Multimodal Optimisation of Roadspace in Europe

D5.2

Case Study Design Methodology – Future Conditions

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1 Introduction

The primary aim of MORE is to provide a comprehensive and objective approach to the planning, design, management and operation of road-space on major urban corridors feeding the inter-national TEN-T road networks (Figure 1), where expanding or building new urban roads is not an option. So that the limited road-space and capacity can be optimised, through the development of new concepts, tools and processes (which it is developed and tested in five cities). This takes into account the multi-modal functioning of the corridors and their links with major inter-modal interchanges (e.g. ports), as well as other policy requirements; thereby enabling city authorities to optimally allocate the limited available capacity, in space and time.

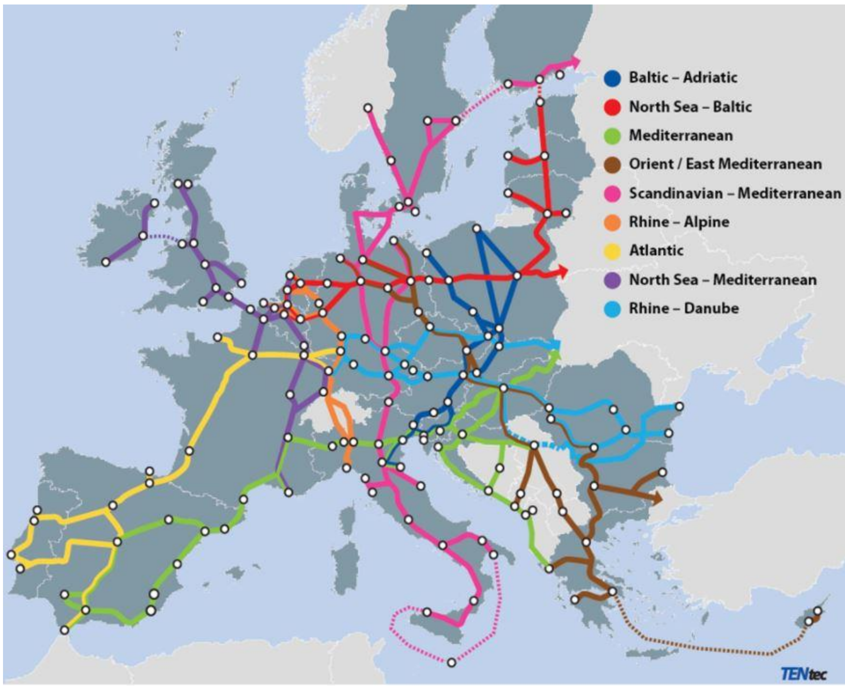


Figure 1. TEN-T Network (Source: European Commission)

The MORE ambition is to understand the current situation of the corridors in the partner cities, but also to understand how future trends may influence the way the roads are used. In this sense an entire line of research has been developed: from understanding the technologies that are influencing the roads – infrastructure, vehicles, operations etc. to future users' needs and future scenarios for city administrations that will allow them to better understand how to be proactive in embracing the changes.

The overall aim of this Deliverable is to set out in some detail the factors that will be taken into account when developing design options for the Future Conditions on the selected 'Future Stress Section'.

The deliverable comprises one section for each of the five MORE cities and introduces the current conditions along the Feeder Route, before examining the future patterns of demand and scenarios looking head by between 10 and 30 years.

Each city has set out - in separate chapters - their Design Briefs. These include details on the ‘sections under stress’ looking ahead and the factors which will influence street designs in the future.

The Design Briefs highlight the overall objectives by profiling the performance indicators by which new designs will be evaluated. Indicators include travel speed, congestion, public transport delay, modal share, persons crossing the road, time spent in area and level of social activities, parking, loading and unloading, accidents and air quality.

The next steps of the project will see sites develop and evaluate these options using the WP4 tools for road space design, stakeholder engagement, simulation (updated VISSIM models) and appraisal.

2 BUDAPEST - Design Methodology for future conditions

2.1 Summary of current conditions along the Feeder Route

2.1.1 Introduction

BKK Centre for Budapest Transport is responsible for sustainable strategic planning and road allocation in Budapest.

TEN-T road networks approach Budapest's city limit as they intersect with the M0 motorway, which is the bypass of Budapest. The Urban Feeder Route connects with the Mediterranean TEN-T route via the M7 motorway (west from Budapest view), and the M3 motorway (east from Budapest view) which is also part of the Mediterranean corridor. Although the bypass has been built, the road infrastructure from 1970s and 1980s has remained which ensures the shortest pass is still through the city centre between the M7 and M3 motorway, and as a result is very well used by motorists. This Urban Feeder Route has been selected for the MORE study along with the surrounding corridor in view of its challenges and also opportunities. It runs from the M0 motorway to the city centre, and it is represented with a black line in Figure 2. The map below shows the entire length of the MORE corridor in Budapest from the M0 motorway to Keleti railway station.

Figure 2. Interaction of TEN-T and other key motorways in Budapest. Green: Mediterranean corridor, brown: Orient / East-Med corridor, blue: Rhine-Danube corridor. On the left: highway, railway, waterway. On the left: motorways, Mediterranean corridor (M7-M0-M3 motorway), Orient / East-Med corridor (M1-M0-M5 motorway), Rhine-Danube corridor (M1-M0-M5 motorway), red: between M7 and M3 motorway shortest path, black: Urban Feeder Route

The Urban Feeder Route has 4 main sections as illustrated in Figure 3 below.

- The first part of the route, M1-M7 motorway, is one of the busiest motorways in Hungary, more than 100,000 cars reach the city limit every day. This section is situated between I1 and I4 intersections in Figure 2. The high number of commuters cause problems in Budapest traffic and beyond (i.e. congestion, parking stress, air quality problems etc.).

- The starting point of second part of the corridor, Budaörsi road, is Kelenföld interchange, which is located next to the city limits and is one of the most important intermodal transport hubs in Budapest. National railways, metro line M4, regional and local bus lines, tram lines and P+R facilities are also available. The endpoint of this section is the BAH interchange, which is an important junction in Buda where the south-north road and the east-west road intersect. This section is situated between I4 and I6 intersections in Figure 3.

- The third part of the section, Hegyalja road, is located between the BAH interchange and Döbrentei square. It goes through Gellért hill and connects the traffic from Buda with a Danube quay and Pest. This section is situated between I6 and I8 intersections in the map.

- The fourth part of the section is the Rákóczi road axis. This axis is one of the most important boulevards in Budapest not just in the aspect of traffic but also in a historical way. Erzsébet bridge, Kossuth Lajos street, and Rákóczi road is part of the axes and ends at Keleti railway station forming an important interchange. This section is situated between I8 and I12 intersections in the map.

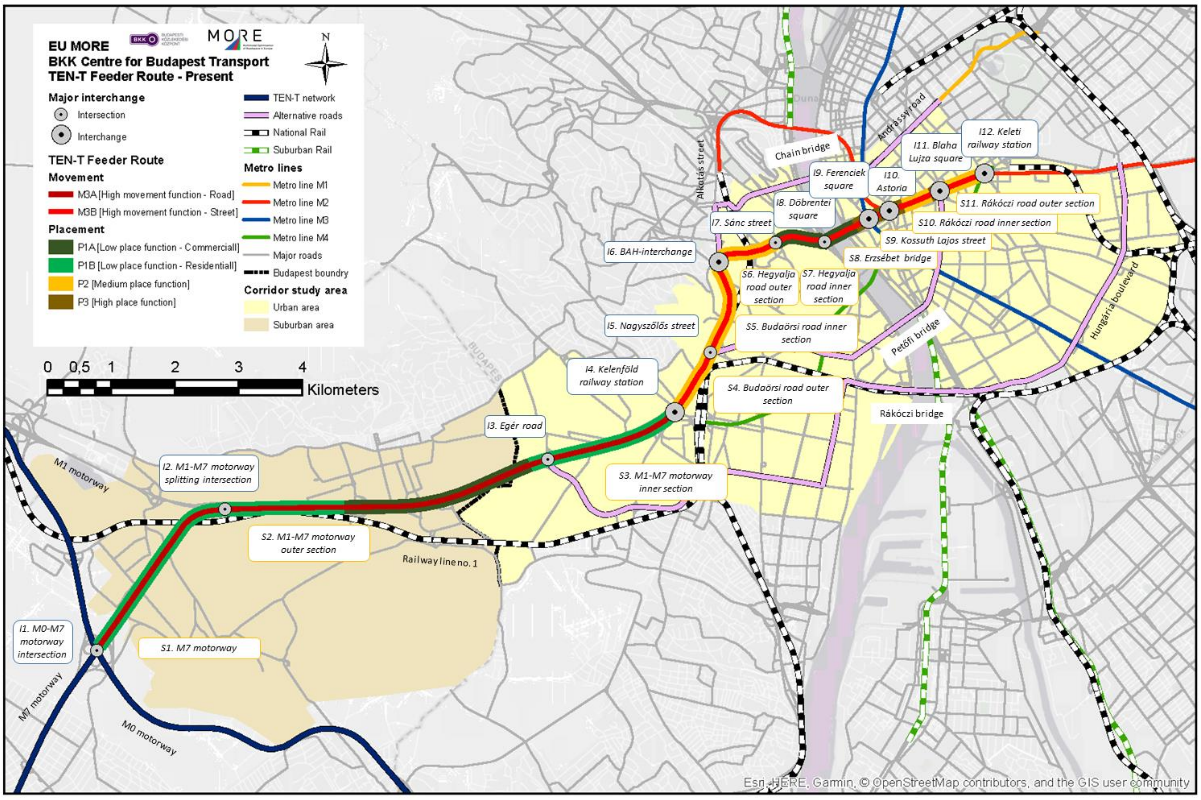


Figure 3. Sections of Budapest Urban Feeder Route in details, MORE project

The Budapest road network was redesigned in the 1970s. The city planners' dreams of more space for cars and a reduced public transport network became reality. The newly built road infrastructure (i.e. road bridges and tunnels) changed Budapest from a public transport-oriented city to a car-oriented city. It caused problems mainly in the city centre because

Budapest is the hub of the road network in Hungary, and several main roads were connected via city centre in these years to ensure easy and quick transit for cars. The Rákóczi axis is suffering from these difficulties in particular. In the last years, several parts of the city were redesigned and Budapest is a sustainable mobility city nowadays, but the city centre of Budapest is still very attractive not only for local traffic but also transit because of lack of alternative roads and (partly) grade-separated interchanges. The axis of Kossuth Lajos street and Rákóczi road is the core axis of the Budapest road network and it is a typical example of significant traffic in the city centre. The west-east axis is part of the MORE corridor. This axis provides the connection between the Buda (west) side and the Pest (east) side, of the city across the Danube. The road section between Ferenciek square and Astoria has been analysed in detail in MORE project.

2.1.2 Urban Feeder Route - Interchanges and intersections

Interchanges and intersections have been defined based on their functions on the Urban Feeder Route. The following table represents their main details with interchange and intersection reference numbers I1 to I12 relating to the map in Figure 2.

Table 1. Interchanges on Urban Feeder Route

No. of interchange / intersection	Type of junctions (interchange / intersection)	Name of interchange / intersection	Short description
I1	intersection	M0-M7 intersection	• Full grade separated intersection
I2	intersection	M1-M7 intersection	• Full grade separated intersection • Only connection from M1-M7 motorway to M1 motorway and M7 motorway
I3	intersection	Egér road (City limits of Budapest)	• Full grade separated intersection • Starting point of alternative route 1
I4	interchange	Kelenföld railway station	• Part grade separated intersection • Transport hub (Kelenföld railway station, 1000 P+R parking spots, metro line M4, bus and tram lines)
I5	intersection	Nagyszőlős street	• Full grade separated intersection • Only connection from Kelenföld railway station to BAH-interchange and Nagyszőlős street • Starting point of alternative route 2
I6	interchange	BAH-interchange	• Part grade separated intersection • Transport hub (bus and tram lines) • Starting point of alternative route 3

No. of interchange / intersection	Type of junctions (interchange / intersection)	Name of interchange / intersection	Short description
I7	intersection	Sánc street	• At-grade junction • Gellért hill
I8	intersection	Döbrentei square	• Part grade separated intersection • Transport hub (bus and tram lines) • End point of alternative route 2
I9	interchange	Ferenciek square	• At-grade junction • Transport hub (metro line M3 and bus lines)
I10	interchange	Astoria	• At-grade junction • Transport hub (metro line M2, bus and tram lines)
I11	interchange	Blaha Lujza square	• At-grade junction • Transport hub (metro line M2, bus and tram lines)
I12	interchange	Keleti railway station	• Part grade separated intersection • Transport hub (Keleti railway station, metro line M2, M4; bus, trolleybus and tram lines)

2.1.3 Urban Feeder Route - Sections

The Urban Feeder Route contains the following, homogenous sections: M7 motorway, M1-M7 motorway, Budaörsi road, Hegyalja road, Erzsébet bridge, Kossuth Lajos street, Rákóczi road. The length of Urban Feeder Route is 17.55 km.

The following table represents the main details of Urban Feeder Route. The section numbers are equal to those set out in Figure 2.

Table 2. Main details of Urban Feeder Route

No. of section	Name of section	Type of section i.	Type of section ii.	Length of section [km]	Road operator	Movement and Place classification (Present)	Start interchange / intersection	End interchange / intersection	Design speed [km/h]	No. of lanes for private vehicles*	Road separation [yes/no]	No. of bus lanes*	No. of bus lines	Public transport [passenger / day]‡	Volume of traffic [vehicle/ day]‡	Share of Goods Vehicle under 3,5t‡	Share of Goods Vehicle over 3,5t‡	Share of Cyclist‡	Share of Passenger car ‡	Parking
S1	M7 motorway	Road	Motorway	3.1	Magyar Közút	M3A / P1B	M0-M7 intersection	M1-M7 intersection	130	2+2	yes	0+0	0	-	56400	14%	8%	0%	79%	No
S2	M1-M7 motorway outer	Road	Motorway	5.1	Magyar Közút	M3A / P1B; P1A †	M1-M7 intersection	City limits of Budapest (Egér road)	100	3+3	yes	0+0	3	5400	110300	15%	8%	0%	77%	No
S3	M1-M7 motorway inner	Road	Urban motorway	2.2	Budapest Közút	M3A / P1B	City limits of Budapest (Egér road)	Kelenföld railway station	100	3+3	yes	0+0	3	5400	83700	13%	2%	0%	85%	No
S4	Budaörsi road outer	Road	Urban motorway	1.1	Budapest Közút	M3A / P2	Kelenföld railway station	Nagyszőlős street	70	3+4 4+4	yes	1+0 0+0	8	12300	121200	9%	1%	1%	89%	No
S5	Budaörsi road inner	Street	Urban main road	1.5	Budapest Közút	M3B / P2	Nagyszőlős street	BAH-interchange	50	2+2	yes	0+0	5	9900	69800	5%	1%	2%	93%	Footway
S6	Hegyalja road outer	Street	Urban main road	1	Budapest Közút	M3B / P2	BAH-interchange	Sánc street	50	2+2	yes	surrounds of bus stops	5	22700	48100	2%	0%	2%	95%	Parking spot
S7	Hegyalja road inner	Street	Urban main road	0.75	Budapest Közút	M3B / P1B	Sánc street	Döbrentei square	50	2+2	yes	0+0	5	22700	48100	2%	0%	2%	95%	No
S8	Erzsébet bridge	Street	Urban main road	0.8	Budapest Közút	M3B / P1B	Döbrentei square	Ferenciek square	50	2+2	no	1+1	9	56000	67300	2%	0%	4%	94%	No
S9	Kossuth Lajos street	Street	Urban main road	0.4	Budapest Közút	M3B / P3	Ferenciek square	Astoria	50	2+2	no	1+1	9	39700	53600	3%	0%	7%	90%	No
S10	Rákóczi road inner	Street	Urban main road	0.85	Budapest Közút	M3B / P3	Astoria	Blaha Lujza square	50	2+2	no	1+1	10	52100**	50300	5%	0%	17%	78%	No
S11	Rákóczi road outer	Street	Urban main road	0.75	Budapest Közút	M3B / P2	Blaha Lujza square	Keleti railway station	50	2+2	no	1+1	10	52100**	50300	5%	0%	17%	78%	No

* directions: before plus sign: eastbound direction; after plus sign: westbound direction

** Metro line M2 operates between Astoria and Keleti railway station, passenger flow of metro line was not taken into account.

† shopping malls are in this section

‡ data from Budapest macroscopic traffic model

2.1.4 Land use

Budapest is spread over an area of 525.12km2, 52% of which is currently occupied by built-up plots, and 48% is undeveloped. The applicable Structural Plan of Budapest (TSZT) would allow that ratio to change to around 59%-41% in the long term. This means that – in accordance with the effective plan – 3,675 hectares of presently undeveloped areas could be newly built-up.

The spatial balance appropriately reflects the purposes for which the area of the capital city is currently being used, and the ratio of built-up / free (undeveloped) area that characterizes it. Analysis shows the areas used by Budapest in a breakdown of built-up areas, free urban areas, and special urban operational areas.

Most of the built-up areas (61%) are used for residential purposes, 12% agricultural land, and all other types of area represent a 6% total. Among undeveloped areas, agricultural land, forest, and areas used for transport/traffic reflect similar proportions. As transport areas are classified as "in use", green areas constitute no more than 32% of the city's total area. More information is shown in the Figure below.

