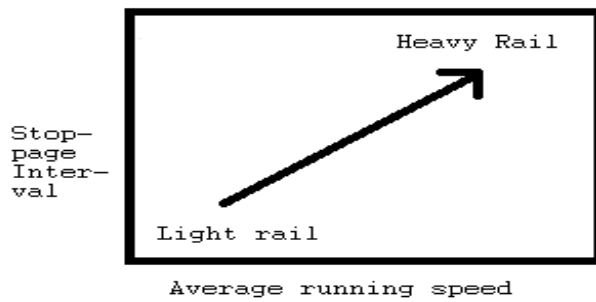
8. The Norrortsbanan heavy rail solution

8.1 Initial understandings

Norrortsbanan is a heavy rail link, designed according to the principles of network planning, with the purpose of shaping Stockholm to a polycentric region and resist the decline of public transport ridership.

8.1.1 What is a heavy rail link?

A railway consists of rail links that run between two nodes (stations). The urban railway can be categorized as either being heavy rail or light rail, depending curvature, right-of-way, speed limits et cetera. Less curvature, higher speed allowance and longer stoppage interval makes heavy rail more suitable for long distances, whereas light rail typically is more present in the street environment. Another general characteristic of heavy rail is that the trains are often very long. Heavy rail lines are typically metro or commuter lines.



Picture 5: The general idea of the difference between light rail and heavy rail

8.1.2 Lines and routes

Public transport is often arranged in networks that consist of several lines. Each line has a specific route between two end stations. Numerous lines may share the same pathway to increase the operation frequency throughout a line segment. As the railway split into branches, the lines diverge, thus offering a great variety of travel opportunities on a restricted amount of infrastructure.

8.1.3 Capacity and frequency

A rail link can have one single track in rural conditions. In urban areas the rail link commonly is a double track link, but there are also four-track links. Capacity is an important attribute of the rail link.

Homogenous urban rail traffic, with similar trains and stopping pattern, has high capacity. A metro line network, for example, normally has no problem operating on tight schedules, such as 90 second headway. Above ground traffic normally require longer headways, partly because of stronger safety regulations. Public transport operating with tight departure frequency (less than 10 minutes⁴⁸) may introduce a rolling scheme or “forget-the-timetable” scheme. So is the case with the Stockholm metro for example, which normally operates every tenth minute.

Limitations in the capacity are caused by heterogeneous traffic operating on the same rail link and aging signal systems that are still in use. In Sweden, Trafikverket has the responsibility of providing train slots and declaring when capacity limit is approaching. The situation for northern Stockholm is presented in Appendix E.

⁴⁸ Dodson, J., et al. (2011)

8.1.4 Destinations

An important factor in the evaluation of accessibility in a transport network is the range of destinations that can be reached from each station. Ideally you should have less than 40 minutes journey to reach your destination⁴⁹. Unless, on a rare occasion, when you are travelling further, the journey should at least take you through to the next phase of your trip, for example a connecting flight.

8.1.5 Our definition of the railway center

At a location where many people is travelling and the railway is split in different directions the railway center is serving an important role for journeys that are carried out. The definition of a railway center is that it should have the possibility to function as an interchange. It should, in other words, be a junction for two rail lines or more.

In the northern Stockholm region there are no junctions between rail lines, due to non-existing diagonal rail lines, and the regional traffic merely flies by the regional subcenters. However on the southern side, Flemingsberg is an example of a railway center, with its mix of regional trains stopping and a commuter train line.

8.2 Railway centers

8.2.1 Design principles for the railway center

The attraction of any travel terminal is partly a question of the quality of traffic that serves the terminal. How attraction is experienced by the public transport user may depend on the frequency of trains, the number of lines serving the railway center or the time required to change from one train to another. The information of departure how to reach a connecting train, departure times is the sort of factors that indicate whether the terminal works well as an interchange point or not.

Almost without exception the public transport collects and distributes pedestrians. It can be argued that pedestrian access is in fact an extension of the public transport network, and therefore must be planned in analogy to the rail network; speed, connectivity and legibility. Steps should be undertaken to avoid disturbance of all kinds, which may otherwise affect the terminal's attractiveness negatively.

Connecting bus routes, parking spaces and even bike parking opportunities are also factors that may add to the attractiveness of the railway center.

Railway centers in the northern Stockholm region will be introduced to the five following subcenters:

⁴⁹ Sandow, E., Westin, K. (2006)

8.2.2 Sollentuna Stockholm Nord Railway Center

- Gain access to a diversity of destinations.
- Direct connection with Arlanda in less than 15 minutes and Uppsala in 30 minutes.
- Doubled number of municipalities within commuting distance.
- A central interchange point for the entire northern Stockholm sector with train departures in every direction: north, east, south and west.
- New land areas will gain top class accessibility.
- Public transport for expanding the commuting area and lay the ground for a vivid and growing regional suburban center.

8.2.3 Täby Central Railway center

- The railway center of Täby develops functionality as an interchange point between heavy rail commuting lines Roslagsbanan light rail system.
- Direct trains to Arlanda in just over 20 minutes, Uppsala in 40 minutes and Kista in less than ten minutes.
- The possibility of a commuter train line to Stockholm city via Helenelund.
- A new direct train line between Täby and 9 municipalities, Västerås, Stockholm Northwest and Sollentuna C. In SL Solna Sollentuna, Uppsala, Järfälla, Håbo, Enköping, Västerås.
- Increased accessibility to the regional subcenter in Täby.
- The first central train station for the entire northeastern sector.

8.2.4 Kista Railway Center

- New travel center in Kista Centrum that will boost new development.
- New train lines offer direct service to Västerås, Uppsala and Enköping within 50 minutes; Sollentuna, Täby and Järfälla within 10 minutes.
- Regional train / Metro interchange.
- Departures every 30 minutes with only 17 minutes to Arlanda.
- Better commuting opportunities for residential and bigger commuting uptake for companies.
- Increased attraction for establishing cultural activities, restaurants and shopping.

8.2.5 Järfälla Stockholm Northwest Central (Stockholm NWC)

- A new central train station in Järfälla will strengthen the strategic position within the northwestern sector.
- Direct train to Arlanda in 20 minutes, Uppsala in 50 minutes.
- Frequent departures to Kista and Täby as well as Sollentuna.
- Existing commuter train maintained.

8.2.6 Arlanda Central

- Frequent departures to Kista and Täby as well as Järfälla.
- Direct train service to Enköping and Västerås
- The possibility to reduce carbon emissions caused by ground travel so that the airport stay within emission limitations.
- Bettering employees commuting conditions.
- Strengthening the airports attraction power.

8.3 Description of Norrortsbanan

The rail link Norrortsbanan is a heavy rail link between the subcenter of Täby in the Stockholm's northeastern sector to the subcenter of Järfälla in the northwest, passing through the Sollentuna area, where the link connects to Ostkustbanan. It consists of approximately 15 kilometer railway and a new railway centers in every regional subcenter of the area. Norrortsbanan is adapting the region's connectivity by rail to support a polycentric structure and stable growth of the region.

Norrortsbanan's political goal is the integration and stimulation of the highly populated areas of northern Stockholm, serving expanding travel markets and a growing region. It supports the local travel market within Stockholm County as well some important relationships traversing the County border.

From a planner's perspective the link can be understood as to strengthen the regional focal points and enhance region enlargement. The adapted railway network gains flexibility by providing a new path in the region, which might be useful in the struggle to increase the punctuality of the network.

8.3.1 Railway center's located in the regional focal points

The regional focal points accessibility level in the Norrortsbanan scenario is summarized in the table below. The diversity of trains stopping at each suburban center and the potential for transfer within each railway center are indicators of stronger functionalities as regional focal points. The transfer opportunities are emphasized by the physical connectivity indicator, which notates the number of directions that is possible to travel from each subcenter. The amount of directions is lowest at Arlanda, which obviously offers numerous airborne traveling directions, with only 2 directions possible (the same as before Norrortsbanan), to Täby, which offers travelling in 6 directions in the scenario of Norrortsbanan.

