CHALMERS
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Consequences for the Rescue Service and its Accessibility

A study of the impacts in autumn 2018 caused by infrastructure projects in Gothenburg

Master's Thesis in the Master's Programme Infrastructure and Environmental Engineering

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Examensarbete BOMX02-17-10/ Institutionen för bygg- och miljöteknik,
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Cover:
Fire engines on a road with reduced capacity due to a road work. Photo: (SVT, 2014).
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ABSTRACT

The city of Gothenburg is facing a period of major change due to a number of extensive city development and infrastructure projects planned for the coming years. What consequences will the rescue service face regarding their accessibility, as a result of the planned infrastructure projects, during the construction period of autumn 2018? The impacts on the traffic system were examined on a system and local level. The system level study included the primary dispatch net for Gårda fire station and the local level study included the studied project areas. The investigation, on a system level, indicated that there will be no direct consequences for the rescue service regarding the primary dispatch net. However, the traffic flows and the number of queues, indirect consequences, along the routes will generally be higher in 2018 than originally. The investigation, on a local level, indicated that there will be direct consequences, in terms of suspension and narrowing of roads and dismantling of bridges, in most of the project areas. Generally there will be alternative routes which are more or less adequate to the original routes concerning several factors. The investigation also indicated that there will be indirect consequences in terms of changed traffic flows in the project areas. However, no general conclusion about the traffic flows could be draw since the traffic varies in different project areas and some traffic data was missing. Nevertheless, the number of queues along the alternative routes in the project areas will increase and this is likely to affect the accessibility negatively. The traffic system will become more vulnerable and therefore unforeseen incidents could cause large problems to a greater extent in 2018. Moreover, a greater use of the remaining dispatch net, to avoid roads with high traffic loads along the primary and secondary dispatch nets, could be expected. Furthermore, the traffic situation will become more complex and a more careful planning, within the rescue service, of strategies to use in different situations may be necessary. In order to facilitate for the rescue service, it could be a good idea to inform the citizens how to act in case of an approaching rescue vehicle demanding free path. Finally, further studies within this area should be conducted due to the lack of available information regarding the subject and the importance of maintaining a good accessibility for the rescue service.

Key words: consequences, rescue service, accessibility, construction period, infrastructure projects, Gothenburg, Räddningstjänsten Storgöteborg, Gårda fire station

Konsekvenser för Räddningstjänsten och dess framkomlighet

En studie av påverkan från infrastrukturprojekt i Göteborg under hösten 2018

Examensarbete inom mastersprogrammet Infrastructure and Environmental Engineering

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SAMMANFATTNING

Göteborgs stad står inför en period med stora förändringar gällande stadens struktur, som en effekt av ett flertal omfattande stadsutvecklings- och infrastrukturprojekt de kommande åren. Vilka konsekvenser angående framkomlighet kommer räddningstjänsten ställas inför, som ett resultat av de planerade infrastrukturprojekten, under byggtiden hösten 2018? Påverkan på trafiksystemet undersöktes på en systemnivå och en lokal nivå. Studien på systemnivå omfattade det primära utryckningsnätet för Gårda brandstation och studien på en lokal nivå inkluderade de studera projektens områden med omgivning. Undersökningen på systemnivå visade på att det inte kommer bli några direkta konsekvenser för räddningstjänsten gällande deras primära utryckningsnätet. Dock kommer det fortfarande bli indirekta konsekvenser i form av ökad trafik samt ökat antal köer längs det primära nätet. Undersökningen på en lokal nivå pekade på att det kommer bli direkta konsekvenser, i form av avstängda och avsmalnade gator samt nedmontering av broar, i de flesta av projektområdena. Generellt kommer det finnas alternativa vägar som är mer eller mindre likvärdiga de ursprungliga vägarna gällande flertalet faktorer. Undersökningen pekade också på att det kommer bli indirekta konsekvenser i form av ändrade trafikflöden genom projektområdena. Inga generella slutsatser kunde dras angående trafikflödena eftersom trafiken skiljer sig mycket mellan projektområdena samt att viss trafikdata fattades. Trots detta kunde man utläsa att antalet köer, längs de alternativa vägarna i projektområdena, kommer öka och detta kommer troligen påverka framkomligheten negativt. Trafiksystemet kommer bli mer sårbart, därav kommer oförutsedda incidenter lättare kunna skapa stora problem. Dessutom förväntas ett större användande av övrigt utryckningsnät för att undvika problem längs det primära och sekundära utryckningsnätet under 2018. En mer komplex trafiksituation förväntas och noggrannare planering av strategier, inom räddningstjänsten, kan bli nödvändigt. Vidare studier inom detta område bör genomföras då upprätthållandet av god framkomlighet för räddningstjänsten är av yttersta vikt.

Nyckelord: konsekvenser, Räddningstjänsten, framkomlighet, byggtid, infrastrukturprojekt, Göteborg, Räddningstjänsten Storgöteborg, Gårda brandstation

Contents

Preface

This report is a Master's thesis which covers 30 credits, one semester of study at normal pace. It is the concluding part of the Infrastructure and Environmental Engineering Master's programme at Chalmers University of Technology.

The idea of this report emerged during a conversation between the authors about the upcoming changes of Gothenburg's transport system. A question arose concerning what the traffic situation in the city would look like during the construction time. The first question led to another; what consequences will the emergency traffic face during that period?

The authors want to thank the respondents and contact persons at Trafikverket, Trafikkontoret, and in SAMKO for their time. Without the material and information obtained from them, this report would have come to a standstill. Thanks to Pär Sköld at COWI for believing in the idea and deciding to support the development of the thesis. The authors want to send special thanks to Pernilla Sott, the mentor at COWI, for her dedication and guidance during the work, this report would not have been possible without her help. Also, special thanks to Michael Lövberg at Räddningstjänsten Storgöteborg for his time and valuable inputs. Finally, the authors want to send special thanks to Claes Johansson and Gunnar Lannér, the mentors at Chalmers, for their support and advices which were of great help during hard periods.

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Jonas Ellneskog
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Notations

Boverket	The National Board of Housing, Building and Planning.
Göteborgs stad	The City of Gothenburg.
Myndigheten för samhällsskydd och beredskap (MSB)	Swedish Civil Contingencies Agency.
Park- och Naturförvaltningen	The Parks and Nature Administration.
Primary dispatch net	A net of roads which are primary used by the rescue service to travel swiftly through the city.
Räddningstjänsten Storgöteborg	The association responsible for firefighting and rescue service in Gothenburg and five other participating municipalities.
SAMKO	Sub-division of KomFram, a construction and coordination group. SAMKO is responsible for the coordination and communication between the involved projects.
Statistiska centralbyrån (SCB)	Statistics Sweden.
Sveriges kommuner och landsting (SKL)	The Swedish Association of Local Authorities and Regions.
Trafikkontoret Göteborg	The City of Gothenburg Transport Administration.
Trafikverket	The Swedish Transport Administration.
Vägverket	Vägverket was reorganised into current Trafikverket in 2010.
Västtrafik	Responsible for the public transport in the Västra Götaland region.

Explanation of References

This section contains a short explanation of the major references which most of the literature review in this report is based on.

Traffic for an attractive city, TRAST

Trafik för en attraktiv stad (Traffic for an attractive city), TRAST, is a guiding document which purpose is to support local politicians, planners and engineers in their work regarding traffic related questions, by bringing up issues concerning transport and travelling within a city (Trafikverket, 2015a). TRAST was produced through a cooperation between Trafikverket, Boverket and Sveriges Kommuner och Landsting. TRAST has been updated over the years and the document now consists of several papers with different focus. The two main documents are the TRAST manual and the basis for the manual. The TRAST manual focus on guidance within traffic work processes, while the basis for the manual contains facts necessary to produce traffic plans and strategies.

Configuration of roads and streets, VGU

Vägar och gators utformning (Configuration of roads and streets), VGU, is a regulatory framework introduced by Trafikverket in cooperation with Sveriges Kommuner och Landsting (Trafikverket, 2015b). VGU contains information about the configuration of roads and streets concerning function and design. VGU is divided into several documents where the two predominant parts are:

- Requirements for configuration of roads and streets - Requirements that must be fulfilled when designing roads and streets in urban and rural areas.
- Advices for configuration of roads and streets - Advices for the design of roads and streets in urban and rural areas, recommended to fulfil but not always mandatory.

Trafikverket must follow this regulatory framework when conducting construction and larger reconstruction measures. The municipalities are not obliged to follow these regulations. VGU is acting as an optional and guiding document and it is up to each municipality if they want to consult it.

Gothenburg technical manual, TH

Many of the larger municipalities in Sweden have their own regulatory framework, so is the case for Göteborgs stad. *Teknisk Handbok* (Technical manual), TH, is a compilation of instructions addressed to persons and administrations performing maintenance, planning, construction, and other activities in public areas on behalf of Trafikkontoret or Park- och Naturförvaltningen (Göteborgs Stad Trafikkontoret, 2016a).

Trafikkontoret is responsible for providing a safe, effective, and sustainable accessibility in the city (Göteborgs Stad Trafikkontoret, 2016a). This is achieved by careful planning of construction, maintenance, and development of the city’s road network. Park- och Naturförvaltningen is responsible of performing maintenance on and developing the city's green areas according to political decisions and policies.

TH does not contain information for all kinds of situations, but should provide guidelines for some areas and some cases (Göteborgs Stad Trafikkontoret, 2016a). There are no standard solutions that are valid for all areas and projects, which means that solving a case requires careful investigation and consideration of the conditions at site. It is not mandatory for Göteborgs stad to use the requirements and advices in VGU, although it is a basis for the technical manual. Therefore, both the VGU and the TH can be regulatory for performers when conducting maintenance, reconstruction, or other activities in public areas. Deviation from instructions in TH must be approved by either Trafikkontoret or Park- och Naturförvaltningen.

1 Introduction

This chapter will give an introduction to the report such as a short background with a problem description, aim and purpose of the report, and necessary limitations. A more theoretical explanation of the problem together with a description of the projects is presented in chapter 3 Literature Review.

1.1 Background

The city of Gothenburg is growing. The population is constantly increasing and the goal is to make room for approximately 700 000 inhabitants until year 2035, which is 150 000 more than today (Göteborgs Stad, 2016). Furthermore, Gothenburg is celebrating its 400th anniversary in 2021 and therefore the municipality is mustering in order to make Gothenburg a role model within sustainable development. To turn these ambitions into reality, many large and extensive infrastructure and construction projects are going to be conducted the coming years.

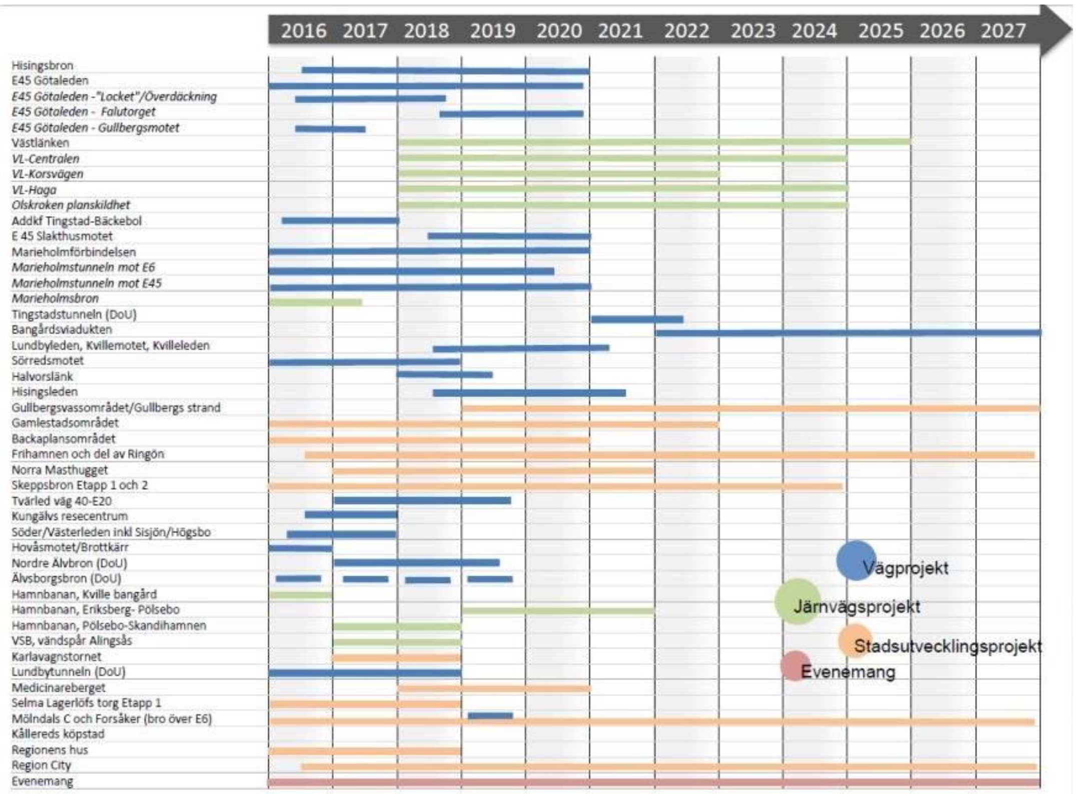


Figure 1.1 Diagram showing the planned projects and their respective planned construction times (Sott, 2016). Note: working material.

Figure 1.1 shows a diagram of planned projects in Gothenburg and its surroundings. As presented in the figure, several projects will be in progress at the same time during a long period. 2018 is a year when many infrastructure projects will start, mostly projects connected to Västlänken. Furthermore, several of these upcoming, and already ongoing, projects will be concentrated to a confined area.

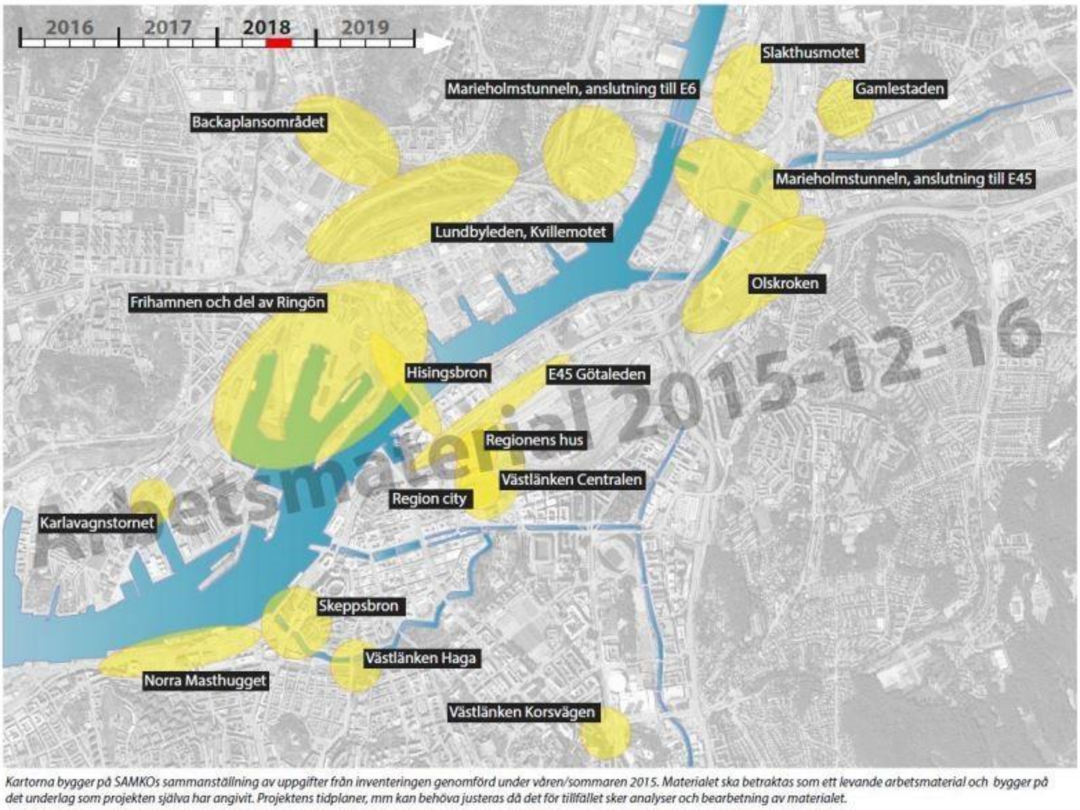


Figure 1.2 Map showing projects planned in the central parts of Gothenburg during autumn 2018 (Sott, 2016). Note: working material.

Figure 1.2 is a map illustrating how several projects are concentrated to the central parts of Gothenburg, and in close connection to important transport routes. These projects will probably interfere with public, service and private traffic and result in temporary suspension of important transport routes. This means that traffic must find alternative routes and increased travel time together with congestion is to be expected. How will this affect vehicles that must get through and cannot accept prolonged travel times? These vehicles are for example police cars, fire engines and ambulances. This report will focus on rescue service vehicles only.

Fire engines and other vehicles belonging to the Gothenburg rescue service must reach their destinations on time, often within 10 minutes (Boverket, 2015). Most of the projects presented in Figure 1.2 are located within the area covered by Gårda fire station, see Appendix I (Mentzer, 2012). Major infrastructure projects with traffic diversions are likely to obstruct an eventual rescue task. It is likely that the dispatch possibilities will be reduced and also that the available roads will be more congested. What consequences will the rescue service face in autumn 2018 due to the upcoming projects?

1.2 Aim and purpose

The purpose with this report is to state the consequences, for the rescue service and its accessibility, due to impacts on the traffic system caused by the major infrastructure projects planned for the coming years in Gothenburg. Construction and road work sites resulting in closed roads and traffic diversions are likely to affect the possible dispatch routes negatively. By investigating how the studied projects will affect the traffic system and its road users, it is possible to identify consequences on a system and local level for the rescue service. The study period will be autumn 2018, when most projects are in progress.

The vision is that this report will raise awareness among authorities and municipalities that accessibility for the rescue service during the construction period may become an issue. Hopefully, this report will also provide support for readiness among rescue service personnel by identifying eventual problem areas.

1.2.1 Objectives

- Investigate the impacts on the traffic system, on a system level, during morning and afternoon peak hours in autumn 2018 by stating the consequences the rescue service will face regarding their primary dispatch net.

- Investigate the impacts on the traffic system, on a local level, during morning and afternoon peak hours in autumn 2018 by stating the consequences the rescue service will face regarding the primary, secondary, and remaining dispatch net within the project areas.

1.3 Limitations

The scope of study for this report is the consequences, in autumn 2018, for the rescue service caused by the major infrastructure projects in progress during that period. The report will focus on Gårda fire station and its coverage area together with the surrounding traffic system. Gårda was chosen since it is the most centrally located fire station and will most likely be affected by the projects.

Due to the vast number of projects in Gothenburg during the next couple of years, only the largest and most extensive infrastructure projects will be analysed. Events and operation, maintenance and city development projects will therefore not be included. The study will focus on projects located on the mainland side of the river. A local level analysis, regarding closed roads and traffic diversions, will be conducted on projects in the vicinity of Gårda fire station. Projects situated at the outskirts of Gårda's district, e.g. *Slakthusmotet* will not be as meticulously analysed, however they are considered in the traffic simulation model which will show the traffic impact on a large scale. Due to difficulties in obtaining data of public transport traffic, the traffic flows concerning buses and trams will not be included in the report, i.e. the public transport lanes will have a flow of zero vehicles per hour in the results. However, the public transport traffic were taken into account in the simulation model in some aspects, e.g. when deciding the green light times in intersections. Otherwise, buses and trams does not affect the vehicles in the model.

The study period will be autumn 2018 since most of the projects will be under construction during that time and it is assumed that this will be a very intense period. Furthermore, it was hard to obtain data and information about years further into the future.

This report is based on working material. It is possible that details will change later on, before the final material is produced. However, most of the material and the major measures should be accurate. During this project, there was no access to the contractors' traffic plans regarding positions of traffic signs and devices during the construction period. Hence, it was not possible to get an idea of what the road work sites actually will look like.

The report is to a great extent based on results from simulations. Simulations are not 100 percent accurate since it is a prediction of how drivers will react to changes in the traffic system. In the end, it is human behaviour which will determine how everything plays out and that is hard to predict.

The sources to some of the material used in this report, e.g. the simulation results, will not be published due to requests from the owner of the material.

2 Methodology

This chapter will describe the work procedures of different phases during the production of the report.

2.1 Reference group

The creation of a reference group was necessary in order to obtain inputs from relevant operators. The reference group consisted of persons from Chalmers University of Technology, Räddningstjänsten Storgöteborg, Trafikkontoret, Trafikverket, and COWI. An initial start-up meeting was held in the beginning of the project to preliminary formulate the scope of the thesis and exchange necessary contacts to persons of interest. Continuous contact between the authors and the reference group was maintained via email and meetings was held later on in the project.

2.2 Literature review

A literature review was necessary to get familiarised with the subject. A study of reports concerning subjects related to the scope of study was conducted. Meetings and interviews with relevant persons was held to obtain detailed information, e.g. about planned traffic diversions. To evaluate the consequences for the rescue service it was necessary to gather information concerning the primary dispatch net and the service area for Gårda fire station. A study visit at Räddningstjänsten Storgöteborg gave valuable intelligence about their view of the coming infrastructure projects and their approach to manage the situation. A compilation of essential information was produced in order to give the readers a good understanding of the subject.

A short description of the major infrastructure projects and their respective impact on the road network was also generated to clarify how each planned construction would affected the road network and the dispatch net. The information for this was retrieved via mobility plans. Interviews with the project managers of the larger projects in the city were performed to give complementary information about the projects' interference with the traffic.

To enable an analysis of the traffic flows, it was necessary to retrieve information regarding the original traffic situation and the expected situation in 2018. This was done by studying the results from a traffic simulation model provided by a sub-division of SAMKO. The original traffic flows in these simulations were measured in 2014-2015, before the city started to undergo too many changes. The values are a mean value during morning and afternoon peak hour traffic, 07.00 - 09.00 and 16.00 - 18.00 respectively. Further on in this report, the original or base situation will refer to the situation in 2015.

2.3 Results and analysis

By using the information retrieved in the literature review, it was possible to point out roads which would be directly affected and how the traffic flows would change along the alternative routes and the primary dispatch net. Furthermore, this enabled an investigation of the consequences for the rescue service to be carried through.

The consequences were firstly investigated on a system level, the primary dispatch net, and whether it would be directly affected by the construction and road works, e.g. closed or narrowed roads. This was done by examining the mobility plans to clarify if any of the projects would conduct measures affecting the roads, belonging to the primary dispatch net, in autumn 2018. After that, the indirect consequences were assessed by comparing the original traffic flows along the primary dispatch net to the expected traffic flows in 2018. The results were illustrated in graphs showing the traffic per lane, originally and in 2018, for each road section along the primary dispatch net.

Thereafter, the consequences were investigated on a local level. The direct consequences on the traffic system, within the project areas, caused the projects were examined by studying the mobility plans. The impacts due to measures such as dismantling of bridges or suspension of roads resulted in difficulties in traveling certain directions, hence affecting the dispatch possibilities. The consequences for the rescue service were examined by assuming an original dispatch route via the affected links. The original route, Alternative 0, was assumed to proceed from the closest part of the primary dispatch net and use roads belonging to the secondary dispatch net. An investigation in how to circumvent the obstacles in order to reach destinations in affected directions was conducted. If possible routes were found, they were measured in length and compared to the original route. The new routes were also examined regarding the number of sharp turns and intersections along them, which is important due to the traffic safety and driving speed. The number of lanes along the roads was studied as well. Traffic calming measures, e.g. speed humps, along the routes were also examined. However, it was not stated in the mobility plans if there would be any traffic calming measures present in the project areas. Therefore, traffic calming measures present in 2015 were assumed to be present in 2018 as well, given that the roads would still exist. Otherwise, it was assumed that no additional measures would be implemented. The measuring of lengths and analysis of intersections, sharp turns, number of lanes and traffic calming measures was performed with Google Maps which is an internet based map and satellite photo service. The original traffic flow and the traffic flow in 2018 along these roads were evaluated as well. This was done by studying the simulation results. The results from the simulations were in some cases, and areas, very hard to read due to the flow lines overlapping/covering each other. Hence, for those roads it was necessary to estimate the traffic flow value by examining the traffic flows on adjacent roads. Unfortunately, there was also lack of traffic flow data for some roads.

The definition of intersections in this analysis was crossings where a vehicle traveling the same direction and route would have to give way for other vehicles, e.g. intersections regulated with traffic lights or with yield signs. Also, left turns along roads onto other roads or streets which meant crossing the path of oncoming traffic were included. The definition of sharp turns in this report was turns and curves where rescue vehicles must maintain a lower speed in order to make the turn. Generally, 90 degree turns such as those in intersections but also sharp curves along roads and roundabouts were included. When estimating the number of lanes along each stretch, all lanes in the driving direction available to the rescue service were included. The lanes must also be in connection to each other without any barriers between them, e.g. railings or traffic islands. Shorter parts like slip roads and exits were not included. Furthermore, driving on other surfaces, e.g. squares and against traffic in one way lanes were not included in that number as well.

3 Literature Review

This chapter will give a deeper understanding of subjects connected to the report. For instance, the concept of accessibility will be described and important information concerning the rescue service will also be covered in this chapter.

3.1 Availability and accessibility

In Sweden, there is a national goal stating that the community should be available for everyone (Trafikverket, 2015a). Availability is defined as the possibility for interaction and exchange (Hansen, 1959). It describes the ease with which private individuals, authorities, and business can reach necessary or desired services, supplies and activities, i.e. opportunities (Litman, 2015). The ease of reaching these destinations refers to the money and time consumed on transportation. Availability can be measured in several ways, depending on which particular area of study that is evaluated. In this project, the consequences for the accessibility will be analysed. Accessibility is a measure of the availability in terms of travel time. Accessibility can describe the time consumed, when traveling from origin to destination, in relation to expected travel time (Trafikverket, 2015a). This is dependent on several factors which generally can be compiled into three categories; the city structure, the transport system, and the human ability. Coordination of factors in these categories are vital to establish a sustainable community (Göteborgs Stad Trafikkontoret, 2015a). The transport system consists of systems for different modes of transportation, e.g. the traffic system and the railroad system. This report will investigate the impact on the traffic system, due to the many infrastructure projects in Gothenburg. Therefore, the city structure and the human ability will not be further analysed.

A balanced traffic system of good quality is an important part in the development of society and benefits the nation as a whole (Trafikverket, 2015a). In order to provide a basic availability and accessibility for everyone, the design and function of the transport system must be carefully considered. The traffic strategy in Gothenburg also emphasises the significance of a safe and reliable traffic system, encouraging people to dwell in the city (Göteborgs Stad Trafikkontoret, 2015b). It is of great importance to take the aspects of all different road users into account. Since the needs may differ a lot among the groups, it is often hard to provide good availability and accessibility for all road users in the same area during the same time (Göteborgs Stad Trafikkontoret, 2016b). However, the overall goal with traffic planning is to achieve as much availability and accessibility as possible for as many as possible with as few negative impacts as possible on the environment, the city and the road users (Trafikverket, 2015a).

3.2 Road network

The traffic system is composed of the road network, the vehicles using the road network and the drivers of the vehicles. Since the roads and streets should provide availability and accessibility for everyone, several questions and factors must be solved and fulfilled. The design of the road network is controlled by these factors and properties which, in VGU, are compiled into so called default values (Trafikverket, 2015c). Aspects regarding traffic environment, drivers, passengers, and vehicles are covered by default values such as vehicle geometries, friction, acceleration, sight and many more.

The road network is divided into a main network and a local network (Trafikverket, 2015a). Roads in these network categories have different purposes and requirements depending on which road user group they are supporting (Trafikverket, 2015b). To include vehicle properties and performances into the design of the road network, both main and local, a number of type vehicles have been developed. The type vehicles should cover properties of regular private cars, busses, and lorries with and without trailers.

The endeavour of achieving as much availability and accessibility as possible for as many as possible often leads to conflicts between different road users (Trafikverket, 2015a). A common problem along the main road network is passage points, where the opinions of motorised traffic and vulnerable road users contradict each other. Physical traffic calming measures, e.g. road bumps, are an effective way to counteract fatal and severe accidents among vulnerable road users. However, these measures may also generate discomfort for drivers, passengers and goods. Another negative effect is that emergency vehicles are forced to lower their speed which results in longer travel times and reduced accessibility. A general description of the main and local network for motorised traffic is presented below.

3.2.1 Main road network

According to Trafikverket (2015a), the main network consists of roads and streets for traffic heading to, through and from the city. Roads and streets connecting districts within the city also belong to the main network. The city centre, business areas and destinations outside the city are important target objects. The main network should be able to handle the peak traffic load of today and any eventual additions due to known expansions of the city. The asphalt coating should be of good quality, i.e. limited cracks, potholes and other irregularities. Any traffic calming measures, especially vertical measures e.g. speed bumps, should be weighed against the vulnerable road users' need for traffic safety and the motorised traffic's need for accessibility.

3.2.2 Local road network

The local network consists of roads and streets for traffic with destinations along the street, e.g. streets in residential areas (Trafikverket, 2015a). The local network connects to the main network via one or several streets. It is important to take into consideration that a street belonging to the local network for cars could belong to the main network for e.g. public and/or emergency traffic (Trafikverket, 2015d). It must be clarified if a street belongs to the main network for any kind of road users or if it is just a local street. The local network must be able to handle the traffic load of today. It must also enable for parking, loading and unloading of goods and other necessary functions. It is possible to relieve the local network from traffic by making the main network more attractive for external and through traffic (Trafikverket, 2015b). This could be done by giving the main network good accessibility and traffic safety. The local network on the other hand should be given low accessibility for motorised traffic and instead increase the traffic safety for vulnerable road users.