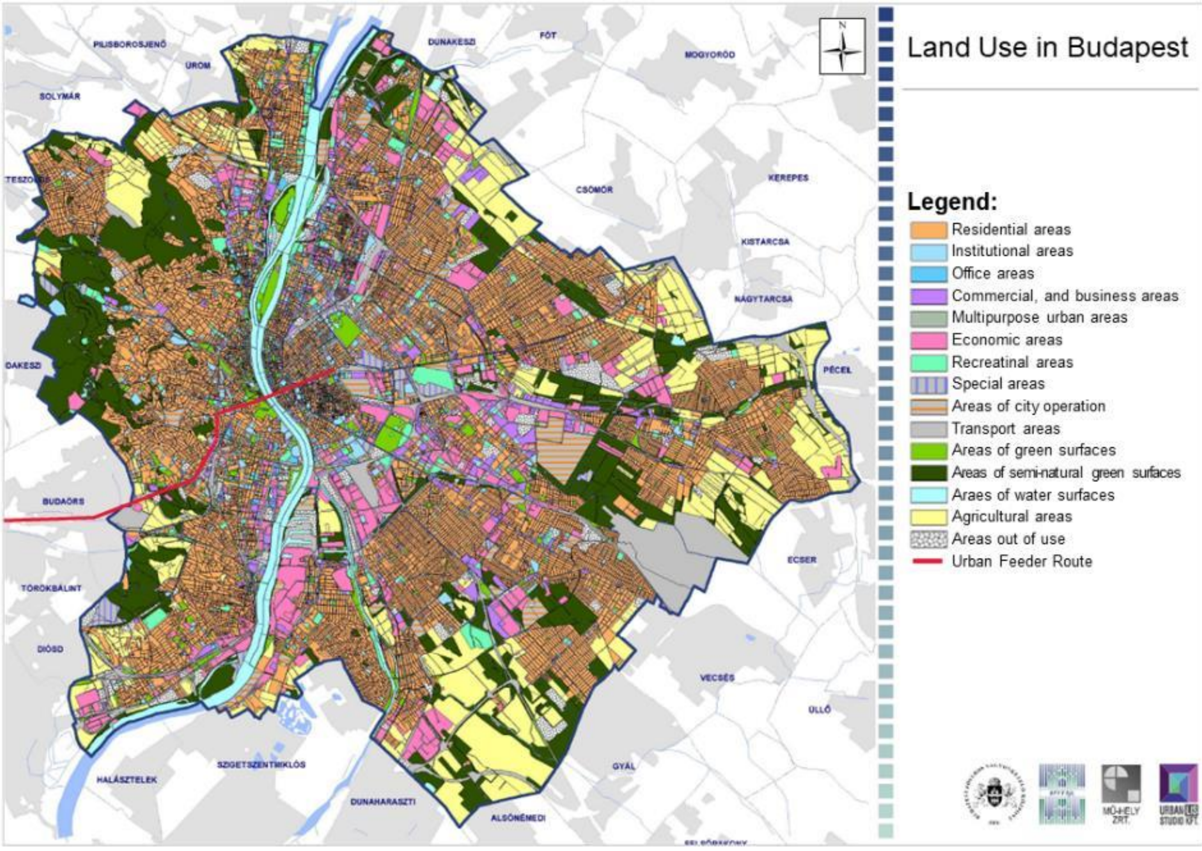


Figure 4. Land Use in Budapest, red line indicates the feeder route[1]

[1] https://budapest.hu/Documents/varosfejlesztesi_koncepcio_2011dec/08_Terulethasznalat_Beepites.pdf

2.1.5 Section Under Stress

The Budapest section under stress is located between Váci street and Síp street on Kossuth Lajos street and Rákóczi road in Budapest and its length is 800m. This east-west boulevard is called the Rákóczi axis, and it is one of the most important and busiest roads in Budapest, which goes through the city centre. Traffic and air pollution are high, and the street is not able to play its natural role, where people can feel confident in the city centre. The road axis splits the city centre into two parts, and only a few connections are available to cross a road. Ferenciek square and Astoria are important mobility hubs and places for living in the city centre. The Stress Section is split into two main parts as shown in the following figures on satellite map (north-west orientation) and traffic map (north orientation).

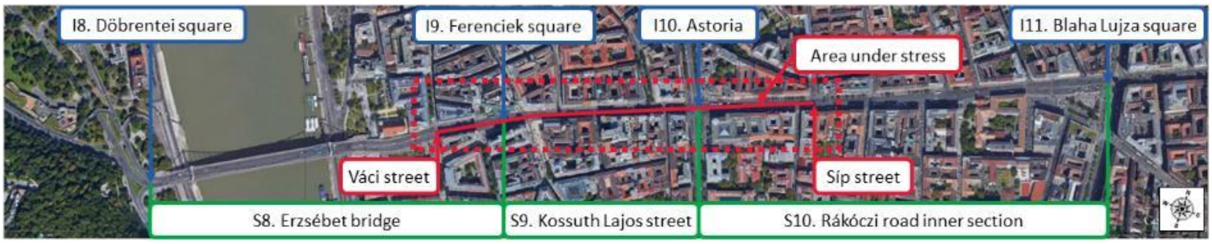


Figure 5. Area Under Stress, satellite map, north-west orientation

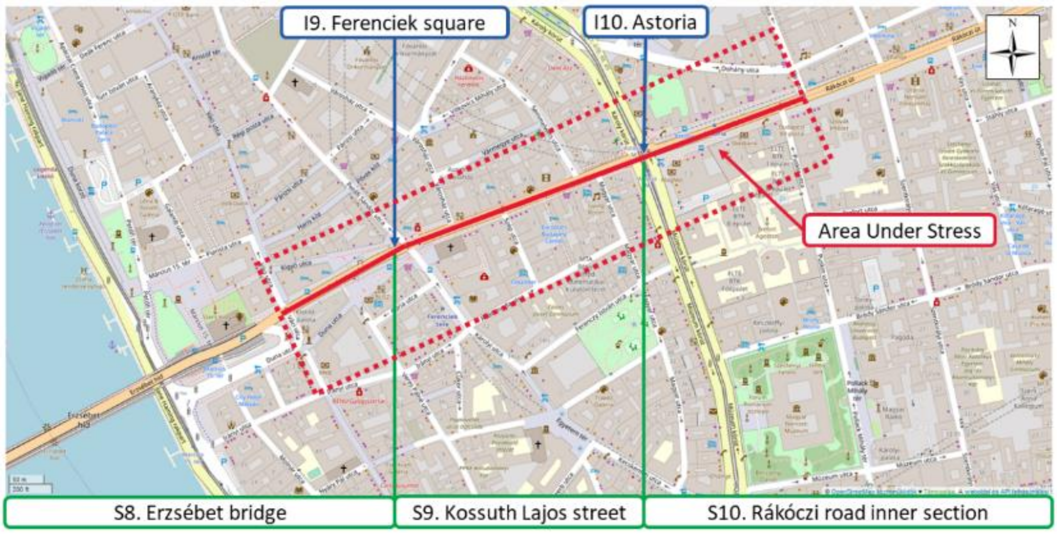


Figure 6. Area Under Stress, traffic map, north orientation

2.1.6 Existing road layout

There are wide carriageways for private and public traffic along the Street Under Stress: Two lanes for private transport; one lane for public transport; and additional lanes at the neighbourhood of junctions in each direction are available for road traffic. The traffic lanes are 3m in width. The following map shows the existing road layout and varying number of lanes in different sections.

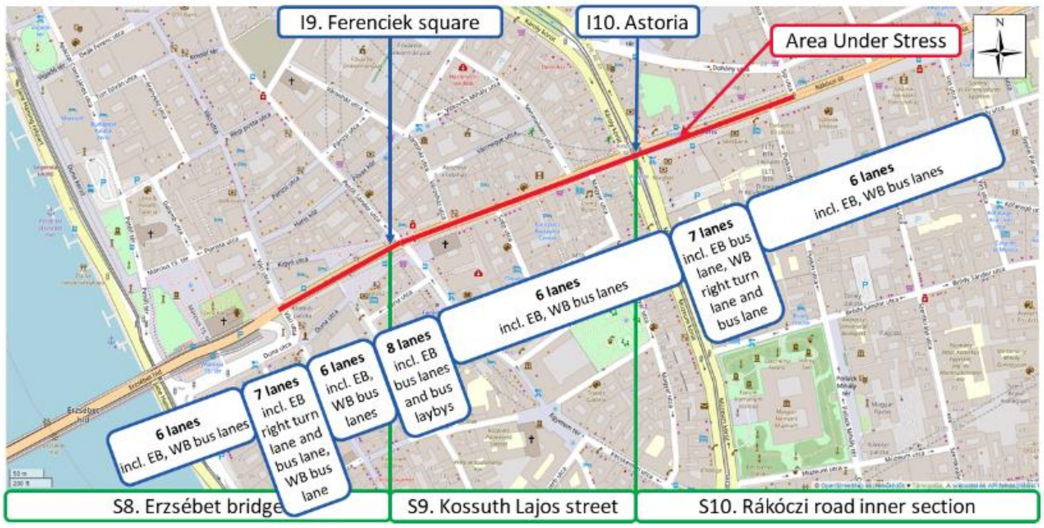


Figure 7. Overview of existing the road layout, the number of lanes in different sections and their purpose

Traffic movement for cars is the main function of the stress section. The 6 traffic lanes take up the majority of the cross-section of the street. Pedestrians have only 4m on each side of the street for walking. The situation is a little bit better around Astoria with the width of the footway 6m on both sides. There isn't enough space for benches, parking and loading bays or even bicycle storage.

The Kossuth Lajos street, which is the main part of the stress section was built at the end of 19th Century. Originally there were small medieval style streets. Politicians and urban planners wanted an avenue at the heart of Budapest. The stress section is part of this avenue which had famous shops, high-quality hotels, pubs and cafés with a busy social life. This condition was significantly changed in the last decade. The number of shops has fallen, car traffic is high, because this road network represents a direct connection between western and eastern part of Budapest. The noise level is high and the air quality level is poor. People are using this street section for moving to the public transport stops and do not for taking time, resting and chatting on the benches. The footway is wide enough only for walking not for making any other place activities.

This part of the city has great potential. The Ferenciek square was rebuilt in 2014 when a car underpass was demolished and space was given to pedestrians. Several pubs and restaurants opened at the southern part of Ferenciek, where formerly cars went through, and locals are using this square for place activities. If the stress section will also reallocate road space, a similar transformation is expected.

Figure 8. Section Under Stress, limited pedestrian space

2.1.7 Traffic data on the carriageway

The following table represents the car traffic at middle of the stress section at Kossuth Lajos street. This part is between Ferenciek square and Astoria junction. The data came from manual surveys between 6AM and 10PM.

Table 3. Car traffic at middle of the stress section at Kossuth Lajos street

Vehicle types	Carriageway traffic	
	Kossuth Lajos street eastbound direction summarized traffic 6AM-10PM	Kossuth Lajos street westbound direction summarized traffic 6AM-10PM
Private car	18737	19242
Taxi	2028	2837
Bicycle	119	425
e-Scooter	25	140
Segway	4	83
Motorcyclists	568	460
Bus (Public and Private)	1231	1010
HGV/LGV with 2 axles, < 3.5t	1727	651
HGV/LGV with 2 axles, 3.5t-7.5t	612	666

HGV/LGV with 2 axles, 7.5t <	22	867
HGV/LGV with 3 axles	0	0
HGV/LGV with 4 axles	0	0

2.1.8 Pedestrians on the footway

Pedestrian movement is quite high on this section despite the poor conditions in order to access public transport stops or shops. The following table show the pedestrians movement value at the same location as the traffic count.

Table 4. Pedestrian movement at middle of the stress section at Kossuth Lajos street

Pedestrian type	eastbound direction 6AM-10PM	westbound direction 6AM-10PM
Pedestrian traffic at the northern footway	4159	3904
Pedestrian traffic at the southern footway	5271	4886
Summarized Pedestrian traffic	9430	8790

Figure 9. Section Under Stress, public transport access

2.1.9 Public Transport data

There are two main public transport stops on the stress section. One is at Ferenciek Square and the other one is at Astoria. These stops are important transfer points of the city interchanging between M3 subway line at Ferenciek square, and between M2 subway line and tram lines at Astoria. The stress section (Kossuth Lajos street and Rákóczi road) is one of the main public transport axes in Budapest. Eight public transport bus lines (5, 7, 8E, 108E, 110, 112, 133E, 178) are operating at the section and almost every minute a bus goes through the corridor during morning and evening rush hours. The following table shows the number of public transport users between Ferenciek square and Astoria stops during 6AM and 10PM.

Table 5. Public Transport users Ferenciek square and Astoria stops

	Public transport users between Ferenciek square and Astoria stops (6AM-10PM)
Westbound direction	19708
Eastbound direction	19574

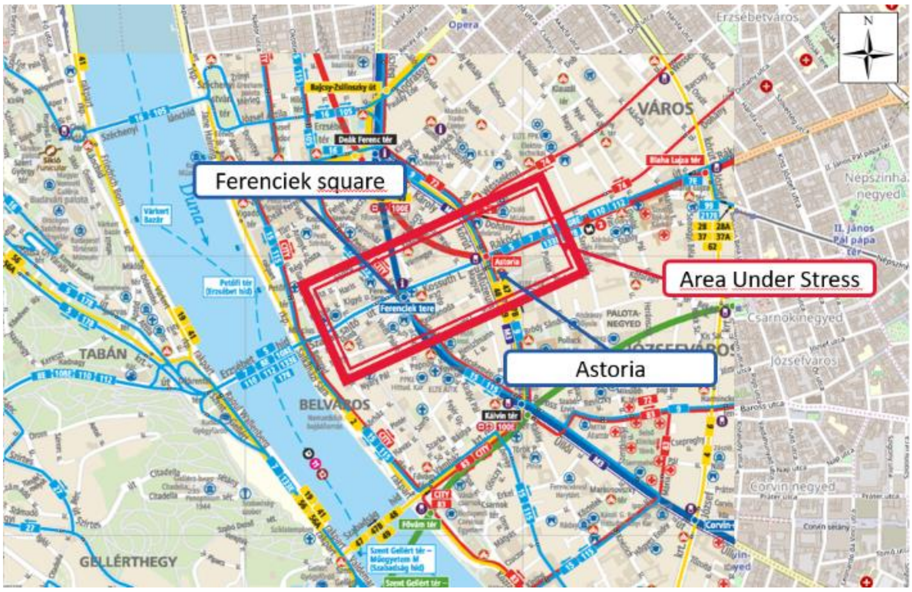


Figure 10. Location of Ferenciek square and Astoria stops

The public transport stops of this corridor are busy and there are crowds at the PT stops not just at the rush hours. The following table summarizes the boarding and alighting passengers at these bus stops between 6AM and 10PM.

Table 6. Public Transport user behaviour at Ferenciek square and Astoria stops

	Ferenciek square		Astoria	
	get off	get on	get off	get on

to/from bus lines - westbound direction	6019	9566	5327	6019
to/from bus lines – eastbound direction	9035	6866	4709	5905

Figure 11. Section Under Stress, inadequate cycling infrastructure

2.2 Future conditions in the Wider Impact Area

2.2.1 Introduction

Budapest has several long term transport and urban development programmes. These strategic documents have several viewpoints and ensure a complex approach at future city conditions. The main documents are: Budapest 2030 – Long-Term Urban Development Concept; Budapest Mobility Plan; and Budapest Integrated Urban Development Strategy. The future demographics and economic trends, ongoing & planned infrastructure projects, and public space & transport sector concepts have to be taken into account when analysing any future conditions. The Budapest macroscopic traffic model contains the most important parts of these frameworks, and we've used this model for making future traffic scenarios in the city.

2.2.2 Budapest 2030 – Long-Term Urban Development Concept

The Budapest urban development document[2] is a municipal policy document that addresses the future shape of Budapest. The concept document defines the long term goals (10 years ahead) and directions of urban development for the entire settlement, based on the city's environmental, social and economic characteristics. The concept serves as a guiding tool along which short and medium-term plans and decisions can be developed. As such, the concept has significant influence on the circumstances of people living and working in Budapest, and on all stakeholders within the economy.

The document contains detailed status assessment on several parts of urban living. A clear picture of the city's current status was an important criterion that Budapest's new development concept had to be based on. It includes a wide range of current data and analysis in order to reveal the characteristics features of the city's actual state.

The long-term concept status assessment has a wide scope, it shows Budapest's society, human infrastructure, economy, urban structure, utilisation of space, nature, features of development, transport, public utility system and the environment.

Budapest is not developing as a stand-alone entity, but rather in connection with the entire area of Hungary owing to Budapest's role as a capital. Budapest's economic impact within 100 kilometres of the city is quite powerful. Based on its official delimitation, Budapest's urban agglomeration represents 2.7% of Hungary's entire land mass and its 2.5 million inhabitants make up one quarter of the country's total population. 70% of the agglomeration's population, a total of 1,734,000 inhabitants, live in 525 km2 area of Budapest. The 2,000 km2 urban agglomeration ring is home to 817,000 people.

[2] https://budapest.hu/sites/english/Documents/Urban%20Development%20Plans/Budapest2030_ENG_full.pdf

2.2.3 Budapest's population

The population is currently 1,734,000, owing to international immigration, improved mortality indicators and longer expected lifetimes. At the same time, unfavourable changes are accelerating in the population's age composition, with the number of infants increasing and the ratio of elderly people growing.

According to predictive calculations, Budapest inhabitants will represent 17.3% of Hungary's population. In the next 20 years, Budapest's population will grow by 30,000 and the positive balance of international migration will have a significant contribution to this: it will offset the natural demographic decline of nearly 200,000.

In 2011-2031, while the number of children aged 0-14 will decrease by 4% and the number of young adults (aged 15-24) will decrease by 11% across the total population, the ratio of adults (aged 24-64) will increase by 3.6% and that of the 65+ age group by 12%. What this means is that a slight increase of Budapest's population will be accompanied by a significant shift between age groups, as shown in Figure 12 below.