The attracting power of the railway centers, demonstrated in the table, is increased as the number of line routes and numbers of departures every hour are increased. People will be traveling through the terminals at greater frequency and with a range of different destinations in mind, thus contributing to create the atmosphere of a railway center. The ultimate indicator is the number of places that are in direct connection with the railway station. Places in this case is being represented by municipalities

Ultimately the number of municipalities in correspondence with each railway center within commuting distance is the indicator of how well Norrortsbanan increases connectivity and enhances region enlargement.

| Regional focal point | Täby C | Kista | Sollentuna C | Järfälla C | Arlanda |
|---|-----------------------------------|--------------------------|------------------------------------|------------------------------------|--------------------|
| Railway standard | Heavy rail | Heavy rail | Heavy rail | Heavy rail | Heavy rail |
| Major trains stopping | Tramway, Commuter, Regional | Underground, Regional | Commuter, Regional, Distance | Commuter, Regional, Distance | Regional, Distance |
| Transfer | Yes | Yes | Yes | Yes | Airport |
| Physical connectivity | 6 (3) | 5 (2) | 4 (2) | 3 (2) | 2 (2) |
| Number of line routes | 5 (2) | 3 (1) | 5 (1) | 4 (1) | 8 (6) |
| Number of departures per hour | 26 (16) | 20 (12) | 20 (8) | 18 (8) | About 22 (14) |
| Municipalities in correspondence by rail | 16 (4) | 17 (2) | 23 (8) | 19 (7) | 38 (30) |
| Within commuting distance | 12 (4) | 10 (2) | 10 (5) | 12 (5) | 10 (5) |

Table 6: Accessibility to train stations in the regional focal points (numbers within parentheses represent conditions before Norrortsbanan).

8.3.2 Key relations

Traveling opportunities between internally between the regional focal points consists of 10 relations that all will benefit from travel times within half an hour. There are five additional travel relations in the correlation with Uppsala and another five in the relation to Västerås, creating a whole span of 20 relations. Of these 20, 11 relations can be defined as key relations. Relations have been rejected as key relation if it is shorter than 5 kilometers, and if it is a relation between two mainly residential areas. Mainly it is the relations with Kista, Arlanda and Uppsala that constitute key relations.

8.4 The phases of Norrortsbanan

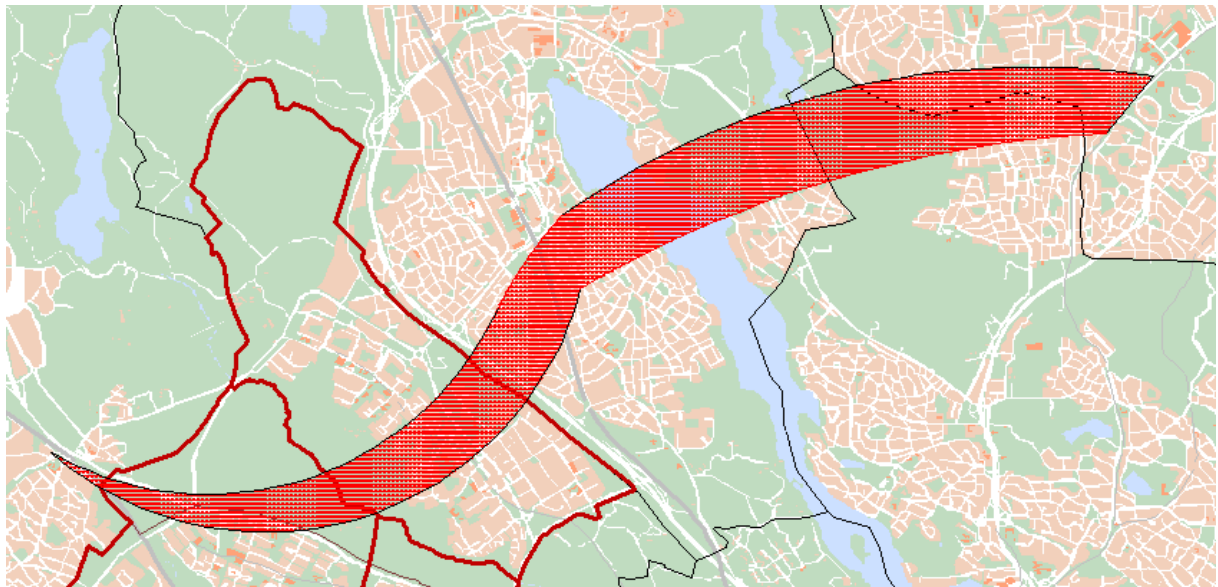
The Norrortsbanan rail project can be divided in three phases. Ostkustbanan is the region's backbone in terms of rail infrastructure connecting Stockholm with Uppsala and passing Sweden's capital airport, Arlanda. The first phase, Mälarpassagen, will bring this backbone to attach with the Mälardalen area. The second phase, Nordostpassagen, will attach the Northeastern sector, which is excluded from heavy rail traffic today, to Ostkustbanan. The project also consists of a third phase – a new central train station north of Stockholm. This station situated along Ostkustbanan will create the opportunity for trains to stop, where they previously have flown by.

8.4.1 The Mälarpassagen phase

The main objectives of Mälarpassagen are to tie the Mälardalen region together with the Stockholm-Uppsala region. The key relations that benefit the most are between the mainly residential areas of Västerås, Järfälla and Sollentuna and the important destination targets of Kista, Arlanda and Uppsala. Mälarpassagen is a traversing link that also relieves pressure and generates flexibility in the otherwise radial railway infrastructure net.

Physical description

The link starts from Barkarby station, situated on Mälarbanan, in direction southeast and will run close to the highway E18 for roughly 2 kilometers until it dives in a tunnel and start bending towards the north in a rail tunnel across Järvafältet and to the commercial part of the Kista district. This is where Kista central train station will be built, below ground, connecting to the above ground metro. The rail link continues in direction northeast under the highway E4 and the residential area of Tureberg and interconnects with Ostkustbanan south of Sollentuna C.



Picture 6: The Norrortsbanan corridor

8.4.2 The Nordostpassagen phase

The main objectives of Nordostpassagen are to create competitive public transport, increase accessibility and strengthen the regional subcenter in the northeastern sector of Stockholm. Since the northeastern sector is mainly a residential area the key relations are those to Kista, Arlanda and Uppsala with high level of working places. Nordostpassagen will also simplify commuting to the city of Stockholm.

Physical description

The rail link starts with the travel terminal between Täby C and Roslags Näsby and run parallelly to Roslagsbanan for one kilometer, before it dives for two kilometers under the villa area of Enebyberg. It stretches through the forests south of Råsjön and then continues under Bergendal and Edsviken, where it finally reaches Ostkustbanan, which it will be interconnected with. The railway, with about 8,5 kilometers route length, is the shortest