3.3 KomFram

Gothenburg is facing a period of major changes in the city structure due to a vast number of infrastructure and construction projects (Göteborgs Stad Trafikkontoret, 2016c). The accessibility in the central parts of Gothenburg is believed to be reduced for several years. This during a time when the municipality wants to achieve a change in the transport behaviour and encourage citizens to travel by foot, bicycle, and public transport. Västsvenska paketet is a collection of improvement measures for the infrastructure in West Sweden. Investments are made on large road and railroad projects until 2027 in order to make Gothenburg and West Sweden a more attractive and sustainable region (KomFram Göteborg, 2016). The construction of many of these infrastructure projects have already started and more construction works will follow the coming years. Additional infrastructure and construction projects, which are not included in Västsvenska paketet, are also planned during these years together with operation and maintenance works of the road and railroad network. Therefore, coordination and cooperation between the projects have become very important. In order to minimise the disturbances and impacts on the accessibility, a group called KomFram Göteborg was created. KomFram Göteborg is a construction coordination group which consists of members from the stakeholders represented in Västsvenska paketet, i.e. Trafikkontoret, Trafikverket, and Västtrafik (Sott, 2016). Some consulting firms are also represented in KomFram due to their expertise within certain areas, e.g. traffic modelling. The purpose with KomFram is to ensure accessibility for public, private and business traffic during the construction time.

SAMKO, a subdivision of KomFram which also consists of members from stakeholders represented in Västsvenska paketet, is involved in the coordination and communication between the projects (Sott, 2016). SAMKO's task is to analyse the impact on the traffic system, in Gothenburg and its vicinity, caused by the projects. By compiling mobility plans, explained in chapter 3.4 Mobility plans, from all upcoming projects with impact on the traffic, it is possible to develop an overview of the total impact in the city during different time periods (Göteborgs Stad Trafikkontoret, 2016c). The focused time period is between 2016 and 2019, when most of the projects will be carried through. The extent of SAMKO's work covers all projects which have or may have an impact on the traffic system. Their responsibilities concern construction, operation, maintenance, city development, and exploitation projects.

One of SAMKO's main tasks is to assess the total impact on the traffic in the city by running large scale traffic flow simulations, also known as macro simulations, which are based on the information from the mobility plans provided by the projects (Göteborgs Stad Trafikkontoret, 2016c). Another main task is to produce guidelines for different types of traffic. The guidelines describe how pedestrians, cyclists, and other road users should be prioritised and how they should be diverted around or led through the construction sites. These guidelines form a basis of requirements which should be fulfilled by the projects in their work with mobility plans.

3.4 Mobility plans

To obtain a general overview of the accessibility in Gothenburg, it is vital to gather information about the impacts on the traffic system from all projects. This information forms the basis for the overview analysis and is called mobility plans (Göteborgs Stad Trafikkontoret, 2016c). A mobility plan is a document containing maps illustrating accessibility in the vicinity of a project. A review, on a large scale, of the impacts on the traffic system should also be present. Furthermore, a description of the planned measures, possible effects, eventual problems, and feasible solutions should be compiled in the mobility plan as well.

It is up to each project to create mobility plans, for each phase of the work, concerning their construction site (Göteborgs Stad Trafikkontoret, 2016c). To get a better understanding of the total impact, common mobility plans should be produced if two or more projects are planned in the same area, which is the case for the Central station area.

The purpose with these plans is to ensure accessibility for all types of traffic in the vicinity of each project (Göteborgs Stad Trafikkontoret, 2016c). Necessary modifications regarding capacity and accessibility for all road users together with the impact caused by these modifications should be presented. The mobility plans are supposed to facilitate the overall analysis made by SAMKO, enable a better coordination between projects and point out stretches or points where problems might arise.

In the end, the work process with mobility plans should benefit the citizens of Gothenburg, visitors, and business (Göteborgs Stad Trafikkontoret, 2016c). The plans provide vital information needed for the task of ensuring accessibility during the construction time. By minimising time losses, impacts on the environment, and extra costs it is possible to maintain a favourable atmosphere and contribute to a sustainable development in Gothenburg.

3.5 Rescue service traffic

Räddningstjänsten Storgöteborg, RSG, is an association responsible for firefighting and rescue service in its six participating municipalities (Räddningstjänsten Storgöteborg, 2016). The area includes Gothenburg, Lerum, Mölndal, Partille, Härryda, and Kungsbacka where each municipality have a number of fire stations and/or fire guards covering various districts. In total, the RSG serves around 800 000 people. The objective of RSG is to prevent, limit, and take actions after accidents, prepare and conduct rescue tasks, and also contribute to crisis management in society.

Göteborgs stad has six fire districts; Gårda, Frölunda, Lundby, Kortedala, Torslanda, and Angered which each has its own fire station and some also have one or several fire guards (Mentzer, 2012). A map illustrating the area covered within 10 minutes' response time from Gårda fire station is presented in Appendix I. By comparing this map with Figure 1.2, showing the upcoming projects, gives an understanding about the issues Gårda fire station is facing.

Time is a crucial factor in an emergency situation. Therefore, emergency vehicles have special needs regarding accessibility in urban areas. The response time for the rescue service is the time from the moment they get the emergency call, until they are on the scene and start doing their work (Lindsten, 2016). A response time of no longer than 10 minutes is normally regarded as sufficient (Boverket, 2015). The response time is composed out of three different parts. According to Lindsten (2016) the following times in each part are generally applied by the rescue service in Gothenburg:

- Turnout time. The time from when the call comes in until the first rescue vehicle leaves the station. The procedure for this part is very well prepared and efficient. Therefore, the turnout time varies very little. Estimated time 1.5 minutes.

- Travel time. The time it takes for the rescue vehicle to get from the station to the scene of an emergency. Could vary a lot due to several factors, e.g. time of the day, distance, design of the roads etc. Estimated time 7.5 minutes. The maps showing the coverage area for each fire station are based on this travel time, see Appendix I.

- Initiation/action time. The time it takes from the moment the rescue vehicle arrives on site until the unit is able to start the rescue work. Estimated time 1 minute.

The travel time is usually the longest of these times, and also has the highest possibility to cause delays for the dispatch. The rescue vehicles are, if there is danger of human lives or severe property damages, allowed to use the means necessary to arrive as fast as possible (SWECO Infrastructure AB, 2011). This includes the use of emergency vehicle lighting, sirens, and the permission to ignore several traffic regulations.

In order to keep the travel time at a minimum, there are requirements concerning space to manoeuvre, capability to keep a steady speed, and possibility to travel as short distances as possible (Trafikverket, 2015a). All these factors are based in the selection of roads available. Space to manoeuvre is especially important for vehicles belonging to the rescue service. Fire engines and ladder appliances are among the largest emergency vehicles, thus requiring most space. The measurements of a fire engine, type vehicle Lu, can be seen in Figure 3.1.

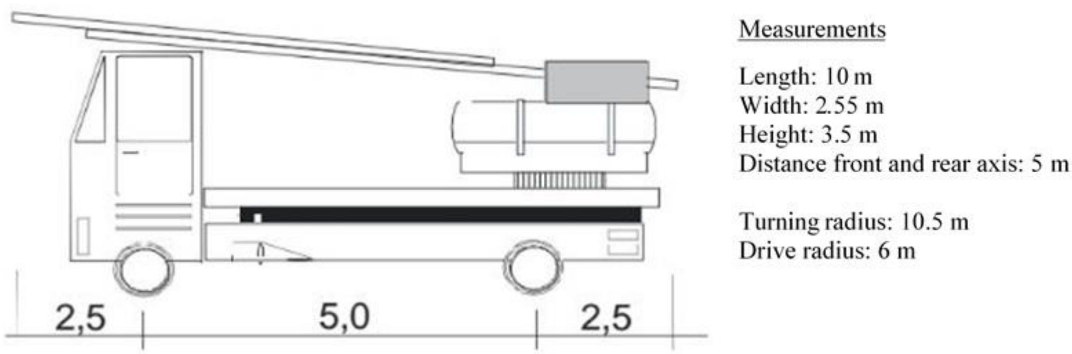


Figure 3.1 The measurements of type vehicle Lu, a ladder appliance (Trafikverket, 2015c).

The requirements and factors mentioned earlier are important criterions when designing the road network. The design of both the main and the local road network are of great significance for the rescue service. Therefore, the dispatch net is divided into a primary, secondary, and remaining net, with different demands for speed and manoeuvring space.

- Primary dispatch net. Road network which provide good accessibility to the most important target objects, e.g. hospitals and schools. Most of the car traffic's main network belongs to the primary dispatch net. These are larger roads which connect districts and allow the rescue service to travel swiftly through the city, see Figure 3.2. Required dimensioned speed is 50 km/h or more.

- Secondary dispatch net. Road network which provide fair accessibility to other major target objects. Comprises of all road-borne motorised traffic's network except streets with walking speed and parts belonging to the primary dispatch net. Required dimensioned speed is 30 km/h or more.

- Remaining dispatch net. Enables accessibility to all dispatch targets. Mainly footways, bicycle paths and alleyways which may be necessary to use in order to reach inaccessible buildings and other sites of accidents. Required dimensioned speed is walking speed.

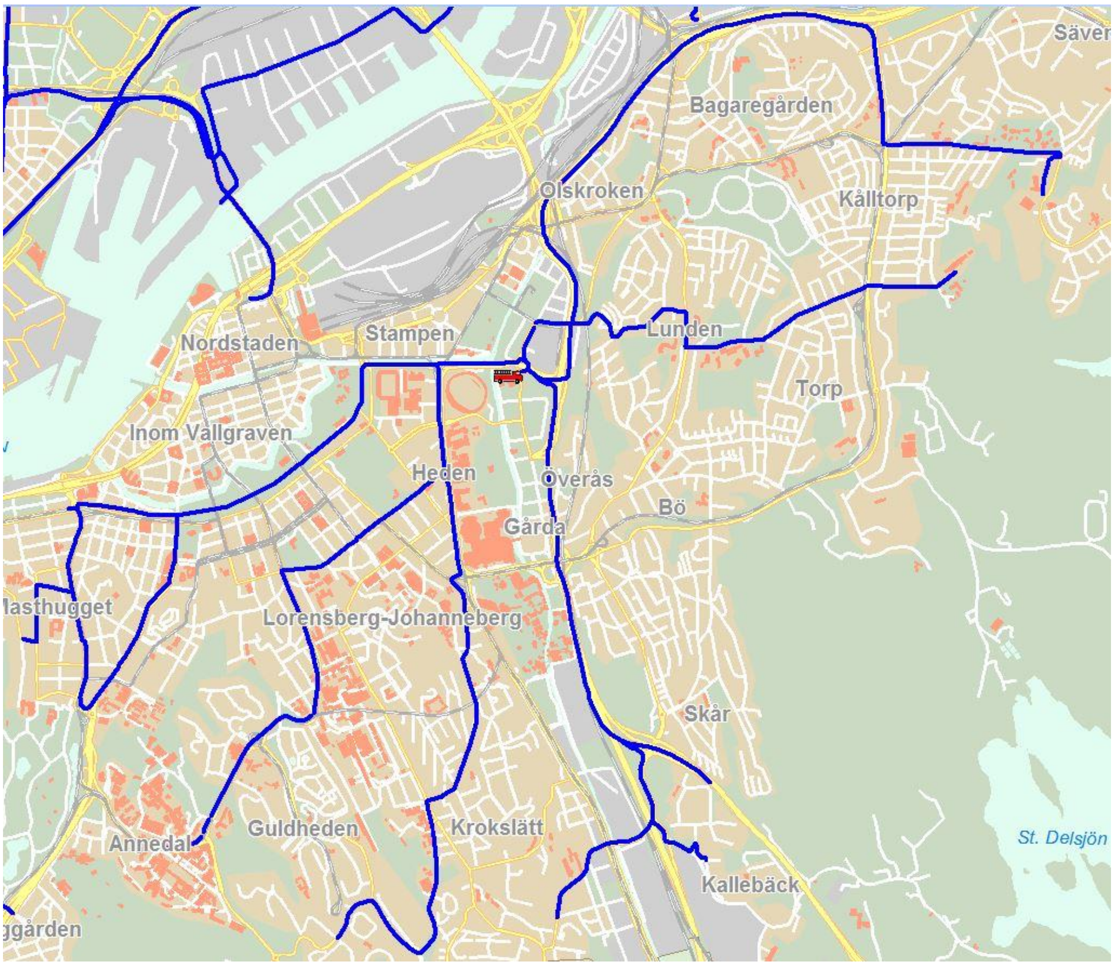


Figure 3.2 The primary dispatch net for Gårda fire station (Lövberg, 2017).

The accessibility for the rescue service is mostly affected by the travel time along the primary dispatch net (Trafikverket, 2015a). In turn, the travel time depends on the distance and speed. Therefore, it is important to analyse congestion, number of lanes and physical traffic calming measures along the primary dispatch net in order to assess the accessibility. The design of crossings, turns, and road sections must also meet the requirements of manoeuvring space. Traffic islands, median strips, narrowed roads, speed bumps and small roundabouts can obstruct the accessibility for the rescue service and should be further analysed before implemented, especially on the primary dispatch net. Sometimes this means that traffic safety increasing measures, e.g. speed bumps, must be weighed against the accessibility for the rescue service.

Due to the risk of traffic jams and other accessibility difficulties along some roads and areas during certain periods, rescue vehicles from two different stations are sent to the emergency. Thus, ensuring that rescue personnel arrive within reasonable time even if the unit located closest to the accident site gets delayed (SWECO Infrastructure AB, 2011). Even though it is effective to send double forces, it is also expensive. Another method applied by the rescue service is to deploy units at strategic places during periods when reduced accessibility is expected, e.g. during peak hours or events. During longer road closures, establishing a temporary rescue station could be an effective solution.

The design of alternative routes could result in a prolonged travel time compared to the originally used routes. In combination with eventual increased traffic, this could reduce the accessibility for the rescue service.

3.6 The costs for delays

The longer time it takes for the rescue service to reach the scene of an accident, the greater risks of severe damage on properties or someone getting seriously injured. The costs for an accident, or an emergency can be divided into three different cost categories: direct costs, indirect costs, and human value (MSB, 2011).

The direct costs are the value of all the properties that is destroyed or lost in the accident, and also the cost of resources used during the rescue operation (MSB, 2011). Indirect costs however, are the lost value of all products and services that were not produced due to human or material damage following a severe accident. The hardest cost to estimate is the value of human life. This is a measure of the reduction in physical quality of life or living after an accident. A life is something that is not possible to buy or sell. Therefore, it has no market-price such as the direct and indirect costs have. With a set of different assumptions and calculations together with a couple of cost-benefit analyses, Vägverket estimated the value of a human life in 2001 (Jaldell, 2004a). The value sums up to 17 500 000 SEK when translated into the average money value of 2016, according to SCB (2017). They did also set costs for severely injured and slightly injured and these costs recalculated into the average money value of 2016 were 3 200 000 SEK respectively 180 000 SEK (SCB, 2017). Jaldell (2004a) have analysed the three costs mentioned above for different missions and especially how they increase with a longer response time.

Jaldell (2004a) have been focusing on the extra costs of using part time firefighters compared to firefighters employed on full time, and the difference in time to reach an accident is approximately five minutes for them. Therefore, an average cost for the five minutes' delay of the rescue operation is calculated from statistics, provided by Swedish and Norwegian rescue services, of different types of operations. Three different average costs, for damages during an emergency dispatch, have been calculated and are presented in Table 3.1 as the costs recalculated into the 2016 average money value.

Table 3.1 Costs for a five minute delay in different situations. The table is a part from Jaldell (2004a), but translated into English and the costs have been recalculated into the average money value of 2016.

	Cost for delay 5 minutes [SEK/5 min]
Average cost for dispatch, Do not include: other missions such as security alarms, medical alarms, false alarms and automatic alarms.	67 000
Average cost for dispatch, Do not include: other missions such as security alarms and medical alarms. Include: false alarms and automatic alarms.	36 500
Average cost for dispatch: Include: other missions such as security alarms, medical alarms, false alarms and automatic alarms.	33 300

The false alarms and security alarms etc. are not harming either people or property, and are therefore not always considered emergencies from a victim's perspective. Due to that the cost for a 5 minutes' delay during an actual emergency is therefore considered to be 67 000 SEK. The cost could also be equivalent to 13 400 SEK per minute and still be sufficiently accurate (Jaldell, 2004a).

These numbers should only be considered accurate during dispatches with a response time up to 15 minutes (Jaldell, 2014b). The required response time for Räddningstjänsten Storgöteborg is less than 10 minutes, which makes the cost assumption suitable for this project and the analysed scenarios. These numbers prove that it should lie in the interest within the municipality to ensure accessibility for the rescue service.

3.7 Upcoming infrastructure projects in Gothenburg

As explained in chapter 1 Introduction, Gothenburg will undergo a major transformation the coming years. The planned timetable for the upcoming projects shows that 2018 will be a critical year, especially the autumn, with many ongoing construction works and several scheduled to start. As can be seen in Figure 3.3, one big event is the initiation of the Västlänken projects.

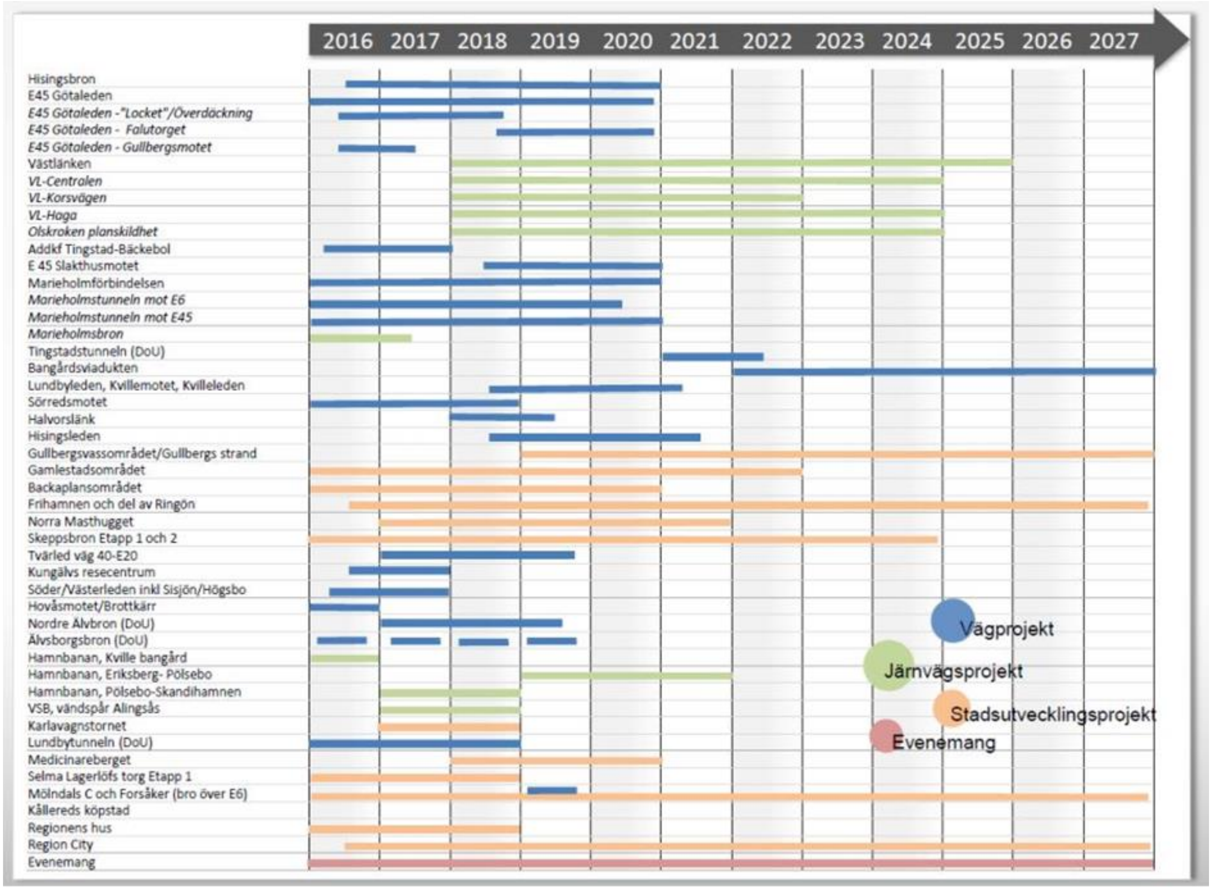
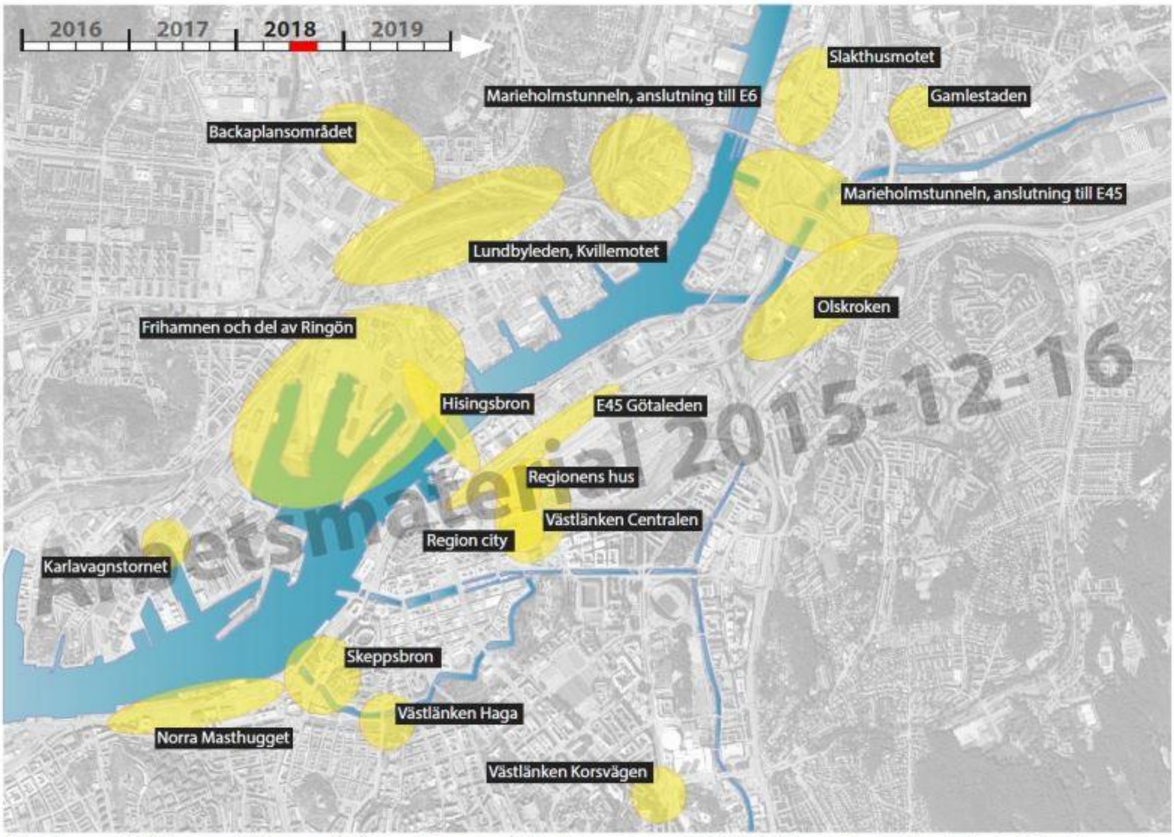


Figure 3.3 *Planned timetable for the projects. This may change due to delays and setbacks (Sott, 2016). Note: working material.*

A majority of the projects will be conducted in and around the most central parts of the city. An overview of the projects planned to be conducted in the autumn of 2018 is shown in Figure 3.4. Figure 3.4 is based on information collected by SAMKO during the summer of 2015.



Kartorna bygger på SAMKOs sammanställning av uppgifter från inventeringen genomförd under våren/sommaren 2015. Materialet ska betraktas som ett levande arbetsmaterial och bygger på det underlag som projekten själva har angivit. Projektens tidplaner, mm kan behöva justeras då det för tillfället sker analyser och bearbetning av materialet.

Figure 3.4 Map showing the different projects in the central parts of Gothenburg during the autumn of 2018 (Sott, 2016). Note: working material.

During the upcoming years Västsvenska paketet will be very conspicuous. But the city's development and densification will generate several other projects with a large impact on the city and the traffic as well. Alongside this, maintenance and operation on the already existing infrastructure network needs to be conducted which will result in even more traffic disruption.

Of all the projects planned for the city, a few is expected to have a more severe impact on the traffic situation. The Central station and its vicinity is a hot spot that will host several immense constructions in a fairly small area. The accessibility for the traffic is believed to be very limited and strained through the area. The major projects planned for the Central station area are the following (Sott, 2016):

- *Hisingsbron*, a new bridge which is going to replace the old *Götaälvbron*. Some parts of the work on the actual bridge is possible to conduct without disturbing the traffic. However, a lot of the work needed for the bridge connections is going to cause a lot of disturbance.

- The E45 road passing through the central parts of the city will undergo some changes. Immersion and over decking of the road will be carried through in order to release ground for further construction of the *Gullbergsvass* area.

- One of the stations for Västlänken, the railway tunnel under the city, is going to be located right next to the existing Central station. The railway tunnel will stretch west through the Kvarnberget area.

Large infrastructure projects in other central parts of the city during the same period of time:

- Västlänken station Haga. In addition to the station located near the Central station, there will also be a station at Haga.

- Västlänken station Korsvägen. The third station in the central parts of Gothenburg.

- *Marieholmstunneln*, a new tunnel under *Göta Älv,* will connect to E6 and E45. It will be located a couple of hundred meters upstream from the existing *Tingstadstunneln*.

- *Olskroken* is a project which aims increase the capacity of the railway hub via a grade separated junction. The purpose is also to connect the Västlänken Central station project with the existing railroad.

- *Slakthusmotet* is a project to improve the design of the existing interchange in order to optimise the connections to *Marieholmstunneln* and the district Gamlestaden.

- Reconstruction of *Lundbyleden* between the two interchanges *Brantingsmotet* and *Ringömotet* is essential to handle the expected traffic flows when *Marieholmstunneln* opens. A new interchange *Kvillemotet* will replace the existing *Brunnsbomotet*.

The two latter projects, *Lundbyleden* and *Slakthusmotet*, are located at the outskirts of Gårda fire station service area. Those places can be reached by Lundby respectively Kortedala fire station as well. Therefore, as mentioned in chapter 1.3 Limitations, the report will not contain a deeper analysis of these projects. The impacts and consequences for motorised traffic are presented in chapter 4 Impacts from Projects.

4 Impacts from Projects

This chapter will describe how the studied infrastructure projects will affect the traffic system. Information about closed and narrowed roads and traffic diversions was obtained from mobility plans received from the projects.

4.1 Haga

The Västlänken project in Haga is planned to be constructed in two phases, where Phase 1 is the main phase and Phase 2 is more of a restoration of the traffic areas to the current design (Fagerberg, 2016a). See Appendix II for an illustration. The scheduled construction period for Phase 1 is 2018-2022, hence Phase 2 will not be covered. The measures and works conducted during Phase 1 will significantly affect the traffic system in Haga and its vicinity. Few and long stages with major changes rather than several shorter stages with minor modifications have been an important focus during the planning of the Västlänken projects (Edin, 2017). This to enable a higher standard of the temporary traffic solutions, but also to minimise the inconvenience for the road users. Therefore, the traffic situation during this time, for various road users in Haga and its vicinity, will look quite different from today's conditions. Trafikverket has chosen to control the design of the temporary traffic more than usual in a traditional procurement (Fagerberg, 2016a). This to ensure as good accessibility during the construction time as possible, especially for public transport (Edin, 2017).

4.1.1 Situation in autumn 2018

One major issue with the Västlänken station in Haga is that the construction work requires an excavation in the area. During 2018, the work will be concentrated to the area north of the canal (Edin, 2017). Extensive work and measures are planned for the area south of the canal as well. However, due to the suspension of eastbound traffic in *Götatunneln* from the 20th of June and 20 weeks onwards, the traffic through the area is expected to increase. Therefore, the initiation of these procedures is not planned to start until 2019 which is outside the scope of the report.

Today, *Rosenlundsgatan* crosses the planned shaft area and it will be transformed into a temporary bridge (Fagerberg, 2016a). The connection over the canal, *Rosenlundsbron*, is located in the path of the planned shaft and must be removed. When the measures concerning the temporary bridge replacing *Rosenlundsgatan* and the dismantling of *Rosenlundsbron* are finished, the whole shaft area north of the canal will be available for further work, see Figure 4.1.