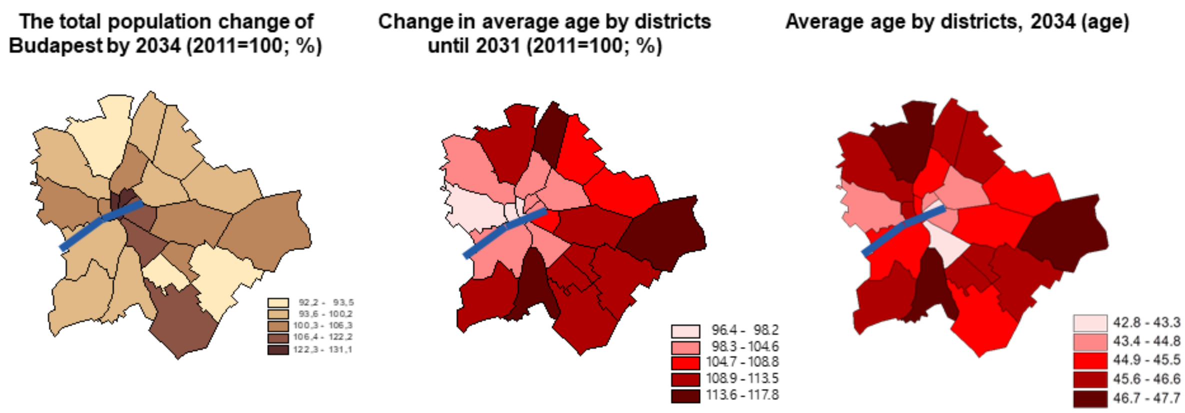


Figure 12. Demographics trends in Budapest, 2011-2031-2034

The declining number of youths will impact both the utilisation of education institutions and the change of age groups entering and exiting the labour market. In line with European trends, Budapest will see a setback in the number and ratio of productive inhabitants and needs to offset the economic impact thereof with effective, flexible and skill-improving procedures.

2.2.4 Economy

The condition of Budapest's economy and the dynamic of its development are of special importance for Hungary's competitiveness. Some 40 per cent of the country's GDP originates from Budapest (see Figure 13 below), while per capita GDP is 230 per cent of the national average. This offers reasons to say that Budapest's economic performance has a fundamental influence on Hungary's ability to perform economically. Even though the city is the Hungarian economy's most important driver, it profits little from its own economic performance.

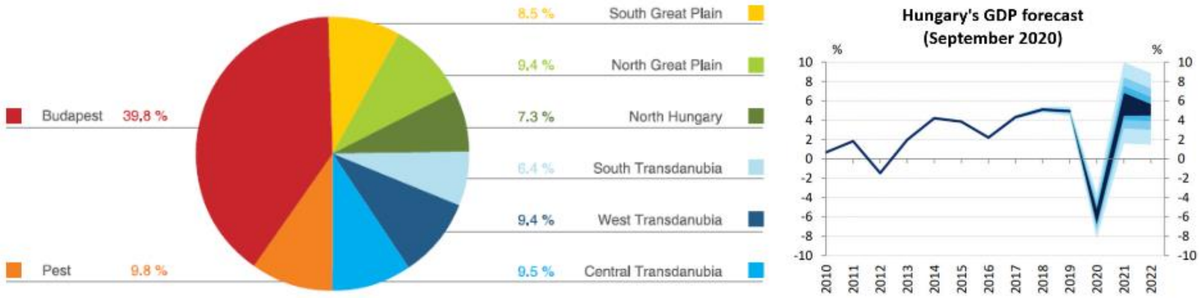


Figure 13. Territorial breakdown of GDP in 2010 (based on GDP at current prices) and GDP forecast

In recent decades, economic development and urban development followed separate paths and sector-specific approach enjoyed priority. Currently urban development is considered to be a reactive science of secondary importance compared to economic development. The goal is to establish a new, sustainable local economic culture to improve quality of life. The new scheme of EU funding is a compelling force promoting the same goal. Local taxation and asset management must be assigned a key role so that the city's next value cycle is boosted with new local impetus in a bottom-to-top manner, shorting out market impacts both in the Budapest area and nationally.

Budapest is interested in being attractive, not only to highly-qualified, young people from the neighbouring regions, but also to those from outside Hungary's borders, especially in the long term. It is inevitable to restructure the city's economic domain as a competitive location, offering the opportunity for international cooperation and relying on Hungarian resources, both national and international investor capital. The quality of city life depends to a good extent on the sustainability of the environmental quality required for a healthy life. Budapest is a part of the world that uses more than its share of global goods, so its economic development strategy must feature and ensure that the economy remains "green".

One of the most outstanding sectors in Budapest's economy is tourism, which plays a crucial role in developing the city's competitiveness and enhancing its economic performance. Out of the main factors for tourist development, being value-based, increasing knowledge and skills and being environmentally friendly are factors to be highlighted.

Figures 14 and 15 below show the commercial, service and economic regions of Budapest and the transport and functional complexity of the local centres show the areas where characteristics, community places, local, district and other smaller centres constituting densification points are decisive. They are important because in most cases they emerged and will continue to emerge in conjunction with public transportation hubs.

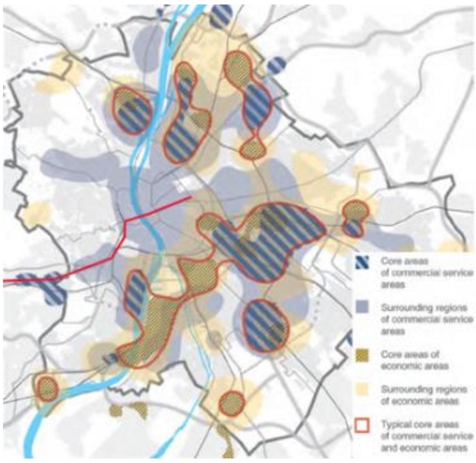


Figure 14. Commercial, service and economic regions

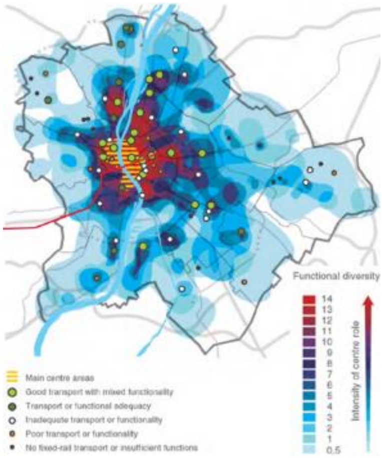


Figure 15. The transport and functional complexity of the local centres network

2.2.5 Future objectives

Liveability, sustainability and equal opportunities are the main aspects at regional, environmental, economic and societal level targets. Budapest is able to develop, if the city is a strong member of the European network of cities, it has valuable knowledge-based sustainable economy, harmonious and versatile urban environment, and improved quality of life with harmonic co-existence. 17 dedicated objectives were determined based on 3 theoretical principles and 4 complex objectives. The specific objectives of the concept determine the balanced spatial structure of Budapest. Figure 16 below summarises the spatial aspect of the main objectives.

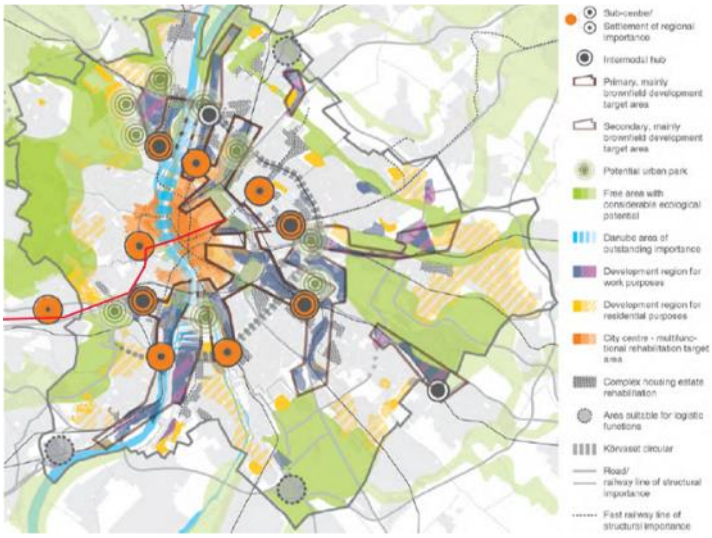


Figure 16. Spatial aspect of the main objectives

2.2.6 Budapest Mobility Plan 2030

Budapest Mobility Plan 2030[3] (BMP) (in Hungarian: Budapesti Mobilitási Terv BMT) is the sustainable mobility plan of Budapest (SUMP). It is the transport strategy of the capital for the year 2030, which consists of two main volumes – Objectives and Measures (Volume I) and Transport Development and Investment Programme (Volume II) – along with additional supporting documents.

The strategic document defines the different scenarios for the 2018–2030 investment programme with the help of a complex evaluation and programming methodology derived from domestic and EU guidelines for SUMP that equally take into account societal, economic and environmental impacts along with a strategic environmental evaluation (SEA). From among those scenarios, the General Assembly selected the most effective one requiring a low budget on the basis of consolidated CBA results.

The role of the overall guidelines is to provide a logical link between the BMT Objectives and the Transport Development Investment Programme and to devise a transport system serving the city structure, in which the transport projects can be placed. Through its overall and strategic goals, the BMT facilitates integration between urban and transport planning, between transport modes as well as between the city and its region. Strategic guidelines identify three layers of the transport structure: (1) liveable destinations; (2) the backbone transport network; and (3) the fine network.

The objectives of the Budapest Mobility Plan are identified by taking into account three fundamental preconditions:

- the overall development goals of the capital;
- tendencies as well as European and national objectives based on international transport development experience; and
- the general and specific transport related problems revealed in the situation analysis, the correlations of the problem tree.

2.2.7 Goals of the Budapest Mobility Plan

The plan is based on the future vision of Budapest urban development, stating that the goals set in the Budapest 2030 Urban Development Concept must be supported through transport.

The three transport-specific strategic objectives of Budapest transport development based on these are:

- liveable urban environment

[3] for more information: https://budapest.hu/sites/english/Lapok/2020/budapest-mobility-plan-2030.aspx

- transport development integrated into urban development through influencing transport needs and mode choice, together with reduction of the environmental impact and strengthening of equal opportunities;

- safe, reliable and integrated transport
    - joint development of transport modes through efficient organisation, stable financing and target-oriented development; and

- cooperative regional relations and connections
    - regional integration of Budapest with the help of a transport system that supports regional cooperation and strengthens economic competitiveness.

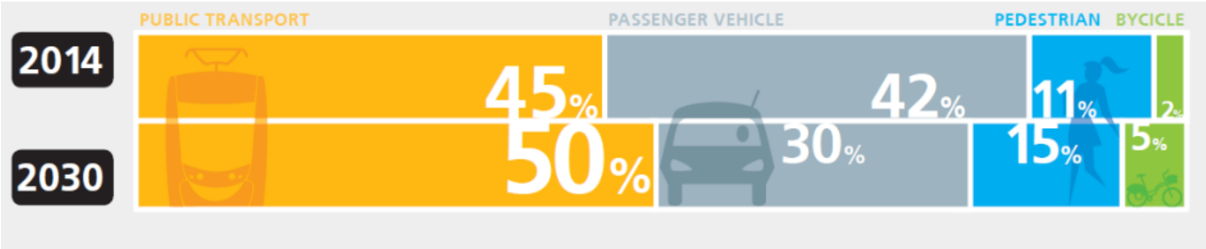


Figure 17. Planned evolution of the modal split in transport (traveller km %)

The intervention areas link the transport development tool set to the strategic objectives of an integrated approach and determine the tasks for each traditional technical field within transport.

The Transport Development Plan focuses on the four following intervention areas: infrastructure, vehicles, services and the institutional system.

- Improving connections: Through the introduction of new connections, the safe and reliable development of existing transport networks, the reallocation of public spaces and the development of passenger-focused intermodal connections

- Attractive vehicles: Achieved through the creation of a comfortable and passenger-friendly vehicle fleet and the encouragement of the proliferation of environmentally friendly technologies

- Better services: Achieved through an efficiently organised and intelligent, widely accessible integrated transport system providing reliable passenger information services

- Efficient governance: Through consistent regulation and passenger-friendly development of network connections at national, regional and city levels

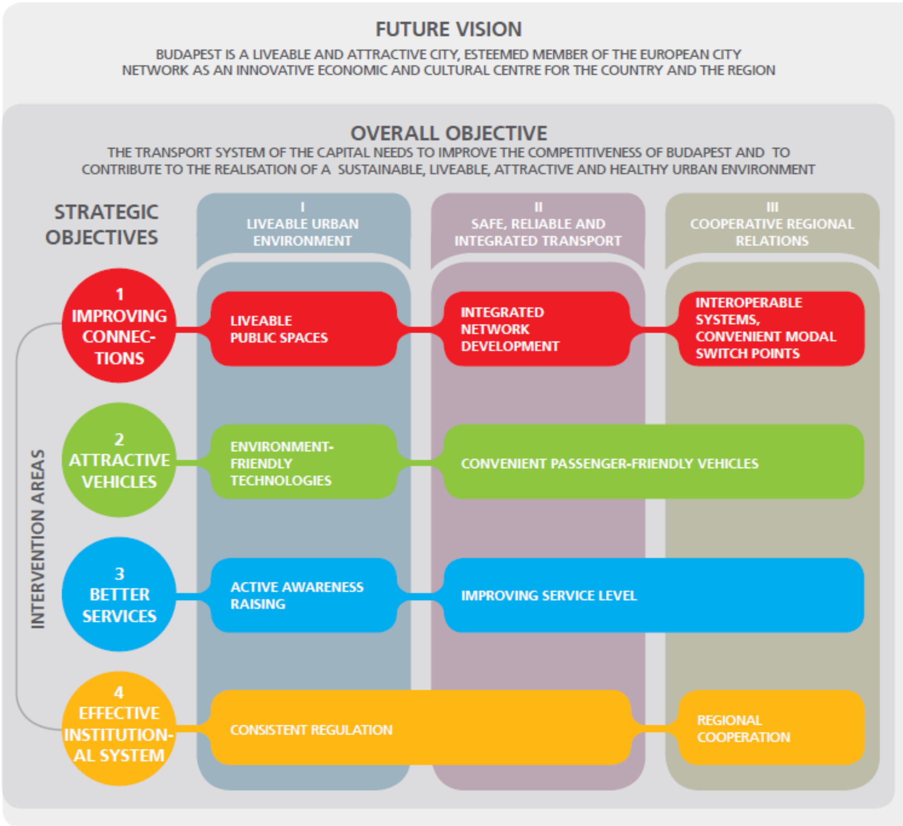


Figure 18. Operational objectives adjusted to strategic objectives and areas of intervention

Figure 18 above shows the nine operational objectives for the four areas of intervention of the transport development plan and measure packages assigned to these objectives. Projects prepared and implemented, and the tasks solved based on the measures, are the tools for implementing the strategy. Each of the nine operational objectives have specific measures, which are handling the main way of future developments. Overall, 57 specific measures are identified.

In order to achieve the BMT objectives, the zones differentiated by the Budapest 2030 Long-term Urban Development Concept and appearing in the BMT require differing interventions. In order to reduce the load and concentration in the inner zone, in addition to reducing the motorised vehicle traffic, it is not beneficial to introduce new public transport transfer connections in this area either. The Rákóczi road, the Budapest stress section, is located at the inner zone of the city.

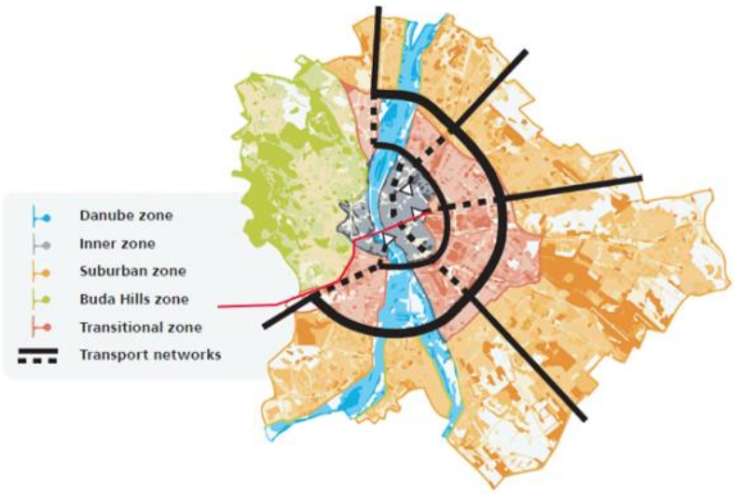


Figure 19. Different transport interventions of BMT in the zones defined by the Budapest 2030 long-term urban development concept

The guidelines define the status where the strategic and territorial objectives are achieved according to three functional layers: (1) liveable urban destinations, (2) backbone network and (3) fine transport network.

More than 200 projects were determined based on the principles of the Budapest Mobility Plan. Hard and soft infrastructure projects, education, interventions are also part of the project list. The projects can be a concrete and modellable project, a concrete and non-modellable project, a non-concrete project, a decided project, a task-type project or a project idea.

The projects compared each other with the following aspects: Connecting measures, Preparation time required, Implementation time required, Investment cost, Project appraisal results (CBA results: BCR, Total profit (million HUF), Total cost (million HUF); Converted CBA or MCA score; Converted MEG score; KÖR score; ILL score), Output indicators, Result indicators, Impact on the natural and built environment. Most of the projects were modelled with Budapest macroscopic traffic model for 2030.

The Budapest stress section represents as a P067-renovation of the Kossuth Lajos utca-Rákóczi út public space project. This project is one of the most profitable projects in the subspecies of the studied characteristics.

Project packages have been developed for the three time periods:

- Phase I. (short term):2021-2025;
- Phase II. (medium term): 2026-2030; and
- Phase III. (long term developments) post-230 times, projects that go beyond short- and medium term priorities.