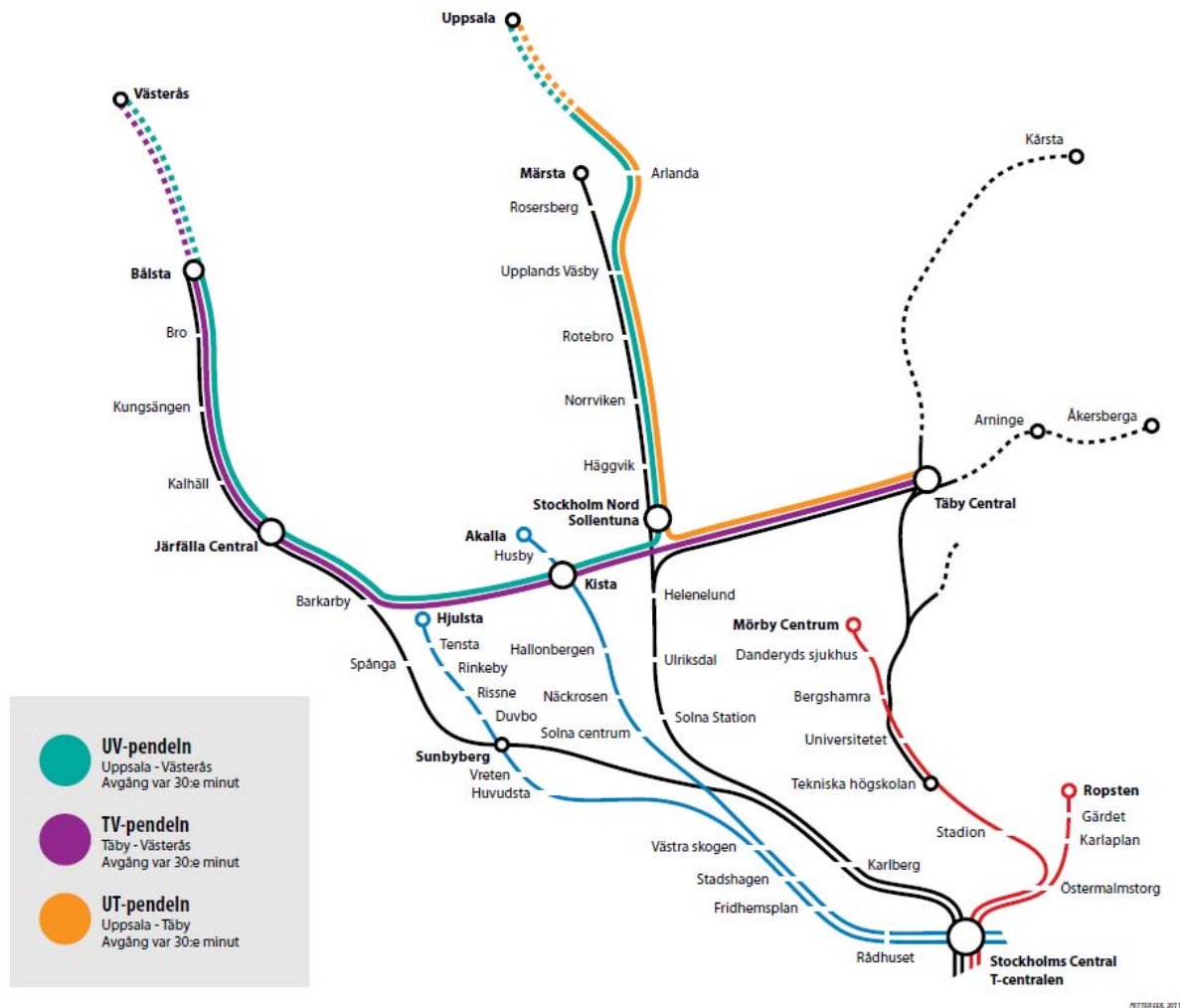
possible way to connect the suggested travel terminal in Täby to Ostkustbanan. Travel times will be decreased greatly to some very important destinations of the region, including Arlanda airport and Stockholm city.

8.4.3 Stockholm Nord Sollentuna railway center

The placement of Stockholm Nord train station has been a matter for discussion for nearly half a century. Based on passenger numbers and surrounding density Sollentuna C is the natural localization of the railway center. Other localizations in Häggvik and Helenelund does offer some advantages, but in relation to the Norrortsbanan rail link Sollentuna C is the most suitable placement for the new terminal. The key is for Sollentuna to gain attraction and rise of passenger numbers so that most trains on Ostkustbanan will make a stop here.

8.5 Traffic

The network created in this scenario may be used in many alternative ways. The suggestion is to create three high speed commuting lines, connecting Täby – Västerås, Uppsala-Täby and Uppsala-Västerås (see map). Departure frequency for each line will be twice per hour, starting around 6 pm. and service will close for six hours. The first commuting line TV between Täby and Västerås will take 48 minutes, stopping in Kista, Jakobsberg, Bålsta, Enköping. The line will attract travelers going diagonally through Stockholm northern sectors.



Picture 7: The rail traffic network map of Northern Stockholm in the main scenario

The second commuting line, UT, between Uppsala and Täby, with a duration of 34 minutes, passing Arlanda is primarily picking up passengers in correspondence with Täby. It also includes stops in Upplands Väsby and Sollentuna C.

The third commuting line between Uppsala and Västerås, is serving nine stations in total. This line route involves 36 trip relations internally, the trip duration of 78 minutes does not compete well on the relation Uppsala – Västerås, but in 27 of the relations covered by the line, travel time will be less than 40 minutes.

| The TV line | | The UT line | | The UV line | |
|-------------|-------|--------------|-------|--------------|-------|
| Täby | 06:15 | Uppsala | 06:16 | Uppsala | 06:23 |
| Kista | 06:20 | Arlanda | 06:34 | Arlanda | 06:41 |
| Jakobsberg | 06:25 | U Väsby | 06:42 | U Väsby | 06:49 |
| Bålsta | 06:37 | Sollentuna C | 06:47 | Sollentuna C | 06:54 |
| Enköping | 06:49 | Täby C | 06:53 | Kista | 06:57 |
| Västerås | 07:04 | | | Jakobsberg | 07:02 |
| | | | | Bålsta | 07:14 |
| | | | | Enköping | 07:26 |
| | | | | Västerås | 07:41 |

Table 7: Timetable for high speed commuter lines; with service level of half hour departure frequency on the high speed commuter lines 14 trains are required.

8.6 Why heavy rail?

Public transport improvements for northern Stockholm's suburban centers have not been successful, resulting in low public transport use. The public transport share is lower than average in Sollentuna and Järfälla and a lot lower in Täby.⁵⁰ These suburban centers are car dependent societies that need dramatically improved public transport to enhance sustainability and grow into the role as regional focal points.

An investigation of a high speed bus network to the northeastern region of Stockholm was published last year under the name SATSA. The investigation was financed by the six municipalities of the northeastern sector. The conclusion was that direct buses can be competitive to car transport in several travel relations and the study also shows that public transport alternatives are highly sought after for the entire northeastern sector.⁵¹

An early study regarding the expansion of the Stockholm's light rail system has been undertaken recently by SL. The study shows how Roslagsbanan can be expanded to Arlanda airport through roughly 15 kilometers new railway. If realized this link will cost between 2,4 and 2,9 billion kronor and cut travel times between the airport and primarily Vallentuna and Täby in the northeastern sector.⁵²

The heavy rail expansion between northeastern and northwestern Stockholm has the advantage of offering shorter travel times than bus or light rail between the acclaimed focal points. Connection to national railways also will bring a new scope of opportunities for the subcenters. The attraction power will be strong as railway centers enjoy a whole new range of accessible destinations. The fixation that naturally comes with railway routes can also be an advantage if coordinated with land use policy-making.⁵³

⁵⁰ sl.se

⁵¹ SATSA (2010)

⁵² SL (2010)

⁵³ Pitot, M. (2006)

8.7 Summary of the main scenario

The main scenario is planned with a multideestination service approach that will increase the interaction of the regional focal points. Täby and Kista will be included in the heavy rail system, and for the first time experience public transport on a regional level. Also the physical connectivity is greatly improved. The diagonal structure of Norrortsbanan brings an extra dimension of traveling to the lined up regional focal points of northern Stockholm.

All subcenters of the study will be served by new line routes by the proposed traffic system. Täby Centrum will be transformed from a local train station along the SL line to a modern railway center, with three new railway lines that accesses all the region's prime commodities. The number of destinations within commuting distance is increased from four municipalities, in the zero scenario, to twelve municipalities in the main scenario. Likewise Kista will enjoy the uplift from having merely a blue metro line stop today, to having an attracting interconnected railway center with new regional train services in three directions.

The focal points in Sollentuna and Jakobsberg will gain service level, commuting possibilities and strengthen the role as attractive and independent suburban cities. Arlanda will benefit from increased connectivity to residential areas where customers and employees today have been dependent on car use.

9. Investment cost

The Norrortsbanan project can without problem be divided into three distinct phases with respective costs:

Nordostpassagen: 4,1 billion kronor

Mälarpassagen: 2,4 billion kronor

Stockholm Nord Railway Center: 600 Mkr

In order to calculate the cost for the proposed rail link we have used recent data from 2010. Because of the urban conditions for the rail link the dominant part of the railway must be placed in tunnel. Therefore the budget depends heavily on tunnel costs, and what type of tunnel that will be necessary on the different locations.