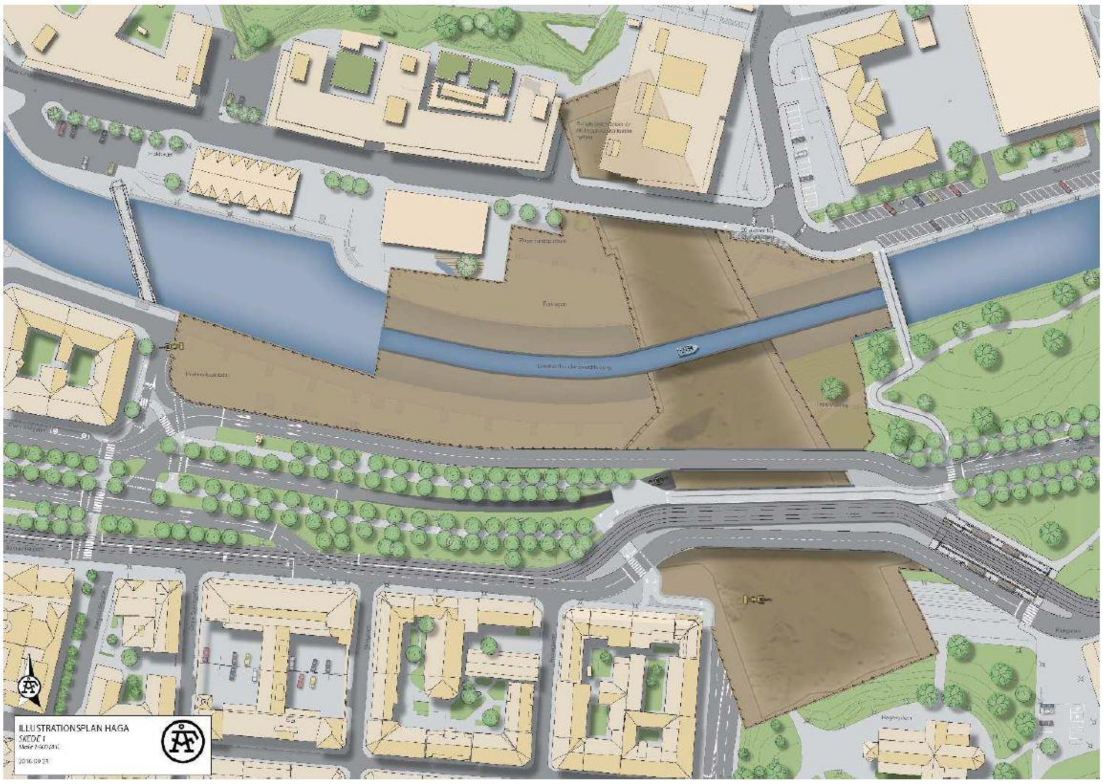


Figure 4.1 Illustrative map showing the temporary road situation during the construction of Haga station (Fagerberg, 2016a). Please notice that the area south of the canal will not look like this until 2019.

4.1.2 Consequences for traffic in autumn 2018

The transformation of *Rosenlundsgatan* into a temporary bridge is expected to be completed until the autumn of 2018. Hence, the functions of the earlier road will be upheld by the temporary bridge and no consequences are expected (Fagerberg, 2016a). Due to the dismantling of *Rosenlundsbron*, motorised traffic which occupies it today will have to find alternate routes. This will put pressure on nearby bridges, *Viktoriabron* and *Pusterviksbron*, as the traffic tries to find another way to cross the canal. In turn, this will lead to an increased traffic on adjacent roads, e.g. *Sahlgrensgatan* and *Rosenlundsgatan*.

4.2 Korsvägen

The Västlänken project at Korsvägen is planned to be constructed in two main phases (Fagerberg, 2016b). See Appendix III for an illustration. Just like in Haga, the project at Korsvägen will require excavations. Phase 1 is planned to be conducted between the summer of 2018 and the summer of 2020. During Phase 1, the traffic situation at Korsvägen will remain almost the same. After that, Phase 2 will commence and finish in the end of summer 2023 (Edin, 2017). In Phase 2, a shaft will be placed in the intersection, causing much more disturbance to the traffic than Phase 1 (Fagerberg, 2016b). However, since the focus in this report is autumn 2018, Phase 2 will not be further considered.

4.2.1 Situation in autumn 2018

A large shaft will be located in the slope next to the museum Universeum, just east of the existing intersection (Fagerberg, 2016b). The major differences will therefore be concentrated to the east side of *Korsvägen*. The existing two lane road with northbound traffic will be reduced to a one lane road (Edin, 2017). The bicycle path will be relocated on the west side, but there are ongoing discussions to combine the bicycle path with the car lane up to the *Korsvägen* bus station.

4.2.2 Consequences for traffic in autumn 2018

The accessibility is not going to be affected in Phase 1 (Fagerberg, 2016b). However, the capacity will be reduced since north and east going traffic will have to share the one lane, passing the shaft, in 2018. Some of the traffic will be expected to choose alternative routes due to the reduced capacity. The traffic heading east on *Örgrytevägen* and are going to go south on the highway, may be choosing to use *Södra vägen* instead of *Örgrytevägen* during the construction, or traveling on *Fridkullagatan*, *Framnäsvägen* in order to completely avoid Korsvägen and the construction site.

4.3 Olskroken

Olskroken is the hub which connects several important railways heading to the city centre. It is of major significance for the railroad transportation sector that the capacity of Olskroken is increased (Trafikverket, 2015e). In order to increase the capacity, security and reliability of the hub, it is necessary to construct and reconstruct the existing railway hub into a grade separated junction. The project is scheduled to start in the first quarter of 2018 and finish in 2022 (Fallgren, 2017). This deadline is rather important since Västlänken will open soon after.

4.3.1 Situation in autumn 2018

The work with the railway hub will require temporary and permanent suspension of both railroad, tramway and roads due to work being conducted on bridges, railroad and surrounding areas (Fallgren, 2017).

The old railway bridge over *Ånäsvägen* and *Gamlestadsvägen* is going to be replaced and will be dismantled during 2018 (Fallgren, 2017). A fence surrounding the project site will be built along the area *Partihandelsområdet* on *Fruktgatan*. *Minuthandelsgatan* will be suspended, however a new connection to *Partihandelsgatan* will be established. The connection between *Gamlestadsvägen* and *Malmsjögatan* will be removed for traffic coming from south and *Malmsjögatan* will become a one way road with west going traffic.

Most of the work in the project will be restricted to the railway in the area (Fallgren, 2017). Therefore, trains and trams will be more affected than the road-borne traffic. However, due to temporary suspensions of tramway and railroad, the disruption in railway traffic will require replacement buses which is believed to increase the traffic on roads in the area.

4.3.2 Consequences for traffic in autumn 2018

The dismantling of the railway bridge over *Gamlestadsvägen* will reduce the capacity of the road since the number of lanes will be reduced from three to two (Fallgren, 2017). This will mainly affect south going traffic since it is those lanes that will be reduced. Northbound traffic will not be affected. A wall will prevent vehicles from entering *Malmsjögatan* from *Gamlestadsvägen*. However, the traffic going west will still be able to access *Gamlestadsvägen* from *Malmsjögatan* as usual, making *Malmsjögatan* a one-way street. Existing eastbound traffic must find an alternative route during 2018.

Fruktgatan will be right on the edge of the project site and will therefore be closed in order to make room for the site and its fences (Fallgren, 2017). There is still a possibility to let the road remain, but with very limited capacity. *Partihandelsgatan* will be provided with a roundabout to increase the capacity and flow of the traffic.

Minuthandelsgatan will be closed. However, a new link will be opened before the old one is closed to ensure accessibility and therefore the consequences of this suspension will be very limited (Fallgren, 2017). During the project, it is most likely that *Kalles väg* will receive additional traffic. However, due to the disturbances to the railway, most of the additional traffic in the area will be large numbers of busses replacing the trams and trains.

4.4 Marieholmstunneln

2016 was the most intensive year regarding the work with *Marieholmstunneln*, at least when looking at the number of workers present at the construction site (Trafikverket, 2017). During spring 2017, the work with *Marieholmsmotet* will be finished.

In the summer of 2017 an intensive construction phase of E6, at *Tingstadsmotet*, will start (Trafikverket, 2017). This phase will last for two years and is supposed to enable the construction of connections to *Marieholmstunneln*, which is estimated to be completed in 2020.

4.4.1 Situation in autumn 2018

The completion of *Marieholmsmotet* in spring 2017 means that there will be no more changes in that part of the area (Trafikverket, 2017). The situation there will be the same in 2018. However, parts of *Marieholmsgatan* will still be suspended since it passes through the construction area.

Due to the construction phase of E6 at *Tingstadsmotet*, starting in the summer of 2017, it will be necessary to move all lanes a bit east (Trafikverket, 2017). Furthermore, the existing bridge over E6 will be dismantled and replaced by a newer one.

The *Marieholmsförbindelsen* project will be in the final stages during autumn 2018 and the main work will be the tunnel, which will not affect the road-bourne traffic (Hjorth & Mårtensson, 2017). The diversions and suspensions in 2018 will have a permanent standard which facilitates for motorists and gives better accessibility and safety.

4.4.2 Consequences for traffic in autumn 2018

There will be no or minor consequences for the traffic at *Marieholmsmotet*. On the other side of the river, there will be minor or almost no consequences due to the relocation of the lanes. However, the dismantling of the existing bridge over E6 and the construction of the new one will result in traffic over the bridge will have to be diverted via other roads.

4.5 Central station area

In the area around the Central station, several projects will be conducted during the same period. See Appendix IV for an illustration. The most critical period will be between 2016 - 2021 when the most prominent projects in the area, the Västlänken station, the new bridge *Hisingsbron* and the over docking of E45, will be conducted (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). In some points and areas, the projects are completely dependent on each other. Therefore, coordination between the projects within different technical areas, e.g. geotechnics and production, combined with accessibility for the traffic is necessary. Hence, one common mobility plan was produced for the whole area.

4.5.1 Situation in autumn 2018

To initiate the over decking process and the work with the tunnels, it is necessary to move the traffic from E45. Several measures are required to enable the project to carry through its work procedures. The entrance ramp onto E45 for eastbound traffic will be closed (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). The exit ramp for westbound traffic at *Stadstjänaregatan* will also be suspended. Traffic in both directions on E45 will be transferred to the newly built roadway just south of E45, north of the DHL logistic terminal and *Partihandelsgatan*.

Götatunneln will be partly closed due to reinforcement works to prepare for Västlänken (Edin, 2017). The tunnel will be open with full capacity for west going traffic whilst completely closed for the traffic going east, and will be so during the whole autumn. The Västlänken project will require a large and very long shaft in the area of *Kvarnberget*, which will extend along the existing road *Västra Sjöfarten* (Trafikverket, 2016). Today *Västra Sjöfarten* got two lanes in each direction, one for private traffic and one for public transport (Edin, 2017). Due to the planned shaft in the *Kvarnberget* area, a relocation of *Västra Sjöfarten* is necessary. The temporary stretch during the construction time will be located in the area just north-west of the shaft. See Appendix IV for an illustration of the situation. In order to prepare for the planned shaft at *Östra Hamngatan* the tramway in the intersection will be moved slightly east, closer to Nordstan (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). A reconstruction of *Kruthusgatan* to enable a connection between *Kruthusgatan*, *Bergslagsgatan*, *Partihandelsgatan* and the *Region City* work site will also be finished in 2018.

Stadstjänarebron will be dismantled which reduces the possibilities to cross the E45. *Bananbron*, will be the only way to cross the highway, except for the intersection at *Falutorget* further east. In preparation for the construction of a ramp connecting with *Nils Ericsonsgatan*, the *Hisingsbron* project will establish a work site between *Nils Ericsonsgatan* and the eastern ramp of *Götaälvbron*.

4.5.2 Consequences for traffic in autumn 2018

The suspension of the entrance ramp onto E45 means that eastbound traffic from the central parts will have to travel via a local street, *Partihandelsgatan*, stretching along the DHL logistic terminal just south of E45 (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). This will lead to an increased traffic along *Bergslagsgatan* and *Partihandelsgatan*. The suspension of the exit ramp from E45 at *Stadstjänaregatan* will contribute to this increase since westbound traffic, with destinations in central parts of the city, will have to exit E45 at *Falutorget*. From there the traffic will be split up between either the same local streets as east going traffic seeking to enter the E45, or *Gullbergs Strandgata*. The later alternative will put more pressure on *Norra Sjöfarten* and *Södra Sjöfarten*. The increased traffic could cause problems at the intersections along the concerned streets.

The transfer of both west and east going traffic on E45 to the temporary road, just south of the original position, is expected to generate small consequences (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). The traffic is simply moved a few meters south along a stretch without any intersections, hence no advanced diversions.

The closing of *Götatunneln* will result in east going traffic being forced to the surface (Edin, 2017). Exit ramps along E45 will most likely be heavily affected, in particular the exit ramp located at *Järntorget* since it is the last one before entering the tunnel. The eastbound traffic will be spread out on local streets all over Gothenburg. *Nya allén*, *Södra Allégatan* and *Parkgatan* are expected to become more trafficked. In order to return to E45 it is possible to enter either via *Partihandelsgatan* and *Bergslagsgatan* or travel via *Ullevigatan*, E6 and enter E45 via *Gullbergsmotet*. Analyses on a general level shows that *Ullevigatan* will be the more popular choice (Röström, 2017).

The temporary relocated *Västra Sjöfarten* in the *Kvarnberget* area will have one lane less for westbound traffic than the original road, resulting in public transport being forced to share lane with other traffic (Edin, 2017). East going traffic will still have two lanes. Its western end will still connect to *Norra Hamngatan* and *Residensbron* (Trafikverket, 2016). Its eastern end however, will connect both to the western *Bananbron* and an extension of *Östra Hamngatan*. Today, only public transport can connect to *Östra Hamngatan* from *Västra Sjöfarten*, but in 2018 other traffic will be able to do this as well. *Sankt Eriksgatan* will be removed which leads to reduced accessibility, due to loss of several connections, into the area east of the shaft. Otherwise, the consequences will be rather small.

The connection at *Kruthusgatan* will improve the accessibility for traffic heading to *Region City* or *Kruthusgatan* since the shaft for the Västlänken station will cut off the existing connection (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). The relocated tramway at *Östra Hamngatan* is expected to have small or no consequences on the traffic situation in 2018.

Due to the dismantling of *Stadstjärnarebron*, motorised traffic will be rerouted towards *Bananbron* via the existing roundabout in order to cross the E45 (Trafikverket & Göteborgs Stad Trafikkontoret, 2016). The accessibility for several road users will be affected. The established construction area for one of the *Hisingsbron* ramps will cause large consequences for motorists. Access to *Götaälvbron* will only be possible via *Drottningtorget* by driving past *Nils Ericsonterminalen* due to the suspension of the entrance ramp from *Bergslagsgatan*. Furthermore, the number of lanes for northbound traffic on *Götaälvbron* will be reduced to one lane for cars, instead of two, and one for public transport.

5 System Level Consequences

This report will state the consequences for the rescue service as result of the impacts from the projects. This chapter will describe the consequences for the primary dispatch net on a system level.

The primary dispatch net crosses several project areas, mostly Haga, Korsvägen and Olskroken, see Figure 5.1. However, by examining the mobility plans from each studied project, it could be determined that no planned construction measures in 2018 would directly affect the primary dispatch net. Hence, the primary dispatch net of Gårda fire station will still have the same layout and capacity during the studied period. However, the traffic flows along these roads could still increase or decrease due to changes in the traffic system caused by the projects.

The primary dispatch net has been examined regarding the traffic per lane for each road section, which is presented in graphs in this chapter. By calculating the area under the graphs it was possible to estimate the traffic flows in vehicle-kilometres for both year 2015 and 2018. Since the length of the routes will remain the same, it was possible to calculate the change in traffic flows. This will be presented in tables in this chapter. The road sections and traffic flow data used to generate the graphs, are compiled in tables which can be found in Appendix V.

Due to the design of the primary dispatch net, the routes have been divided into different parts for the Linnéplatsen/Masthugget area in order to make the results more comprehensible. Sections with lanes for public transport, bus lanes, are highlighted in order to show problem areas and possible extra space for the rescue service.

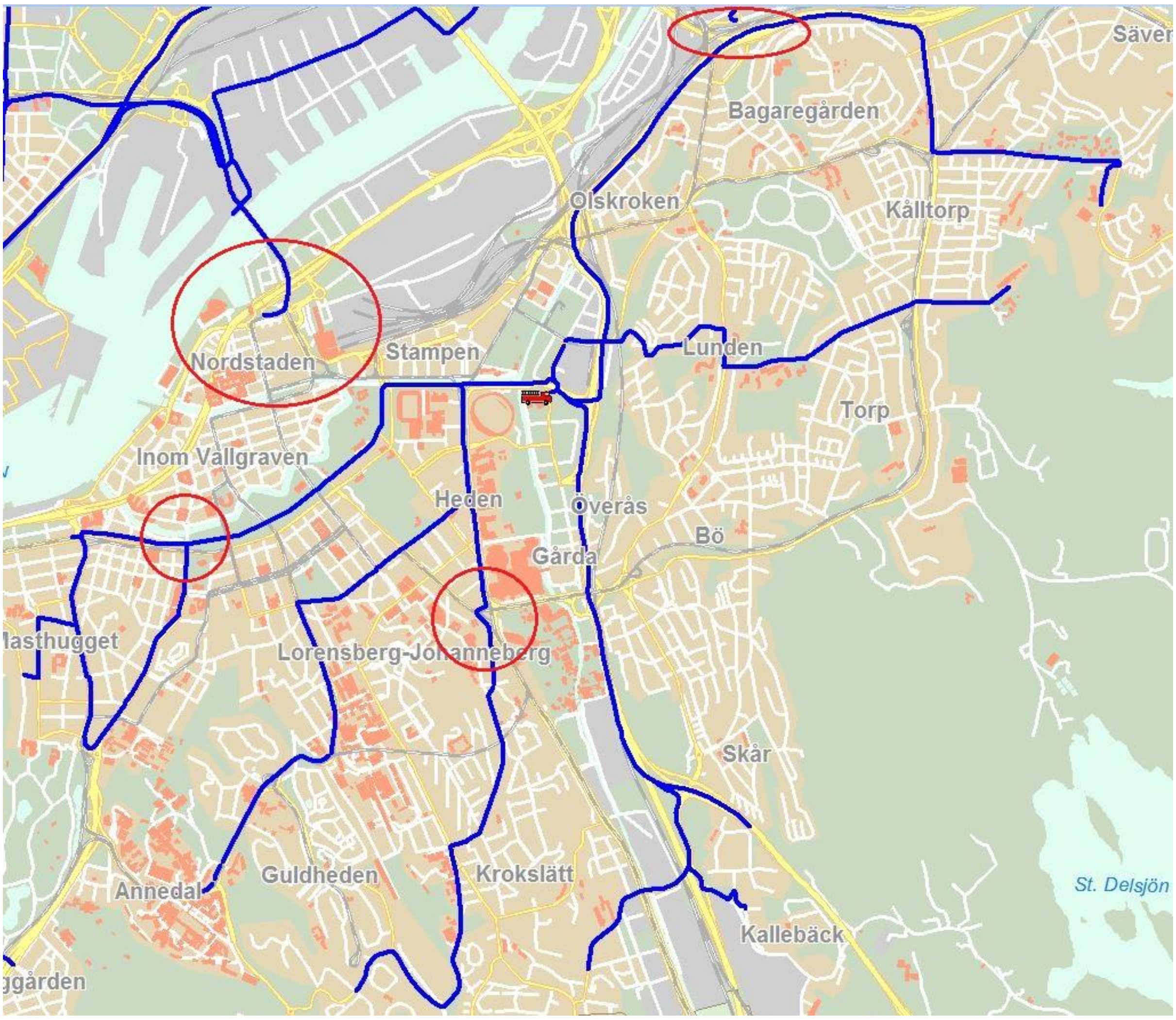


Figure 5.1 The primary dispatch net for Gårda fire station and the studied project areas (Lövberg, 2017).

5.1 Linnéplatsen/Masthugget

As can be seen in Figure 5.1, the primary dispatch net going through Haga, Linné and Masthugget, is designed as a branch. Therefore, it was divided into three parts to avoid including large parts of same roads several times.

5.1.1 Part 1 – via Järntorget

Part 1, the longest route, is from Gårda fire station and goes to Linnéplatsen via Järntorget. The traffic is presented in Figure 5.2 and Figure 5.3.

In the morning, the traffic will increase along almost the whole stretch except along *Norra Allégatan*, the last part of *Nya allén* and around *Järntorget* where there will be a slight decrease in traffic. The part which will have the largest increment of traffic (from 190 veh/h to 353 veh/h in 2018) is the section of *Ullevigatan* between *Skånegatan* and *Nya allén*. The most trafficked section along the route from Gårda fire station to *Linnéplatsen* was and will still be the section of *Nya allén* between *Sten Sturegatan* and *Södra Vägen*.

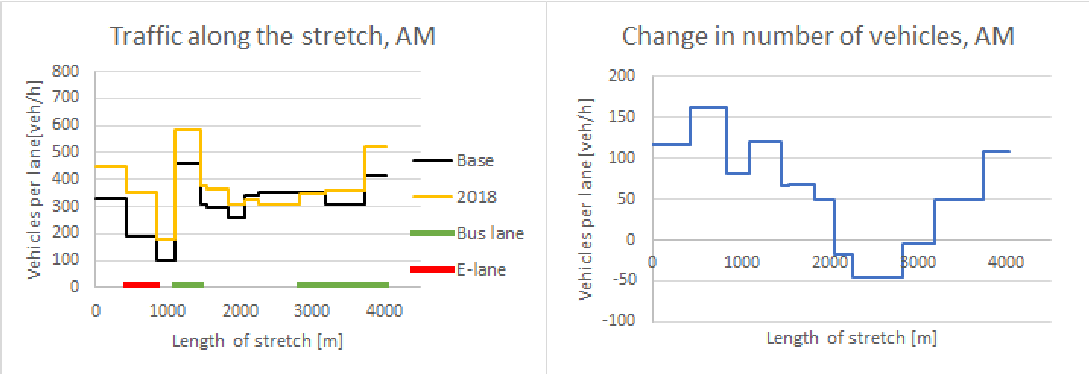


Figure 5.2 *The traffic flows, during morning peak hours, along Part 1 from Gårda to Linnéplatsen via Järntorget. Emergency and public transport lanes show possibilities to circumvent problem areas.*

In the afternoon, the traffic flow along the stretch will generally increase. The largest increment (from 486 veh/h to 605 veh/h in 2018) will be along the last section of *Linnégatan*. The most trafficked part was and will still be *Nya allén* between *Sten Sturegatan* and *Södra Vägen*, the same section as during the morning peak hours.

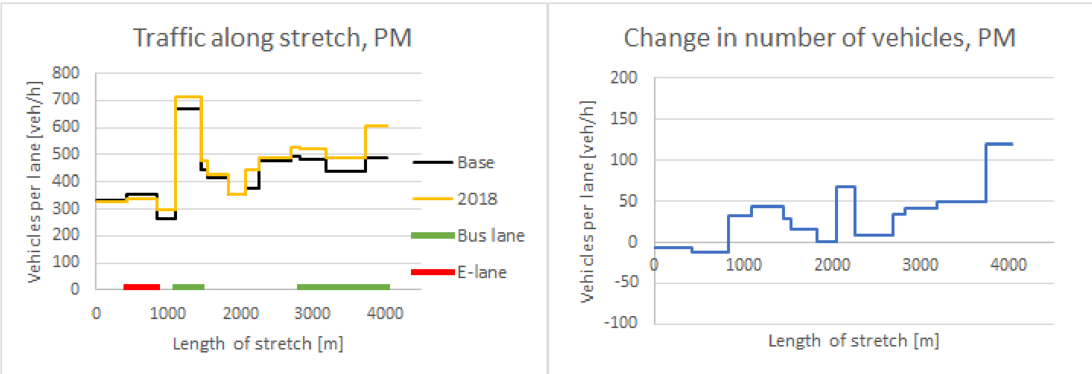


Figure 5.3 *The traffic flows, during afternoon peak hours, along Part 1 from Gårda to Linnéplatsen via Järntorget. Emergency and public transport lanes show possibilities to circumvent problem areas.*

Generally, the traffic flows will increase along the route during both morning and afternoon peak hours. The morning traffic situation will experience the most change. However, the number of vehicles will generally be higher during the afternoon, see Table 5.1. Seen to the whole day, the traffic will increase with around 12.2% along Part 1.

Table 5.1 Table showing the change of vehicle-kilometres, hence traffic flows, along Part 1.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	1268.9	1513.6	1737.1	1859.2
Increase [Veh*km]	-	244.8	-	122.0
Increase [%]	-	19.3%	-	7.0%
Average [Veh/h]	315	376	432	462
Max [Veh/h]	463	583	670	713
Min [Veh/h]	99	179	266	299

According to the simulation results, congestion and queues are to be expected along Part 1. Originally, during the morning peak hours, queues are likely to occur along the last section of *Ullevigatan*. However, during mornings in 2018 no queues are expected to arise. Originally, in the afternoon no queues are expected. However, during afternoons in 2018, queues are expected to arise along the section of *Ullevigatan* between Gårda fire station and *Skånegatan*. The increased traffic could cause a deterioration of the accessibility, and in turn prolonged travel times. As seen in Figure 5.2 and Figure 5.3, there are public transport lanes along many of the highly-trafficked roads which could be used to bypass the traffic. There is also an emergency lane, along *Ullevigatan* between *Skånegatan* and *Nya allén*, which could prove useful. This could reduce the negative impact on the accessibility.

5.1.2 Part 2 – via Sprängkullsgatan

Part 2 of the primary dispatch net through the area starts from *Nya allén* instead of Gårda fire station, since those roads are the same as for Part 1. Part 2 goes to *Linnéplatsen* via *Sprängkullsgatan* and *Övre Husargatan*. The traffic is presented in Figure 5.4 and Figure 5.5.

In the morning, the traffic flow will increase slightly along the whole stretch. The largest increment (from 362 veh/h to 468 veh/h in 2018) will be along the first section of *Sprängkullsgatan* between *Nya allén* and *Vasagatan*. Originally, the section of *Sprängkullsgatan* between *Vasagatan* and *Skanstorget* was the most trafficked stretch of the route and it will continue to be so in 2018 as well.

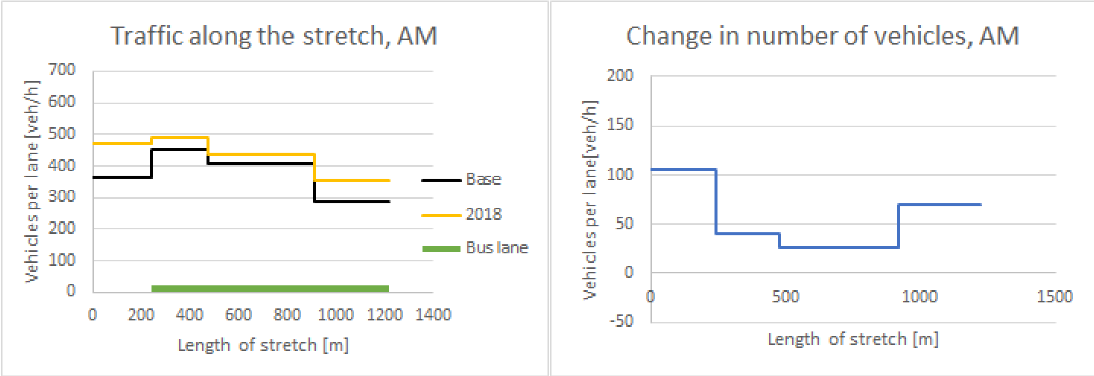


Figure 5.4 *The traffic flows, during morning peak hours, along Part 2 from Nya allén to Linnéplatsen via Sprängkullsgatan. Public transport lanes show possibilities to circumvent problem areas.*

In the afternoon, the traffic flow will increase slightly along almost the whole stretch except along the last section of *Sprängkullsgatan* where the traffic will remain the same. The number of vehicles is around 600 veh/h throughout the whole stretch except along the last section of *Övre Husargatan* between *Nordenskiöldsgatan* and *Linnéplatsen*, where the traffic will be around 500 veh/h in 2018.

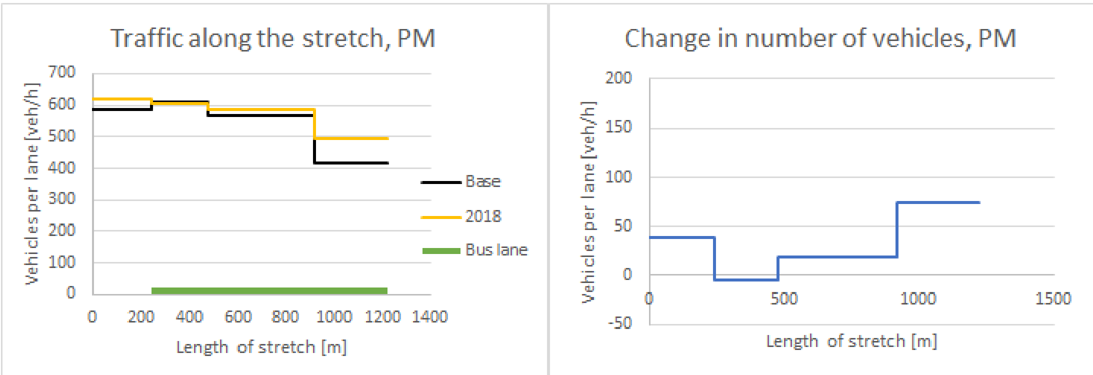


Figure 5.5 *The traffic flows, during afternoon peak hours, along Part 2 from Nya allén to Linnéplatsen via Sprängkullsgatan. Public transport lanes show possibilities to circumvent problem areas.*

Generally the traffic will increase during both the morning and afternoon peak hours. According to Table 5.2, the morning peak hours will increase the most. However, the traffic flows along the route will still be higher in the afternoon than in the morning. Seen to the whole day, the traffic will increase with approximately 9.6% along Part 2.