Programming is also taking into account the available funds (scenario for low budget, medium budget and full budget). The Macroscopic Traffic model contains the main infrastructure elements for 2030 and 2050 models.

2.2.8 Transport development concepts

The experts determined several hard infrastructure projects for liveable Budapest, but these solutions are not the only way to make sustainable environments and streets for local users. For instance, promoting active transport modes and improving the infrastructure elements are tools to shift a modal split to a sustainable condition. These interventions support Budapest the become a city of places instead of car oriented city. COVID-19 pandemic helped to improve these facilities, during spring and summer 2020 a number of measures were implemented that were previously unthinkable.

BKK currently has started a number of interventions and regulations that do not require as much money but affect traffic at least as much as large investments.

More than 20 km of new bike lanes were installed from March 2020, with the first wave of COVID-19. These new elements were partly settled instead of traffic lanes and connected the fragmented network elements. A Grand Boulevard, which is one of the most important roads in the inner part of Budapest, also got a bike lane instead of a car lane.

Figure 20. Sustainable mobility

New bike lanes have been the first step for emphasizing biking in Budapest. BKK is developing Active and Micro-mobility Strategy, which could help to improve Budapest's street as a bike friendly one in long-term. The spread of cycling in Budapest helps to reduce the everyday car usage in the city, and also has several environmental and health benefits.

The Budapest Mobility Plan 2030 has a target to reduce 50% deadly and serious traffic accidents by 2030 and protect vulnerable road users. Traffic safety and traffic calming action framework helps to reach this target. It is an ongoing process and traffic calming in middle-term is its aim. Learning from the mistakes of the past, when the 'existing state' was determined during public space renovations, the aim is to provide adequate space for all street users. The action plan has several aspects to handle the current situation.

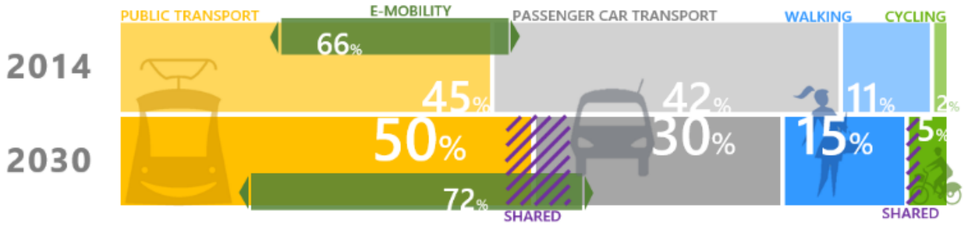


Figure 21. Budapest Modal split (distance based, working day)

The available national and international experiences and the outcomes of pilot actions are the pillars of the action plan. The most useful measures to be applied include: slowing the street traffic, speed limits, middle islands, narrowing and chicanes, pedestrian crossings, traffic calming zones, banning through traffic at the living areas, one-way streets, reducing car lanes, improving pedestrian and cycling infrastructures, solving parking, Kiss and Ride at the schools.

Figure 22. Traffic Calming

BKK is the mobility manager of Budapest. There are several ongoing regulatory frameworks, which have significant effects on Budapest transport and liveability. Regulation of old (taxi, parking) and new (e-scooter, carsharing) means of transport, active and micro-mobility strategy, E-mobility strategy, MaaS strategy, Public Transport Network and Vehicle strategy will help to reduce car traffic at the city centre, and other parts of the city.

2.3 Future patterns of demand in the Wider Impact Area and along the Feeder Route

2.3.1 Introduction

The following map shows the future design and function of the Budapest Urban Feeder Route. The map represents movement and placement functions as well.

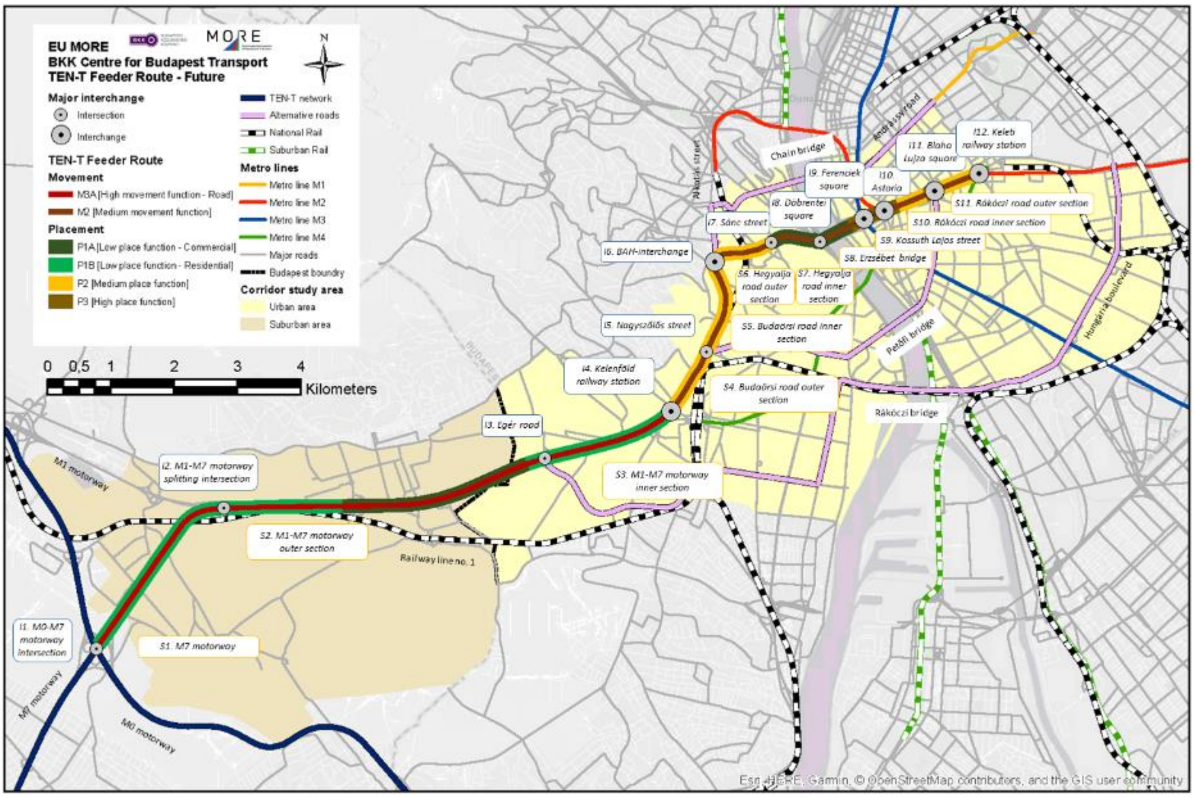


Figure 23. Sections of Budapest Urban Feeder Route in details, MORE project

2.3.2 Urban Feeder Route

In the future, additional shopping malls and logistics centres are expected to appear on the outer highway section (S1, S2, S3). In the event of a further increase in traffic, it is proposed to use the motorway stop lanes as public transport lanes in the morning and afternoon peak hours.

The current movement condition may change significantly from the Kelenföld railway station (I4) in the future. Several possible developments, like high-capacity P+R in the surrounds of the railway station, new Danube bridges in South Budapest, congestion charge at the city limits and other traffic calming measures (i.e. continuous bus lanes between Kelenföld railway station and inner-city) will result in fewer cars in the city centres.

Due to the constantly growing population and economic role of the South Buda region, local traffic will appear more and more strongly at Budaörsi road (S4, S5). The BAH-interchange (I6) has an important role in Buda’s traffic. Most of the cars, which appear on the Rákóczi road and stress section, go through this partly separated interchange without any traffic delays. The new layout of the junction can help at the traffic calming, give the locals a safer and homogeneous urban space with a better environment, and reduce the suction effect of the Rákóczi road. It is an ongoing project at Hegyalja road (S7) to transform a traffic lane into a bus lane to give priority to the bus lines and to reduce car traffic.

2.3.3 Stress Section

The future condition of movement and placement analysis of the stress section (S9) and the Rákóczi road (S10, S11) are presented in detail in the following part. The stress section is a prominent part of Rákóczi road, and thus the findings of the section can be extended to the entire axis. The following examinations and findings discuss the possible vision of the stress section, but they will be applied to the whole Rákóczi road.

Figure 24. Stress section at the Rákóczi road axis

The potential of the area can be well illustrated with the renovation of Ferenciek square in 2014. A significant part of the southern section of the square was returned to pedestrians, which was almost immediately filled with life, bars and restaurants.

Budapest's stress section nowadays is full of cars, very noisy and untidy. This road is located at the heart of the city, but the locals do not use it for their own purpose, the street doesn't work as a sustainable place. The street has been transformed many times over the decades, with more and more space for car traffic, and people were pushed out. The street is the subject of public discourse very often. Most of the people have their own ideas about the future of the street.

The current condition is unsustainable. There are several plans for the future of the street and its pedestrian-friendly design. Rethinking is important not only to reduce traffic, but to fill the street with life. By creating a quality environment, a heterogeneous, inclusive, pleasant, urban landscape can be created, where people love to stay and spend time.

2.3.4 Vision

The future vision of the Budapest stress section and the whole Rákóczi-axis is a humanized, green liveable public space, which has heterogeneous functions for local users and open space for citizens. The section is keeping its metropolitan character and building from the legacy of the past. The current car-oriented street layout is shifting into a sustainable one to serve local needs and emphasise walking and cycling. Clever and complex view leads to reach the future vision. The main aims include:

- traffic calming measures at the downtown of Budapest;

- reallocation of public space at the stress section to reduce car traffic and give more space for active mobility;
- harmonization and balancing different public space needs;
- pleasant sense of space for pedestrians and for all travellers;
- quality and pedestrian-friendly renewal of public spaces;
- increasing the economic value of the area, restoring its former glory of shops; and
- strengthening green character with trees.

Figure 25. Future vision takes inspiration from the past

Trees and flourishing commerce ensure to form the street into a people-oriented healthy street and full of life. Currently, the stress section is full of cars, citizens and commuters use this street section to travel among different parts of Budapest. Two car lanes at each direction ensure a huge capacity for commuters, reducing the lanes could help to transform more space for pedestrians and bicycle users and reduce noise and air pollution.

2.3.5 Measures

The measures can be examined from 4 perspectives: Sustainable transport by redistributing public space, Urban green infrastructure, Metropolitan values and Vibrant street life.

Sustainable transport by redistributing public space

- In order to traffic calm the city centre and humanize public spaces, in addition to reducing through traffic, high-quality public transport and the development of appropriate cycling infrastructure are also needed.

- In order to create better conditions for cycling, it is necessary to create comfortable and safe cycling facilities, thus strengthening the main cycling network.
- In order to expand pedestrian surfaces and barrier-free pedestrian traffic, it is necessary to develop not only longitudinal but also transversal connections by establishing newly designated pedestrian crossings.
- The area has a good public transport network and citizens can easily approach the stress section using Public Transport. It is a great value to be maintained in the future.

Urban green infrastructure

- Wide pavement surfaces can create opportunities for creating avenue trees and green surfaces.
- As a result of the enrichment of green space elements and reduced traffic, less noise, and better air can be provided, helping urban climate adaptation and mitigating the heat island effect.

Metropolitan values

- Based on the historical precedents, it is necessary to create a sustainable cross-section of the street, giving space to a two-sided avenue trees, wide sidewalks, and flourishing commerce.
- It is an important aspect of preserving the valuable building stock and enhancing the prestige of the city in order to restore the elegance of the metropolitan character of a street with avenue trees.

Vibrant street life

- An attractive environment for pedestrians with the appropriate use of public space creates a quality-shopping environment for a functioning local economy, thematic shops.
- In order for trade and hospitality to work, it is necessary to create new loading points for last-mile delivery and better infrastructural conditions of city logistics services.
- A good public transport network, cycling, and pedestrian infrastructure are enough to cover mobility needs, strengthening parking is not a necessary condition.

2.3.6 Interventions

The vision, main goals and measures of the stress section and the Rákóczi axis require urban place-related interventions. There can be mobility related and urban space related ones. The mobility related ones are helping to handle mobility related problems (more space for pedestrians, cyclist, less space for cars, and people use public transport, active or micro-mobility solutions, sharing vehicles if they travel). And the urban space related interventions are helping to shift the street to a liveable space, where people like stay and spending time. These measures and interventions provide the residential and commercial land use (cinemas, universities, hospitals, shops, offices, hotels, pubs, restaurants, church) better environment, and strengthen the local economy and leisure values.

Urban space (pedestrian areas) related interventions

- Street furniture
- The stress section becomes more liveable with the use of street furniture, benches, sitting places. They can provide seating for people to spend more time, chatting and relaxing in the area.
- With unique street furniture (i.e. street stage, street workout parks, playgrounds) the range of everyday visitors to the area can be expanded.
- In order to emphasize the built environment, it is advisable to use simple geometric shapes and a restrained appearance.
- Shading of pedestrian and bicycle surfaces should be provided in summer.

Renewal of green areas

- The green environment with trees, bushes and street planter boxes helps to reduce air and noise pollution.
- Avenue trees in double rows on each side of a street provide a likeable environment and sustainable urban conditions. They can restore the original splendour and form of the avenue.

Street fountains

- People's relationship with water is unique, the proximity of water is appealing to most of them. People like to touch the water. The stress section can transform into a liveable space with different types of fountains and wells, where people like to stay.
- Drinking fountains and misting shade systems are useful in every season, especially in summer.

Street terraces

- It is possible to place a street terrace of different sizes and types on each road section for local bars, cafés, hotels, and shops, but in all cases a pedestrian surface at least 4.00 m wide must be provided.
- The street terraces help to create a pleasant street environment. There are able to place the stress section on the citizens' mental map. Locals and tourists can spend there more time in the street section for leisure and business.

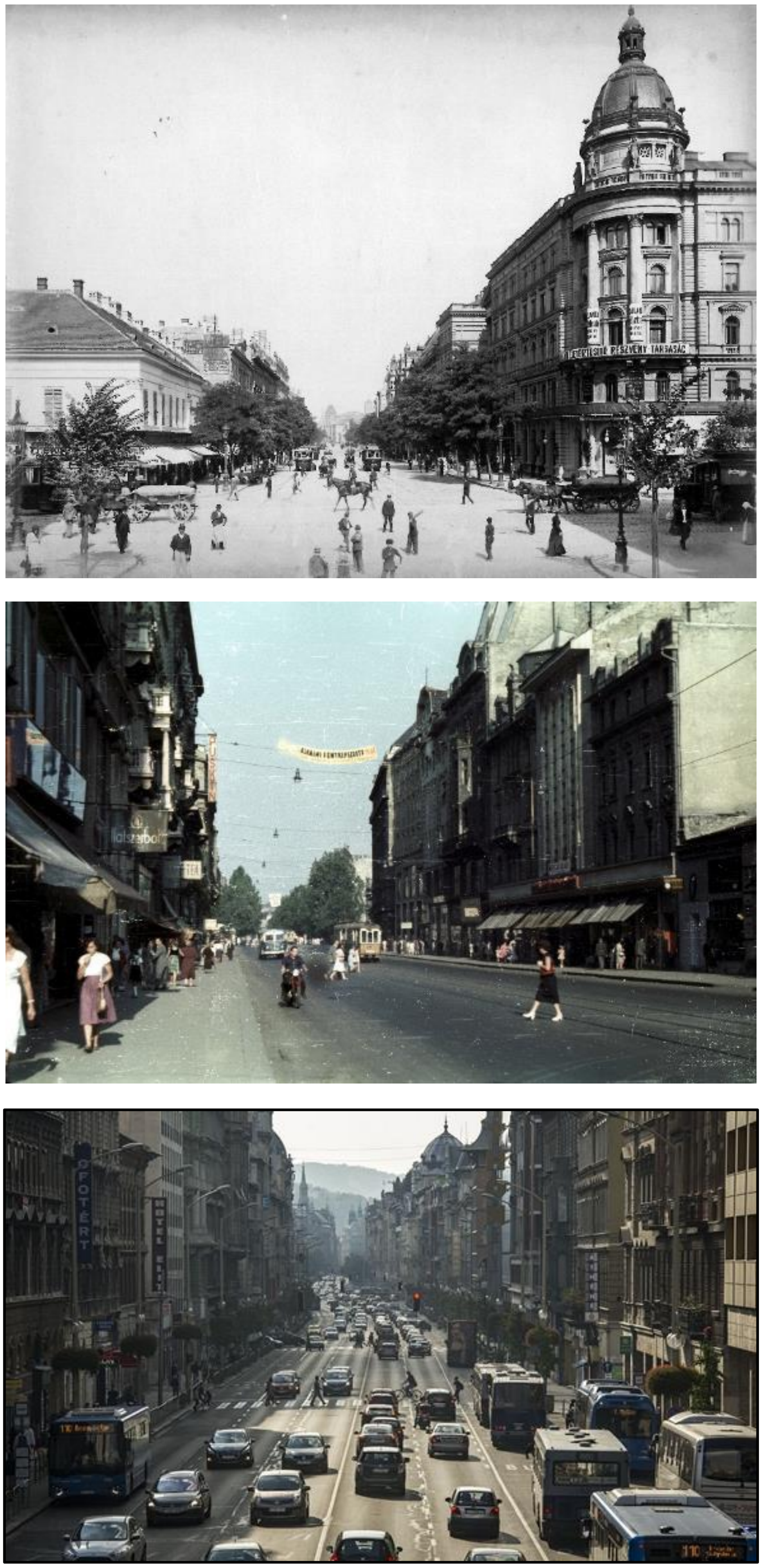


Figure 26. Rákóczi road through the ages and the growing dominance of the car

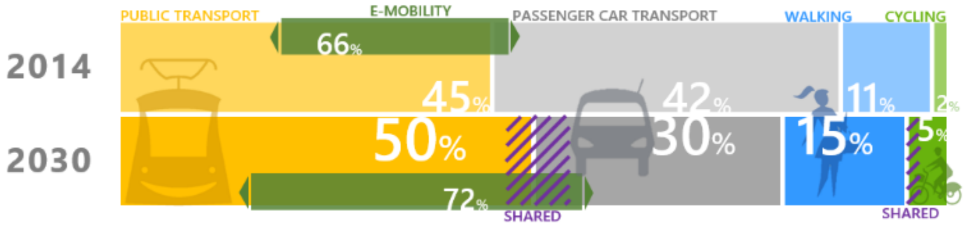


Figure 27. Modal split (distance based, working day)

Mobility related interventions

- Redistribution of mobility supply
  - Reducing car lanes help to exclude through traffic and to have traffic calming and reduce noise and air pollution.
  - Multiple lanes are required at junctions due to turning traffic demands. It requires a complex approach by allocating available space.
  - New bicycle lanes and/or micro-mobility lanes provide safe and sustainable place for cycling and other light mobility devices.
  - Stress section is one of the main parts of Budapest public transport network, which needs to be maintained. In the future, it can be a joint public transport lanes with bus, trolleybus and tram. It is better for traffic reasons if the bus lanes (PT lanes) locates in the middle of the street and not next to the kerbsides.
  - Wider sidewalks give more space for pedestrians to walk, chat, view shop windows, and install street furniture. They give a better environment to citizens to spend much more time at the stress section.
  - More pedestrian crossings give safer and liveable space for walkers.