The estimated total cost of the Norrortsbanan heavy rail link is around 4,7 billion kronor. The greatest part of the cost is tunnel expenditures. Concrete tunnels are about three times more costly than rock tunnels. Fortunately the ground conditions of Stockholm allow for the greatest part of the tunnel to be built in rock. The risks of constructing tunnel in urban areas are also the biggest explaining factor to the uncertainties about the cost. Precautions necessary for constructing in urban areas result in higher cost, but the exactness of this expense is almost impossible to know.

| Pathway double track* | Cost/km rural | Cost/km urban | Length | Cost [Msek] |
|-------------------------------------|---------------|---------------|--------|-------------|
| | [Msek] | [Msek] | [km] | [Msek] |
| Rock tunnel | 170 | 255 | 10 | 2423 |
| Concrete tunnel | 510 | 765 | 2 | 1454 |
| Bridge | 320 | 480 | 0 | 144 |
| Above ground – cutting | 20 | 30 | 2 | 51 |
| Above ground – embankment | 15 | 23 | 2 | 50 |
| Track superstructure total** | 24 | 36 | 16 | 557 |
| Railway center [Msek] | | | | 1680 |
| Projecting cost [Msek] | | | | 706 |
| Total cost [Msek] | | | | 7064 |

**including evacuation tunnel*

*** including tracks in ballast, electricity supply and signaling ERTMS level 1*

Table 8: The estimated costs for the construction of Norrortsbanan

Apart from the rail link the scenario includes investments in three new railway centers. The cost for each railway center depends on the extensiveness of the detailed regulatory plan that is conducted by the municipalities. The prognosis of the cost is based on the estimated construction cost of a rebuilt railway center in Norrköping, hundred and sixty kilometers south of Stockholm.

The cost for projecting the railway scenario has been estimated to 10 % of the final cost. This rule of thumb is often used in early calculations regarding project costs. These calculations indicate that the total cost of Norrortsbanan is approximately 7,1 billion kronor.

9.1 Operational cost

The “network effect” assumes that the marginal gain in the elasticity of demand due to improved interconnection and integration exceeds the marginal cost of service improvement.⁵⁴

10. Financing

10.1 Contemporary railway financing

Railway is in most cases financed majorly by the government through tax revenues. Lately however, new forms of financing have been tested throughout the world. The financing model that has been discussed in Sweden recently consists in part of governmental resources, and in part through co-financing, co-financing being that companies and municipalities help financing infrastructure to better benefit their needs and expectations. This paper aims to show how increased property value due to the emergence of a railway station can help to finance a railway project.

⁵⁴ Dodson, J., et al. (2011)

10.2 Financing methods

10.2.1 The Swedish financing method

The Swedish government lets Trafikverket and the regions work out a plan for future investments. When the plan is final it is sent back to the government for approval. If the plan is approved, money is assigned and the framework for future investments is set. This is called "the national plan".⁵⁵ The current national plan has a time frame reaching from 2010 to 2021. The financing of this plan consists to a majority of governmental resources (417 billion kronor), mainly from tax revenues, but it also contains funding from road taxes, the EU , municipal contributions and co-financing. The total budget for the current national plan is estimated to 482 billion kronor.

Storstockholms Lokaltrafik (SL) is the organization responsible for financing, operating and maintaining public transport in the county of Stockholm. SL, controlled by the Stockholm County Council, is financed to 50% by the county and the remaining 50% is financed through ticket revenues.

10.2.1.1 Co-financing

Co-financing is when an external part help financing, in this case a railway. An example of this is Vegastaden, located in Haninge, south of Stockholm, where a new railway station and freeway exit have been co-financed. The co-financing in this particular case was a result of discussions regarding financing, which were held between Trafikverket, the municipality and the landowners. An alternative detailed regulatory plan, developed by the municipality was vital when the discussions took place. By giving the landowners opportunity to develop land to a greater extent, they would benefit more from the property value increase in the area, hence giving them incentive to contribute further financially.⁵⁶

10.2.2 PPP (Public-Private partnership)

PPP is built on the theory that each partner should do what it is most suited for. Public actors should decide to which type of infrastructure should be developed and to which purpose it should serve, whereas the private actor is in charge of designing, constructing, financing, operating and the maintenance of the facility for an extended period of time. A solution like this may allow for proper division of labor between the principal and the agent.

The parties are from different points of interest able to minimize total project costs, especially long-term, thus reducing government costs. The private sector's expertise and ingenuity is concentrated on creating and implementing solutions that deliver the lowest total cost in terms of design, construction, operation and maintenance.

A great advantage to the government is that a great amount of financial risk involved often is laid on the private party in a PPP.

⁵⁵ Regeringskansliet (2011)

⁵⁶ Cars G, Malmsten B, Witzell J (2011) Pp. 56-67

The private party is paid by the commuters in the form of ticket revenues and by the government paying "rent" for using the railway for its desired purposes.

PPP is however no longer used in Sweden as the Swedish government came to the conclusion that PPP in fact causes the state to lose money in the long run.

10.2.3 Privately financed railway

Not many railway transit systems in the world are financed solely using private funding. A reason for this is that costs and risks are high. In order for such a project to be fruitful, massive funding is required and the accessibility advantage from such a railway must be extensive. An investment like such would not be profitable just from ticket revenues. No Swedish railway is currently financed using solely private funding.

The Las Vegas monorail is the only solely privately financed railway in the USA. Initially, it was a joint venture between the MGM Grand and Bally's hotel and casino, closing the gap in which the public previously had to go by foot between the casinos. In 1997, the state of Nevada passed expansion plans and a legislation that permits the private company to own, operate and charge ticket fares as a public Monorail system. The monorail has expanded and today it has seven stops along Las Vegas boulevard (the strip), linking together at least seven hotels and casinos with the possibility of further expansion. Revenues are created in the form of ticket fares and sponsorships. Branding rights for all the stations and trains are available and the sponsorship prices reach millions of dollars.⁵⁷ In January 2010, however, the LV monorail filed for bankruptcy protection due to a 30 percent decline in traffic to Las Vegas. The monorail is still operational and a restructure of the company's debt is in progress.⁵⁸

10.3 How value capture can be utilized in financing Norrortbanan

In contemporary Swedish infrastructural financing; citizens living in a region where new infrastructure is implemented get all the benefits, while taxpayers in the whole country pay the costs. This causes people to indirectly pay for roads and railways which they are not likely to ever travel in their entire lives. It would seem appropriate if the values generated from Norrortsbanan in the capitalization of property values would finance the project. To maximize the social economical benefits it is important that tickets are not too expensive so that as many people as possible find good incentives to commute with Norrortsbanan.⁵⁹ To keep ticket fares to a minimum it is important to constructively involve some type of collective financing. Presented below, are some suggestions regarding financing that could help eliminating the unfairness generated by the current financing system.

⁵⁷ Las Vegas Monorail(2011)

⁵⁸ Ibid.

⁵⁹ Andersson, R., Söderberg, B. (2008) p. 57

10.3.1 Taxation of commercial properties

An effective way to help financing a railway such as Norrortsbanan would be to add a yearly property tax on commercial properties within a close radius from a railway center. Commercial properties are more likely to experience substantial economical benefits from being accessible through railway and the property owners would still be likely to benefit from the increase in costumers and commerce due to the railway accessibility.

10.3.2 Expanded co-financing

The idea about co-financing is that everyone affected positively by a project should be part of the financing process and be able to impact the project to an extent. However, co-financing from existing properties surrounding a new station can prove to be difficult. Lack of incentive would be significant unless current landowners would strongly benefit from the construction and the property value increase. A possible solution would be for the municipality to give out extended building rights to existing properties. This can be made possible by dividing properties in 3D, giving landowners rights to, for example, add floors to existing buildings.