Table 5.2 Table showing the change of vehicle-kilometres, hence traffic flows, along Part 2.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	458.9	527.0	660.9	700.1
Increase [Veh*km]	-	68.1	-	39.2
Increase [%]	-	14.8%	-	5.9%
Average [Veh/h]	376	432	542	574
Max [Veh/h]	450	490	608	622
Min [Veh/h]	286	356	418	493

According to the simulation results, congestion and queues are to be expected along Part 2. During the morning, no queues are to be expected either originally or in 2018. During the afternoon however, queues are to be expected along the first section of *Sprängkullsgatan* between *Nya allén* and *Vasagatan*, both originally and in 2018. The increased traffic could indicate a deterioration of the accessibility along the route, and in turn point to prolonged travel times. As seen in Figure 5.4 and Figure 5.5, there are public transport lanes along most of the stretch which could reduce the negative effect of increased traffic.

5.1.3 Part 3 – Prinsgatan to Jungmansgatan

Part 3 is the remaining part of the primary dispatch net in the area. It is a branch of Part 1 and it starts from *Linnégatan* and goes to *Jungmansgatan*. The traffic is presented in Figure 5.6 and Figure 5.7.

In the morning, the traffic flow will decrease slightly along the whole stretch. The flows along the stretch are relatively equal with no larger differences between the sections.

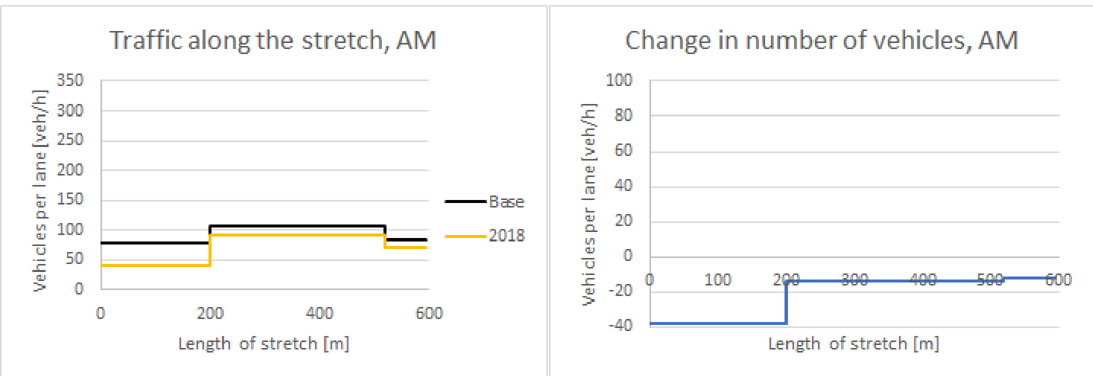


Figure 5.6 The traffic flows, during morning peak hours, along Part 3 from Prinsgatan to Jungmansgatan.

In the afternoon, the traffic flow will remain almost the same throughout the stretch except along the last section of the route where the traffic will increase from 241 veh/h to 327 veh/h in 2018. The traffic flow along the route during the afternoon varies a bit more than in the morning.

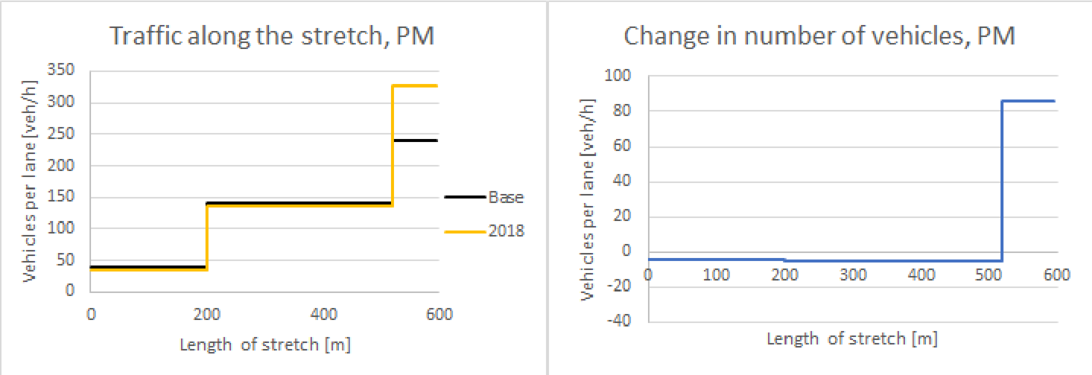


Figure 5.7 The traffic flows, during afternoon peak hours, along Part 3 from Prinsgatan to Jungmansgatan.

The traffic along the route will decrease except along the last section during the afternoon, as can be seen in Figure 5.6 and Figure 5.7. According to Table 5.3, the morning traffic flows will decrease and the afternoon traffic flows will increase. The traffic in the afternoon will still be higher than the traffic in the morning. Generally, there will be a decrease of traffic, approximately 7.0%, along Part 3. This indicates an improvement of the accessibility along the route.

Table 5.3 Table showing the change of vehicle-kilometres, hence traffic flows, along Part 3.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	56.1	43.2	71.0	75.0
Increase [Veh*km]	-	– 13.0	-	4.1
Increase [%]	-	– 23.1%	-	5.7%
Average [Veh/h]	94	73	119	126
Max [Veh/h]	106	92	241	327
Min [Veh/h]	80	42	39	35

5.2 Guldheden via Korsvägen

The traffic along the primary dispatch net starting at Gårda fire station and going to Guldheden via *Korsvägen*, *Skånegatan* and *Eklandagatan* is presented in Figure 5.8 and Figure 5.9.

In the morning, the traffic will remain almost the same or decrease slightly except an increase in traffic (from 331 veh/h to 447 veh/h in 2018) along *Ullevigatan*, see Figure 5.8. *Ullevigatan* will also be the most trafficked road along this primary dispatch route during the morning peak hours in 2018.

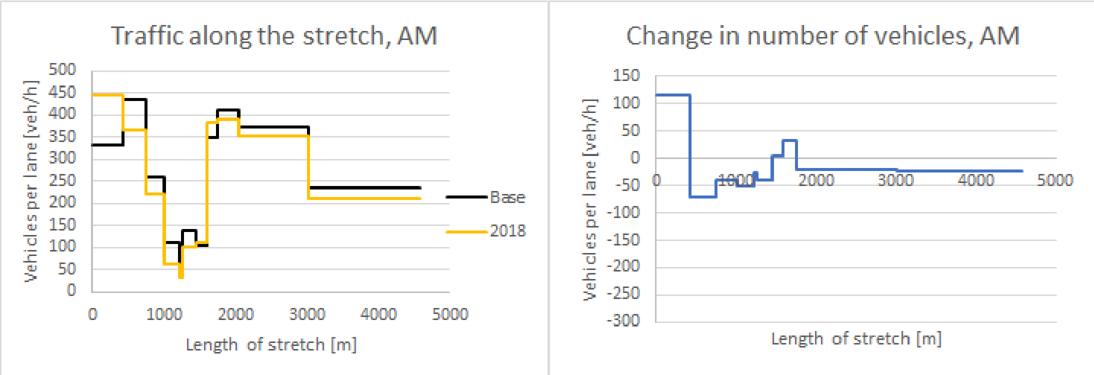


Figure 5.8 The traffic flows, during morning peak hours, from Gårda to Guldheden via Korsvägen.

In the afternoon, there will be a significant decrease in traffic along *Skånegatan* and *Eklandagatan*, see Figure 5.9. The traffic along *Eklandagatan*, which originally was the most trafficked part of the route, will be halved down to 215 veh/h. In 2018, *Korsvägen* will be the most trafficked section in the afternoon.

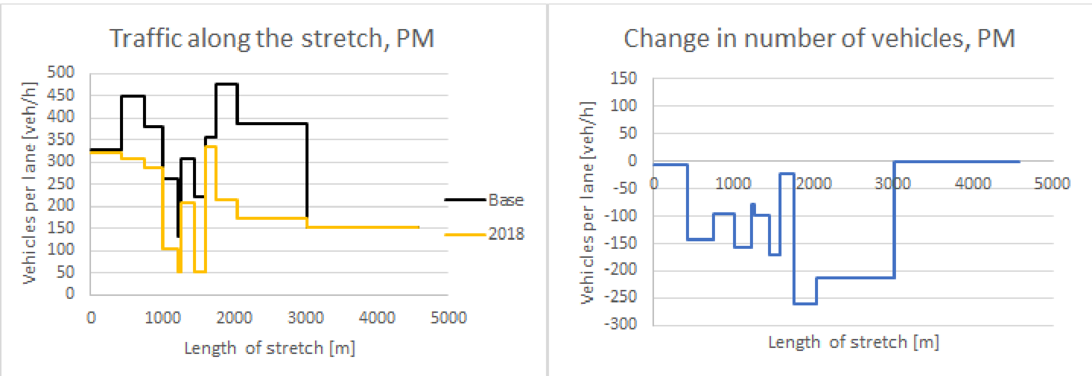


Figure 5.9 The traffic flows, during afternoon peak hours, from Gårda to Guldheden via Korsvägen.

According to Table 5.4, the traffic situation will generally improve during 2018 compared to the original situation. The traffic flows in the afternoon will change the most and the traffic situation will be better in the afternoon than in the morning. Seen to the whole day, the traffic flows will generally decrease with 18.7%.

Table 5.4 Table showing the change of vehicle-kilometres, hence traffic flows, along the route from Gårda to Guldheden via Korsvägen.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	1323.5	1263.7	1347.5	908.4
Increase [Veh*km]	-	– 59.7	-	– 439.1
Increase [%]	-	– 4.5%	-	– 32.6%
Average [Veh/h]	289	276	294	198
Max [Veh/h]	437	447	476	335
Min [Veh/h]	56	31	132	52

According to the simulation results, congestion and queues are to be expected along the route. Originally, no queues are expected. However, during morning peak hours in 2018, queues are likely to occur along the last section of *Korsvägen*. This queue is expected to be present during the afternoon peak hours as well. In addition to this, queues are also likely to occur along the section of *Ullevigatan* between Gårda fire station and *Skånegatan* in the afternoon. This is the same section as in Part 1 for *Linnéplatsen*/*Masthugget*. There are no public transport lanes along the route which means that the impact from the change in traffic cannot be reduced through bypassing in adjacent public transport lanes. However, the general decrease of traffic along the route could point to an improved accessibility.

5.3 Sahlgrenska/Annedal

The traffic along the primary dispatch net starting at Gårda fire station and going to the Sahlgrenska hospital and Annedal, via Chalmers, is presented in Figure 5.10 and Figure 5.11.

In the morning, the traffic flow will remain almost the same or slightly decrease along the first half of the route except *Ullevigatan* as mentioned earlier, see Figure 5.10. The second half of the route will have an increased traffic flow. *Aschebergsgatan* was the most trafficked road originally and will continue to be so during 2018 (increases from 532 to 613 veh/h, in 2018).

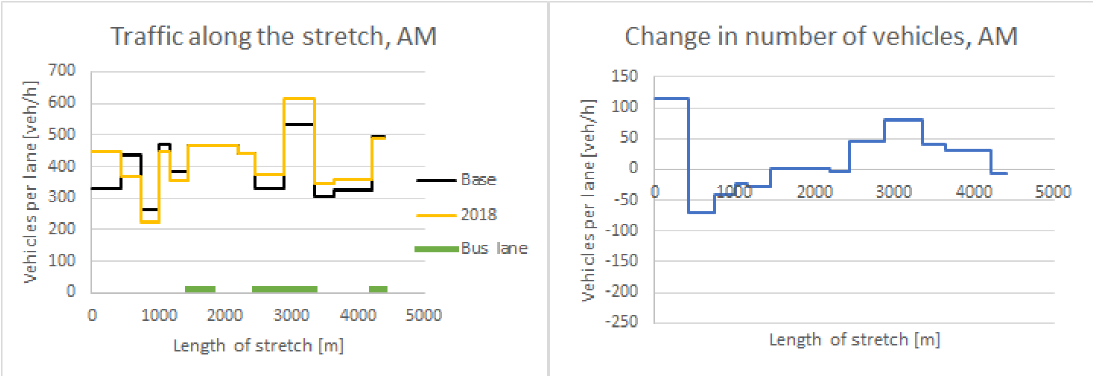


Figure 5.10 The traffic flows, during morning peak hours, from Gårda to Sahlgrenska/Annedal via Chalmers. Public transport lanes show possibilities to circumvent problem areas.

In the afternoon, there will be a significant decrease in traffic flow along the first part of the route, *Skånegatan*, as mentioned earlier. Otherwise, along most of the route the traffic flow will increase, see Figure 5.11.

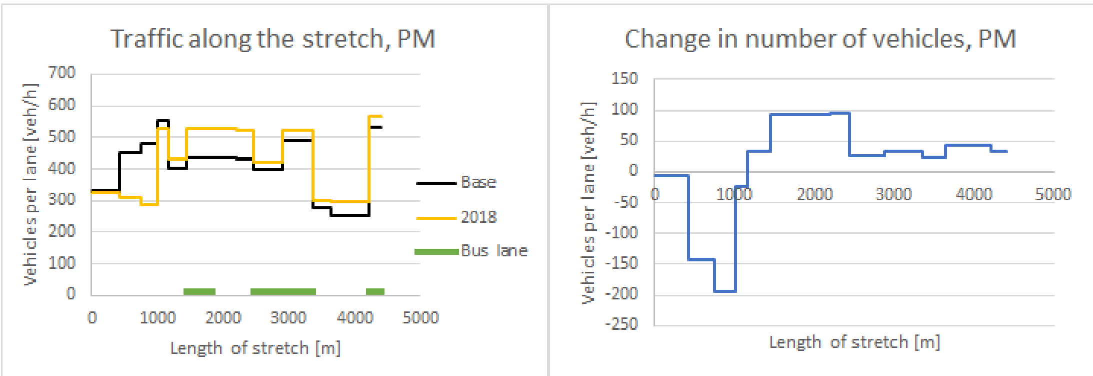


Figure 5.11 The traffic flows, during afternoon peak hours, from Gårda to Sahlgrenska/Annedal via Chalmers. Public transport lanes show possibilities to circumvent problem areas.

As shown in Figure 5.10 and Figure 5.11, the traffic will decrease along *Skånegatan* both during the morning and the afternoon peak hours. However, there will be a general increase of traffic along the rest of the route with 4.4% seen to the whole day. According to Table 5.5, the morning traffic flows will increase the most, but the flows will be more or less the same during the morning and afternoon peak hours.

Table 5.5 Table showing the change of vehicle-kilometres, hence traffic flows, along the route from Gårda to Sahlgrenska/Annedal via Chalmers.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	1747.2	1839.7	1770.7	1833.9
Increase [Veh*km]	-	92.4	-	63.3
Increase [%]	-	5.3%	-	3.6%
Average [Veh/h]	397	418	402	417
Max [Veh/h]	532	613	552	568
Min [Veh/h]	261	221	251	286

No queues are expected along the route except during the afternoon in 2018, along the first section of *Ullevigatan* as mentioned earlier, which will affect this route as well. The general increase of traffic along the route could point to a deterioration of the accessibility. There are public transport lanes present along some parts of the stretch which could be used to reduce the negative impact from the increased traffic flows.

5.4 Kålltorp via E6/E20

The traffic along the primary dispatch net starting at Gårda fire station and going to Kålltorp via *Munkebäcksmotet* is presented in Figure 5.12 and Figure 5.13. However, the simulation does not cover areas beyond *Torpagatan* and therefore the primary dispatch net will only be examined to that point.

In the morning, there will be a rather large increase in traffic flow along E6 and its interchanges and along *Torpagatan*. The traffic flow along E20, between the interchange from E6 and the exit ramp, will remain almost the same or decrease slightly. The interchange from E6 to E20 was and will still be the most trafficked section of the route during the morning.

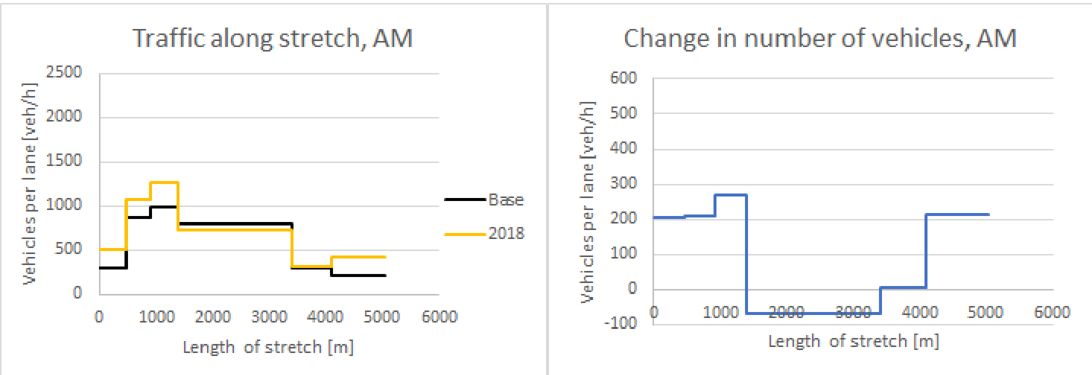


Figure 5.12 The traffic flows, during morning peak hours, from Gårda to Kålltorp via E6/E20.

In the afternoon, the traffic will increase along almost the whole route. Especially the traffic flow on the interchange from E6 to E20 will experience a major increase (from 1470 veh/h to 2030 veh/h in 2018). The interchange will have the highest traffic flow per lane in 2018, originally it was E20.

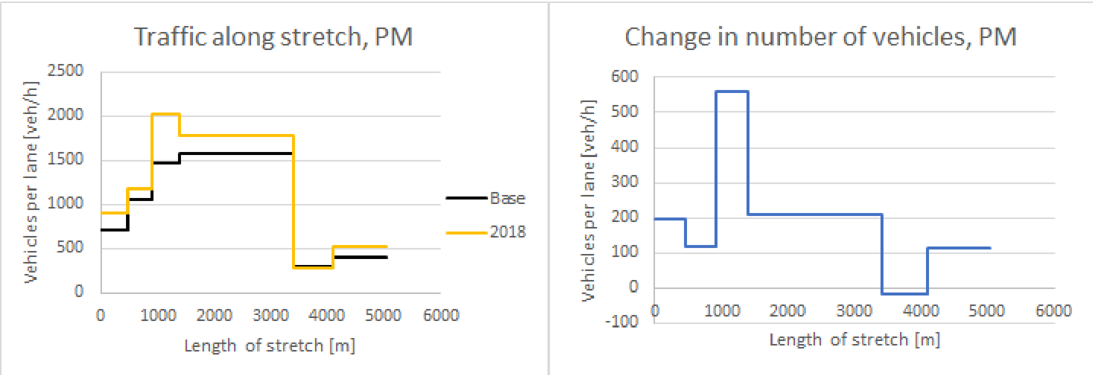


Figure 5.13 The traffic flows, during afternoon peak hours, from Gårda to Kålltorp via E6/E20.

According to Table 5.6, the traffic flows will generally increase along this route, especially during the afternoon. The traffic flows will also be much higher during the afternoon than in the morning. Seen to the whole day, the traffic flows will increase with 15.8%.

Table 5.6 Table showing the change of vehicle-kilometres, hence traffic flows, along the route from Gårda to Kålltorp via E6/E20.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	3020.3	3397.0	5258.1	6186.7
Increase [Veh*km]	-	376.7	-	928.6
Increase [%]	-	12.5%	-	17.7%
Average [Veh/h]	599	674	1043	1228
Max [Veh/h]	988	1256	1568	2030
Min [Veh/h]	208	308	295	277

Originally in the morning, there are no queues along the route. However, during morning peak hours in 2018 queues are expected to occur along E6 between the slip road and the interchange to E20. The original queue situation, during afternoon peak hours, indicates that queues are expected to occur along the same part of E6 as just mentioned and along a section of *Munkebäcksgatan*. In the afternoon in 2018, these two locations will still be exposed to queues. Moreover, queues are expected to arise along the last part of *Ullevigatan* and the slip road on to E6 as well. The increased traffic flows and number of queues indicates a deterioration of the accessibility along the route.

5.5 Kålltorp via Lunden

The traffic along the primary dispatch net starting at Gårda fire station and going to Kålltorp via Lunden is presented in Figure 5.14 and Figure 5.15. However, the simulation does not cover areas beyond *Kärralundsgatan* and therefore the primary dispatch net will only be examined to that point.

In the morning, the traffic is expected to increase throughout the whole stretch, see Figure 5.14. Especially along the roads *Rantorget*, *Willinsbron* and *Sankt Pauligatan* which are expected to have a significant increase of traffic flow. The highest traffic flow during the morning peak hours will be along *Rantorget* (from 471 veh/h to 549 veh/h in 2018).

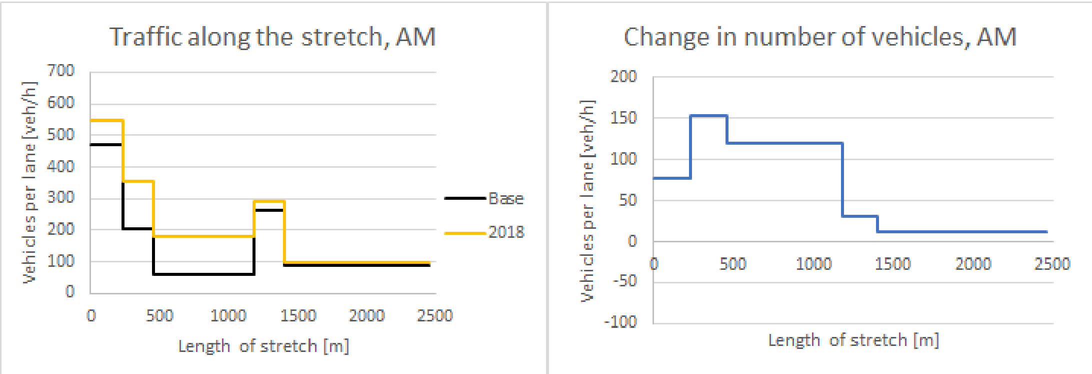


Figure 5.14 The traffic flows, during morning peak hours, from Gårda to Kålltorp via Lunden.

The traffic in the afternoon is expected to increase slightly along *Sankt Pauligatan* and *Ingeborgsgatan*, see Figure 5.15. Otherwise the traffic situation will remain almost the same except a decrease on *Danskavägen*. The highest traffic flow during the afternoon peak hours will be along *Willinsbron* (from 636 veh/h to 656 veh/h in 2018).

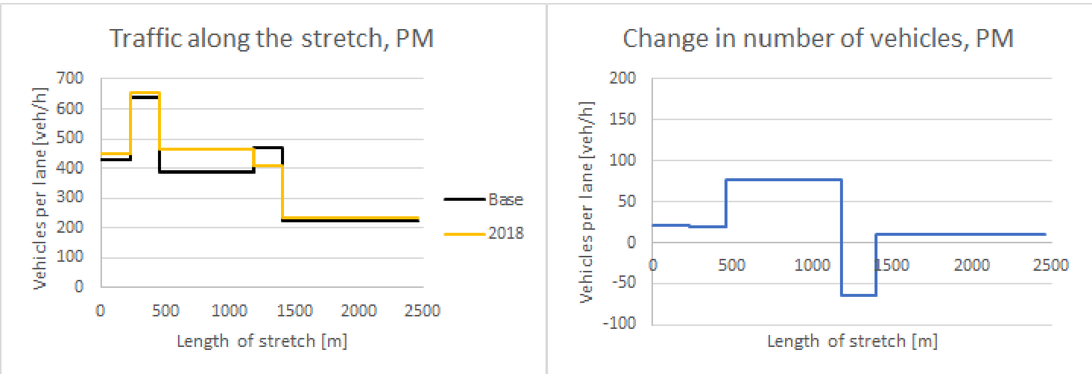


Figure 5.15 The traffic flows, during afternoon peak hours, from Gårda to Kålltorp via Lunden.

According to Table 5.7, the traffic will generally increase along the route during both the morning and afternoon peak hours. Furthermore, it can be seen that the morning flows will increase the most but the afternoon flows will still be higher. Seen to the whole day, the traffic will increase with 18.3%.

Table 5.7 Table showing the change of vehicle-kilometres, hence traffic flows, along the route from Gårda to Kålltorp via Lunden.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	345.6	503.8	865.6	928.7
Increase [Veh*km]	-	158.2	-	63.0
Increase [%]	-	45.8%	-	7.3%
Average [Veh/h]	141	205	353	378
Max [Veh/h]	471	549	636	656
Min [Veh/h]	59	98	226	237

According to the simulations, there is risk of queues occurring along the route. During the morning peak hours in 2018, queues are expected to arise at *Willinsbron*. Originally during the afternoon peak hours, *Willinsbron* is also exposed to queuing. However, during the afternoon in 2018 it is expected to be no queues. The increased traffic flows points to a reduced accessibility along the route.

5.6 Kallebäck via E6

The primary dispatch net going to Kallebäck via E6 is split up into branches at *Kallebäcksmotet*. However, the simulation does not cover areas beyond *Kallebäcksmotet* and therefore the primary dispatch net will only be examined to that point. The traffic along the route is presented in Figure 5.16 and Figure 5.17.

In the morning, the traffic will remain more or less the same in 2018, see Figure 5.16. The most trafficked section was and will still be E6 between *Ullevimotet* and *Örgrytemotet* (from 1062 veh/h to 1061 veh/h in 2018).

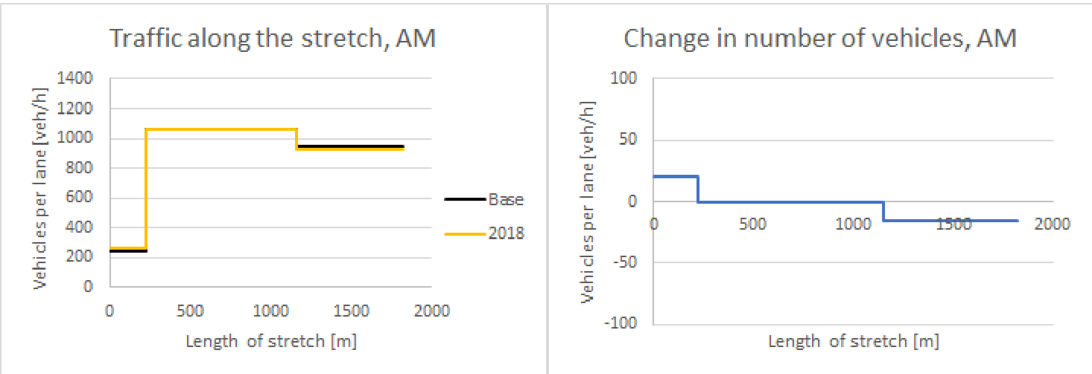


Figure 5.16 The traffic flows, during morning peak hours, from Gårda to Kallebäck via E6.

The traffic in the afternoon will only experience small changes in traffic as well, and it will hardly be enough to be noticeable, see Figure 5.17. Therefore, it can be said that the traffic flow will be almost the same in 2018. The most trafficked section was and will be E6, the same section as in the morning (from 1352 veh/h to 1305 veh/h in 2018).

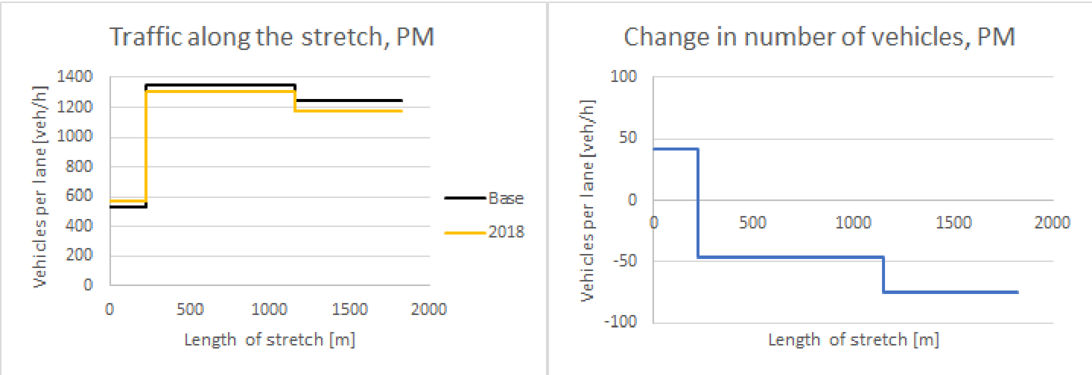


Figure 5.17 The traffic flows, during afternoon peak hours, from Gårda to Kallebäck via E6.

According to Table 5.8, the traffic flows along this route will remain almost the same during the morning while slightly decrease during the afternoon in 2018, compared to the original traffic situation. The flows will generally be higher in the afternoon. Seen to the whole day, the traffic will decrease with 2.4%.

Table 5.8 Table showing the change of vehicle-kilometres, hence traffic flows, along the route from Gårda to Kallebäck via E6.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	1673.9	1666.8	2205.9	2121.7
Increase [Veh*km]	-	– 7.1	-	– 84.1
Increase [%]	-	– 0.4%	-	– 3.8%
Average [Veh/h]	920	916	1212	1166
Max [Veh/h]	1062	1061	1352	1305
Min [Veh/h]	245	265	527	569

According to the simulation results, there is risk of queues occurring along the route. During the morning peak hours, both originally and in 2018, no queues are expected to occur. However in the afternoon, originally, there is risk of queues along E6 between *Ullevimotet* and *Gårdamotet* and between *Örgrytemotet* and *Kallebäcksmotet*. During the afternoon in 2018, the risk of queues will decrease but are expected to arise along the last part of *Ullevigatan*, the same section as for Kålltorp via E6. The general preservation or slight decrease of traffic flows and general decrease of number of queues points to an improvement of the accessibility along the route.