Figure 28. Reallocation of road space from car to bicycle

Kerbside activities

- Participative planning with locals can cover the local needs to form a well-functioning area.
- A new distribution of the cross-section of the street gives an opportunity to reallocate and optimize the location of taxi stops, parking facilities for locals, commuters and carsharing users, mobility points, EV-charging points, bicycle street storage, city tour bus stops, goods loading zones (for cars, vans, cargo bikes, cargo drones) for delivery companies and shops.
- Public transport stops locate next to the bus lane in the middle.

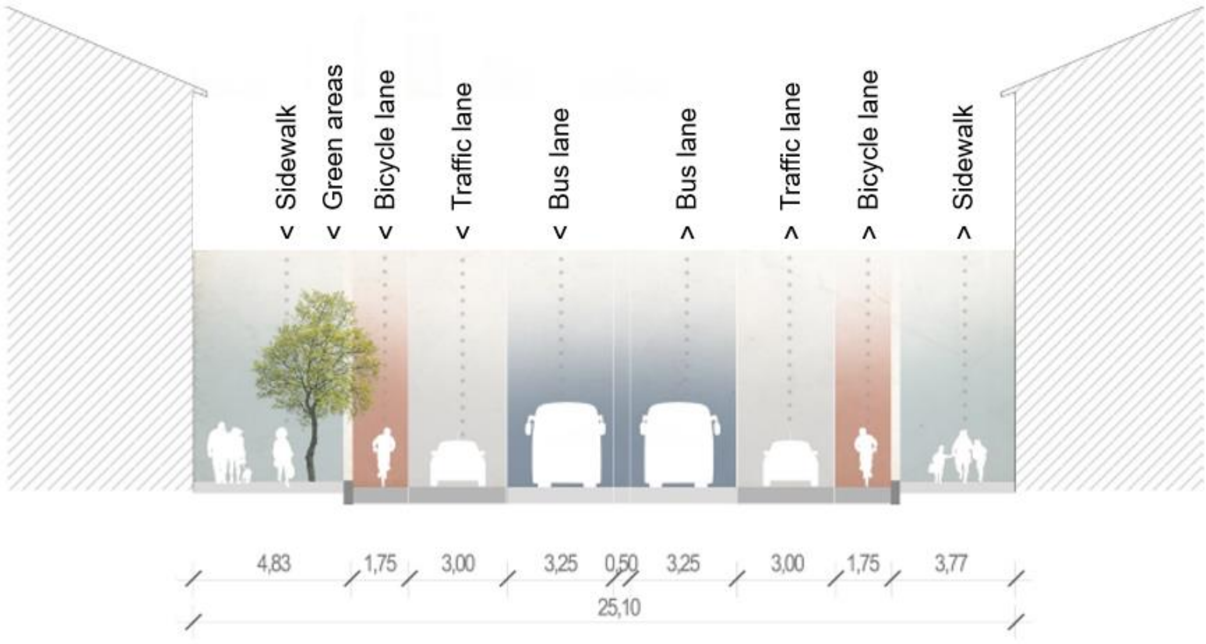


Figure 29. Future cross-section of the stress section

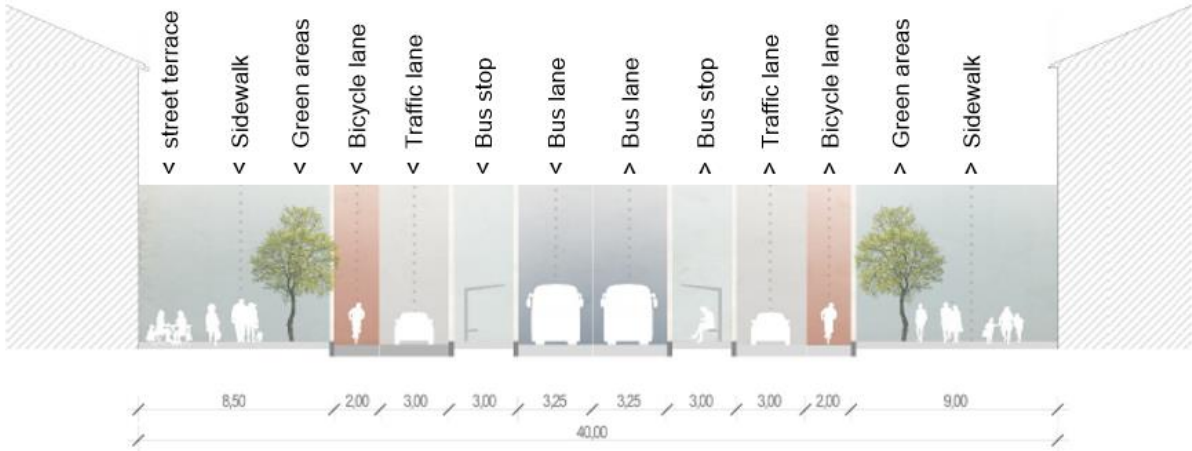


Figure 30. Future cross-section of the stress section at the Public transport stop

These interventions must be implemented together, in accordance with the social, population, and economic processes taking place in the area, in the direction of the set goals. In order to achieve the vision, the city has to act proactively in transforming the area of stress section in a sustainable way.

The following chapter provides different scenarios and outcomes with macroscopic traffic model up to 2030 and 2050.

2.4 Future patterns of demand in the Wider Impact Area and along the Feeder Route

The future patterns along Feeder Route and Stress section were modelled with the macroscopic Transport Model of Budapest, which is a VISUM based strategic model.

2.4.1 The Macroscopic Transport Model of Budapest

For the purpose of analysing the impacts of each transport development project in the capital and comparing the development alternatives from the same aspects, a uniform traffic model covering the entire territory of Budapest and its agglomeration was prepared with the support of the European Union. The Macroscopic Transport Model is a multimodal, strategy macroscopic model, which is owned by the Transport Centre of Budapest (BKK). The traffic model (network and demand model) data must be continuously, regularly updated in order to have up-to-date content. The updated unified traffic model and the related continuous traffic monitoring help to review the development plans in Budapest and in the suburbs and to evaluate new projects. With accurate traffic analysis, the model is a practical tool for advanced transport planning and contributes to the preparation of cost-effective, well-planned and feasible investments in the development of the transport system.

The transport model consists of three elements:

1. **Area model:** the geographical framework serving the mapping of the places of emergence (traffic zones) and the spatial relations (networks) of transport demands.
   Traffic zones were formed with such an accuracy that the available data determined on the level of house blocks could clearly be assigned to the zones and clearly be aggregated according to urban development zones (522), subdistricts (164) and districts (23). Major agglomeration settlements are also divided into zones, and cordon zones were developed at the border of the modelled area. The resulting zone division consists of 1201 zones. The resulting model includes **cordon zones** too, which represent the incoming traffic and crossing the area of the model from outside of the delimited model.
   Summary: the area model consists of **1201** transport modelling zones on the lowest level in the hierarchic system of zone division, divided as follows:
   - 922 transport modelling zones of Budapest
   - 255 transport modelling zones of the agglomeration
   - 24 external zones (cordon zones)

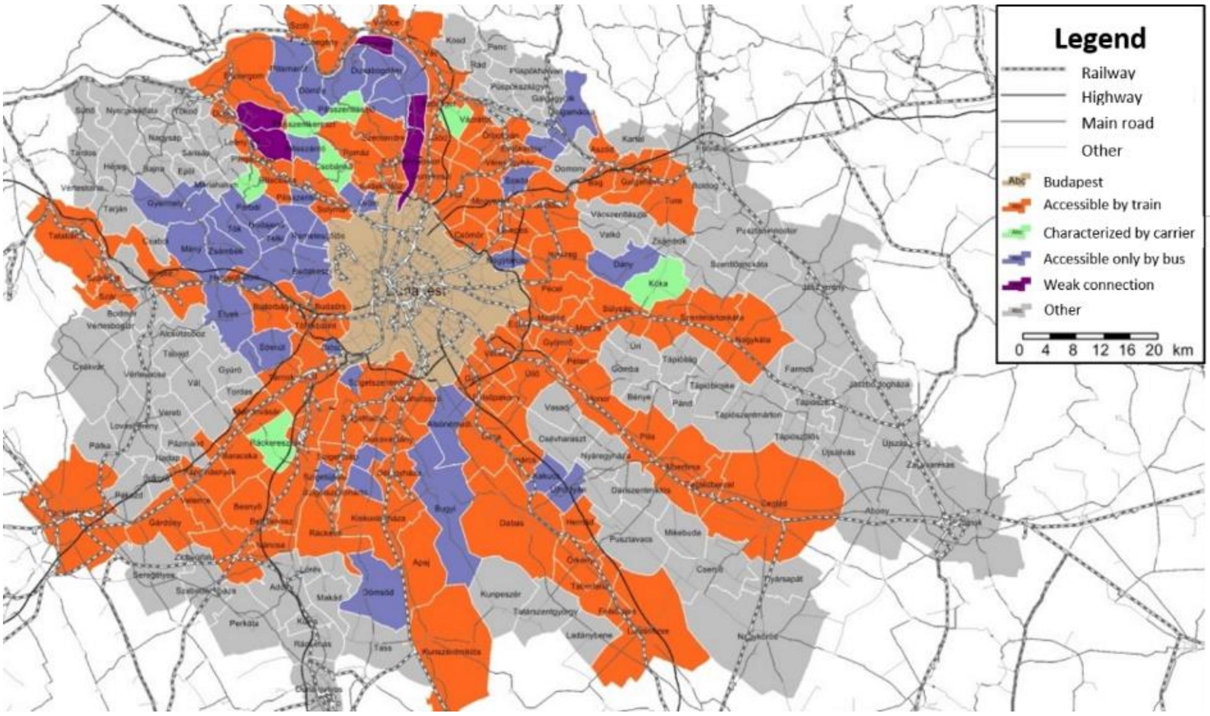


Figure 31. Area model

2. **Transport supply model:** the appropriate description of transport networks and services as well as their features and the terms of use which enable the calculation of the choice of routes of the modal transport demands, the network loads and their typical circumstances.
   The traffic needs of individual and public transport appear on the transport network (supply). When modelling, our aim to reflect reality, so it is important to set the pieces of network in an adequate relationship with adequate parameterisation.
   The network's smallest units are junctions that are connected by sections. Traffic needs are included in the network via so-called connectors, which connect zones of the spatial model with junctions and sections.
   Because of their differences in characters and parameterisation, individual and public transport supply models will be presented separately.
3. **Transport demand model:** the inter-zone quantitative, modal and temporal description of passenger transport and freight traffic demands arising from daily economic and social processes, taking into account to the factors influencing demand.

Long-term basic conditions taken into account

A current condition was created along with two long-term agreements on basic network conditions, which contain the most likely future developments of road traffic and public transport (e.g., M0 north-west sector, new Danube bridge at Albertfalva, etc.). Terms of long-term networks are the following: 2030, 2050.

The following table shows the developments, which are applied for the base version of the terms:

Table 7. Applied modification for the future scenarios

Term	Project
2030	Extending Underground 1 between Vigadó Square and Kassai Square
	Interconnected tram network in Buda
	North-South regional trainline (H6-H7 HÉV extending to Kálvin Square)
	Szegedi út overpass
2050	M0 north-west sector
	Albertfalva Bridge
	Galvani Bridge
	Reconstruction and extension of the cogwheel train between Normafa and Széll Kálmán tér
	Northern extension of tram line 3 to Árpád híd underground station
	Tram line on Bajcsy-Zsilinszky út (Deák tér - Lehel tér)
	Extending tram line 42 to Gloriett telep
	Southern branch line of the North-South regional high-speed railway
	Tram line on Thököly út (Astoria – Újpalota)
	Outer tram line on Bécsi út (Aranyvölgy – Vörösvári út)
	Northern extension of Underground 3 to Káposztásmegyer

2.4.2 Macroscopic modeling task in MORE – Future scenarios

One of the aims of the MORE Budapest pilot project is to model the traffic conditions in the area of the Rákóczi-axis with VISSIM. This microscopic modelling task required some input data, which is produced by the VISUM based Macroscopic Transport Model of Budapest. In the case of this investigation, different scenarios were modelled for three periods. Each time period was modelled in four versions (every version were examined in every time period). The model, during the determination of the future transport demand, is counted with the current prognosis, because of the basic properties of the Unified Transport Model. That means, by 2030 and 2050, it assumes an increase in the traffic demand. The macroscopic model could give us information about the changes of the traffic volumes in whole city.

In the framework of the MORE pilot project, the stress section is defined from the Síp street to Váci Avenue, but after the consultation with the mayor's office, the investigation area was expanded, so the whole Rákóczi Avenue is the part of the examination. This area was divided into 6 zones, as shown in the following figure:

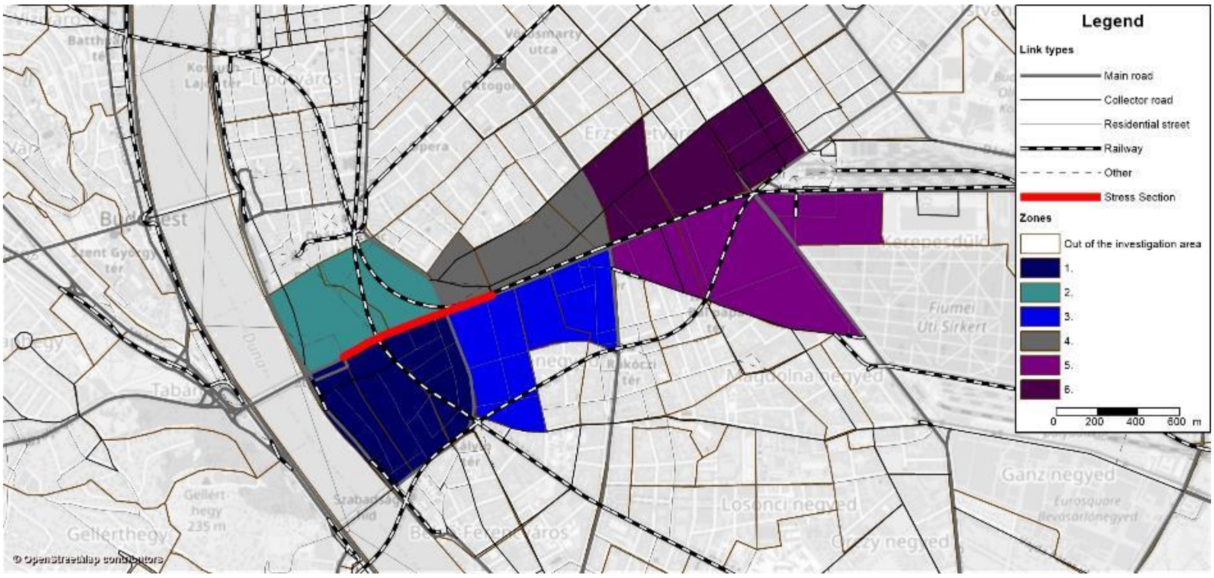


Figure 32. Six Zones of the Stress Section

The 1st and 2nd zones are located between the Danube and the Astoria; the 3rd and 4th zones are located between the Astoria and the Blaha Lujza square; the 5th and 6th zones are located from Blaha Lujza square to Baross square along the Rákóczi-axis.