Companies located in the outskirts of town are often dependant on good accessibility. Being easily accessible to both customers and employees is of great importance, this creating incentive for companies to be a part of infrastructure development. Companies located in clusters to benefit each other, such as the IT-cluster in Kista, could potentially get further advantages by investing in infrastructure and contributing to the planning process together. This way all concerned parties could more efficiently benefit from the increased accessibility provided by railway services.

10.3.3 Sponsorship and branding

Sponsorships and advertisements on both railway centers and railway cars can be an efficient source of collecting resources as has been proven by the Las Vegas monorail. By selling branding rights to trains and railway centers (both interior and exterior); companies can be allowed to decorate them for advertising purposes. Furthermore, name rights to railway centers can be sold to gain even more resources.

10.3.4 Regional property taxes

To exclude financing in the form of tax revenues from people that might never commute with Norrortsbanan, it is central that property taxes are collected and spent regionally rather than at a national level. If the municipalities could each collect and decide the amount of property taxes or fees a landowner should pay, such projects as Norrortsbanan could be financed more efficiently and the tax-level could be adjusted to fit the current conditions. This way the government would be relieved from financing infrastructure projects while allowing the regions more freedom to dispose of their assets. This would also increase the socio-economical benefits as it gives the regions incentive to only would finance necessary projects of great importance. Today many projects are financed seemingly to attract political votes, leaving the socio-economical benefits unprioritized.⁶⁰

⁶⁰ Ibid.

10.3.5 A regional property sales fee

A regional property sales fee could correspond to the estimated property value increase due to Norrortbanan. This would mean that residential properties would still benefit from the increased accessibility while contributing to public transport in the region. The downside is that it may take a long time before the resources reach the initial investors.

10.4 CBA

To estimate a market value for the subcenters intersected by Norrortbanan, data has been collected from Lantmäteriet - the Swedish mapping, cadastral and land registration authority.⁶¹

Following data has been collected

- Names of the affected properties.
- The assessed value (collective and single).
- The type of property (retail, apartment buildings, family houses, offices, warehouses and production estates).
- Building category.

The calculation of the estimated market value has been performed by adjusting the assessed value which in theory corresponds to 75% of the market value on properties.

The property value has been measured within a radius of 400 - 600m from where the proposed railway centers should be located.

⁶¹ lantmateriet.se (2011)

Järfälla (400m):

| | |
|------------------|------------------------------|
| 1 461 255 000 kr | Total assessed value |
| 1 948 340 000 kr | Total estimated market value |

| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | |
|------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------------------|--------------------------|-------|
| 15 000 | 41 300 | 621 | 5 730 | 760 | 76 | |
| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | Total |
| 76 % | 21 % | 0 % | 3 % | 0 % | 0 % | 100 % |

Table 9: Property values in Järfälla within a radius of 400m from the suggested location of a new railway center.

Stockholm-Kista (600m)

| | |
|-------------------|------------------------------|
| 14 860 816 000 kr | Total assessed value |
| 19 813 926 000 kr | Total estimated market value |

| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | |
|------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------------------|--------------------------|-------|
| 427 529 | 853 612 | 15 165 | 32 206 | 40 952 | 185 | |
| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | Total |
| 31 % | 62 % | 1 % | 2 % | 3 % | 0 % | 100 % |

Table 10: Property values in Kista within a radius of 600m from the suggested location of a new railway center.

Sollentuna (400m)

| | |
|------------------|------------------------------|
| 5 036 936 000 kr | Total assessed value |
| 6 715 913 000 kr | Total estimated market value |

| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | |
|------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------------------|--------------------------|-------|
| 265 570 | 219 212 | 1 148 | 1 353 | 2 923 | 5 641 | |
| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | Total |
| 54 % | 44 % | 0 % | 0 % | 1 % | 1 % | 100 % |

Table 11: Property values in Sollentuna within a radius of 400m from the suggested location of a new railway center.

Täby (600m)

| | |
|-------------------|------------------------------|
| 25 674 193 000 kr | Total assessed value |
| 34 232 249 000 kr | Total estimated market value |

| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | |
|------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------------------|--------------------------|-------|
| 2 563 060 | 289 675 | 0 | 0 | 0 | 641 | |
| Apartments (m ²) | Retail prop. (m ²) | Office prop. (m ²) | Warehouse (m ²) | Production estate (m ²) | Houses (m ²) | Total |
| 90 % | 10 % | 0 % | 0 % | 0 % | 0 % | 100% |

Table 12: Property values in Täby within a radius of 600m from the suggested location of a new railway center.

The total estimated market value on all properties in the above mentioned subcenters within a radius of 400 – 600 meters from a railway center is estimated to around 63 billion kronor.

This reveals that the increase of property values does not have to be vast in order to exceed the estimated cost for the project. One must also bear in mind that properties' value increase is likely to occur in a radius bigger than 400 – 600 m. Previous reports have shown significant property value increase at a radius as great as 3 miles (4800m).

By prolonging the radius to 1200 -1800m the following market values are given:

| Subcenter | Radius | Core | Sector 2 | Sector 3 | Market value* |
|------------|--------|-------------------|-------------------|-------------------|--------------------|
| Järfälla | 1200 m | 1 948 340 000 kr | 4 164 576 749 kr | 4 383 765 000 kr | 10 496 681 747 kr |
| Kista | 1200 m | 19 813 926 000 kr | 42 352 266 767 kr | | 62 166 192 740 kr |
| Sollentuna | 1200 m | 6 715 913 000 kr | 14 355 264 011 kr | 15 110 804 222 kr | 36 181 981 221 kr |
| Täby | 1800 m | 34 232 249 000 kr | 73 171 431 757 kr | 77 022 559 744 kr | 184 426 240 277 kr |

Total
Demanded increase

*Market values is an estimation of the values for core + sector 2 + sector 3 put together.

293 271 096 000 kr
2,421 %

Table 13: Estimated property values in the regional focal points, within a radius of 1200- 1800m from the suggested location of a new railway center.

By dividing the focal points into three sectors, values are calculated for each sector. The core is the only sector calculated with numbers directly picked from Lantmäteriet. Sector 2 and sector 3 are calculated using the following assumptions:

- Sector 2
Density corresponds to 75% of the core building density.
Market value is estimated to 95% of the core value.
- Sector 3
Density corresponds to 50% of the core building density.
Market value is estimated to 90% of the core value.

This example shows that if value increase would occur within a distance of 1200 – 1800 meters from a railway center, the property value increase would have to be higher than 2,421% to exceed the project cost. As mentioned before, it is highly possible that value increase on properties might occur in locations further away than the suggested ones.

As shown previously in this report, value increase above 2,421% is more than likely to occur in the areas.

10.4 Sensitivity analysis

Access value is determined once every six years for each property type; this may cause some values to be misleading since prices have varied over the last years. Some properties are assessed at 0 kr; properties like this may include parking lots, parks, industrial properties and houses that are tax free. These properties are likely to carry a significantly higher value. If parking lots and parks were to be developed with buildings, the assessed value would increase radically. Overall the market value estimation above is expected to be at the lower edge.

10.5 SWOT-analysis

A SWOT analysis is made to point out **Strengths**, **Weaknesses**, **Opportunities** and **Threats** that can be associated with a project. The following analysis is applied to Norrortsbanan:

Strengths –

- The decrease of commuter time and cost for people in the affected areas.
- Norrortsbanan offers a sustainable way of commuting, economically, socially and environmentally.
- Norrortsbanan creates a new corridor of travel, where public transport is lacking today.
- The interconnectivity of three other cities in the vicinity of Stockholm.
- Connecting the northern parts of Stockholm to Arlanda and Västerås airport.
- Railway is the most reliable way of commuting over time.
- Stockholm's population increase demands further development of infrastructure.

Weaknesses –

- Possible noise and unsightliness generated by railway.
- Takes a long time to plan and construct.
- Uncertainties regarding railway construction costs.

Opportunities –

- Allows for a more polycentric development of the region.
- Can relieve some congestion on other railway lines as well as roads.
- Can bring more retail and urban activities to the affected subcenters, making them more attractive.
- Subcenters offer more space where further construction of buildings is possible, offering an alternative to Stockholm CBD when people want to relocate. May take some heat of the property market in the inner-city of Stockholm.
- Increased interest in alternative financing methods.