5.7 Summary system level consequences

Seen to the total length of the primary dispatch net, the traffic will generally increase. The percentage of the stretch with increased traffic will be 57% during the morning peak hours and 58% during the afternoon peak hours. The increments of traffic are also generally larger, seen to the number of vehicles, than the reductions. The traffic will increase with 8.4% in the morning and 5.8% in the afternoon. Seen to the whole day, the traffic will increase with 6.9% along the primary dispatch net.

Concerning queues along the primary dispatch net, it can clearly be seen in Table 5.9 that the number of queues will increase in 2018.

Table 5.9 Table showing the change in queues along the primary dispatch net.

Queues system level		
	2015	2018
AM	1	3
PM	6	7
Total	7	10

6 Local Level Consequences

Even though the projects will not directly affect the primary dispatch net, most of them will still have an impact on roads in their respective areas. Suspension and narrowing of roads and dismantling of bridges will result in loss of links along the secondary and/or remaining dispatch net, which could affect the accessibility negatively. Therefore, based on the information in chapter 4 Impacts from Projects, the consequences for the accessibility along possible alternative routes have been studied and compared to the original routes. The direct consequences will be presented as the change, in different factors concerning the road design, between the original routes and the alternative routes. The indirect consequences, change of traffic flows in traffic per lane, along the roads will also be presented.

As in chapter 5 System Level Consequences, the vehicle-kilometres will be calculated for the original and alternative routes in order to estimate the increase or decrease. However, the original and alternative routes may differ in length and therefore the change in vehicle-kilometres describes both the change in traffic flows and length. There was lack of traffic flow data for some roads along a few routes. Therefore, the vehicle-kilometres were not calculated for those routes.

6.1 Haga - Rosenlundsbron

As described in chapter 4 Impacts from Projects, the primary dispatch net in Haga will not be affected directly since the area south of the canal will remain the same during 2018. The impacts on the traffic system during 2018 will be north of and over the canal due to the dismantling of *Rosenlundsbron*.

The dismantling of *Rosenlundsbron* results in a loss of a north-south link (Alt. 0) over the canal. Fire engines traveling on the primary dispatch net along *Nya allén* will have to cross the canal via another bridge. Hence, it is of interest to investigate the alternative paths towards the north end of *Rosenlundsbron*. The three closest bridges are *Viktoriabron* (Alt.1), *Vasabron* (Alt. 2), and *Pusterviksbron* (Alt. 3). All alternative routes start at Gårda fire station and goes via *Ullevigatan* and *Nya allén*, but they differ from the intersection *Raoul Wallenbergs gata - Nya allén*. This point will be referred to as the point of difference. See Figure 6.1 for an illustration.

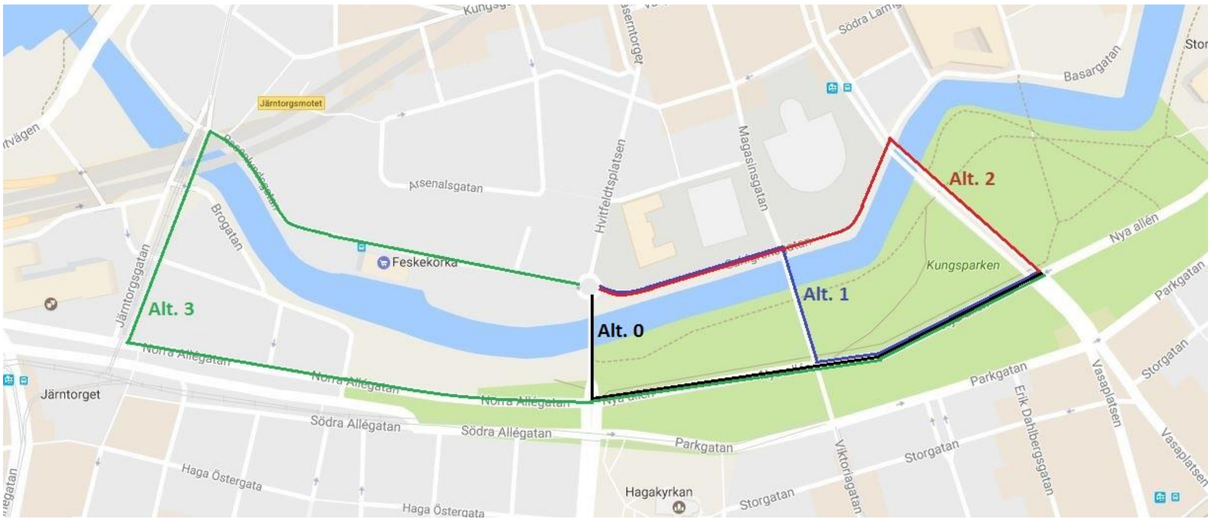


Figure 6.1 The original and alternative routes in the Haga area.

The original route via *Rosenlundsbron*, Alternative 0, is approximately 535 m when measured from the point of difference. From that location, the route passes three intersections with traffic lights, where a 90 degree turn towards right is necessary in the crossing *Sprängkullsgatan - Nya allén*. There are no traffic calming measures along the way. Table 6.1 shows the distances, traffic flows and number of lanes for each section.

Table 6.1 Alternative 0 for the Haga area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	Base PM [veh/h]	Number of lanes (total ; public transport)
Nya allén (*Raoul Wallenbergs gata* - *Viktoriagatan*)	225	257	355	3 ; 0
Nya allén (*Viktoriagatan* - *Sprängkullsgatan*)	205	297	378	3 ; 0
Rosenlundsbron/ Sprängkullsgatan (*Nya allén* - *Hvitfeldtsplatsen*)	105	208	157	1 ; 0

Alternative 1, via *Viktoriabron*, is 515 m long and slightly shorter than Alternative 0. However, it also results in the need of making one additional 90 degree turn at the intersection *Magasinsgatan - Sahlgrensgatan*. The route also passes three crossings which is the same number as Alternative 0. Two of the crossings are regulated with traffic signals and one, the intersection mentioned above, where it is necessary to make a left turn and pass through oncoming traffic. There are no traffic calming measures along the route. See Table 6.2 for a compilation of the sections along Alternative 1.

Table 6.2 Alternative 1 for the Haga area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Nya allén (*Raoul Wallenbergs gata - Viktoriagatan*)	225	257	307	19%	355	355	0%	3 ; 0
Viktoriabron/ *Viktoriagatan* (*Nya allén - Sahlgrensgatan*)	110	235	425	81%	75	160	113%	1 ; 0*
Sahlgrensgatan (*Viktoriabron - Hvitfeldtsplatsen*)	180	145	300	107%	50	80	60%	1 ; 0

** The lane is a combined lane, with rail for trams.*

Alternative 2, via *Vasabron*, is 520 m long and slightly shorter than Alternative 0. Also in this case it is necessary to make one extra 90 degree turn to the left and cross the path of oncoming traffic. From the point of difference the route crosses three intersections where one is regulated with traffic lights. It is worth noting that the section of *Sahlgrensgatan* between *Vasabron* and *Viktoriabron*, is a one way road in the opposite direction. Furthermore, there is a speed hump along the way. See Table 6.3 for a compilation of the sections along Alternative 2.

Table 6.3 Alternative 2 for the Haga area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Raoul Wallenbergs gata/*Vasabron* (*Nya allén - Sahlgrensgatan*)	185	447	477	7%	341	445	30%	2 ; 1
*Sahlgrensgatan** (*Vasabron - Viktoriabron*)	155	90	90	0%	108	108	0%	0 ; 0*
Sahlgrensgatan (*Viktoriabron - Hvitfeldtsplatsen*)	180	145	300	107%	50	80	60%	1 ; 0

** One way road in opposite direction.*

Alternative 3, via *Pusterviksbron*, is 1465 m long which is much longer than Alternative 0. This route requires an extra 90 degree turn as well, just like Alternative 1 and 2. However, the path passes three additional crossings, where two of them are regulated by traffic lights and the third is a roundabout, compared to the other alternatives. Furthermore, there are two elevated pedestrian crossings along this route. See Table 6.4 for a compilation of the sections along Alternative 3.

Table 6.4 Alternative 3 for the Haga area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Nya allén (*Raoul Wallenbergs gata - Viktoriagatan*)	225	257	307	19%	355	355	0%	3 ; 0
Nya allén (*Viktoriagatan - Sprängkullsgatan*)	205	340	323	-5%	378	445	18%	3 ; 0
Norra Allégatan (*Sprängkullsgatan - Järntorgsgatan*)	430	353	308	-13%	477	486	2%	2 ; 0
Järntorgsgatan/ *Pusterviksbron* (*Norra Allégatan - Rosenlundsgatan*)	210	70	350	400%	150	320	113%	2 ; 1
Rosenlundsgatan (*Pusterviksbron - Hvitfeldtsplatsen*)	395	74	39	-47%	190	190	0%	1 ; 0

The original route, Alternative 0, is as shown in Table 6.5 clearly better than the other alternatives regarding the number of lanes in the driving direction and the length of stretch with less than two lanes. However, if the traffic is low enough or moves fast enough to not obstruct the rescue service, the number of lanes is of less importance regarding the accessibility.

Table 6.5 Compilation of the differences between the alternatives in Haga.

	Distance [m]	Number of sharp turns	Number of intersections	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	535	1	3	2.61	105 ; 20%	0
Alt. 1	515	2	3	1.87	290 ; 56%	0
Alt. 2	520	2	3	1.06*	335 ; 64%	1
Alt. 3	1465	2	6	2.02	395 ; 27%	2

** If the one way road in opposite direction is assumed as a lane, then the value is 1.36.*

Looking at the alternative routes in 2018, Alternative 3 could be ruled out due to the long distance and high number of intersections which could highly affect the accessibility in a negative way. Furthermore, according to the simulation results regarding congestion and queues in 2018, no queues are to be expected in the Haga area except during the morning peak hours along the section of *Sahlgrensgatan* with one way traffic which is a part of the Alternative 2 route. With the expected congestion along this section, in addition to the fact that it is a one way street in the opposite direction with only one lane, Alternative 2 would not be possible to use during the peak hours.

Alternative 1 is, according to several factors, adequate to Alternative 0 and therefore considered the most favourable route in 2018, even though the number of lanes available could cause problem during much congestion. According to Table 6.6, the vehicle-kilometres along Alternative 1 will be higher than along Alternative 0 in the morning, but lower in the afternoon. Seen to the whole day, there will be a general decrease of vehicle-kilometres with 10.4%. This could indicate an improved accessibility in the Haga area via Alternative 1.

Table 6.6 The change of vehicle-kilometres between using Alternative 0 in 2015 and Alternative 1 in 2018, in the Haga area.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	140.4	169.8	173.9	111.9
Increase [Veh*km]	-	29.3	-	– 62.0
Increase [%]	-	20.9%	-	– 35.7%
Average [Veh/h]	262	330	325	217
Max [Veh/h]	297	425	378	355
Min [Veh/h]	208	300	157	80

Regarding the change in number of queues between Alternative 0 and Alternative 1, it can be seen in Table 6.7 that there will be no change. Along both alternatives it is expected to be no queues.

Table 6.7 The change in number of queues between using Alternative 0 in 2015 and Alternative 1 in 2018, in the Haga area.

Queues Haga area		
	Alt. 0	Alt. 1
AM	0	0
PM	0	0
Total	0	0

6.2 Korsvägen – rescue and service road

As described in chapter 4 Impacts from Projects, the construction site will be located just east of Korsvägen during 2018. Therefore, there will only be minor consequences for the traffic. No roads are going to be closed or relocated during this period and the most affected road users will be the ones going north and east, since that section of *Korsvägen* will be reduced to a one lane road. The primary dispatch net will not be directly affected since that part of *Korsvägen* does not belong to the primary net. However, a rescue and service road will have to be relocated due to the excavation.

Due to the location of the shaft, an important rescue and service road for both the amusement park Liseberg and the museum Universeum will have to be moved (Edin, 2017). It will be relocated a bit further to the east on *Örgrytevägen* and most likely quite close to the east edge of the shaft. In order to reach the present position of the rescue and service road, it is assumed that the primary dispatch net via *Skånegatan* and *Korsvägen* is used as far as possible, Alternative 0. All alternatives will follow the same primary dispatch route, but they will differ from the intersection *Skånegatan - Burgårdsgatan* which is referred to as the point of difference. See Figure 6.2 for an illustration. Note that Alternative 1 and 2 ends slightly further to the east than Alternative 0. This is a result of the relocation of the rescue road due to the excavation.

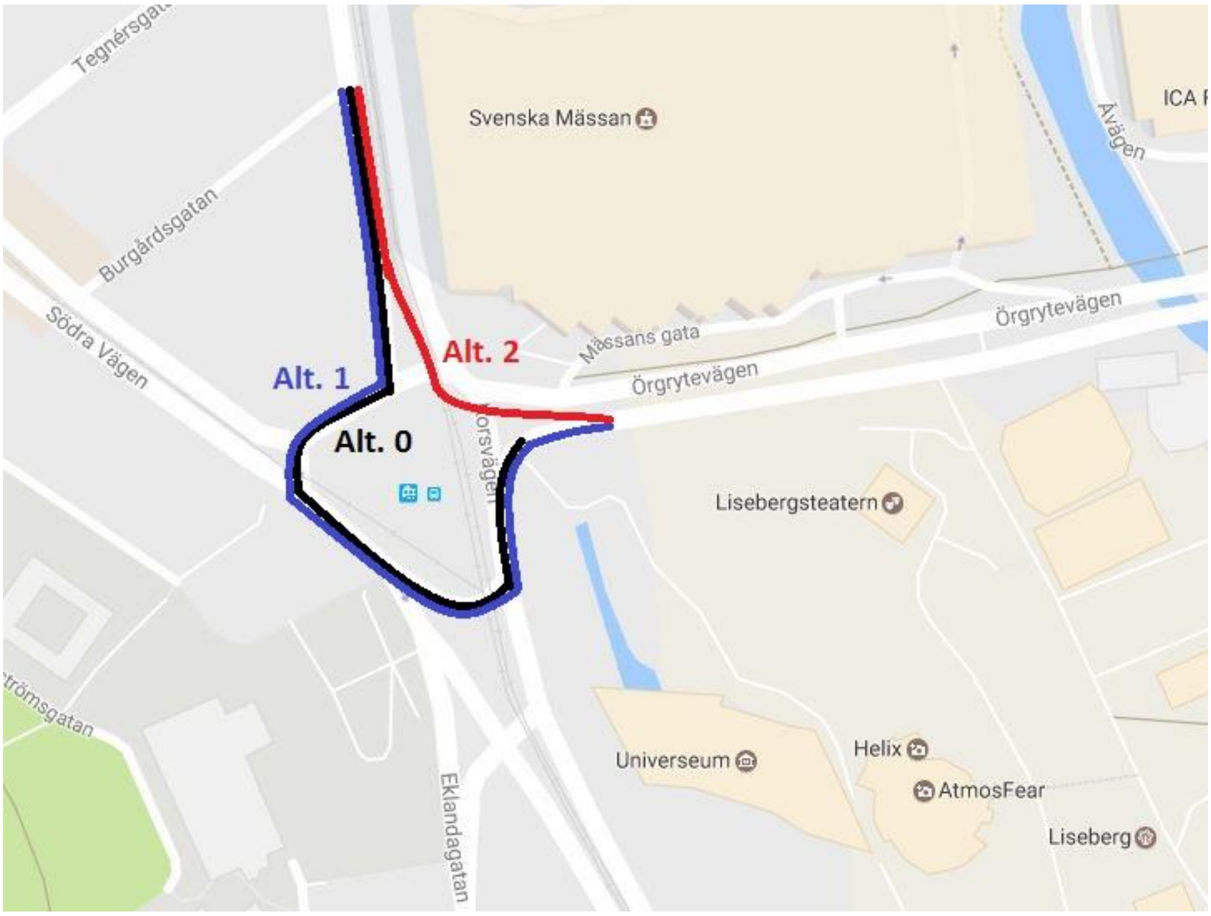


Figure 6.2 The original and alternative routes in the Korsvägen area.

The original route, Alternative 0, is approximately 385 m long when measured from the point of difference. From that location, the path passes three intersections. The route also passes four rather sharp turns which could affect the speed of the rescue vehicle. Furthermore, there are three speed humps along the way in terms of elevated pedestrian crossings. Table 6.8 presents Alternative 0 and its respective sections.

Table 6.8 Alternative 0 for the Korsvägen area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	Base PM [veh/h]	Number of lanes (total ; public transport)
Skånegatan (*Burgårdsgatan - Korsvägen*)	135	105	222	2 ; 0
Korsvägen (*Skånegatan - Södra Vägen*)	70	300	300	2 ; 0
Korsvägen (*Södra Vägen - Södra Vägen*)	120	678	335	1 ; 0
Korsvägen (*Södra Vägen - Örgrytevägen*)	60	485	460	2 ; 0

Alternative 1 is around 435 m long and slightly longer than Alternative 0 even though it is the same route. The relocation of the rescue and service road requires the use of an additional section along *Örgrytevägen*. Furthermore, the last section along *Korsvägen* will be reduced to a one lane road. This means that traffic going east will have to share that one lane road with traffic going north. Otherwise, there are no additional intersections, sharp turns or traffic calming measures. Table 6.9 presents Alternative 1 and its respective sections.

Table 6.9 Alternative 1 for the Korsvägen area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Skånegatan (*Burgårdsgatan - Korsvägen*)	135	105	65	-38%	222	52	-77%	2 ; 0
Korsvägen (*Skånegatan - Södra Vägen*)	70	300	300	0%	300	150	-50%	2 ; 0
Korsvägen (*Södra Vägen - Södra Vägen*)	120	678	678	0%	335	500	49%	1 ; 0
Korsvägen (*Södra Vägen - Örgrytevägen*)	60	485	915*	89%	460	1195*	160%	1 ; 0
Örgrytevägen (*Korsvägen -* Rescue road)	50	485	390	-20%	460	486	6%	3 ; 1

** This road will have to handle both north and east going traffic in 2018.*

Alternative 2, via the public transport lanes inside the traffic hub, is around 235 m and is shorter than Alternative 0. See Figure 6.2 for an illustration. The path crosses two intersections and requires only one 90 degree turn. It is also free from traffic calming measures such as speed humps. However, the route goes via lanes reserved for public transport which belongs to the remaining dispatch net. Table 6.10 presents Alternative 2 and its respective sections. Due to the relocation of the rescue and service road, the rescue service will be able to access it when traveling through Korsvägen via the lanes reserved for public transport.

Table 6.10 Alternative 2 for the Korsvägen area with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Skånegatan (*Burgårdsgatan - Korsvägen*)	90	105	65	-38%	222	52	-77%	2 ; 0
*Skånegatan** (*Skånegatan - Örgrytevägen*)	70	0	0	-	0	0	-	1 ; 1
*Örgrytevägen** (*Skånegatan - Örgrytevägen*)	40	0	0	-	0	0	-	1 ; 1
Örgrytevägen (*Korsvägen -* Rescue road)	35	485	390	-20%	460	486	6%	3 ; 1

** The parts of the route which are reserved for public transport.*

As seen in Table 6.11, Alternative 1 is more or less adequate to the original route, Alternative 0. However, Table 6.12 indicates that the vehicle-kilometres will increase drastically if using Alternative 1. Seen to the whole day, the vehicle-kilometres will increase with 35.8% along Alternative 1 and this is likely to decrease the accessibility through the Korsvägen area.

Table 6.11 Compilation of the differences between the alternatives in the Korsvägen area.

	Distance [m]	Number of sharp turns	Number of intersections dif.	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	385	4	3	1.69	120 ; 31%	3
Alt. 1	435	4	3	1.70	180 ; 41%	3
Alt. 2	235	1	1	1.68	110 ; 47%	0

Table 6.12 The change of vehicle-kilometres between using Alternative 0 in 2015 and Alternative 1 in 2018, in the Korsvägen area.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	145.6	185.5	118.8	173.5
Increase [Veh*km]	-	39.9	-	54.7
Increase [%]	-	27.4%	-	46.1%
Average [Veh/h]	378	426	308	399
Max [Veh/h]	678	915	460	1195
Min [Veh/h]	105	65	222	52

According to the simulation results, congestion and queues are to be expected in the Korsvägen area in 2018, see Table 6.13. During both the morning and afternoon peak hours, queues are expected to arise along the western section of *Korsvägen*. This will affect the Alternative 1 route.

Table 6.13 The change in number of queues between using Alternative 0 in 2015 and Alternative 1 in 2018, in the Korsvägen area.

Queues Korsvägen area		
	Alt. 0	Alt. 1
AM	0	1
PM	0	1
Total	0	2

As seen in Table 6.11, Alternative 2 is clearly the better alternative in 2018 with respect to the analysed factors. It is even better than the original route, Alternative 0. Even though Alternative 2 goes via lanes reserved for public transport, hence belonging to the remaining dispatch net, it could probably be justified to use those roads in order to reduce the vehicle-kilometres. By using the Alternative 2 route it is also possible to avoid the expected queues along the western section of *Korsvägen*. This, in addition to the fact that the traffic flows along Alternative 2 will be lower than along the original route, could improve the accessibility through the Korsvägen area.

6.3 Olskroken - Malmsjögatan

As described in chapter 4 Impacts from Projects, the planned construction measures in the Olskroken area will not directly affect the primary dispatch net nearby. Regarding the traffic system in the Olskroken area, there will be suspension of roads belonging to the secondary dispatch net which could cause problems reaching certain locations in the vicinity, e.g. the suspension of eastbound traffic along *Malmsjögatan*. Since there was no data available regarding traffic flows in the Olskroken area, only the direct consequences will be presented, see Table 6.14.

The suspension of the existing connection from *Gamlestadsvägen* to *Malmsjögatan*, for traffic coming from the south, results in the loss of a link to the west end of *von Utfallsgatan*. *von Utfallsgatan* is a rather important road for the rescue service since it passes an industrial area and the loss of a link to it could affect the accessibility negatively. As mentioned in chapter 2 Methodology it was assumed that the original route, Alternative 0, towards the west end of *von Utfallsgatan* goes via the primary dispatch net to a point as close to the destination as possible. The route then goes along roads belonging to the secondary dispatch net and via the affected link. In this case, the affected link is *Malmsjögatan*. Therefore, Alternative 0 connects to the primary dispatch net at the exit ramp from E6 and then via *Ånäsmotet* and *Malmsjögatan* reaches the west end of *von Utfallsgatan*. The other alternatives will start from the same location, the point where E6 and the exit ramp merges, which will be referred to as the point of difference. See Figure 6.3 for an illustration.

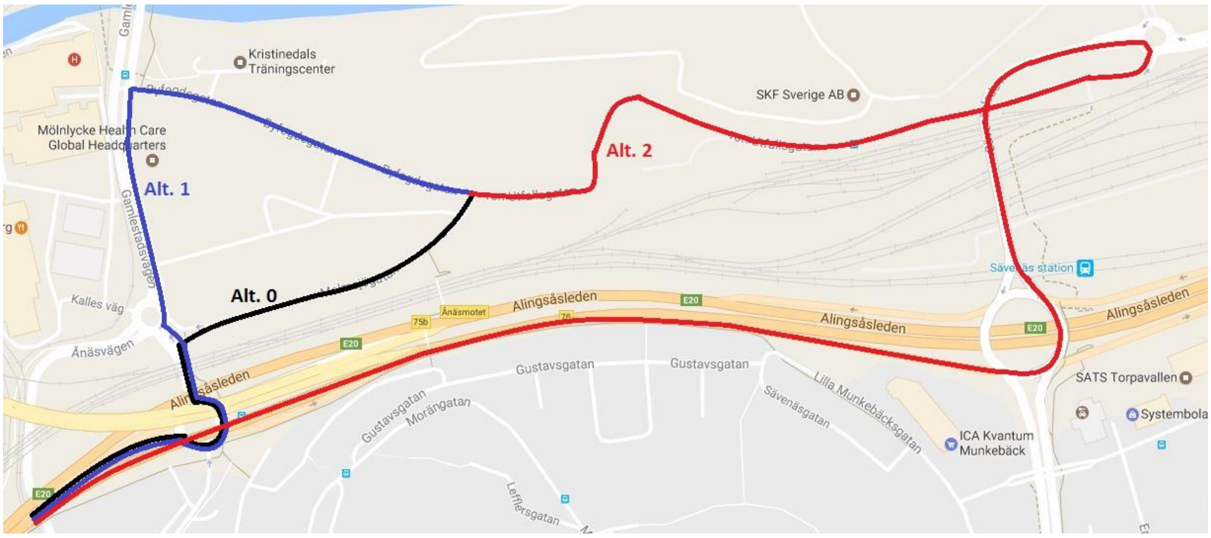


Figure 6.3 The original and alternative routes in the Olskroken area.

The original route, Alternative 0, is approximately 715 m long. It goes via the exit ramp from the E20 highway, *Ånäsmotet*, *Gamlestadsvägen* and *Malmsjögatan* to the west end of *von Utfallsgatan*. See Figure 6.3 for an illustration. The route passes one intersection, which is a roundabout, and two sharp turns along the way. It also passes an elevated pedestrian crossing, a speed hump.

One option that was not further investigated was driving via a small alleyway just north of *Malmsjögatan*. However, it was neglected due to the width of the road being too narrow for a fire engine. The route that was investigated instead, Alternative 1, is approximately 1025 m long and slightly longer than Alternative 0. Due to the suspension of the connection between *Gamlestadsvägen* and *Malmsjögatan*, the route continues north along *Gamlestadsvägen* and instead turns right onto *Byfogdegatan* and ends at the western part of *von Utfallsgatan*. See Figure 6.3 for an illustration. The route passes four intersections where two of them are roundabouts and the other two are regulated by traffic lights. There are two sharp turns along the way but no traffic calming devices.

Alternative 2 is approximately 2505 m long and much longer than Alternative 0. The route continues on E6 from the point of difference and exits the highway via *Munkebäcksmotet*. From there the path goes via *Sävenäsleden* to the east end of *von Utfallsgatan* and then via that road to the west end. See Figure 6.3 for an illustration. Alternative 2 passes two intersections, both of them roundabouts, and three sharp turns. There is one traffic calming device, an elevated pedestrian crossing, along the way.

As seen in Table 6.14, both available routes in 2018 are longer and passes more intersections than Alternative 0. Alternative 2 could be ruled out due to its length which is more than two times the length of Alternative 1. It is unclear whether the accessibility along Alternative 1 is inferior to the accessibility along Alternative 0, depending on what factor affects the travel time the most. It is also necessary to examine the traffic flows along these alternatives in order to perform a proper analysis of the alternatives.

Table 6.14 Compilation of the differences between the alternatives in the Olskroken area.

	Distance [m]	Number of sharp turns	Number of intersections	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	715	2	1	1	715 ; 100%	1
Alt. 1	1025	2	4	1,25	772 ; 75%	0
Alt. 2	2505	3	2	1,76	1340 ; 53%	1

Note that this area is located right between the service area for both Gårda and Kortedala fire station. If the consequences, to reach this area, for dispatches from Gårda fire station are too severe, this area could still be covered by Kortedala fire station in most possible scenarios.

6.4 Marieholmstunneln

There will be no or minor consequences for the traffic in the project area, on the mainland side of the river, since *Marieholmsmotet* will be completed. On the Hisingen side of the river, the dismantling of the bridge over E6 will result in a loss of a link over E6. Hence, both traffic and the rescue service must find alternative routes. However, according to chapter 1.3 Limitations, the Hisingen side of the river is not included in the study and therefore there will be no further investigation of that area. Furthermore, due to the minor consequences and absence of traffic flow data, no analysis of the mainland side area of the project will be conducted as well. Moreover, there is no predefined dispatch net for Gårda fire station in the Marieholm area, hence the impact on the accessibility for the rescue service is believed to be very small.

6.5 Central station area

There is no predefined primary dispatch net for Gårda fire station in the Central station area, see Figure 5.1. This due to the traffic situation there being so complex and the rescue service drives wherever it is possible to get through (Lövberg, 2017). Hence it is not possible to analyse the impact on the primary dispatch net in this area.

6.5.1 Hisingen via Götaälvbron

One important link is *Götaälvbron* since it is the only passage over the river in the area and it is used to reach destinations on Hisingen. Hence, it is of great interest to investigate how to reach *Götaälvbron* in 2018. Due to the established construction site for one of the ramps to *Hisingsbron*, there will only be one way for traffic in the area to access *Götaälvbron* which is via *Drottningtorget* and driving past Nils Ericsonterminalen.

As mentioned earlier, the traffic situation at the Central station area is very complex and there is no predefined primary dispatch net in the area. However, it is assumed that the rescue service strives to use roads belonging to the primary dispatch net as far as possible and then use the secondary dispatch net. Therefore, it can be assumed that they use *Östra Stampbron*, *Polhemsplatsen*, *Burggrevegatan*, and *Drottningtorget* to reach *Götaälvbron* and Hisingen today. Hence, this route will be referred to as Alternative 0. See Figure 6.4 for an illustration. To be able to enter the Central station area at all, from the primary dispatch net, it is necessary to cross *Östra Stampbron*. *Östra Stampbron* will be presented for each alternative, even though it is from the intersection *Östra Stampbron* - *Stampgatan* just north of the bridge that the alternatives will differ.