The model took into account the population changes. The following figure shows the present and the estimated population for Budapest:

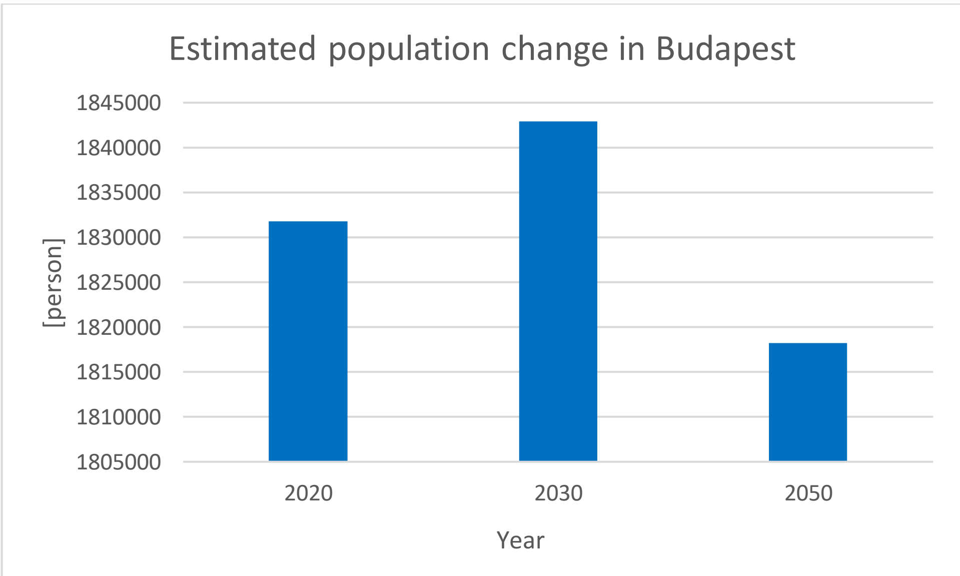


Figure 33. Estimated Population change in Budapest

These numbers appear differently in our 6 investigated zones. The following figure shows the detailed population information:

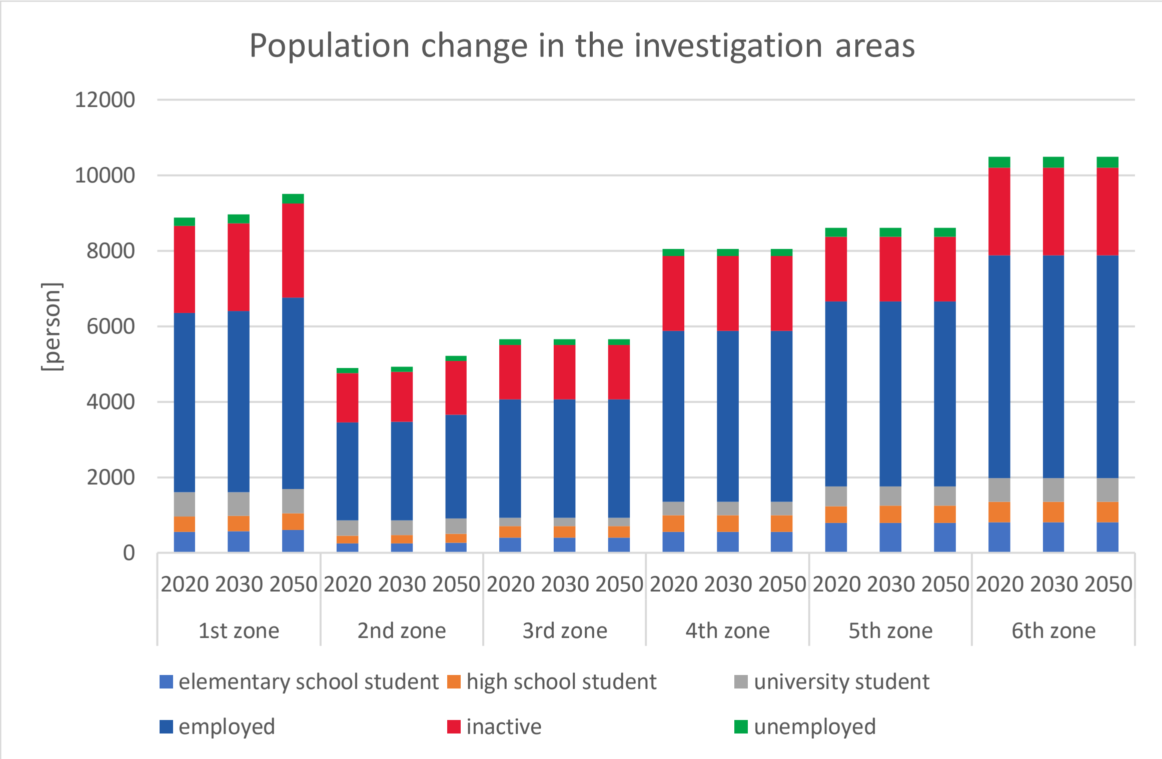


Figure 34. Population changes in the six zones of the section under stress

As the chart shows, there are some zones, where the population will change in the future, but in the 3rd, 4th, 5th and 6th zones, no changes are expected.

The 6 defined zones have different trip attraction facilities. There are several educational and healthcare (pharmacy, hospital) institutions. Those zones which are in the centre of Budapest (the 1st and 2nd) have a lot of restaurants, cafés and entertainment places (like theatre, cinema, clubs).

The figure below shows the number of urban facilities in the 6 zones.

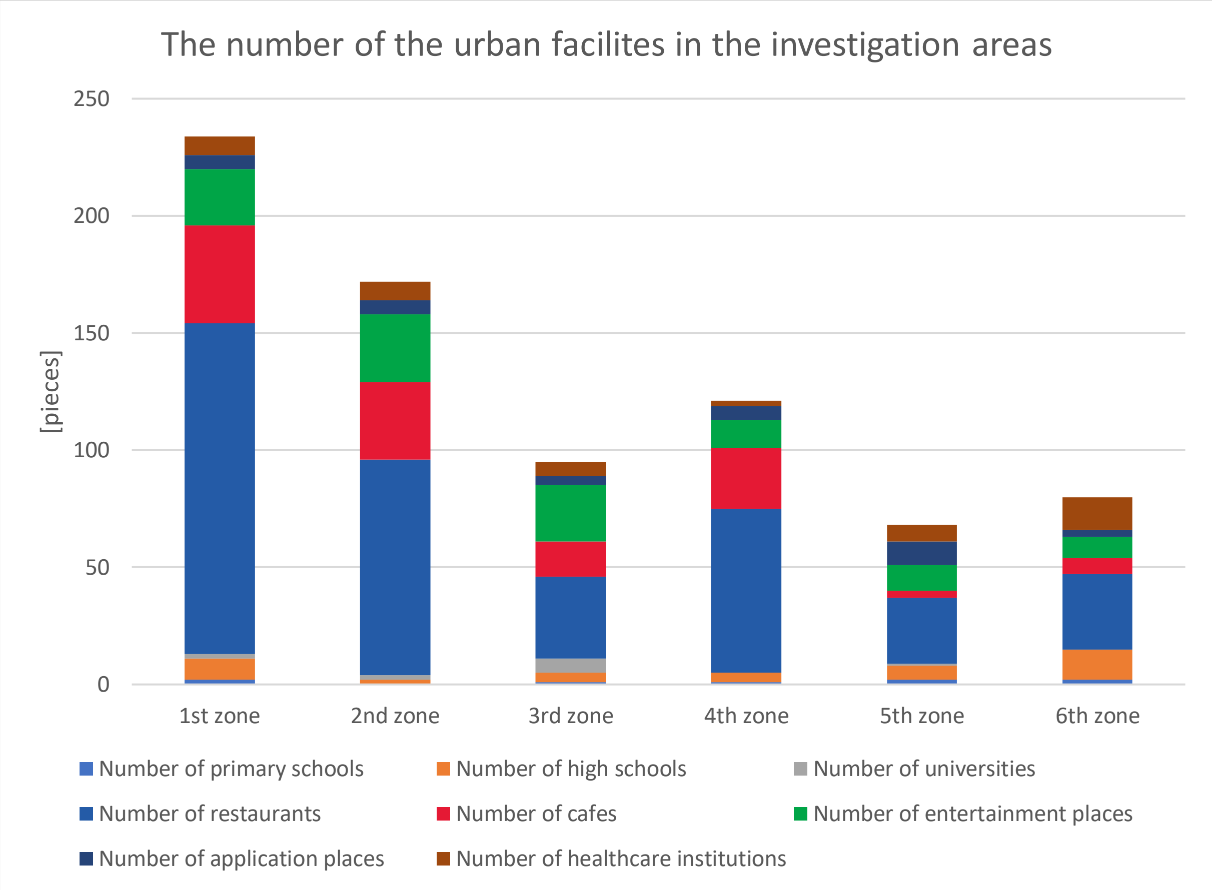


Figure 35. Urban facilities in the six zones of the section under stress

Another important parameter for the planning is the number of the employees. The figure below shows the number of jobs in the 6 investigated zones:

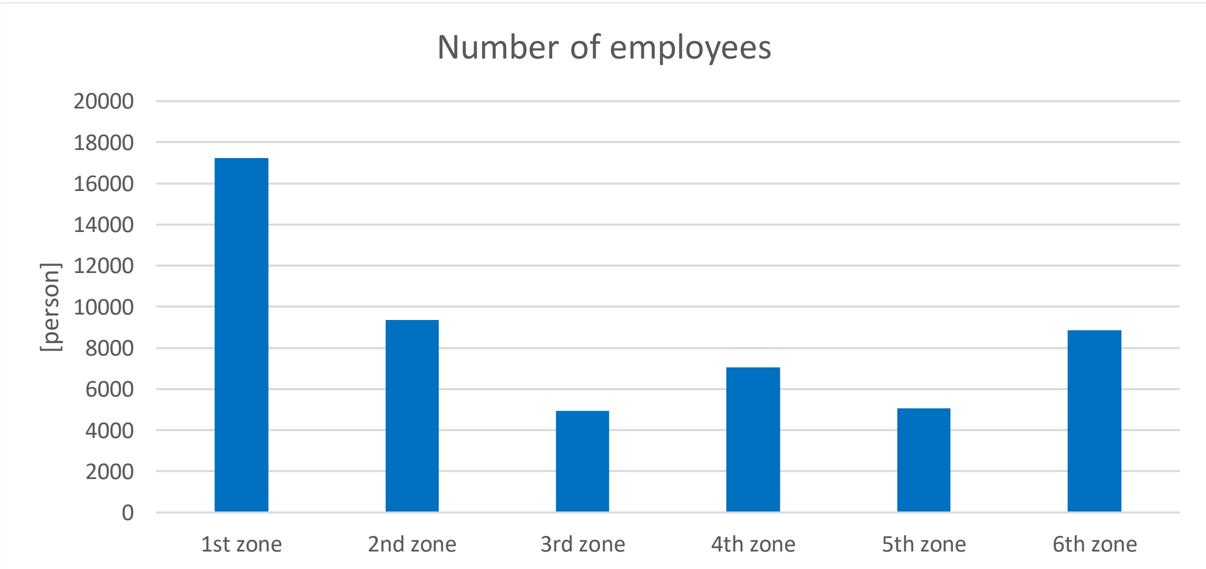


Figure 36. Number of employees in the six zones of the section under stress

The table below shows the modelled scenarios:

Table 8. Modelled scenarios

	Description	2020 (present)	2030	2050
BASE version	Do nothing – Current condition	✓ SvBase_2020	✓ SvBase_2030	✓ SvBase_2050
A version	Local traffic calming along the Rákóczi street	✓ SvA_2020	✓ SvA_2030	✓ SvA_2050
B version	„Sustainable version" – Traffic calming activites along the main road's in the downtown	✓ SvB_2020	✓ SvB_2030	✓ SvB_2050
C version	„Place function version" - Complete traffic calming in the inner part of Budapest	✓ SvC_2020	✓ SvC_2030	✓ SvC_2050

The BASE versions are modelled with basis model parameters in each corner year, without any extra modifications. These scenarios include the basis network and demand modifications, which are detailed in the table below.

The A versions model the local traffic calming activity, with only one modification (reducing the lane number in the Rákóczi Avenue).

The B versions model a sustainable scenario. These scenarios examined the capacity reduction on the main roads. These scenarios try to achieve the traffic calming in the downtown.

The C versions are the „place function versions", which means that the applied modifications affect the whole inner part of Budapest, so the results of this scenario could show the complete traffic calming in Budapest.

The following Table shows the applied modifications in the different scenarios.

Table 9. Applied modifications in the different scenarios

Street	Current condition (2019 autumn)	„A" scenario	„B" scenario	„C" scenario
Rákóczi Avenue	2x2 lane + bus lane	from Keleti Railway Station to Avar Street 2+1 or 1x1 lane	from Keleti Railway Station to Avar Sreet 2+1 or 1x1 lane	from Keleti Railway Station to Avar Sreet 2+1 or 1x1 lane
Pesti alsó Quay	2x1 or 2+1 lane	-	from Margaret Bridge to Közraktár street closed, except Belgrád Quay	from Margaret Bridge to Közraktár street closed, except Belgrád Quay
Közraktár Street	2x2 lane	-	2x1 lane	2x1 lane
Ferenc Boulevard	2x2 lane	-	2x2 lane + cycle lane	2x2 lane + cycle lane
Üllői Avenue	2x2 or 2x3 lane	-	inner part 2x1 lane, to Száva Street 2x2 lane + cycle lane	inner part 2x1 lane, to Száva Street 2x2 lane + cycle lane
Baross Street	2x1 or 2x2 lane	-	2x1 lane	2x1 lane + break in the Grand Boulevard
Grand Boulevard (Nyugati-Corvin)	2x2 lane	-	from Corvin negyed to Nyugati Railway Station 2x1 lane	from Corvin negyed to Nyugati Railway Station 2x1 lane
Andrássy Avenue	2x2 lane + cycle lane	-	between Bajcsy-Zsilinszky Street and Hősök Square 2x1 lane	between Bajcsy-Zsilinszky Street and Hősök Square 2x1 lane, break in the Opera
Podmaniczky Sreet	2x1 or 2x2 lane	-	-	2x1 lane, break in the Grand Boulevard
Lehel Street	2x2 lane	-	2x1 lane + cycle lane to Dózsa György Street	2x1 lane+cycle lane to Dózsa György Street
Váci Avenue	2x2 or 2x3 lane	-	from Nyugati Railway Station to Árpád Bridge 2x2 lane + cycle lane	from Nyugati Railway Station to Árpád Bridge 2x2 lane + cycle lane
Bajcsy-Zsilinszky Street	2x2 lane + bus lane	-	2x1 lane + bus lane	2x1 lane + bus lane
Szent istván Boulevaed	2x2 lane	-	2x2 lane + cycle lane	2x2 lane + cycle lane
József Attila Street	2x2 lane	-	-	2x1 lane
Chain Bridge	2x1 lane	-	-	closed to car traffic
Honvéd-Pannónia and Szemere-Hegedűs Street	one-way streets	-	-	the Grand Boulevard is not interoperable
Apáczai Cs. J. Street	one-way street	-	bidirectional	bidirectional
Krisztina krt. and Attila Street	partly 2x2 lane	-	directionally correct 2x1 lane	directionally correct 2x1 lane
Árpád fejedelem Street	partly 2+1 lane	-	Margaret Bridge - Zsigmond Square 2x2 lane, Zsigmond Square - Árpád Bridge 2x1 lane	Margaret Bridge - Zsigmond Square 2x2 lane, Zsigmond Square - Árpád Bridge 2x1 lane
Bécsi Avenue	partly 2x2 lane	-	2x1 lane to Vörösvári Street	2x1 lane to a Vörösvári Street
Szent Gellért Quay	2+1 lane	-	2x1 lane	2x1 lane
Pázmány Péter promenade	2x2 lane	-	2x1 lane	2x1 lane
Bartók Béla Street	partly 2x2 lane	-	2x1 lane	2x1 lane
Irinyi József Street	2x3 lane	-	2x2 lane	2x2 lane
Október huszonharmadika Street	2x3 lane	-	2x2 lane	2x2 lane
Bocskai Street	2x2 lane + bus lane	-	2x2 lane	2x2 lane
Inner IX. district traffic claming	-	-	-	traffic calming measures are working, through traffic is prohibited
Outer IX. district traffic calming	-	-	-	
Inner VIII. district traffic calming	-	-	-	
Outer VIII. district traffic calming	-	-	-	
Inner VI. and VII. district traffic calming	-	-	-	
Outer VI. and VII. district traffic calming	-	-	-	
Újlipótváros traffic calming	-	-	-	
Inner XI. district traffic calming	-	-	-	

2.4.3 The results of the macroscopic modelling

During the evaluation we also examined the mode choice and the traffic rearrangements for each milestone year. The applied modifications have only a few effects of the mode choice, due to the specificity of the model and the types of the modifications.

a) Current period (2020)

The SvA_2020 version examined the traffic calming activity along the Rákóczi – axis. The result of the lane reduce intervention, the traffic volumes will decrease significantly in the Rákóczi Avenue and the Elizabeth Bridge, compared to the SvBase_2020 version. This traffic will appear on the other parallel main roads. Thus, the Margaret Bridge's, the Chain Bridge's and the Petőfi Bridge's traffic volumes will increase.

The SvB_2020 version is examined not only the Rákóczi-axis traffic calming but the main roads' capacity reduction effects. The traffic volumes will decrease are similar to the A version in the Rákóczi-axis. Due to the lane reductions on the Grand Boulevard, the traffic volumes will decrease significantly. The downtown's residential areas' traffic volumes will increase because of the main roads' traffic calming.

Beside the SvB_2020 version's modifications, the SvC_2020 version examined the Chain Bridge closing from the road traffic and breaking the inner part of the residential areas' interoperability. The traffic volumes on the nearby bridges will increase. The residential areas' traffic volumes will decrease to a lesser extent, than the SvB_2020 version, because of the parallel lower capacity streets are decreased the „escape" possibilities.

b) Future scenarios (2030)

Due to the basic modifications in the network, the modal split of the public transportation will increase by 2030, compared to the Sv_2020 scenarios.

The SvA_2030 version examined the traffic calming activity along the Rakóczi – axis. The rate of the change is similar to SvA_2020. So the traffic volumes will decrease significantly in the Rákóczi Avenue and the Elizabeth Bridge, compared to the SvBase_2030 version.

In the SvB_2030 version examined not only the Rákóczi-axis traffic calming but the main roads' capacity reduction effects. The rate of the change is similar to SvB_2020. The traffic volumes will reduce like the A version in the Rákóczi-axis.