Threats –

- Possible increase of prices on commodities used to construct railway.
- Other ways of commuting taking priority when financing new infrastructure.
- Difficulties to coordinate involved parties.

11. Discussion

As the reader has observed it is shown that the value increase for the regional focal points does not have to be vast in order to exceed the estimated project cost. Apart from the increase of property values due to the increased accessibility in the subcenters, other socio-economical benefits may occur outside the areas directly affected by the project. People preferring to travel by Norrortsbanan due to heavily decreased commuting time may relieve some of the congestion on public roads in the whole region, this benefitting more than just commuters that will use the railway to commute. Furthermore, Norrortbanan offers a more sustainable way of travel, leaving less impact on the environment than motorized vehicles do.

Although some of the subcenters affected by Norrortsbanan may have railway connectivity today, the emergence of the new rail line would greatly increase the number of connections and dramatically decrease commuting time to many destinations, so that Norrortbanan's railway centers may be looked upon as introducing new railway stations to the region.

At least one study has shown value decrease on residential properties close (1/4 mile) to a railway station. This might be caused by the unsightliness and noises generated from a railway station. To eliminate this, Norrortsbanan has railway centers placed in connection commercial properties and centers. Commercial properties are not disturbed by noise and unsightliness of railway centers; hence they only experience positive effects from the enhanced accessibility. Modern railway stations are not to be strictly judged as “ugly”. Railway stations are to be seen as an asset in the development of urban activities, such as restaurants, shopping and cultural activities. As has been pointed out previously in this report, increases of urban activities also carry a huge potential value increase to adjacent residential areas.

Parking lots and bicycle parking in connection to the railway center will also allow for easier access to the railway center itself, thus likely resulting in value increase on properties at distances further away.

If Norrortsbanan reaches its full potential in developing subcenters, making Stockholm more polycentric, it will strengthen the region and offer an alternative to Stockholm CBD as the city grows. Companies, job opportunities and homes will be able to relocate to the area, benefitting each other and reduce the commuting time and possibly taking some heat of the property market in central Stockholm.

12. Conclusion

It is very likely that the increased property values generated from Norrortsbanan would exceed the project cost. To finance the project with increased property values, it is important that both private and public parties find incentives to contribute. By letting the regions and companies be a part of the planning process and by letting the municipalities spend and collect fees that are strictly to be used for infrastructure, Norrortsbanan can reach its maximum potential and level of efficiency.

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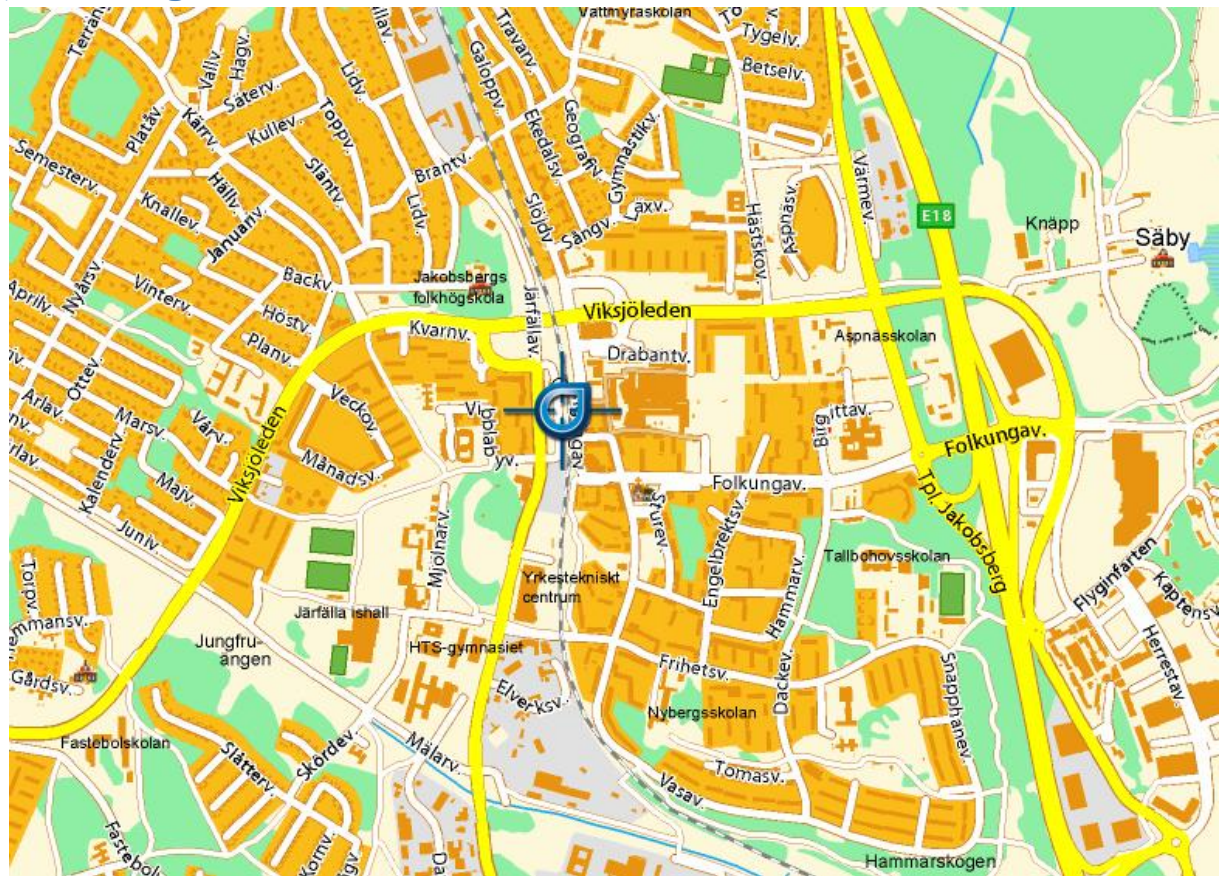
Data supplied by Lantmäteriet through Metria. The data concerns properties in four regional focal points.