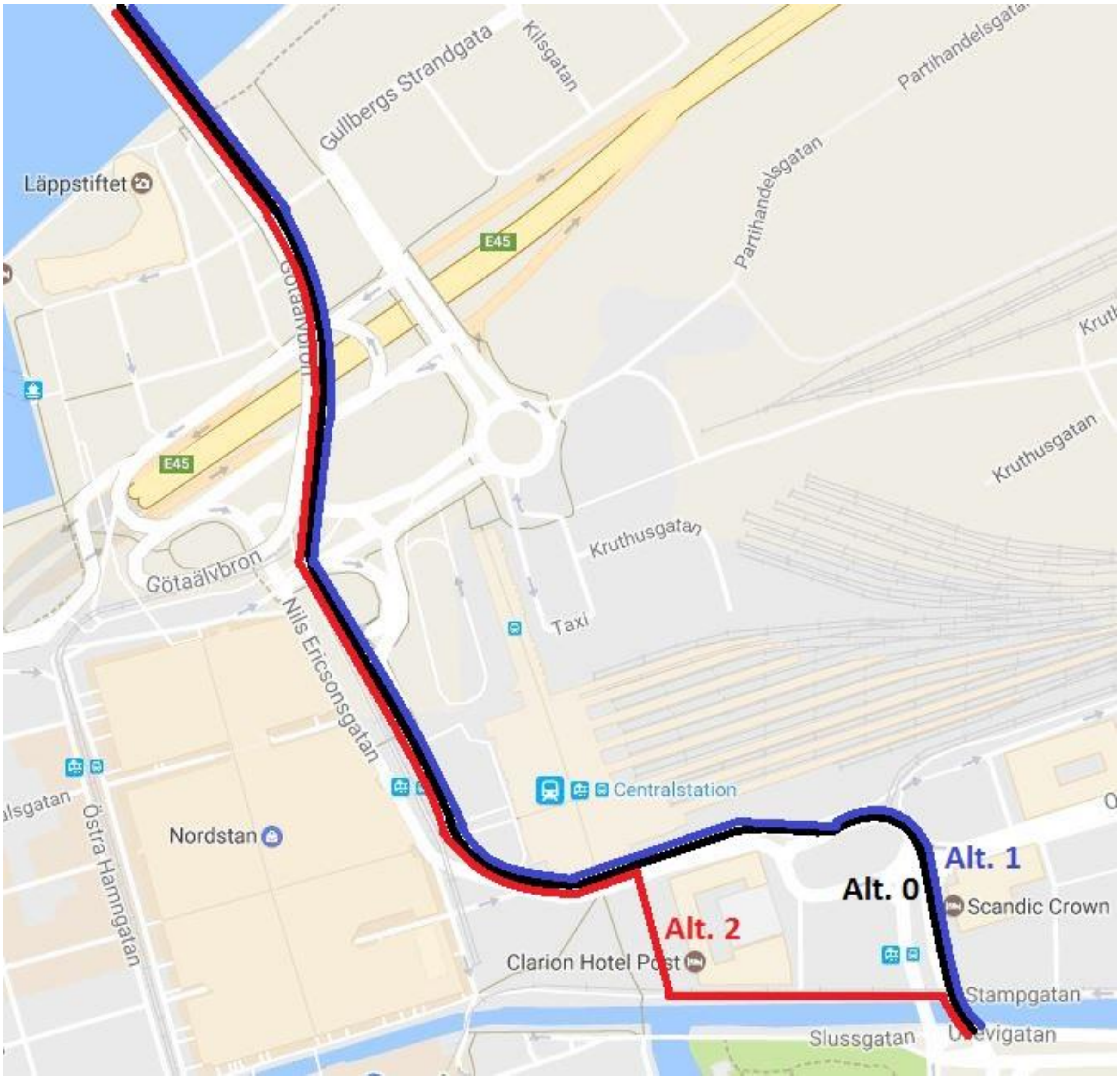


Figure 6.4 *The original and alternative routes, to Götaälvbron, in the Central station area.*

The original route, Alternative 0 is, approximately 1605 m long when measured from the connection to the primary dispatch net. The route passes two sharp turns and ten intersections, all of them regulated by traffic lights, along the way. In terms of traffic calming devices, the route also passes an elevated pedestrian crossing. Table 6.15 shows the distances, traffic flows and number of lanes for each section.

Table 6.15 Alternative 0, to Götaälvbron in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	Base PM [veh/h]	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	600	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	300	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	616	2 ; 1
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 1	113	526	615	2 ; 1
Drottningtorget (*Burggrevegatan – Götaälvbron*) Part 2	113	263	308	2 ; 0
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 3	105	280	335	1 ; 0
Götaälvbron (*Drottningtorget - Hjalmar Brantingsgatan*)	885	394	411	3 ; 1

Alternative 1, is the same route as Alternative 0. However, with reduced capacity due to narrowed roads and loss of lanes. Due to the suspension of the connection from *Bergslagsgatan*, there will be one less crossing along the route. The length and the number of sharp turns and traffic calming measures will be the same as for Alternative 0. Table 6.16 shows the distances, traffic flows and number of lanes for each section.

Table 6.16 Alternative 1, to Götaälvbron in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	580	132%	600	600	0%	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	290	132%	300	300	0%	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	667	27%	616	707	15%	2 ; 1
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 1	113	526	666	27%	615	706	15%	2 ; 1
Drottningtorget (*Burggrevegatan – Götaälvbron*) Part 2	113	263	666	153%	308	706	129%	1 ; 0
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 3	105	280	269	-4%	335	306	-9%	1 ; 0
Götaälvbron (*Drottningtorget - Hjalmar Brantingsgatan*)	885	394	269	-32%	411	306	-26%	2 ; 1

Alternative 2 is approximately 1570 m long and slightly shorter than Alternative 0. The route goes via the public transport lane, belonging to the remaining dispatch net, along the first section of *Stampgatan* and then the combined lane for public and private traffic during the second section. Thereafter it turns right onto the north-south section of *Drottningtorget*, which is a street with walking speed and therefore belongs to the remaining dispatch net. After that the route connects to Alternative 1 at the intersection *Drottningtorget - Burggrevegatan*. See Figure 6.4 for an illustration. The route passes six intersections, all of them regulated by traffic lights, and four sharp turns. It also passes the same speed hump as the other alternatives. Table 6.17 shows the distances, traffic flows and number of lanes for each section.

Table 6.17 Alternative 2, to Götaälvbron in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	580	132%	600	600	0%	2 ; 1
Stampgatan (*Östra Stampbron - Drottningtorget*)	215	0	0	-	0	0	-	1 ; 1*
Drottningtorget (*Stampgatan - Burggrevegatan*)	105	-	-	-	-	-	-	1 ; 0**
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 1	113	526	666	27%	615	706	15%	2 ; 1
Drottningtorget (*Burggrevegatan – Götaälvbron*) Part 2	113	263	666	153%	308	706	129%	1 ; 0
Drottningtorget (*Burggrevegatan - Götaälvbron*) Part 3	105	280	269	-4%	335	306	-9%	1 ; 0
Götaälvbron (*Drottningtorget - Hjalmar Brantingsgatan*)	885	394	269	-32%	411	306	-26%	2 ; 1

** One lane for buses only along first half, then converted into a one lane road with mixed traffic 1 ; 0.*
*** Street with walking speed, belongs to the remaining dispatch net. No traffic flow data available.*

According to Table 6.18, both Alternative 1 and Alternative 2 are almost adequate to the original route seen to several factors. Since Alternative 2 goes via roads reserved for buses and trams, remaining dispatch net, Alternative 1 should probably be used to as great extent as possible. As can be seen in Table 6.19, the vehicle-kilometres will increase during the morning peak hours and decrease during the afternoon peak hours. Seen to the whole day, the vehicle-kilometres will decrease with around 0.4%. There are public transport lanes along most of the Alternative 1 route which could mean that the possible increase in vehicle-kilometres, in the morning, not necessarily affects the accessibility.

Table 6.18 Compilation of the differences between the alternatives, towards Götaälvbron, in the Central station area.

	Distance [m]	Number of sharp turns	Number of intersections	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	1605	2	10	2.56	105 ; 7%	1
Alt. 1	1605	2	9	1.94	218 ; 14%	1
Alt. 2	1570	4	6	1.66	538 ; 34%	1

Table 6.19 The change of vehicle-kilometres between using Alternative 0 in 2015 and Alternative 1 in 2018, in the Central station area towards Götaälvbron.

	Base AM	2018 AM	Base PM	2018 PM
[Veh*km]	614.0	628.0	704.0	684.9
Increase [Veh*km]	-	14.0	-	– 19.1
Increase [%]	-	2.3%	-	– 2.7%
Average [Veh/h]	383	391	439	427
Max [Veh/h]	527	667	616	707
Min [Veh/h]	125	300	300	300

According to the simulation results, congestion and queues are to be expected in the Central station area, see Table 6.20. Originally, there are no queues in the area. However, during both the morning and afternoon peak hours in 2018, queues are expected to occur along *Polhemsplatsen* and the first section of *Burggrevegatan*. This will affect Alternative 1. Fortunately, there are public transport lanes along *Polhemsplatsen* and *Burggrevegatan* which could be used to bypass the expected queues. If necessary, it is possible to use Alternative 2 in order to circumvent the problem area as well.

Table 6.20 The change in number of queues between using Alternative 0 in 2015 and Alternative 1 in 2018, towards Götaälvbron.

Queues towards *Götaälvbron*		
	Alt. 0	Alt. 1
AM	0	2
PM	0	2
Total	0	4

6.5.2 Gullbergsvass

The dismantling of *Stadstjänarebron* and the suspension of exit ramps from E45 will result in the city area Gullbergsvass becoming more cut off and remote than earlier. *Stadstjänarebron* is an important link over the E45 and connects the Gullbergsvass area with the Central station area. As mentioned earlier there is no predefined primary dispatch net in this area. Therefore, it was assumed that Alternative 0, the original dispatch route, consisted of *Östra Stampbron*, *Polhemsplatsen*, *Burggrevegatan*, *Drottningtorget*, *Bergslagsgatan*, and *Stadstjänaregatan*/*Stadstjänarebron*. See Figure 6.5 for an illustration. Since there was lack of traffic flow data for some roads along the routes, the vehicle-kilometres will not be calculated.

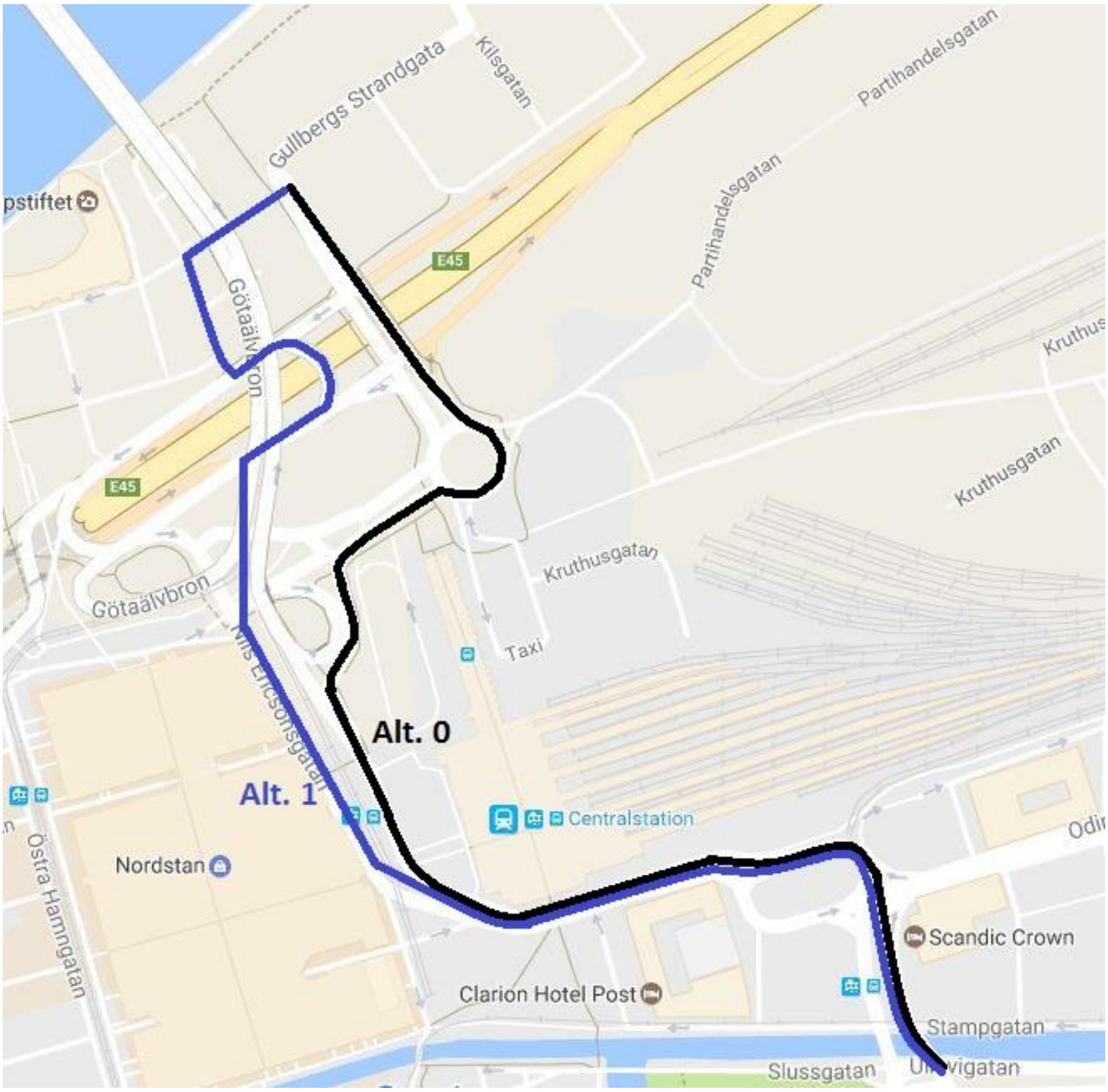


Figure 6.5 *The original and alternative route, to Gullbergsvass, in the Central station area.*

The original route, Alternative 0, is approximately 1205 m long when measured from the connection to the primary dispatch net. The route passes five sharp turns and 14 intersections, where all of them are regulated by traffic lights except one which is a roundabout. Alternative 0 also passes a traffic calming device in terms of a speed hump. Table 6.21 shows the distances, traffic flows and number of lanes for each section.

Table 6.21 Alternative 0, to Gullbergsvass in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	Base PM [veh/h]	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	600	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	300	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	616	2 ; 1
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 1	113	526	615	2 ; 1
Drottningtorget (*Burggrevegatan – Bergslagsgatan*) Part 2	113	263	308	2 ; 0
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 3	80	290	335	1 ; 0
Drottningtorget (*Burggrevegatan – Bergslagsgatan*) Part 4	80	145	168	3 ; 1
Bergslagsgatan (*Drottningtorget - Stadstjänaregatan*)	200	239	268	2 ; 0
Stadstjänaregatan (*Bergslagsgatan - Södra Sjöfarten*)	70	-*	-*	2 ; 0
Stadstjänaregatan/ *Stadstjänarebron* (*Södra Sjöfarten - Norra Sjöfarten*)	65	-*	-*	3 ; 0
Stadstjänaregatan (*Norra Sjöfarten - Hamntorgsgatan*)	95	538	193	1 ; 0

** No traffic flow data available.*

Alternative 1 is approximately 1295 m long and slightly longer than Alternative 0. It is a route going through the Central station area towards Gullbergsvass via the same roads as Alternative 1 for *Götaälvbron* until the end of *Burggrevegatan*. From there the route goes via *Nils Ericsonsgatan*, *Södra Sjöfarten*, *Norra Sjöfarten*, *Hamntorget*, and *Hamntorgsgatan*. See Figure 6.5 for an illustration. The path crosses five sharp turns and nine intersections, all of them regulated by traffic lights, along the way. Furthermore, there are two speed humps located on the route. Table 6.22 shows the distances, traffic flows and number of lanes for each section.

Table 6.22 Alternative 1, to Gullbergsvass in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	580	132%	600	600	0%	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	290	132%	300	300	0%	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	667	27%	616	707	15%	2 ; 1
Drottningtorget (*Burggrevegatan - Nils Ericsonsgatan*)	155	526	666	27%	615	706	15%	2 ; 1*
*Nils Ericsonsgatan*** (*Drottningtorget - Södra Sjöfarten*) Part 1	265	-	-	-	-	-	-	1 ; 1
Nils Ericsonsgatan (*Drottningtorget - Södra Sjöfarten*) Part 2	90	0	410	-	0	475	-	1 ; 0
Södra Sjöfarten (*Nils Ericsonsgatan - Bananbron*)	90	230	509	121%	300	295	-2%	2 ; 0
Bananbron (*Södra Sjöfarten - Norra Sjöfarten*)	70	230	808	251%	300	563	88%	2 ; 0
Norra Sjöfarten (*Bananbron - Hamntorget*)	45	600	808	35%	768	563	-27%	2 ; 0
Hamntorget (*Norra Sjöfarten - Hamntorgsgatan*)	100	-***	472	>0%	-***	206	>0%	1 ; 0

Hamntorgsgatan (*Hamntorget - Stadstjänaregatan*)	90	-***	472	>0%	-***	206	>0%	1 ; 0

** One lane is for buses first half, then reduced to a one lane road for public transport only 1 ; 1.*
*** Normally the traffic travels in the opposite direction, south, along Nils Ericsonsgatan, but in 2018 the bus lane is redirected north instead. That is why there are no values for the traffic.*
**** Data not available. However, the values are expected to be lower than in 2018.*

According to Table 6.23, Alternative 1 is a more favourable route seen to the number of intersections, but is unfavourable seen to the number of lanes available along the route.

Table 6.23 Compilation of the differences between the alternatives, towards Gullbergsvass, in the Central station area.

	Distance [m]	Number of sharp turns	Number of intersections	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	1205	5	14	2.07	175 ; 15%	1
Alt. 1	1295	5	9	1.73	623 ; 48%	2

According to the simulation results the queues along *Polhemsplatsen* and *Burggrevegatan*, during both morning and afternoon peak hours as mentioned earlier, will affect Alternative 1 for *Gullbergsvass* as well. In addition to this, queues are to be expected along *Bananbron* during morning peak hours and *Södra Sjöfarten* during afternoon peak hours in 2018, see Table 6.24. There are public transport lanes along large parts of Alternative 1 which could be used to bypass congested roads, but not along *Södra Sjöfarten* and *Bananbron*.

Table 6.24 The change in number of queues between using Alternative 0 in 2015 and Alternative 1 in 2018, towards Gullbergsvass.

Queues towards *Gullbergsvass*		
	Alt. 0	Alt. 1
AM	0	3
PM	0	3
Total	0	6

6.5.3 The opera

Another target object which is of interest for the rescue service is the wharf area north east of the Gothenburg opera. Additionally, to the opera itself being a well-attended institution, this point is used by the rescue service as a command post in case of emergencies in the river around *Götaälvbron* (Lövberg, 2017). Therefore, it is important to examine the possibilities of reaching this point. Earlier, the command post was established closer to the bridge, nearby the office building known as Läppstiftet. However, due to the demolition of a multi-storey car park in the area, a floating car park called P-arken was moved there and the interference with the command post resulted in the latter being relocated. Since there was lack of traffic flow data for some roads along the routes, the vehicle-kilometres will not be calculated.

It is assumed that the original route connects to the primary dispatch net at *Ullevigatan* via *Östra Stampbron* and then use sections along roads belonging to the secondary dispatch net. The original route is almost the same as Alternative 0 for Gullbergsvass, but keeps going west on *Norra Sjöfarten* and then via *Västra Sjöfarten* and *Christina Nilssons gata*. See Figure 6.6 for an illustration. This path will be affected mainly by the dismantling of *Stadstjänarebron*, but also by the measures being conducted in the Kvarnberget area.

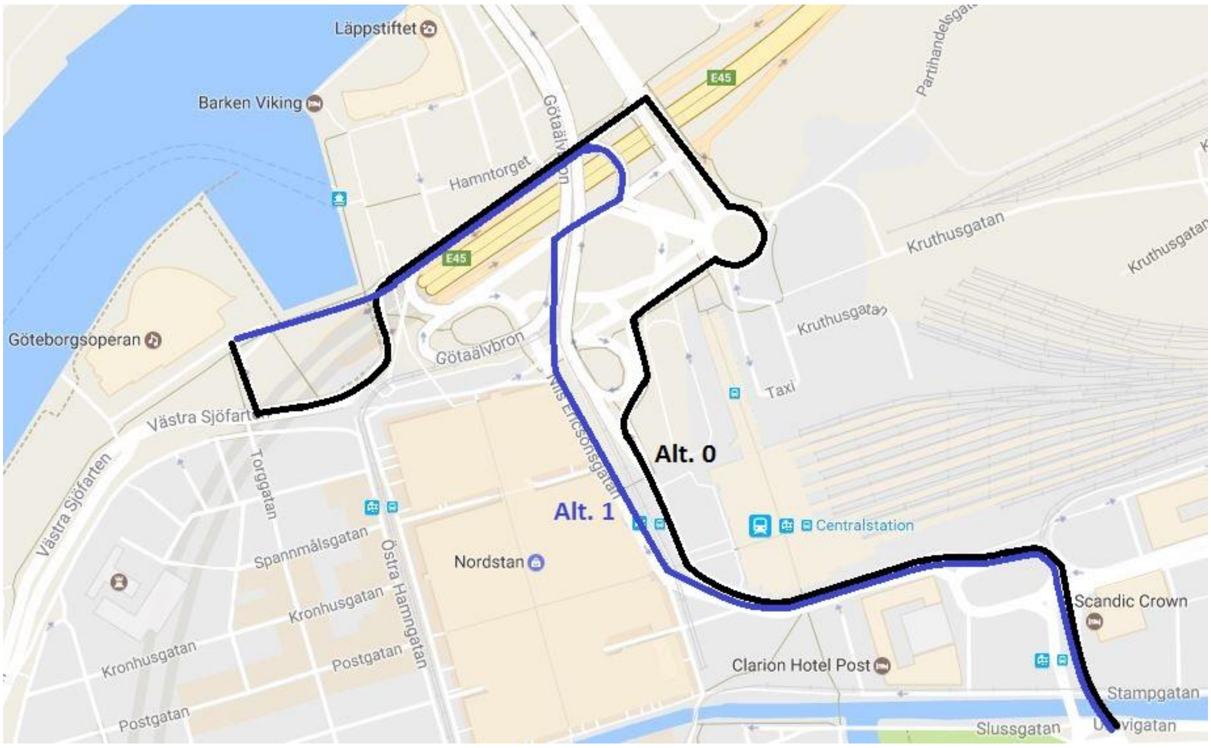


Figure 6.6 The original and alternative route, to the opera, in the Central station area.

The original route, Alternative 0, is approximately 1715 m long when measured from the connection to the primary dispatch net. From that location, the route passes 15 intersections where all of them are regulated by traffic lights except one which is a roundabout. The path also extends through eleven rather sharp turns and passes three speed humps. Table 6.25 shows the distances, traffic flows and number of lanes for each section.

Table 6.25 Alternative 0, to the opera in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	Base PM [veh/h]	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	600	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	300	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	616	2 ; 1
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 1	113	526	615	2 ; 1
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 2	113	263	308	2 ; 0
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 3	80	290	335	1 ; 0
Drottningtorget (*Burggrevegatan - Bergslagsgatan*) Part 4	80	145	168	3 ; 1
Bergslagsgatan (*Drottningtorget - Stadstjänaregatan*)	200	239	268	2 ; 0
Stadstjänaregatan (*Bergslagsgatan - Södra Sjöfarten*)	70	-*	-*	2 ; 0
Stadstjänaregatan/ *Stadstjänarebron* (*Södra Sjöfarten - Norra Sjöfarten*)	65	-*	-*	3 ; 0
Norra Sjöfarten (*Stadstjänaregatan - Bananbron*)	70	370	468	2 ; 0
Norra Sjöfarten (*Bananbron - Hamntorget*)	45	600	768	2 ; 0
Norra Sjöfarten (*Hamntorget - Norra Sjöfarten*)	140	482	430	2 ; 0
Norra Sjöfarten (*Norra Sjöfarten - Västra Sjöfarten*)	80	808	739	1 ; 0
Västra Sjöfarten (*Norra Sjöfarten - Christina Nilssons gata*)	175	808	739	1 ; 0
Christina Nilssons gata (*Västra Sjöfarten* - Destination)	95	-*	-*	1 ; 0

** No traffic flow data available.*

Alternative 1 is around 1415 m long and is slightly shorter than Alternative 0. The route will partly run along the same roads as Alternative 1 for Gullbergsvass, with start at *Östra Stampbron* which is the connection to the primary dispatch net. However, at the intersection *Norra Sjöfarten - Hamntorget* the route continues west via *Norra Sjöfarten* and *Västra Sjöfarten*. See Figure 6.6 for an illustration. The path passes three sharp turns and ten intersections, all of them regulated with traffic lights, along the way. Due to the relocation of *Västra Sjöfarten*, the path will only pass one speed hump. Table 6.26 shows the distances, traffic flows and number of lanes for each section.

Table 6.26 Alternative 1, to the opera in the Central station area, with its respective sections.

Road (Section)	Distance [m]	Base AM [veh/h]	2018 AM [veh/h]	Increase AM	Base PM [veh/h]	2018 PM [veh/h]	Increase PM	Number of lanes (total ; public transport)
Östra Stampbron (*Ullevigatan - Stampgatan*)	35	250	580	132%	600	600	0%	2 ; 1
Polhemsplatsen (*Stampgatan - Burggrevegatan*)	120	125	290	132%	300	300	0%	3 ; 1
Burggrevegatan (*Polhemsplatsen - Drottningtorget*)	235	527	667	27%	616	707	15%	2 ; 1
Drottningtorget (*Burggrevegatan - Nils Ericsonsgatan*)	155	526	666	27%	615	706	15%	2 ; 1*
*Nils Ericsonsgatan*** (*Drottningtorget - Södra Sjöfarten*) Part 1	265	-	-	-	-	-	-	1 ; 1
Nils Ericsonsgatan (*Drottningtorget - Södra Sjöfarten*) Part 2	90	0	410	-	0	475	-	1 ; 0
Södra Sjöfarten (*Nils Ericsonsgatan - Bananbron*)	90	230	509	121%	300	295	-2%	2 ; 0

Bananbron (*Södra Sjöfarten - Norra Sjöfarten*)	70	230	808	251%	300	563	88%	2 ; 0
Norra Sjöfarten (*Bananbron - Hamntorget*)	45	600	808	35%	768	563	-27%	2 ; 0
Norra Sjöfarten (*Hamntorget - Östra Hamngatan*) Part 1	140	482	489	2%	430	344	-20%	2 ; 0
Norra Sjöfarten (*Hamntorget - Östra Hamngatan*) Part 2	105	963	978	2%	859	687	-20%	1 ; 0
Västra Sjöfarten (*Östra Hamngatan* - Destination)	65	808	682	-16%	739	252	-66%	1 ; 0

** One lane is for buses first half, then reduced to a one lane road for public transport only 1 ; 1.*
*** Normally the traffic travels in the opposite direction, south, along Nils Ericsonsgatan, but in 2018 the bus lane is redirected north instead. That is why there are no values for the traffic.*

As seen in Table 6.27, Alternative 1 is more favourable than the original route concerning several factors. This could probably improve the accessibility towards the opera.

Table 6.27 Compilation of the differences between the alternatives, towards the opera, in the Central station area.

	Distance [m]	Number of sharp turns	Number of intersections	Average lanes in driving direction	Section with < 2 lanes [m ; %]	Number of traffic calming measures
Alt. 0	1715	11	15	1.90	430 ; 25%	3
Alt. 1	1415	3	10	1.65	620 ; 44%	1

According to the simulation results, queues are expected along *Polhemsplatsen* and *Burggrevegatan* in the morning and afternoon, as for Alternative 1 for both *Götaälvbron* and *Gullbergsvass*. Furthermore, as for Alternative 1 for *Gullbergsvass*, queues are expected along *Bananbron* in the morning and *Södra Sjöfarten* in the afternoon. In addition to this, queues are also expected along *Norra Sjöfarten* during both morning and afternoon peak hours in 2018, see Table 6.28. This is likely to affect the accessibility negatively along Alternative 1. There are public transport lanes along Alternative 1 which could be used to bypass traffic, however not along *Södra Sjöfarten*, *Bananbron* and *Norra Sjöfarten*.

Table 6.28 The change in number of queues between using Alternative 0 in 2015 and Alternative 1 in 2018, towards the opera.

Queues towards the opera		
	Alt. 0	Alt. 1
AM	0	4
PM	0	4
Total	0	8

7 Discussion

The study clearly states some consequences, both on a system and local level, for the rescue service due to the impacts on the traffic system in Gothenburg. The impacts are presented as the difference between the original situation in 2015 and the expected situation in autumn 2018. However, the study cannot clearly validate that the accessibility for the rescue service vehicles, stationed at Gårda fire station, will deteriorate.

On a system level, the studied projects with their respective work sites will not cause any direct consequences on the primary dispatch net in the autumn 2018. Hence, the primary routes will have the same layout during the studied period as originally. However, the projects will cause indirect consequences such as changed traffic flows due to transferring of traffic as a result of the works conducted in the project areas. The traffic along the primary dispatch net, together with the number of queues, will generally increase in 2018. However, the traffic flows along the routes from Gårda to Guldheden via Korsvägen and to Kallebäck via E6, are expected to decrease. In general, an overall deterioration of the accessibility along the primary dispatch net could be expected.

On a local level, the studied projects will in several locations cause direct consequences on the traffic system in the vicinity of the projects due to suspension and narrowing of roads. This resulting in loss of links and reduced capacity. Consequently, alternative routes have to be used. The direct consequences for the rescue service will be changed travel distances, number of intersections, traffic calming measures, sharp turns etc. Generally, concerning most of the studied factors, there are alternative routes in each project area which are more or less adequate to the original routes. However, it is unclear how each factor will affect the accessibility. In addition to the direct consequences, there will also be indirect consequences in terms of changed traffic flows. The number of vehicle-kilometres increases in some project areas and decreases in others. Therefore, no general conclusions can be drawn regarding the traffic flows in the project areas. However, there will be an increased number of queues along the alternative routes and this is likely to reduce the accessibility.