In the SvC_2030 version examined the B version modifications, the Chain Bridge closing from the road traffic and breaking the inner part of the residential areas' interoperability. The rate of the change is similar to SvC_2020.

c) Future scenarios (2050)

The basis modifications include a new tramline in the Rákóczi-axis by 2050. This modification has a huge effect of the traffic volumes and modal split in the investigation area. Due to the properties of the MTM, with the new tram line will be the public transportation system more attractive, and it will generate more demand.

The SvA_2050 version examined the traffic calming activity along the Rakóczi – axis. Due to the new tramline (and other public transportation development interventions), the ratio of the public transportation will increase along the Rákóczi-axis. Also the traffic calming activity will have effects of the Rákóczi Avenue, the traffic volumes will decrease significantly, compared to the SvBase_2050 version.

The SvB_2050 version examined not only the Rákóczi-axis traffic calming but the main roads' capacity reduction effects. The traffic volumes will reduce like the A version in the Rákóczi-axis.

The SvC_2050 version examined the B version modifications, the Chain Bridge closing from the road traffic and breaking the inner part of the residential areas' interoperability.

The following tables show the results of the different time-periods:

2.4.4 Outcomes of modelling (tables)

Table 10. Modelling outcome SvBase_2020

	SvBase_2020					SvA_2020				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	61000	101200		37,61%	62,39%	63000	101300		38,34%	61,66%
Chain Bridge	32500	14400		69,30%	30,70%	35800	14400		71,31%	28,69%
Elizabeth Bridge	66300	58400		53,17%	46,83%	40500	58400		40,95%	59,05%
Liberty Bridge	19900	29800		40,04%	59,96%	22500	29800		43,02%	56,98%
Petőfi Bridge	83400	55700		59,96%	40,04%	89600	55800		61,62%	38,38%
Rákóczi Bridge	106200	24900		81,01%	18,99%	118000	24900		82,58%	17,42%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	134800	22000		85,97%	14,03%	132600	22100		85,71%	14,29%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**58700**	**48800**		**54,60%**	**45,40%**	**31800**	**48800**		**39,45%**	**60,55%**
Rákóczi Avenue - Akácfa Street (S10)	40000	45000	151800	47,06%	52,94%	20300	45000	151800	31,09%	68,91%
Rákóczi Avenue - Berzsenyi Street (S11)	51700	56200	163100	47,91%	52,09%	31200	56200	163100	35,70%	64,30%
total journey distance PuT [km]	30 356 546,87	41,18%				30 360 202,81	41,15%			
PrT total journey distance [km]	43 356 944,65	58,82%				43 411 369,15	58,85%			

Table 11. Modelling outcome SvB_2020

	SvB_2020					SvC_2020				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	65800	101400		39,35%	60,65%	72200	101600		41,54%	58,46%
Chain Bridge	36000	14400		71,43%	28,57%	1600	14700		9,82%	90,18%
Elizabeth Bridge	38800	58500		39,88%	60,12%	42100	58700		41,77%	58,23%
Liberty Bridge	21700	29700		42,22%	57,78%	21300	29900		41,60%	58,40%
Petőfi Bridge	71000	55800		55,99%	44,01%	69900	56100		55,48%	44,52%
Rákóczi Bridge	119600	24900		82,77%	17,23%	128400	25100		83,65%	16,35%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	129300	22100		85,40%	14,60%	126700	22200		85,09%	14,91%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**31400**	**48800**		**39,15%**	**60,85%**	**33700**	**39600**		**45,98%**	**54,02%**
Rákóczi Avenue - Akácfa Street (S10)	21100	45000	151900	31,92%	68,08%	25800	45300	152000	36,29%	63,71%
Rákóczi Avenue - Berzsenyi Street (S11)	32100	56200	163200	36,35%	63,65%	36800	56400	163400	39,48%	60,52%
total journey distance PuT [km]	30 365 800,54	41,04%				30 435 337,32	40,99%			
PrT total journey distance [km]	43 633 133,62	58,96%				43 816 725,39	59,01%			

Table 12. Modelling outcome SvBase_2030

	SvBase_2030					SvA_2030				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	61800	96400		39,06%	60,94%	63900	96500		39,84%	60,16%
Chain Bridge	33400	13600		71,06%	28,94%	36800	13600		73,02%	26,98%
Elizabeth Bridge	67700	56400		54,55%	45,45%	41500	56400		42,39%	57,61%
Liberty Bridge	20600	33900		37,80%	62,20%	23400	33900		40,84%	59,16%
Petőfi Bridge	89300	57400		60,87%	39,13%	95200	57500		62,34%	37,66%
Rákóczi Bridge	114700	38500		74,87%	25,13%	120400	37450		76,27%	23,73%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	137200	22100		86,13%	13,87%	136800	22100		86,09%	13,91%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**59700**	**46500**		**56,21%**	**43,79%**	**32300**	**46500**		**40,99%**	**59,01%**
Rákóczi Avenue - Akácfa Street (S10)	40000	41500	142900	49,08%	50,92%	20300	41500	142900	32,85%	67,15%
Rákóczi Avenue - Berzsenyi Street (S11)	51500	50500	152600	50,49%	49,51%	31200	50500	152600	38,19%	61,81%
total journey distance PuT [km]	30 215 888,45	40,53%				30 219 350,24	40,50%			
PrT total journey distance [km]	44 327 586,01	59,47%				44 387 880,69	59,50%			

Table 13. Modelling outcome SvB_2030

	SvB_2030					SvC_2030				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	66800	96500		40,91%	59,09%	73400	96800		43,13%	56,87%
Chain Bridge	37000	13700		72,98%	27,02%	1600	14000		10,26%	89,74%
Elizabeth Bridge	39700	56500		41,27%	58,73%	42900	56700		43,07%	56,93%
Liberty Bridge	22500	33800		39,96%	60,04%	22100	34000		39,39%	60,61%
Petőfi Bridge	75300	57400		56,74%	43,26%	74100	57900		56,14%	43,86%
Rákóczi Bridge	128700	38900		76,79%	23,21%	137900	39100		77,91%	22,09%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	133500	22100		85,80%	14,20%	130800	22300		85,43%	14,57%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**32000**	**46500**		**40,76%**	**59,24%**	**34400**	**46700**		**42,42%**	**57,58%**
Rákóczi Avenue - Akácfa Street (S10)	21200	41500	142900	33,81%	66,19%	25900	41700	143000	38,31%	61,69%
Rákóczi Avenue - Berzsenyi Street (S11)	32200	50400	152700	38,98%	61,02%	37000	50600	152800	42,24%	57,76%
total journey distance PuT [km]	30 221 273,13	40,39%				30 289 775,99	40,35%			
PrT total journey distance [km]	44 599 346,15	59,61%				44 786 742,04	59,65%			

Table 14. Modelling outcome SvBase_2050

	SvBase_2050					SvA_2050				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	60800	95600		38,87%	61,13%	63000	95700		39,70%	60,30%
Chain Bridge	31600	15600		66,95%	33,05%	34900	15600		69,11%	30,89%
Elizabeth Bridge	64400	52000		55,33%	44,67%	38300	52000		42,41%	57,59%
Liberty Bridge	18800	44200		29,84%	70,16%	22000	44200		33,23%	66,77%
Petőfi Bridge	79600	55900		58,75%	41,25%	85800	55900		60,55%	39,45%
Rákóczi Bridge	92900	39600		70,11%	29,89%	97700	39600		71,16%	28,84%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	129100	21700		85,61%	14,39%	126400	21800		85,29%	14,71%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**57500**	**40600**		**58,61%**	**41,39%**	**31200**	**40600**		**43,45%**	**56,55%**
Rákóczi Avenue - Akácfa Street (S10)	39700	66200	129500	37,49%	62,51%	20300	65200	129500	23,74%	76,26%
Rákóczi Avenue - Berzsenyi Street (S11)	50600	76200	135900	39,91%	60,09%	31100	76300	135900	28,96%	71,04%
total journey distance PuT [km]	28 999 135,14	39,32%				29 001 443,49	39,29%			
PrT total journey distance [km]	44 752 987,06	60,68%				44 810 793,81	60,71%			

Table 15. Modelling outcome SvB_2050

	SvB_2050					SvC_2050				
	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT	unit vehicle/day	passenger/day	parallel subway	modal split PrT	modal split PuT
Margaret Bridge	65700	95800		40,68%	59,32%	72500	96000		43,03%	56,97%
Chain Bridge	35700	15700		69,46%	30,54%	1600	16000		9,09%	90,91%
Elizabeth Bridge	38500	52100		42,49%	57,51%	41500	52300		44,24%	55,76%
Liberty Bridge	20900	44100		32,15%	67,85%	20900	44400		32,01%	67,99%
Petőfi Bridge	66500	55900		54,33%	45,67%	65100	56300		53,62%	46,38%
Rákóczi Bridge	104600	39700		72,49%	27,51%	112300	39900		73,78%	26,22%
M1/M7 Budaörsi Street - Nagyszőlős Street (S4)	124800	21800		85,13%	14,87%	121600	21900		84,74%	15,26%
Ferenciek Square - Kossuth Lajos Street (stress section) (S9)	**31200**	**40700**		**43,39%**	**56,61%**	**33300**	**40800**		**44,94%**	**55,06%**
Rákóczi Avenue - Akácfa Street (S10)	21200	66200	129600	24,26%	75,74%	25400	66600	129600	27,61%	72,39%
Rákóczi Avenue - Berzsenyi Street (S11)	31900	76200	136000	29,51%	70,49%	36500	76500	136100	32,30%	67,70%
total journey distance PuT [km]	29 009 550,19	39,17%				29 075 454,34	39,12%			
PrT total journey distance [km]	45 050 117,29	60,83%				45 257 712,75	60,88%			

The following maps represent the outputs of SvBASE_2030 model for private transport (in unit vehicle/day) and public transport (in passenger/day) usage. The appendix contains the outputs of other scenarios.

Figure 37. Budapest SvBASE_2030 [unit vehicle/day]

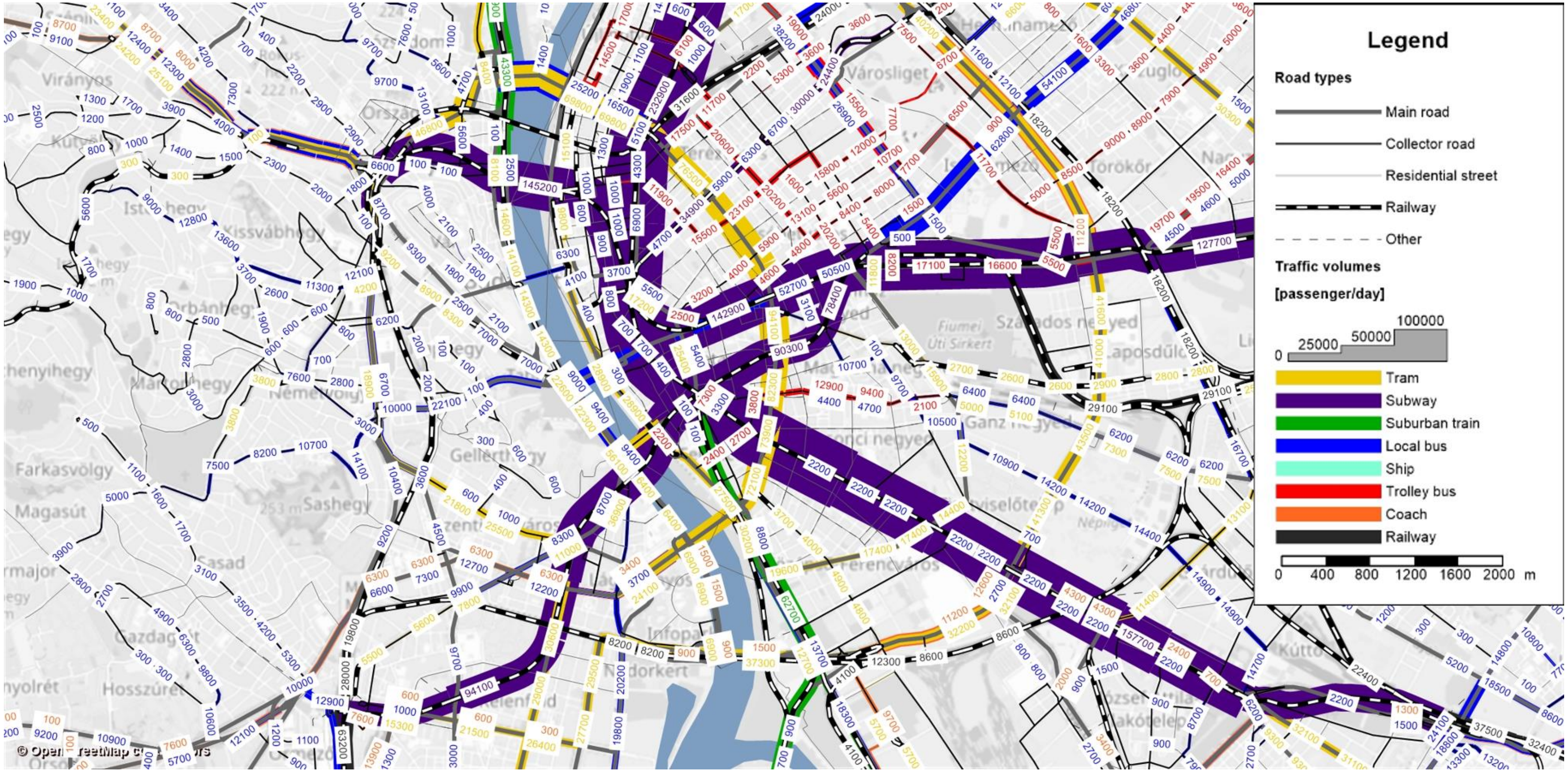


Figure 38. Budapest SvBASE_2030 [passenger/day]

2.5 Design brief for Future Conditions

Chapter 2.2 presents the most important urban planning and transport strategies, with the expected population and economic forecast of the city in the future. Chapter 2.3 details the future vision of the stress section, the measures, and interventions required for it, with regard to mobility and urban land use. Chapter 2.4 presents 4-4 scenarios for 2030 and 2050 (I. Do nothing-current condition; II. Local traffic calming along the Rákóczi road; III. “Sustainable version” - Traffic calming activities along the main roads in the downtown; IV „Place function version” - Complete traffic calming in the inner part of Budapest). The following table represents the differences between the current conditions and future ones at the stress section.

The following tables summarise the main design objectives based on these three chapters at the stress sections and they represent a differences among them.

Table 16. Mobility and urban space features of current conditions and future conditions

Mobility	Current conditions	Future conditions
Pedestrians	• Relatively narrow space for pedestrians at the sidewalk, • Fence between carriageway and footways • The number of pedestrian crossing is low • Pavement is asphalt	• Wider space for pedestrians at the sidewalk • More pedestrian crossings at the junctions • Green surface • Elevators at the undergrounds
Traffic	• Wide carriageway, 2 lanes for private transport at each direction • 50km/h speed limit, frequent overspeed	• Reduced carriageway, 1 lane for private transport at each direction • 30km/h speed limit
Public transport	• Bus lane at each direction next to the kerbside • Bus stops at the kerbside	• Public transport lane (bus, trolleybus, tram) at each direction at the middle of the street • Reallocation of the stops
Cycling and micro-mobility	• There isn’t cycling lane at the stress section • MOL Bubi bike sharing system points and some street bicycle storage are available	• Bike lane next to the kerbside for bicycles and micro-mobility vehicles. • Street bicycle storage at every corner • Mobility points
Parking	• There isn’t any parking spot at the stress section • Illegal parking on a sidewalk (Parking violation)	• Short-time parking spots for customers
Taxi stops	• Parking stops at Ferenciek square and Astoria	• Parking stops at Ferenciek square and Astoria • Mobility points
EV-chargers	• Lack of EV-chargers at the stress section	• EV chargers for locals, taxis, carsharing
Car sharing	• No dedicated car sharing parking spot	• Mobility points

(Goods) loading zones	• Loading zones at Ferenciek square and Astoria • Illegal loading on a sidewalk (Loading violation)	• More loading zones and better timing
City tour bus stops	• City tour bus stops at the kerbside	• City tour bus stops at the kerbside
Urban space	Current conditions	Future conditions
Street furniture	• Street furniture are available at the bus stops and Ferenciek square	• Street furniture along the stress section • Promenade at the Ferenciek square and Astoria
Green zones	• Trees at Ferenciek square	• Trees and green areas along the streets section
Street fountains	• There isn't any street fountains or wells at the street sections	• street fountains at the squares, street wells at the main corners
Street terraces	• Only a few street terraces	• New restaurants and pubs with street terraces

The following table shows a timeline of the utilisation of the MORE design tools for the Budapest pilot area.

Table 17. Utilisation of MORE Design Tools

BUDAPEST																		
			FEB	FEB	MAR	MAR	MAR	MAR	MAR	APR	APR	APR	APR	MAJ	MAJ	MAJ	MAJ	MAJ
Task Ref	Function	Tool	15	22	1	8	15	22	28	5	12	19	26	3	10	17	24	31
4,1	Option generation tool	Policy intervention tool																
4,1	Option generation	Road designs tool																
4,2	Stakeholder engagement	Blocks and acetates																
4,2	Stakeholder engagement	LineMap																
4,2	Stakeholder engagement	TraffWeb																
4,3	Micro Simulation	Vissim modelling (upgraded)																
4,4	Appraisal tool	Political and technical assessment																
4,4	Appraisal tool	Cost benefit analysis																
4,4	Appraisal tool	Multi-criteria analysis																

BUDAPEST															
			JUN	JUN	JUN	JUN	JUL	JUL	JUL	JUL	AUG	AUG	AUG	AUG	AUG
Task Ref	Function	Tool	7	14	21	28	5	12	19	26	2	9	16	23	30
4,1	Option generation tool	Policy intervention tool													
4,1	Option generation	Road designs tool													
4,2	Stakeholder engagement	Blocks and acetates													
4,2	Stakeholder engagement	LineMap													
4,2	Stakeholder engagement	TraffWeb													
4,3	Micro Simulation	Vissim modelling (upgraded)													
4,4	Appraisal tool	Political and technical assessment													
4,4	Appraisal tool	Cost benefit analysis													
4,4	Appraisal tool	Multi-criteria analysis													

3 CONSTANTA - Design Methodology for future conditions

3.1 Summary of current conditions along the Feeder Route

Constanta City is located in the South-East of Romania connected to the TEN-T Rhine Danube Corridor by road, rail and water (inland waterway through the Danube – Black Sea Channel and maritime through Constanta Port). See Figure 39.