Appendix A - Municipal facts

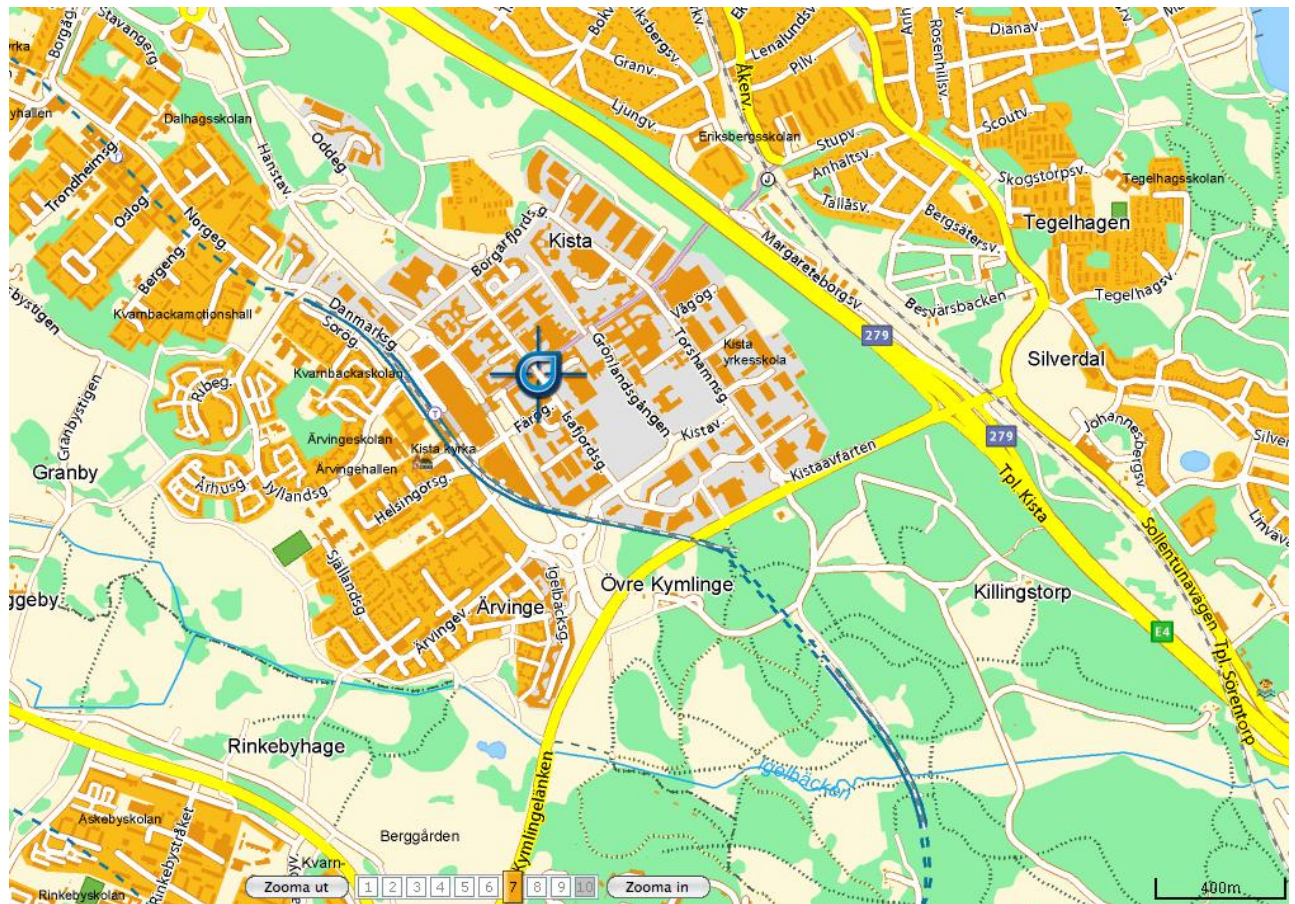
| Municipality | Inhabitants | Population increase /year | Commuting in (daily) | Commuting out (daily) | Political majority | Distance to Stockholm CBD (radius) | Apartments | Houses |
|----------------|-------------|---------------------------|----------------------|-----------------------|---------------------|------------------------------------|------------|--------|
| Danderyd | 30 851 | 299 | | | Rightwing | 7 km | 5 907 | 6 842 |
| Håbo | 19 452 | 230 | 1 507 | 6 272 | Socialist/Liberal | 38 km | 2 012 | 5 209 |
| Järfälla | 65 295 | 929 | 12 658 | 21 202 | Rightwing - liberal | 14 km | 17 713 | 10 867 |
| Norrtälje | 55 528 | 399 | 2146 | 7999 | Rightwing - liberal | 60 km | 10 715 | 13 991 |
| Sigtuna | 38 372 | 579 | 15 852 | 8 460 | Socialist/Center | 35 km | 10 899 | 5 828 |
| Sollentuna | 63 347 | 1256 | 15 865 | 22 577 | Rightwing - liberal | 10 km | 13 215 | 12 409 |
| Stockholm | 829 417 | 18 785 | 261 523 | 109 173 | Rightwing - liberal | - | 395 382 | 44 184 |
| Täby | 63 014 | 751 | 13 586 | 21 499 | Rightwing - liberal | 11 km | 12 431 | 13 866 |
| Upplands-Bro | 23 202 | 520 | | | Rightwing - liberal | 29 km | 5 308 | 4 232 |
| Upplands Väsby | 38 248 | 393 | | | Rightwing - liberal | 21 km | 11 088 | 6 404 |
| Uppsala | 194 751 | 4 082 | 17 385 | 21 836 | Rightwing - liberal | 62 km | 62 026 | 27 268 |
| Vaxholm | 10 747 | 254 | | | Rightwing | 18 km | 1 829 | 2 427 |
| Västerås | 137 207 | 1264 | 12 065 | 9 925 | Socialist | 90 km | 42 949 | 23 403 |
| Vallentuna | 29 361 | 415 | 3339 | 10 568 | Rightwing | 22 km | 3 856 | 11 372 |
| Österåker | 38 720 | 453 | | | Rightwing - liberal | 30 km | 4 518 | 10 683 |

Appendix B – Facts for each sector

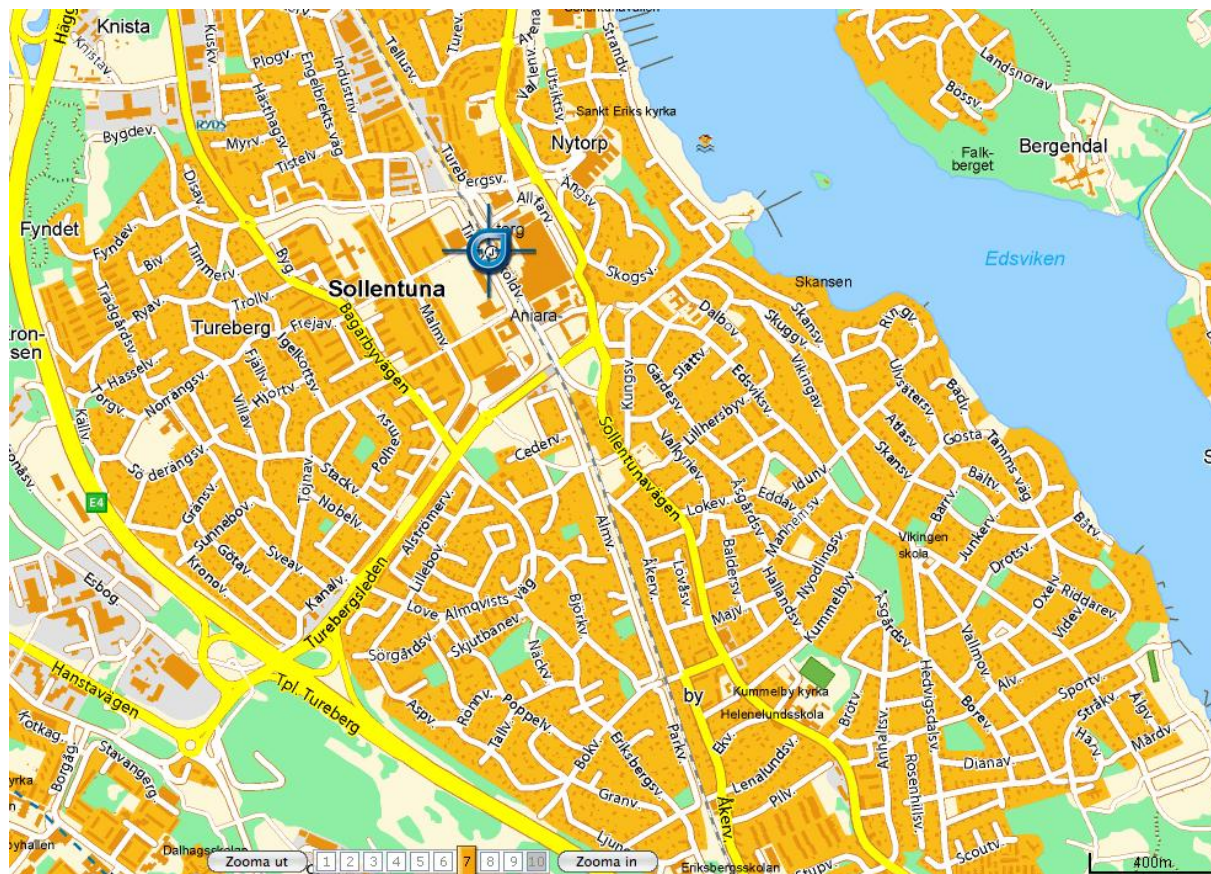
| Sector | Inhabitants | Population increase /year | Commuting in | Commuting out | Workingplaces |
|--------------|-------------|---------------------------|--------------|---------------|---------------|
| Northern | 139 967 | 2 228 | 31 717 | 31 037 | 64 700 |
| Northeastern | 228 221 | 2 571 | 19 071 | 40 066 | 79 200 |
| Nortwest | 88 497 | 1 449 | 17 966 | 25 434 | 30 000 |