The results raise new questions. This report has focused on autumn 2018 since it was assumed to be the worst period, concerning the number of ongoing projects. However, as mentioned in chapter 4 Impacts from Projects, both the Haga and Korsvägen projects will affect the primary dispatch net to a greater extent later on. What consequences will the rescue service face during that period? It is possible that another year will be more critical for the rescue service regarding their accessibility. Another issue is also how each consequence affect the accessibility in terms of travel time. How much extra time will it take to travel along the studied roads? After an eventual rescue task, it might be necessary to return to the station to resupply. How will the travel times back to the station be affected? These questions form scopes for future study and researches.

The uncertainties in the results could be fairly high, since the results are based on working material and simulations. The studied mobility plans from each project was only working material which means that the overall layout is decided, but some adjustments could still be implemented. The simulations are not 100 percent accurate since it is a prediction of how drivers will react to changes in the traffic system. In the end, it is human behaviour which will determine how everything plays out and that is hard to predict. Furthermore, the simulations are also based on working material. The results from the simulations were in some cases, and areas, very hard to read due to the flow lines overlapping/covering each other. Hence, for those roads it was necessary to estimate the traffic flow value by examining the traffic flows on adjacent roads. In some cases there was also lack of available traffic flow data for some locations and roads, e.g. the area around Olskroken and Marieholm. This meant that only an analysis of direct consequences for both Olskroken and Marieholm was possible. Furthermore, it made it harder to calculate the vehicle-kilometres and compare the roads. However, the data is believed to be reliable since it was provided directly by first hand sources, e.g. from Trafikverket, with insight in the projects. Furthermore, some of the data obtained was considered as classified information. Permission was obtained to use only the most relevant data in the material. Due to requests from the owner of the material, the source of the information, e.g. the traffic simulation results, was not published. This reduces the credibility of the report since no one can verify the generated results. Perhaps the results is not the most important aspect in this report, but the potential method in how to assess the accessibility for the rescue service during the construction time.

The results also indicate that public transport lanes could be used to bypass roads with high traffic load and shorten travel distances. However, this report does not take public transport flows into account. Hence, it is uncertain whether it is suitable or not to use public transport lanes during peak hours. It might be inappropriate to use these lanes in the vicinity of bus/tram stops where there is risk of public transport vehicles blocking the way. Furthermore, buses and trams have a harder time to give way for rescue vehicles.

Due to the vast number of projects that will be carried through in Gothenburg during 2018, it was necessary to limit the study. If all projects in the central parts of Gothenburg would have been included, the results may have represented the reality more. Unfortunately, the time and available data were not sufficient to conduct such a study properly. Therefore, it was decided to study the largest infrastructure projects since those were expected to have the most impact on the traffic system. As a result of this, the report does not take into account several other projects such as operation and maintenance projects and city development projects. Furthermore, the report does not cover smaller projects or any events planned in 2018. The limitations made were necessary to keep the report on a manageable level. Therefore, the results will not completely represent the reality in 2018. It only indicates how the studied projects will affect the traffic system and the resulting consequences for the rescue service.

The assumption of original dispatch routes in the project areas could affect the results. It was assumed that the rescue service, in 2015, would drive along the primary dispatch net as long as possible and then use roads belonging to the secondary dispatch net to reach the indicated destinations. This assumption was necessary in order to get a consistent work procedure. However, in some areas it is more likely that they use other roads than the ones assumed which could mean that the obtained results are worse than in reality. Furthermore, the mobility plans did not point out any traffic calming measures in 2018. Therefore, it was assumed that traffic calming measures in 2015 will still be present in 2018, given that the road where it is located still exists, and that no additional traffic calming measures will be implemented. It is possible that the number of speed humps and similar will increase in 2018 which would affect the accessibility negatively.

The results, in terms of change of traffic flows and alternative routes, indicates how the accessibility could be affected in a negative way. Deteriorated accessibility for the rescue service could lead to prolonged travel times which would delay an eventual rescue task. According to chapter 3.6 The costs for delays, this would lead to increasing costs for the society. Even though the report does not state the exact accessibility in terms of travel times, there is still a strong connection between travel times, increased traffic, prolonged travel distances and obstacles, e.g. speed humps and intersections.

This report points to a method in how to assess the accessibility for the rescue service during the construction time. The purpose with a rescue service is to save life and property. It should lie in everybody's interest to ensure a good accessibility, in all situations, for the rescue service. Therefore, further studies in this area is a vital part in the process of ensuring good accessibility for the rescue service and other emergency vehicles.

8 Conclusions

The primary dispatch net will not be directly affected by the infrastructure projects, i.e. no closed or narrowed roads. However, the traffic flows and number of queues along these routes will change and will generally increase in 2018. This could indicate a deterioration of the accessibility for the rescue service along the primary dispatch net. As a result of this, a more extensive use of roads belonging to the secondary and remaining dispatch nets, in order to avoid roads with high traffic load, could be expected.

The projects will directly affect, to various extent, the traffic system in the vicinity of the project areas in 2018. The report indicates that there will be alternative routes, through each project area, which are more or less adequate to the original routes considering factors such as distance and number of lanes, intersections, sharp turns and traffic calming measures. However, it is unclear how the factors will affect the accessibility and no general conclusions could be drawn about the traffic flows due to the varying results. The number of queues along the alternative routes will be higher than along the original routes which could indicate a reduced accessibility.

Further studies are required to investigate exactly how the factors and the traffic flows will affect the accessibility. It is also necessary to analyse other periods since it was discovered that several projects, e.g. Haga and Korsvägen, will have a greater impact on the primary dispatch net later on during their construction phases.

The traffic system in the central parts of Gothenburg will become more vulnerable. The suspension and narrowing of roads, within the project areas, could lead to decreased accessibility for the rescues service in terms of reduced selection of possible dispatch routes. Therefore, unforeseen incidents could cause large problems to a greater extent in 2018 than originally.

Overall, the traffic situation will become more complex due to earlier mentioned consequences. Therefore, careful planning of strategies, e.g. deployment of units at strategic locations during peak hours, may become more important. In order to facilitate for the rescue service, it could be a good idea to inform the citizens how to act in case of an approaching rescue vehicle demanding free path.

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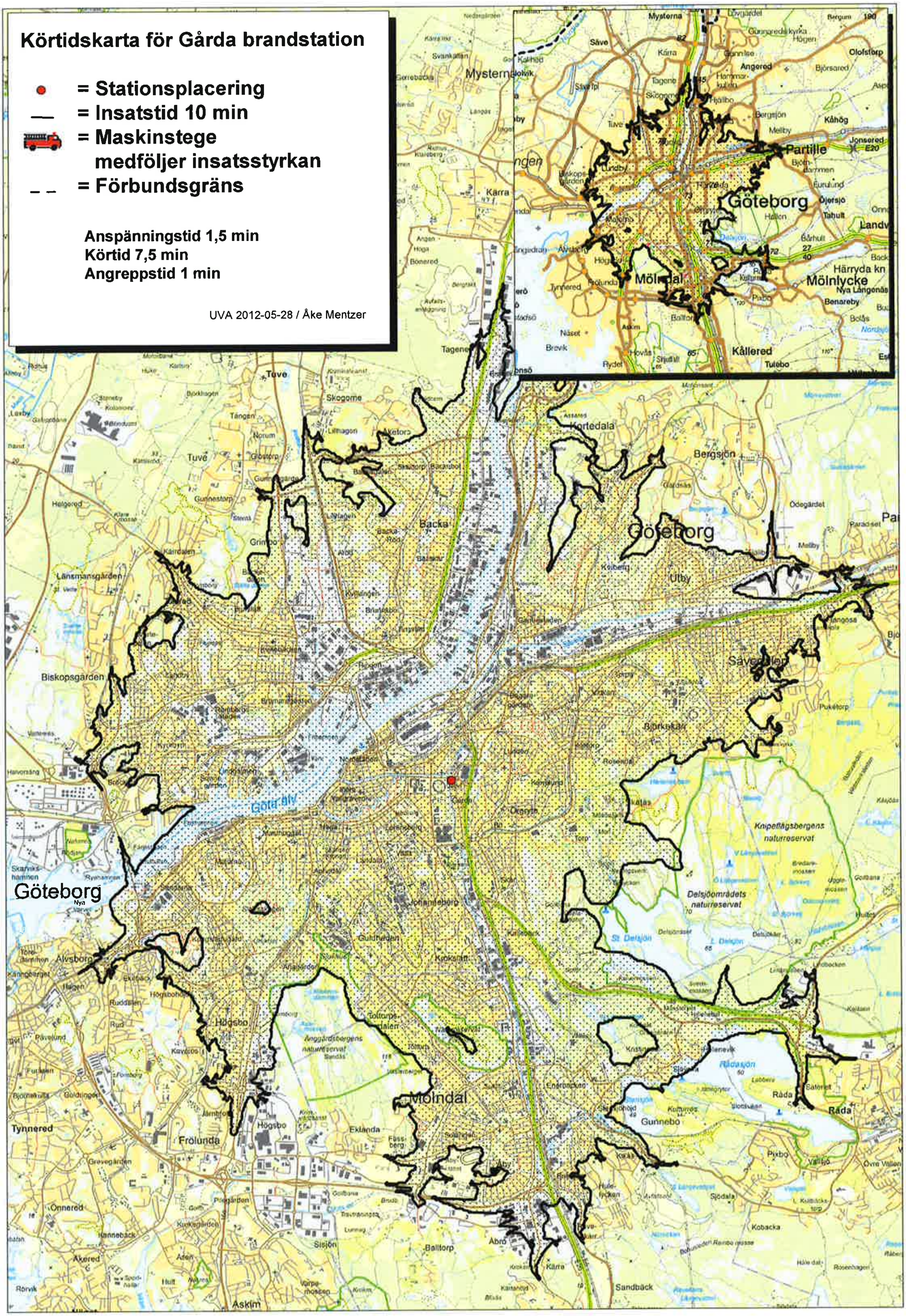
Appendix

Appendix I	Coverage area for Gårda fire station.
Appendix II	Mobility plans Haga.
Appendix III	Mobility plans Korsvägen.
Appendix IV	Mobility plans Central station area.
Appendix V	Tables with traffic flows along the primary dispatch net.

Appendix I

Coverage area for Gårda fire station, see next page.


Körtidskarta för Gårda brandstation
= Stationsplacering
= Insatstid 10 min
= Maskinstege medföljer insatsstyrkan
= Förbundsgräns
Anspänningstid 1,5 min
Körtid 7,5 min
Angreppstid 1 min
UVA 2012-05-28 / Åke Mentzer
Göteborg
Partille
Mölndal
Mölnlycke
Kållered
Göta älv
Tuve
Skogome
Kortedala
Bergsjön
Backa
Utby
Sävedalen
Biskopsgården
Knipeflågsbergens naturreservat
Delsjöområdets naturreservat
Rådasjön
Gunnebo
Högsbo
Frölunda
Tynnered
Askim
Sandbäck

Appendix II

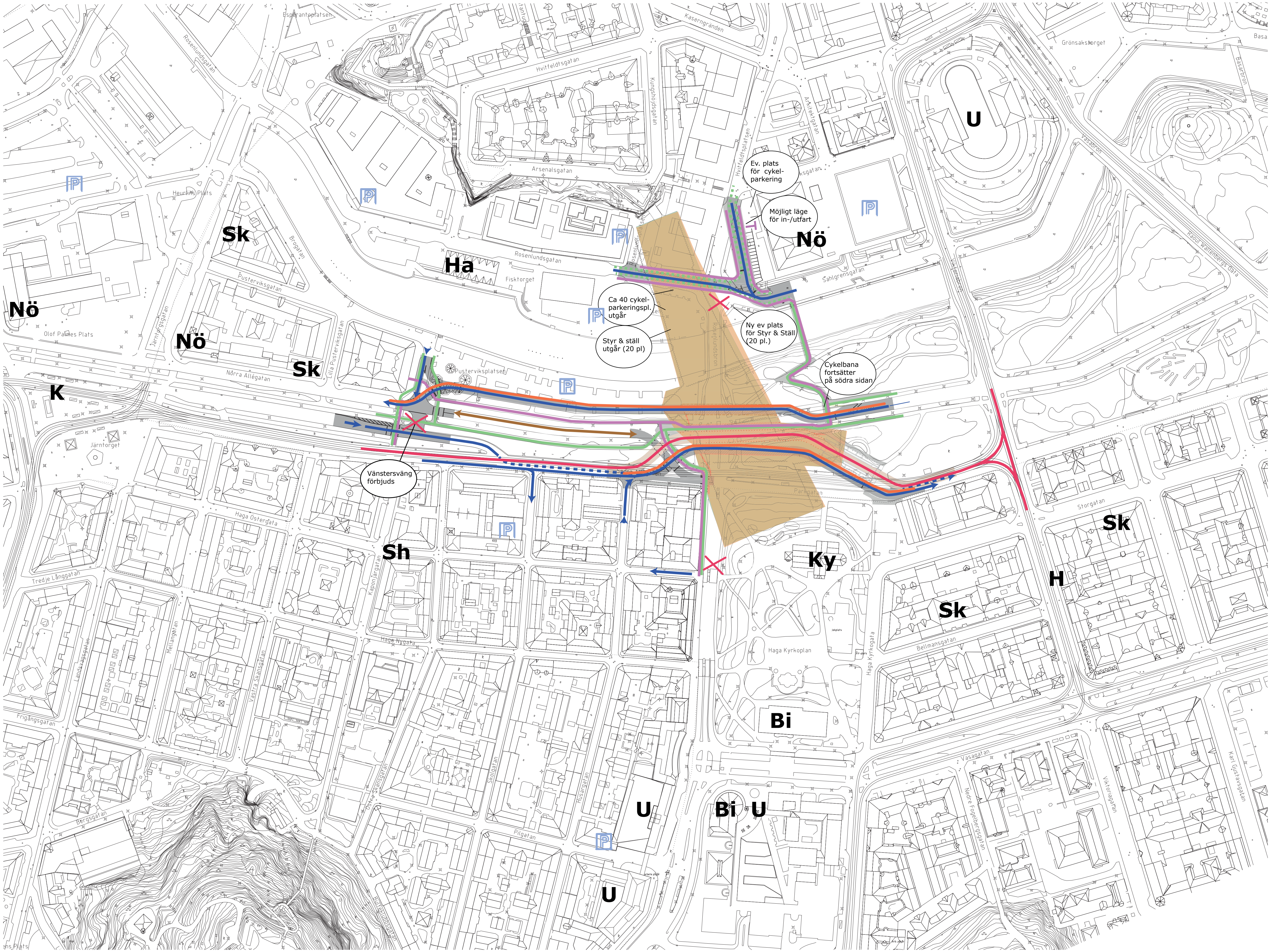
Mobility plans for the Västlänken Haga station. The document contains following information:

- Mobility plans accessibility.

BILAGA 1A

Haga trafik under byggtid huvudskede 1, år 2018-2022

Trafikföringsprincip tillgänglighet



FÖRKLARINGAR

- Byggdel i produktion
- Arbetsområde (vid behov)
- Byggtrafik
- Spårväg
- Busskörfält
- Spårväg med busstrafik
- Gata med busstrafik
- Biltrafik
- Biltrafik i spår
- Cykelbana
- Cykeltrafik i gata
- Gångtrafik (vid behov)
- Räddningsfordon
- Transporter/angöring
- Infart garage/port
- Förstudie ev. trimningsåtgärd
- Avstängning biltrafik
- Rivning byggnader (vid behov)

/erksamheter

P	Parkering/Parkeringshus
Bi	Bibliotek
Ha	Handel
H	Hotell
Id	Idrottsanläggning
K	Kollektivtrafikknutpunkt
M	Museum
Nö	Nöjesanläggning
Rä	Räddningstjänsten
Sj	Sjukhus
Sk	Skola
Sh	Shopping
U	Universitet/högskola
Ky	Kyrka

ÅF INFRASTRUCTURE
Grafiska vägen 2
Box 1551, 401 51 Göteborg
Tel: 010-505 00 00
www.afconsult.com

UPPDRAG NR | RITAD AV | HANDLÄGGARE
ANSVARIG | GRANSKAD AV
DATUM 2016-05-16 | GRANSKNINGSDATUM | REV./REL. DATUM

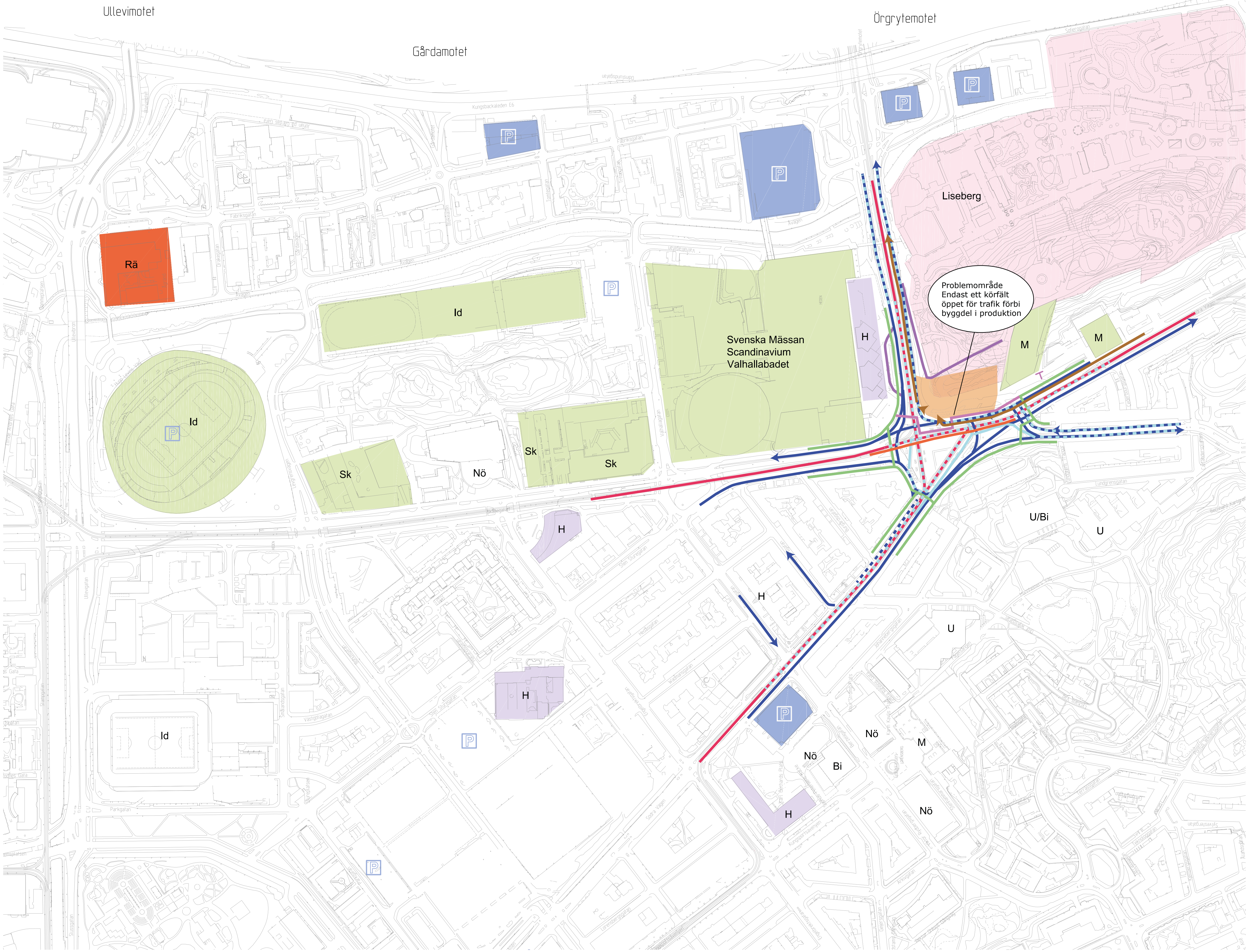
Appendix III

Mobility plans for Västlänken Korsvägen station. The document contains the following information:

- Mobility plans accessibility.

BILAGA 1A

Korsvägen trafik under byggtid huvudskede 1, år 2018-2020
Trafikföringsprincip tillgänglighet



FÖRKLARINGAR

- Byggdel i produktion
- Arbetsområde (vid behov)
- Byggtrafik
- Spårväg
- Busskörfält
- Spårväg med busstrafik
- Gata med busstrafik
- Biltrafik
- Biltrafik i spår
- Cykelbana
- Cykeltrafik i gata
- Gångtrafik (vid behov)
- Räddningsfordon
- Transporter/angöring
- Infart garage/port
- Förstudie ev. trimningsåtgärd
- Avstängning biltrafik
- Rivning byggnader (vid behov)

Verksamheter

P	Parkerinig/Parkeringshus
Bi	Bibliotek
Ha	Handel
H	Hotell
Id	Idrottsanläggning
K	Kollektivtrafikknutpunkt
M	Museum
Nö	Nöjesanläggning
Rä	Räddningstjänsten
Sj	Sjukhus
Sk	Skola
Sh	Shopping
U	Universitet/högskola

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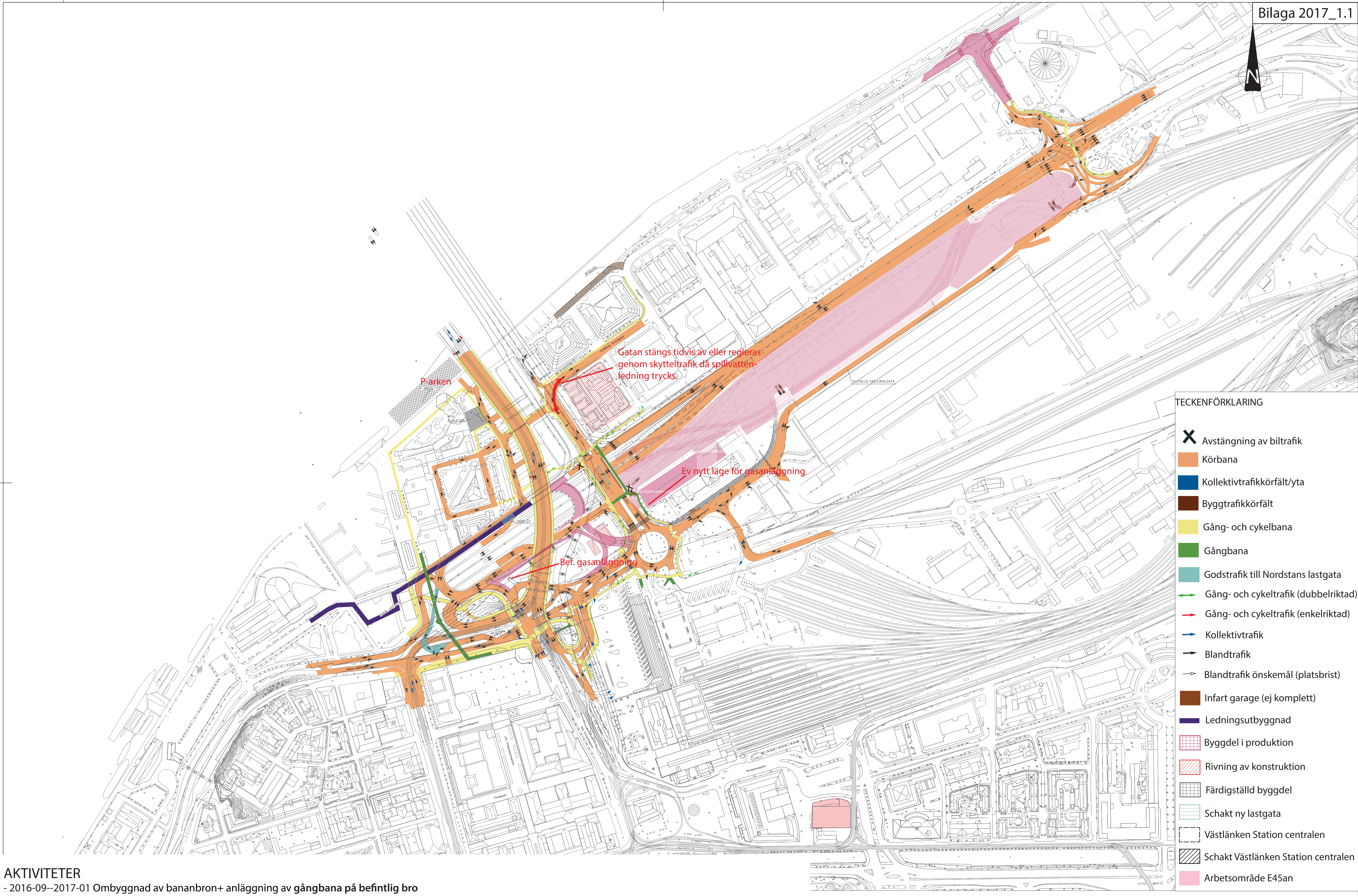
UPPDRAG NR	RITAD AV	HANDLÄGGARE
ANSVARIG	GRANSKAD AV	
DATUM 2016-05-16	GRANSKNINGSDATUM	REV./REL. DATUM

Appendix IV

Mobility plans for the Central station area. The document contains the following information:

- Central station area 201701 – 201810.
    - 201701.
    - 201702 – 201705.
    - 201706 – 201708.
    - 201709 – 201712.
    - 201801 – 201810.
- Kvarnberget area 2018.

Bilaga 2017_1.1

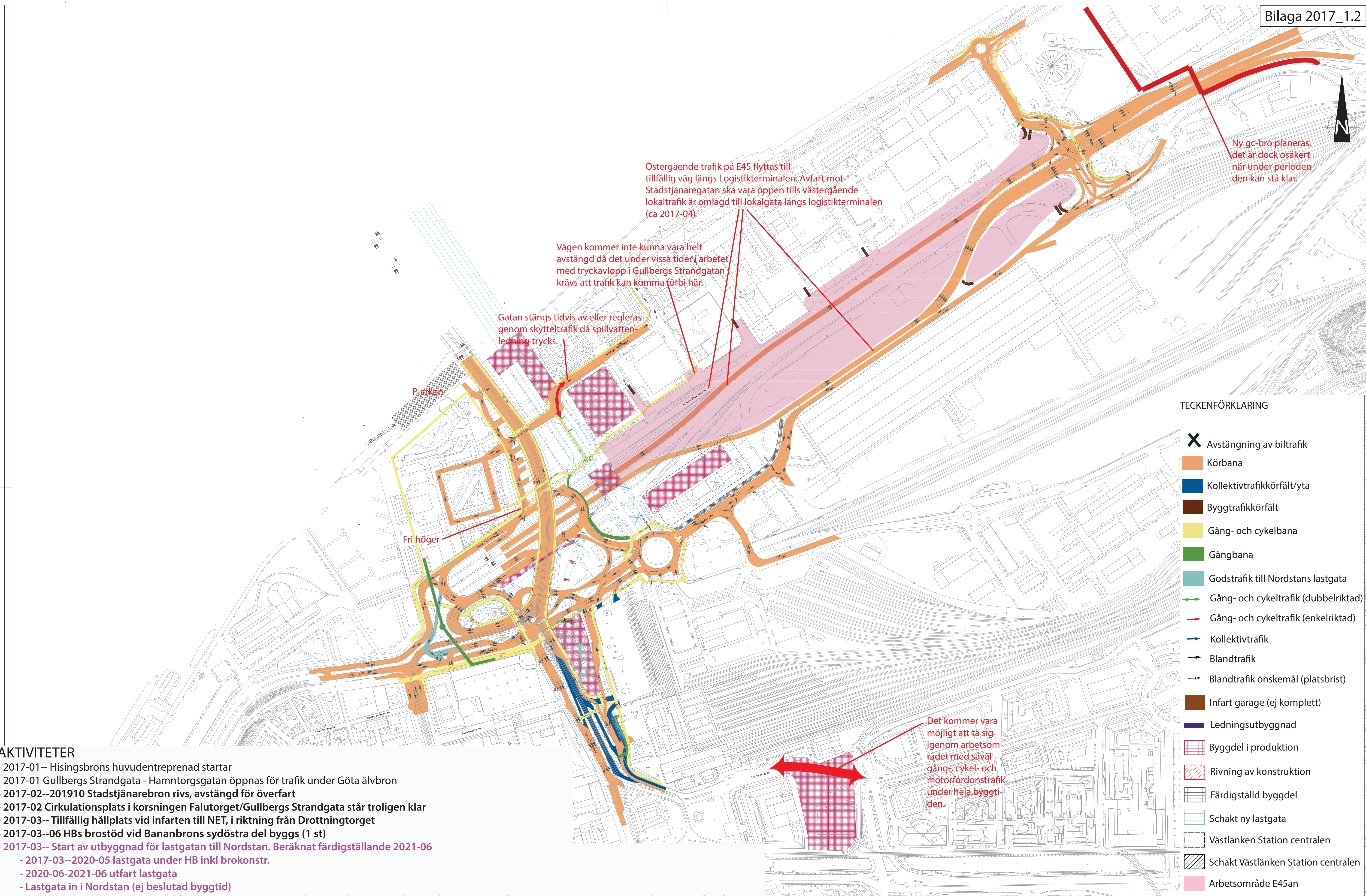


AKTIVITETER

- 2016-09--2017-01 Ombyggnad av bananbron+ anläggning av **gångbana på befintlig bro**
- **2017-01-- Hisingsbrons huvudentreprenad startar**
- **2017-01 Gullbergs Strandgata - Hamntorgsgatan öppnas för trafik under Göta älvbron**
- **2017-01 Bananbrons norra del avstängd, omledning sker via Stadstjänaregatan och Hamntorgsgatan**
- **2017-01 Byggnation av cirkulationsplats i korsningen Falutorget-Gullbergs Strandgata**
- **2017-01 P-huset vid Åkareplatsen rivs**

ARBETSMATERIAL 2016-11-04

Delområde Centralstationen
201701
Skala 1:2500 (A1)



AKTIVITETER

- 2017-01-- Hisingsbrons huvudentreprenad startar
- 2017-01 Gullbergs Strandgata - Hamntorgsgatan öppnas för trafik under Göta älvbron
- **2017-02--201910 Stadstjänarebron rivs, avstängd för överfart**
- **2017-02 Cirkulationsplats i korsningen Falutorget/Gullbergs Strandgata står troligen klar**
- **2017-03-- Tillfällig hållplats vid infarten till NET, i riktning från Drottningtorget**
- **2017-03--06 HBs brostöd vid Bananbrons sydöstra del byggs (1 st)**
- **2017-03-- Start av utbyggnad för lastgatan till Nordstan. Beräknat färdigställande 2021-06**
  - **2017-03--2020-05 lastgata under HB inkl brokonstr.**
  - **2020-06-2021-06 utfart lastgata**
  - **Lastgata in i Nordstan (ej beslutad byggtid)**
- **2017-03-- Uppfart till Göta älvbron från Bergslagsgatan stängs för biltrafik. Cykeltrafik överflyttad till K1 på den östra sidan bron (där trafiken kan gå i båda riktningar)**
- **2017-04 Avfart från E45 i västlig riktning mot Norra Sjöfarten stängs**
- **2017-04--2019-03 Byggnation norra tunnelröret/delar av södra tunnelröret mellan E45/Norra Sjöfarten/överdäckning väster om Kämpegatan**
- **2017-04--12 Byggnation av Åkareplatsen**

2017-04-06 - Rivning norra P-huset vid Hamntorgsgatan

- **2017-05--09 HBs brostöd mellan Södra Sjöfarten och VL byggs (2 st)**
- **2016-2019 Rivning och nybyggnation av gamla Sweco-huset (Gullbergs Strandgata-Vikingsgatan)**

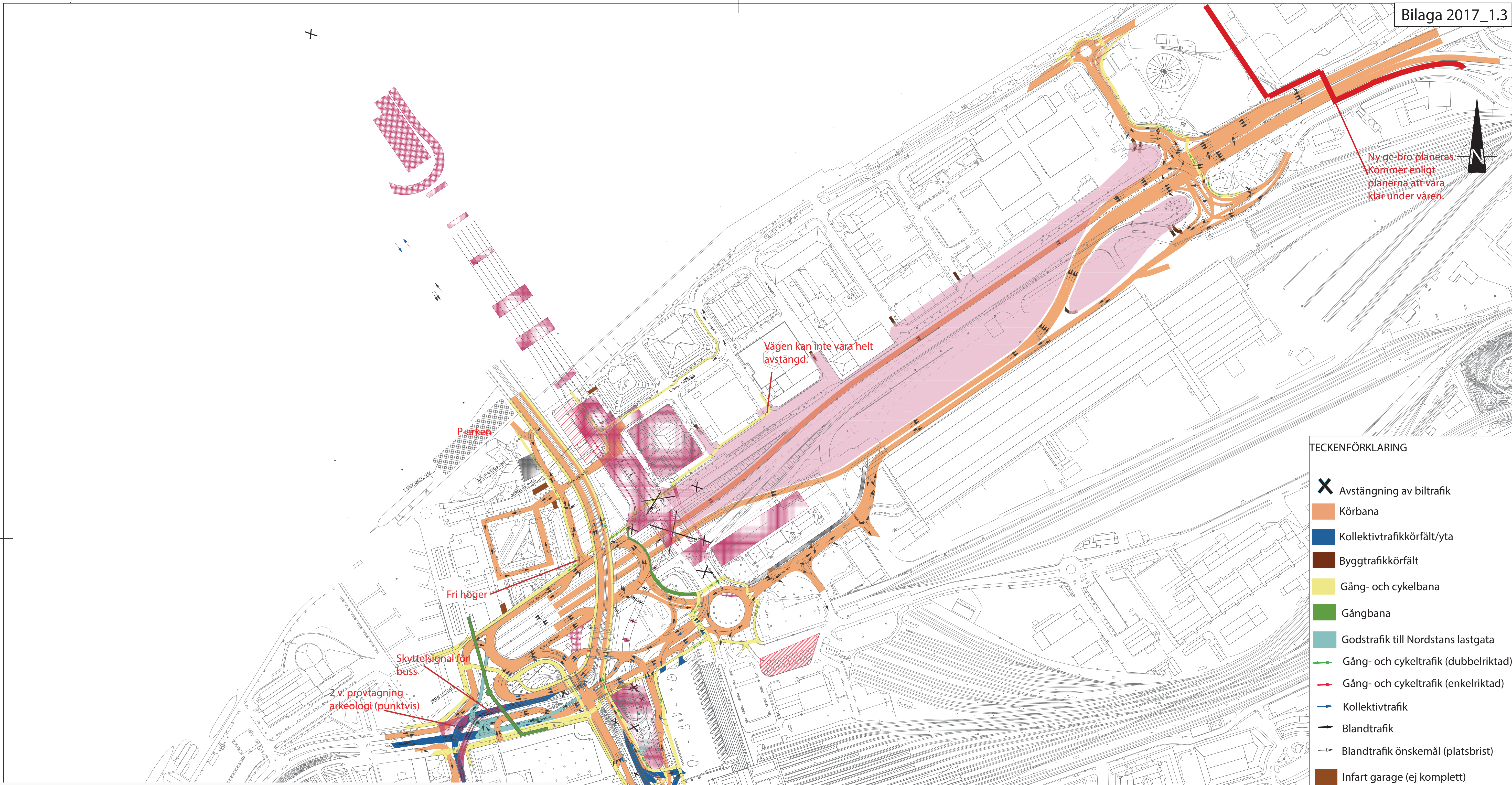
ARBETSMATERIAL 2016-11-04

Delområde Centralstationen

201702-201705

Skala 1:2500 (A1)

Bilaga 2017_1.3



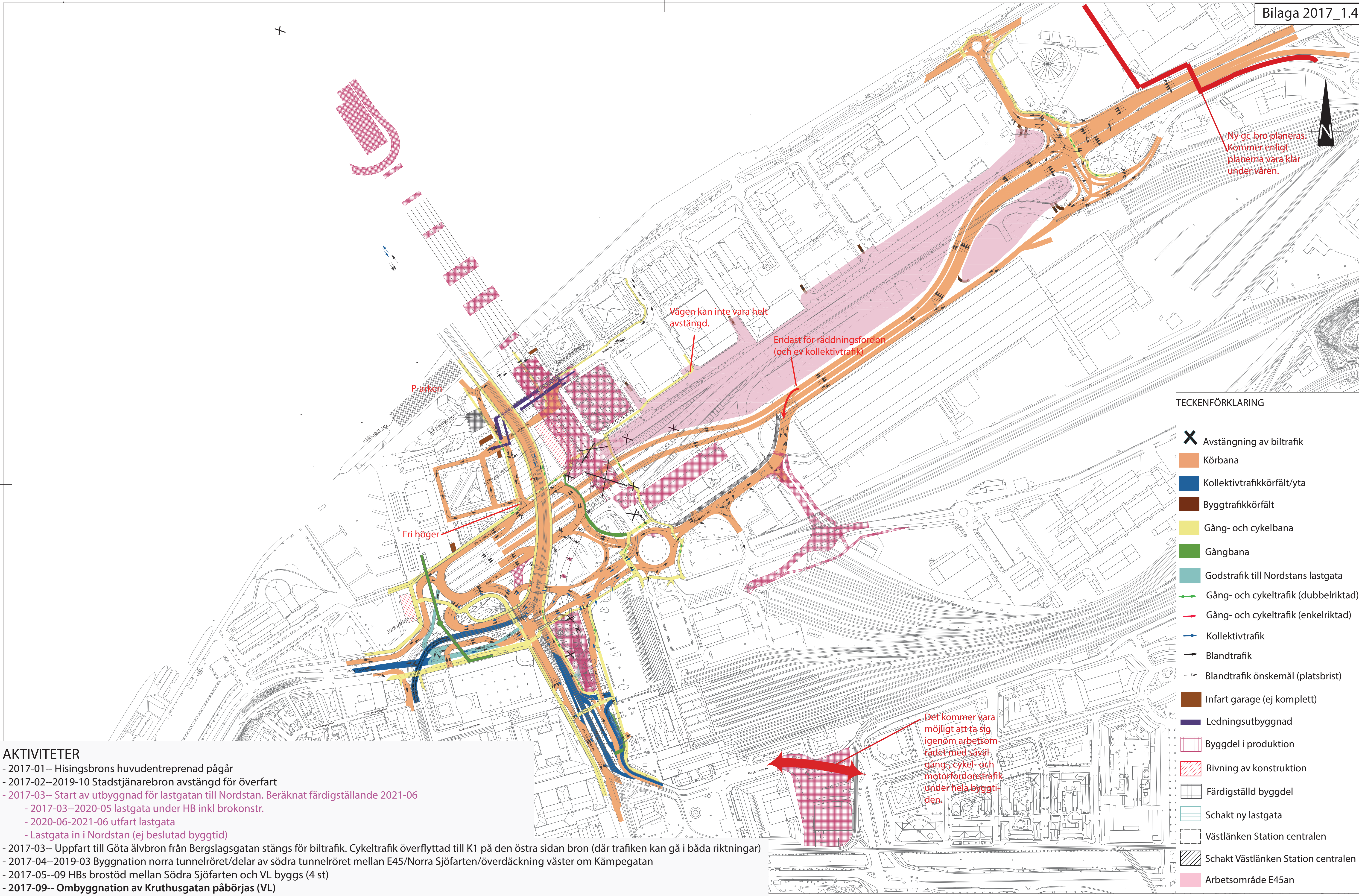
AKTIVITETER

- 2017-01-- Hisingsbrons huvudentreprenad pågår
- 2017-01-- Tillfällig hållplats vid infarten till NET, i riktning från Drottningtorget
- 2017-02--2019-10 Stadstjänarebron avstängd för överfart
- 2017-03--06 HBs brostöd vid Bananbron byggs (1 st)
- 2017-03-- Start av utbyggnad för lastgatan till Nordstan. Beräknat färdigställande 2021-06
    - 2017-03--2020-05 lastgata under HB inkl brokonstr.
    - 2020-06-2021-06 utfart lastgata
    - Lastgata in i Nordstan (ej beslutad byggtid)
- 2017-03-- Uppfart till Göta älvbron från Bergslagsgatan stängs för biltrafik. Cykeltrafik överflyttad till K1 på den östra sidan bron (där trafiken kan gå i båda riktningar)
- 2017-04--2019-03 Byggnation norra tunnelröret/delar av södra tunnelröret mellan E45/Norra Sjöfarten/överdäckning väster om Kämpegatan
- 2017-05--08 Ledningsarbete mellan Nordstan och NET, samt längs NET, tryckgrop och mottagargrop. Beslut saknas om när det ska ligga i tid- förberedande eller i ECI-entreprenaden
- 2017-05--09 HBs brostöd mellan Södra Sjöfarten och VL byggs (2 st)
- **2017-06--08 Sommaravstängning spårtrafik på GÄ-bron+ rivning av nedgångar till tunneln mellan Nordstan och Centralstationen**
- **2017-06--08 Byggnation av spårramp från Ö. Hamngatan till GÄ-bron startar, pågår under 9 v. Busstrafik ska kunna trafikera rampen under hela perioden.**
- **2017-06--08 Byggnation av tillfällig gångbro öster om Stadstjänarebron**
- **2017-06--08 Arkeologiska undersökningar lastgatan**
- **2017-04--12 Byggnation Åkareplatsen**
- **2017-08--10 Rivning södra P-huset vid Hamntorgsgatan**
- 2016-2019 Rivning och nybyggnation av gamla Sweco-huset (Gullbergs Strandgata-Vikingsgatan).

ARBETSMATERIAL 2016-11-04

Delområde Centralstationen
201706-201708
Skala 1:2500 (A1)

Bilaga 2017_1.4

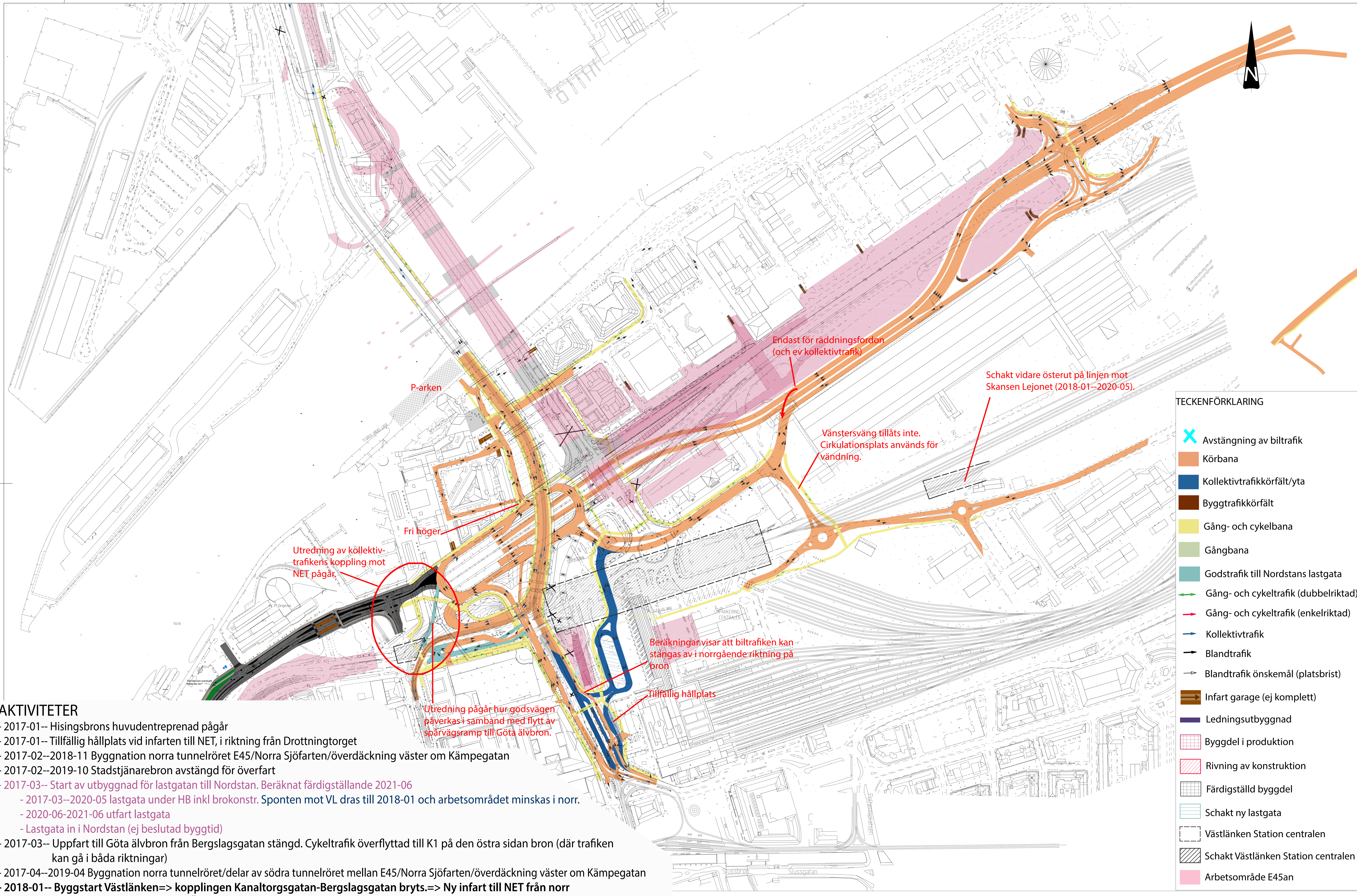


AKTIVITETER

- 2017-01-- Hisingsbrons huvudentreprenad pågår
- 2017-02--2019-10 Stadstjänarebron avstängd för överfart
- 2017-03-- Start av utbyggnad för lastgatan till Nordstan. Beräknat färdigställande 2021-06
  - 2017-03--2020-05 lastgata under HB inkl brokonstr.
  - 2020-06-2021-06 utfart lastgata
  - Lastgata in i Nordstan (ej beslutad byggtid)
- 2017-03-- Uppfart till Göta älvbron från Bergslagsgatan stängs för biltrafik. Cykeltrafik överflyttad till K1 på den östra sidan bron (där trafiken kan gå i båda riktningar)
- 2017-04--2019-03 Byggnation norra tunnelröret/delar av södra tunnelröret mellan E45/Norra Sjöfarten/överdäckning väster om Kämpegatan
- 2017-05--09 HBs brostöd mellan Södra Sjöfarten och VL byggs (4 st)
- **2017-09-- Ombyggnation av Kruthusgatan påbörjas (VL)**
- **2017-09--12 Rivning södra P-huset vid Hamntorgsgatan**
- **2017-09--12 HBs brostöd vid Stadstjänarebron byggs (1 st)**
- **2017-12 Slutbesiktning Åkareplatsen (2017-12-10)**
- **2017-12-31 Älvstranden utveckling (Älvrummet)-byggnad ska vara riven riven**
- 2016-2019 Rivning och nybyggnation av gamla Sweco-huset (Gullbergs Strandgata-Vikingsgatan)

ARBETSMATERIAL 2016-11-04

Delområde Centralstationen
201709-201712
Skala 1:2500 (A1)



AKTIVITETER

- 2017-01-- Hisingsbrons huvudentreprenad pågår
- 2017-01-- Tillfällig hållplats vid infarten till NET, i riktning från Drottningtorget
- 2017-02--2018-11 Byggnation norra tunnelröret E45/Norra Sjöfarten/överdäckning väster om Kämpegatan
- 2017-02--2019-10 Stadstjänarebron avstängd för överfart
- 2017-03-- Start av utbyggnad för lastgatan till Nordstan. Beräknat färdigställande 2021-06
  - 2017-03--2020-05 lastgata under HB inkl brokonstr. Sponten mot VL dras till 2018-01 och arbetsområdet minskas i norr.
  - 2020-06-2021-06 utfart lastgata
  - Lastgata in i Nordstan (ej beslutad byggtid)
- 2017-03-- Uppfart till Göta älvbron från Bergslagsgatan stängd. Cykeltrafik överflyttad till K1 på den östra sidan bron (där trafiken kan gå i båda riktningar)
- 2017-04--2019-04 Byggnation norra tunnelröret/delar av södra tunnelröret mellan E45/Norra Sjöfarten/överdäckning väster om Kämpegatan
- **2018-01-- Byggstart Västlänken=> kopplingen Kanaltorgsgatan-Bergslagsgatan bryts.=> Ny infart till NET från norr (ESI entreprenad Centralen, Östra Hamngatan - E6/E20)**
- **2018-01 Ny koppling mellan Bergslagsgatan och Kruthusgatan som inkluderar infart till P för Centralen står klar (VL)**
- **2018-01--05 Utbyggnad av ny sträckning för Västra Sjöfarten i ett nordligare läge**
- **2018-02--05 HBs brostöd norr om Stadstjänarebron byggs (2 st)**
- **2018-06-- Kvarnbergsetappen av VL startar (från Göta älvbrons ramp mot Östra Hamng och västerut). Arkeologiska utgrävningar inleder**
- **2018-06--11 Götatunneln avstängd växelvis norra och södra tunnelröret. Tunneln är öppen för trafik i västlig riktning under hela perioden medan östlig leds om. Ej beslutat!**
- 2016-2019 Rivning och nybyggnation av gamla Sweco-huset (Gullbergs Strandgata-Vikingsgatan)

ARBETSMATERIAL 2016-09-09

Delområde Centralstationen
201801-201810
Skala 1:2500 (A1)

TECKENFÖRKLARING

SCHAKT (UPPSKATTAD YTA)
KÖRBANA
GÅNGBANA
CYKELBANA
REFUG ELLER BUFFERTYTA
HÅLLPLATS
GRÖNYTA

0 10 20 30 40 50 60 70 80 90 100
SKALA 1:1000

INNOVATION BY EXPERIENCE
TRAFIKVERKET

VÄSTLÄNKEN TILLFÄLLIG TRAFIK

E03 Kvarnberget
ÖVERSIKTSKARTA 1:1000
Trafiklösning Kvarnberget, Blad 1

GRANSKNINGSHANDLING 2016-11-14

Appendix V

Tables with traffic flows along the primary dispatch net.

- Linnéplatsen/Masthugget.
    - Part 1.
    - Part 2.
    - Part3.
- Guldheden via Korsvägen.
- Sahlgrenska/Annedal.
- Kålltorp via E6/E20.
- Kålltorp via Lunden.
- Kallebäck via E6.

Linnéplatsen/Masthugget

Part 1

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Ullevigatan (Gårda station - *Skånegatan*)	425	331	447	35%	329	323	-2%	3 ; 0
Ullevigatan (*Skånegatan - Nya allén*)	415	190	353	86%	352	339	-4%	3 ; 1*
Nya allén (*Ullevigatan - Sten Sturegatan*)	250	99	179	81%	266	299	12%	3 ; 0
Nya allén (*Sten Sturegatan - Södra Vägen*)	360	463	583	26%	670	713	6%	3 ; 1
Nya allén (*Södra Vägen - Kungsportsavenyen*)	90	309	375	22%	446	475	6%	3 ; 0
Nya allén (*Kungsportsavenyen - Raoul Wallenbergs gata*)	290	297	364	22%	414	429	3%	3 ; 0
Nya allén (*Raoul Wallenbergs gata - Viktoriagatan*)	225	257	307	19%	355	355	0%	3 ; 0
Nya allén (*Viktoriagatan - Sprängkullsgatan*)	205	340	323	-5%	378	445	18%	3 ; 0
Norra Allégatan (*Sprängkullsgatan - Järntorgsgatan*)	430	353	308	-13%	477	486	2%	2 ; 0
Olof Palmes plats (*Järntorgsgatan - Järnvågsgatan*)	135	353	307	-13%	493	527	7%	2 ; 0
Järntorget/ Linnégatan (*Järnvågsgatan - Plantagegatan*)	365	353	348	-1%	480	522	9%	2 ; 1
Linnégatan (*Plantagegatan - Nordensskiöldsgatan*)	545	309	359	16%	437	487	11%	2 ; 1

Linnégatan (*Nordenskiöldsgatan - Linnéplatsen*)	290	413	522	26%	486	605	24%	2 ; 1

* One lane reserved only for emergency vehicles

Part 2

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Sprängkullsgatan (*Nya allén - Vasagatan*)	240	362	468	29%	584	622	7%	1 ; 0
Sprängkullsgatan (*Vasagatan - Skanstorget*)	235	450	490	9%	608	603	-1%	2 ; 1
Övre Husargatan/ Skanstorget (*Skanstorget - Nordenskiöldsgatan*)	440	407	434	7%	569	588	3%	2 ; 1
Övre Husargatan (*Nordenskiöldsgatan - Linnéplatsen*)	305	286	356	24%	418	493	18%	2 ; 1

Part 3

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Prinsgatan (*Linnégatan - Vegagatan*)	200	80	42	-48%	39	35	-10%	1 ; 0
Vegagatan (*Prinsgatan - Nordospassagen bridge*)	320	106	92	-13%	141	136	-4%	1 ; 0
Vegagatan - Jungmansgatan	75	83	71	-14%	241	327	36%	1 ; 0

Guldheden via Korsvägen

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Ullevigatan (Gårda station - *Skånegatan*)	425	331	447	35%	329	323	-2%	3 ; 0
Skånegatan (*Ullevigatan* - *Bohusgatan*)	315	437	367	-16%	451	309	-31%	2 ; 0
Skånegatan (*Bohusgatan* - *Engelbrektsgatan*)	265	261	221	-15%	382	286	-25%	2 ; 0
Skånegatan (*Engelbrektsgatan* - *Burgårdsplatsen*)	220	112	62	-45%	263	105	-60%	1 ; 0
Burgårdsplatsen (*Skånegatan* - *Skånegatan*)	40	56	31	-45%	132	53	-60%	2 ; 0
Skånegatan (*Burgårdsplatsen* - *Burgårdsgatan*)	190	140	100	-29%	308	209	-32%	2 ; 0
Skånegatan (*Burgårdsgatan* - *Korsvägen*)	135	105	110	5%	222	52	-77%	2 ; 0
Korsvägen (*Skånegatan* - *Eklandagatan*)	165	350	383	10%	358	335	-6%	3 ; 0
Eklandagatan (*Korsvägen* - *Carlandersplatsen*)	290	411	391	-5%	476	215	-55%	1 ; 0
Eklandagatan (*Carlandersplatsen* - *Gibraltargatan*)	970	372	352	-5%	387	175	-55%	1 ; 0
Gibraltargatan (*Eklandagatan* - *Doktor Forselius gata*)	870	236	212	-10%	153	152	-1%	1 ; 0
Doktor Forselius gata (*Gibraltargatan* - *Doktor Allards gata*)	400	236	212	-10%	153	152	-1%	1 ; 0

Doktor Allards gata (*Doktor Forselius gata - Doktor Wrestlings gata*)	300	236	212	-10%	153	152	-1%	1 ; 0

Sahlgrenska/Annedal

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Ullevigatan (Gårda station - *Skånegatan*)	425	331	447	35%	329	323	-2%	3 ; 0
Skånegatan (*Ullevigatan - Bohusgatan*)	315	437	367	-16%	451	309	-31%	2 ; 0
Skånegatan (*Bohusgatan - Engelbrektsgatan*)	265	261	221	-15%	482	286	-25%	2 ; 0
Engelbrektsgatan (*Ullevigatan - Sten Sturegatan*)	160	471	448	-5%	552	528	-4%	1 ; 0
Engelbrektsgatan (*Sten Sturegatan - Södra vägen*)	280	382	354	-7%	400	433	8%	1 ; 0
Engelbrektsgatan (*Södra vägen - Kungsportsavenyn*)	375	465	467	0%	438	530	21%	2 ; 1
Engelbrektsgatan (*Kungsportsavenyn - Götabergsgatan*)	375	465	467	0%	438	530	21%	1 ; 0
Engelbrektsgatan (*Götabergsgatan - Aschebergsgatan*)	250	442	439	-1%	429	525	22%	1 ; 0
Aschebergsgatan (*Engelbrektsgatan - Läraregatan*)	440	330	375	14%	398	423	6%	2 ; 1
Aschebergsgatan (*Läraregatan - Guldhedsgatan*)	465	532	613	15%	490	523	7%	2 ; 1
Guldhedsgatan (*Aschebergsgatan - Wavrinskys plats*)	290	304	344	13%	277	300	8%	2 ; 0

Guldhedsgatan (*Wavrinskys plats - Per Dubbsgatan*)	580	325	357	10%	251	294	17%	2 ; 0
Per Dubbsgatan (*Guldhedsgatan - Sahlgrenska*)	180	494	488	-1%	534	568	6%	3 ; 1

Kålltorp via E6/E20

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Ullevigatan and sliproad (Gårda station - E6)	465	294	497	69%	707	901	27%	2 ; 0
E6 (*Ullevigatan* - interchange to E20)	445	872	1079	24%	1061	1179	11%	4 ; 0
Interchange (E6 - E20)	480	988	1256	26%	1470	2030	38%	1 ; 0
E20 (interchange - *Munkebäcksmotet*)	2020	800	730	-9%	1568	1778	6%	3 ; 0*
Munkebäcksgatan (*Munkebäcksmotet - Torpagatan*)	690	304	308	1%	295	277	-6%	2 ; 0
Torpagatan (*Munkebäcksgatan - Rosendalsgatan*/*Stenungsundsgatan*)	940	208	421	102%	405	517	28%	1 ; 0
*Stenungsundsgatan***	280	-	-	-	-	-	-	1 ; 0

*Only two lanes past Ånäsmotet
**No data available for this part of the stretch.

Kålltorp via Lunden

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Rantorget (Gårda station - *Willinsbron*)	230	471	549	16%	429	450	5%	2 ; 0
Willinsbron (*Rantorget - Sankt Pauligatan*)	225	202	355	76%	636	656	3%	1 ; 0
Sankt Pauligatan/*Ingeborgsgatan*	725	59	178	202%	387	465	20%	1 ; 0

(*Willinsbron - Danska vägen*)								
Danska vägen (*Ingeborgsgatan - Kärralundsgatan*)	225	261	292	12%	471	407	-14%	1 ; 0
Kärralundsgatan (*Danskavägen - Virginsgatan*)	1050	86	98	14%	226	237	5%	1 ; 0
*Virginsgatan**	500	-	-	-	-	-	-	1 ; 0

*No data available for this part of the stretch.

Kallebäck via E6

Road (Stretch)	Distance [m]	Base AM per lane [veh/h]	2018 AM per lane [veh/h]	Increase AM	Base PM per lane [veh/h]	2018 PM per lane [veh/h]	Increase PM	Number of lanes (total ; public transport)
Ullevigatan/sliproad (Gårda station - E6)	225	245	265	8%	527	569	8%	1 ; 0
E6 (*Ullevigatan - Örgrytemotet*)	930	1062	1061	0%	1352	1305	-3%	3 ; 0
E6 (*Örgrytemotet* - interchange to riksväg 40)	665	949	933	-2%	1248	1173	-6%	4 ; 0
No data for further on the stretch								