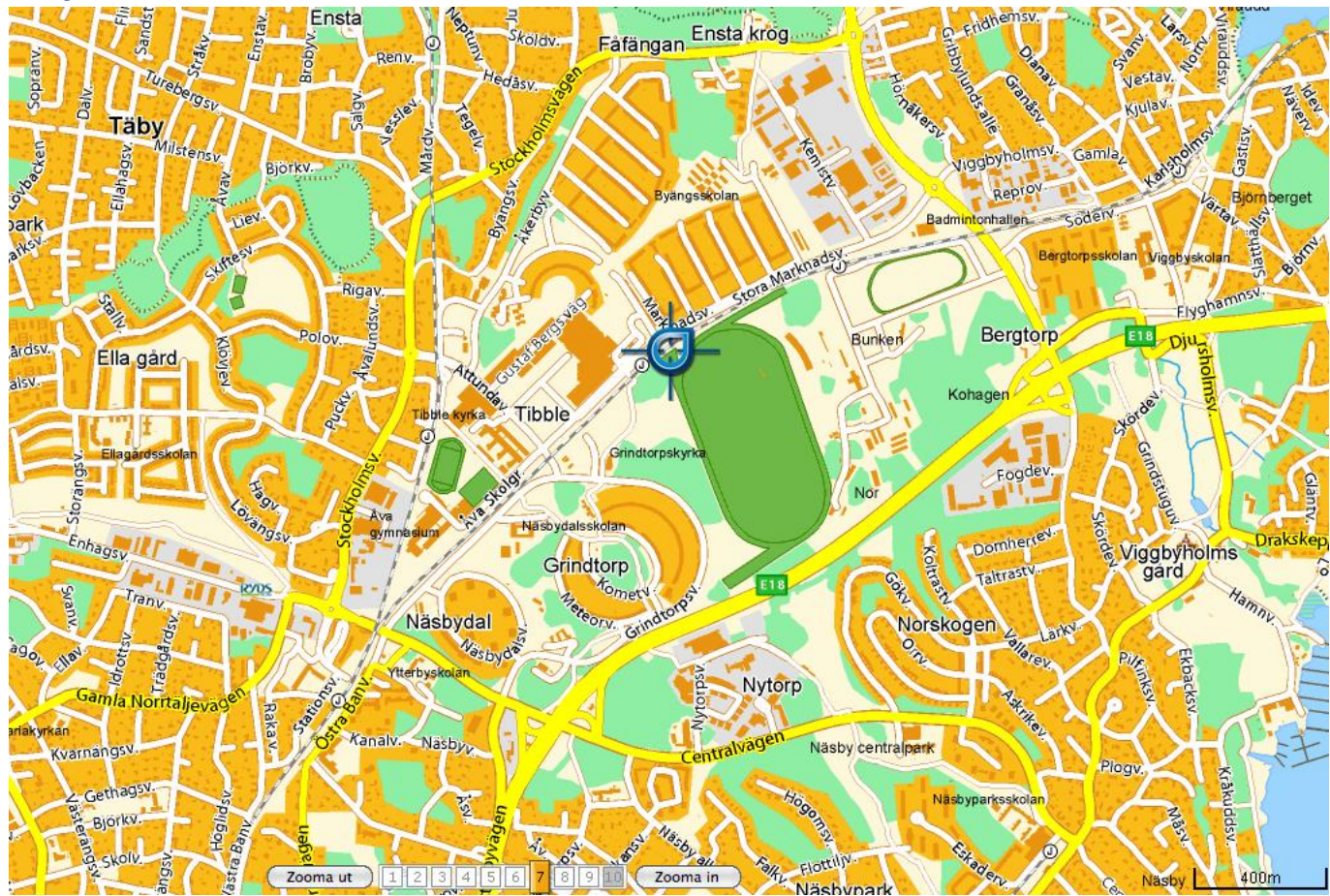
Kista



Sollentuna



Täby



Täby

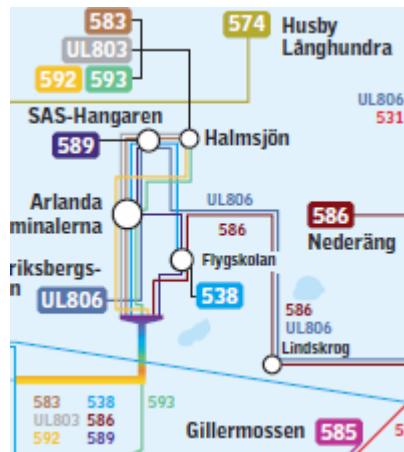


The map illustrates the Stockholm commuter rail network, highlighting the following features:

- Zones:** The network is divided into three main zones: Zone A (blue), Zone B (green), and Zone C (yellow).
- Stations:** Major stations are marked with white circles and labels, including Akalla, Kista, Tensta centrum, Spånga station, and Vällingby.
- Lines:** Lines are color-coded and labeled with numbers and names. Key lines include T11 (blue), T10 (green), T12 (yellow), and T13 (orange).
- Connections:** The map shows connections to other transport modes, such as the metro (T) and regional trains (R).
- Geography:** The map includes geographical features like the Baltic Sea (Baltiska havet) and the city of Stockholm.

[illegible]

Arlanda



Appendix E – Capacity constraints on OKB and MB

| Kapacitetsbegränsningar och kapacitetsutnyttjande 2010 | | | | | | |
|---|------------------------------|-----|-------------------------------------|-------------|-------------|-----------------------|
| Gradering av begränsningar | | | | | | |
| | stora begränsningar | | | | | |
| | medelstora begränsningar | | | | | |
| | små eller inga begränsningar | | | | | |
| Banor och linjedelar med indikerad grad av kapacitetsbegränsningar 2010 | Dsp/esp | Fjb | Antal tåg per dygn och dim riktning | | | Kapacitetsutnyttjande |
| | | | Persontåg | Godståg | Summa tåg | dygn (%) |
| | | | hösten 2010 | hösten 2010 | hösten 2010 | hösten 2010 |
| 5. Ostkustbanan | | | | | | |
| Stockholm C - Karlberg (i) | Dubbelspår | Fjb | 160 | 0 | 160 | 81-100 |
| Stockholm C - Karlberg (y) | Dubbelspår | Fjb | 166 | 10 | 176 | 81-100 |
| Karlberg - Skavstaby (i) | Dubbelspår | Fjb | 80 | 4 | 84 | <=60 |
| Karlberg - Skavstaby (y) | Dubbelspår | Fjb | 142 | 3 | 145 | 61-80 |
| Skavstaby - Märsta | Dubbelspår | Fjb | 107 | 8 | 115 | <=60 |
| Märsta - Myrbacken | Dubbelspår | Fjb | 27 | 8 | 35 | <=60 |
| Skavstaby - Arlanda Nedre | Dubbelspår | Fjb | 152 | 0 | 152 | 61-80 |
| Arlanda Nedre - Arlanda norra | Dubbelspår | Fjb | 80 | 0 | 80 | <=60 |
| Arlanda Nedre - Myrbacken | Dubbelspår | Fjb | 72 | 0 | 72 | <=60 |
| Myrbacken - Uppsala | Dubbelspår | Fjb | 99 | 8 | 107 | <=60 |
| 16. Mälardalen | | | | | | |
| Karlberg - Jakobsberg | Dubbelspår | Fjb | 104 | 4 | 108 | <=60 |
| Jakobsberg - Kungsängen | Dubbelspår | Fjb | 96 | 4 | 100 | <=60 |
| Kungsängen - Bålsta | Dubbelspår | Fjb | 65 | 3 | 68 | <=60 |
| Bålsta - Västerås N | Dubbelspår | Fjb | 24 | 3 | 27 | <=60 |
| Västerås N - Västerås C | Dubbelspår | Fjb | 39 | 8 | 47 | <=60 |

Green indicates that capacity is not an issue, yellow indicates small constraints and red indicates severe capacity constraints.