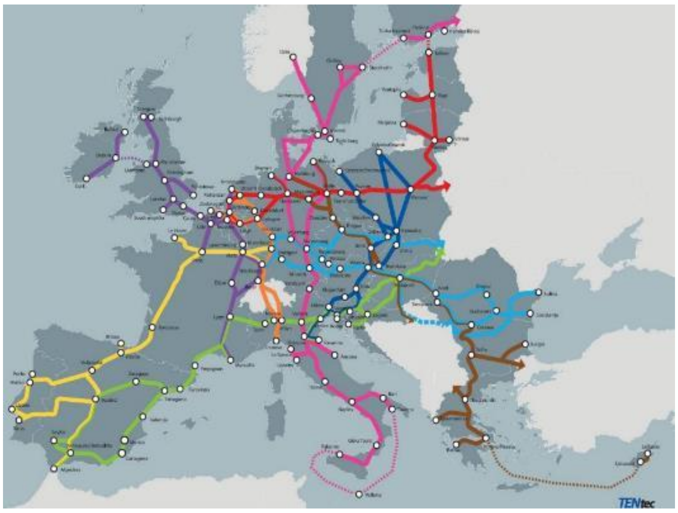
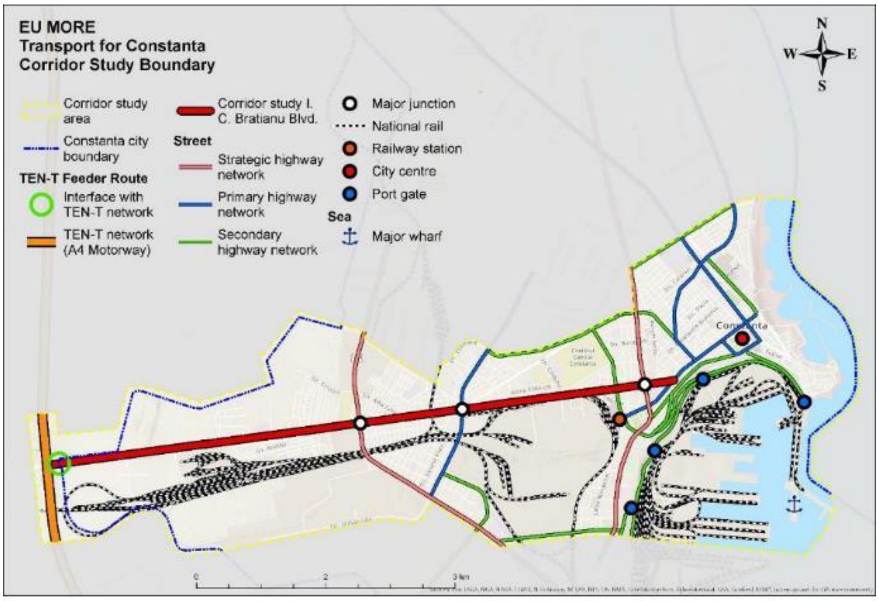


Figure 39. The Core Network Corridors map

National Road (DN) no. 3/ I.C. Brătianu Boulevard connects Constanta to the Rhine – Danube TEN-T Corridor and is the main entrance to the City on a West – East direction. The boulevard is part of the strategic street network of the City connecting it with other neighbouring localities from the South East Development Region and with Bucharest – the capital City of Romania through A4 / A2 motorway. As shown in the map below the boulevard connects some important areas of the City like the Central Railway station, the Port of Constanta, Mamaia resort, the industrial areas of Constanta and the City Centre.

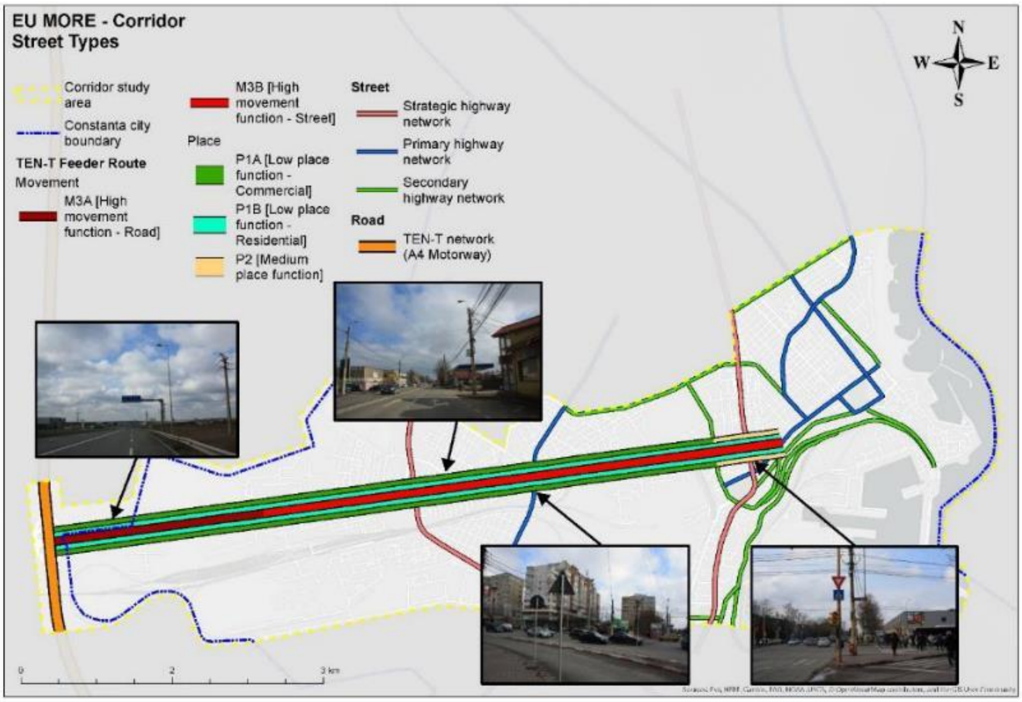


The map was created with the ESRI ArcGIS Pro Standard 2.2.0 application, EFL850542887 license

Figure 40. MORE - Movement Corridor Area

3.1.1 Feeder Route characteristics - Movement and Place functions

The corridor tackled in the MORE project has a length of 7,5 km and is composed of two main segments: a) the first segment is represented by the DN 3 (National Road no. 3), represented with dark red on the map; and b) I.C. Bratianu Boulevard segment, represented with light red on the map below.



The map was created with the ESRI ArcGIS Pro Standard 2.4.1 application, EFL850542887 license

Figure 41. MORE – Corridor street types

d) Segment 1 - National Road no. 3 description of current conditions

The first segment is represented by the DN 3 (National Road no. 3) linking A4 Ring Road (the TEN-T interface) with Constanta City. The road has a length of about 1,7 km with two lanes per direction separated by a concrete Jersey wall. There are no junctions on this segment of the road, except one roundabout that allows for turning and which ensures access to the businesses located near to the road.

There are no sidewalks along this segment of the road, the maximum speed limit is 90km/h and stopping and parking is not allowed.

The road is used both by private and public transport vehicles (inter-county bus services). Since the construction of A4 ring road an important part of the heavy traffic was taken over by the A4, especially the one related to the Port activities but the road is still used by heavy trucks/vehicles that access the Industrial area of Constanta and the companies alongside Aurel Vlaicu Boulevard (the former ring road of the city, now an important and congested urban street).

From the ‘Movement and Place’ classification point of view the road can be classified as M3A (High-movement Roads) and P1A (Places of more local importance with non-residential uses).

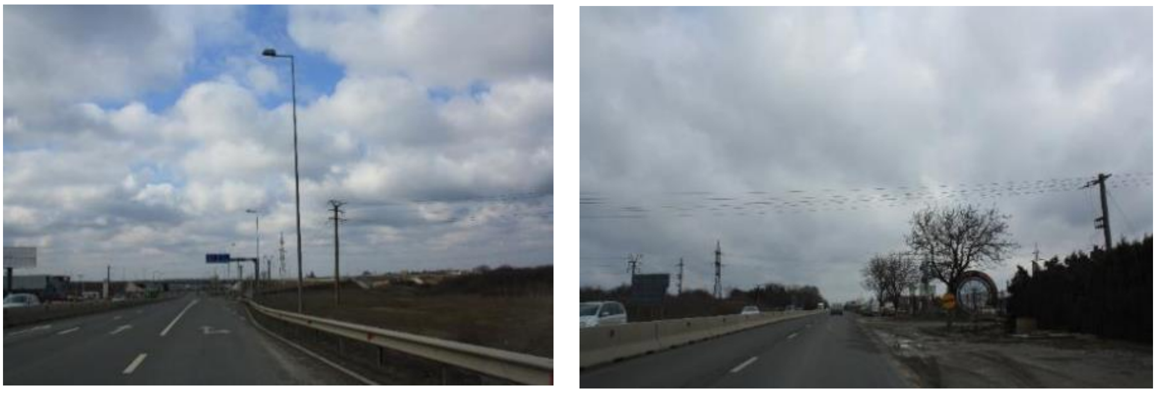


Figure 42. National Road no. 3

This segment of the road is owned by the Romanian State and is managed by the National Company for Road Infrastructure Administration (CNAIR S.A.), a company of national strategic interest working under the authority of the Romanian Ministry of Transport. The aim of CNAIR S.A. is to manage, to develop and to exploit the elements of the national road and motorway infrastructure on the basis of commercial principles for ensuring that the road traffic is performing in safe, fluent and continuous conditions.

e) Segment 2 - I.C. Bratianu Boulevard description of current conditions

The second segment is represented by I.C. Bratianu Boulevard a category I type of street (def. Category I streets – thoroughfare, which assures the takeover of the major traffic flow of the city on the direction of the national roads crossing the city or in the main direction of connection with these roads) and part of the strategic road network of the city, as described in the City SUMP (see Figure below).

Figure 43. Constanta street network

I.C. Bratianu Boulevard is parallel to the railway network connecting Constanta to Bucharest but there is no train station alongside it except the CFR Railway Station, which is connected through Ferdinand Boulevard, Theodor Burada Street and also through Labirint Street.

The street has a length of approximately 5,8 Km (5.816 m), the width of the carriageway varies between 16m and 12m and has an approximate total surface of 93.056 m^2, the width of the sidewalks varies between 6 m and 2 m and has an approximately total surface of 34.896 m^2. The maximum speed limit on this street is 50 km/h and according to the law, parking is allowed in special designated spaces.

There are 12 junctions along the road length, from which 3 roundabouts and 3 traffic light signalized junctions when approaching the City centre, the rest being signalized through traffic signs and road markings.

The street is used by all type of road users, both private and public transport vehicles, freight transport vehicles, pedestrians, cyclists etc.

There are no bicycles lanes on this segment and the footways are not in such a good state and are not adapted to the needs of people with reduced mobility.

The local public transport service provider in the City is CT BUS Company that is owned by the municipality. I.C. Bratianu Boulevard area is served by the local bus route no. 48, which is operated by a fleet of 10 buses (ISUZU Euro Diesel VI with a length of 12 m and MAZ Euro Diesel IV with a length of 15 m). The bus route has a length of 13,2 km/trip and a trip duration of approx. 55min. The service is provided from 5:15 o’clock to 23:00 o’clock on all working days and from 5:45 o’clock to 23:00 o’clock during weekends with a frequency of 10 minutes.

There are a number of eleven bus stops on each side of the street. Most of the bus stops alongside the Feeder Route are Bus Bay type and are used both by CT BUS vehicles and those of the private county/national transport operators, especially those from Murfatlar, Valu lui Traian, Cobadin, Medgidia and Cernavoda localities.

This segment of the street is owned by the municipality and is managed by S.C. Confort Urban S.R.L. Company, a company working under the Municipality`s authority responsible for the management of the City streets and parking places.

From the ‘**Movement and Place’** Classification point of view the street can be classified as M3B (High-movement Streets) and P1 (Places of more local importance: P1A- with residential and P1B - with non-residential uses) and when approaching the City centre P2 (Medium Place function), see Figure 41.

For a better description purpose and for better identifying the Movement and Place functions of I.C. Bratianu Boulevard, it can be divided in different street sections taking into consideration the numbers of lanes of the carriageway and also the urban functions that the street is serving, as follows:

b.1) Street section no. 1 – From the City entrance to the junction with Aurel Vlaicu Boulevard (see Figures 44 and 45)

The section starting from the City entrances to the junction with Aurel Vlaicu Boulevard (street section no. 1), where the traffic is carried out on two lanes per direction and where alternatives routes to the street cannot be identified. This street section is characterised by the existence of individual housing, different public institution buildings (the Road Police and the Constabulary), education facilities (Pontica High school) and some local commercial activities.

On this segment the traffic is mainly fluent except the peak hours when the street suffers from congestion and all related consequences (air and noise pollution, safety etc.).

On-street parking is not allowed and there are few parking places near the street, even though most people park on the sidewalks, creating a bad environment for pedestrians.

The corridor is used both by private vehicles and public transport, there are no dedicated bus lanes. On this section of the street, there are no bicycles routes and the footways are not in a proper state and adapted to the needs of people with reduced mobility.

Figure 44. Bratianu Boulevard – street section 1 – city entrance

Aurel Vlaicu Boulevard is an important street in the city (the former ring road of Constanta) it connects important business, housing, touristic and other sites in Constanta and has direct link with Mamaia resort and other neighbouring localities.

Aurel Vlaicu Boulevard can be considered as a parallel route to I.C. Bratianu Boulevard due to the fact that it connects the industrial areas of the city, especially for heavy duty vehicles. It also it connects to Mamaia resort and the housing neighbourhoods around the area and the city centre. I.C. Bratianu Boulevard connects with Aurel Vlaicu Boulevard through a roundabout junction, this junction is a place where most traffic jams are created.

Figure 45. IC. Bratianu Boulevard – street section 1 – connection with Aurel Vlaicu Boulevard

b.2) Street section no. 2 - From Aurel Vlaicu Boulevard junction to the junction with Dezrobirii/Cumpenei street junction/ Cora roundabout (see Figure 46).

This section shares most of the characteristics of section 1, except the fact that on this section there are more collective housing and there are also some big retail business that attract more people. Parking is a big problem on this section of the street due to the limited number of parking spaces compared with the car ownership and also the enforcement of parking rules.

Figure 46. IC. Bratianu Boulevard – street section no. 2

b.3) Street section no. 3 - From Cora roundabout to the junction with Ferdinand Boulevard (see Figure 47).

This section has three lanes per direction, except the small portion approximately 300 m from the 1st of December 1918 Boulevard to the junction with Ferdinand where there are 2 lanes per direction. Here we can identify some alternative routes but with a limited capacity compared to I.C. Bratianu Boulevard which make them less desirable.

This section is characterised by the existence of all the urban functions alongside the street (hospitals, individual and collective housing buildings, schools and high schools, important/big commercial centres, small economical agents, the ambulance service, restaurants etc.). On this section of the street the traffic is fluent, the biggest issue regarding the traffic flow on this section is the junction with Cumpenei/Dezrobirii Street/Cora roundabout, especially in peak hours when congestion occurs. The corridor is used both by private vehicles and public transport, but there are no dedicated bus lanes. On this section of the street there are no bicycles routes and the footways are not in a proper state and not adapted to the needs of people with reduced mobility.

On-street parking is not allowed on this section but there are some parking lots (parallel to the street and 45 degree angled) arranged on this section serving the collective housing buildings and the economical agents located on/near the street.

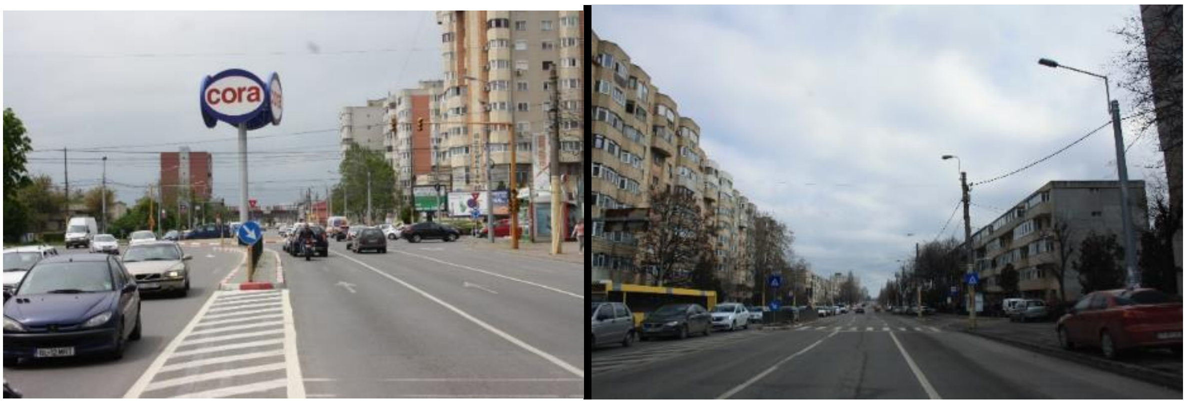


Figure 47. I.C. Bratianu Boulevard – street section 3 – Cora roundabout

The current road network load is represented in the following figures:

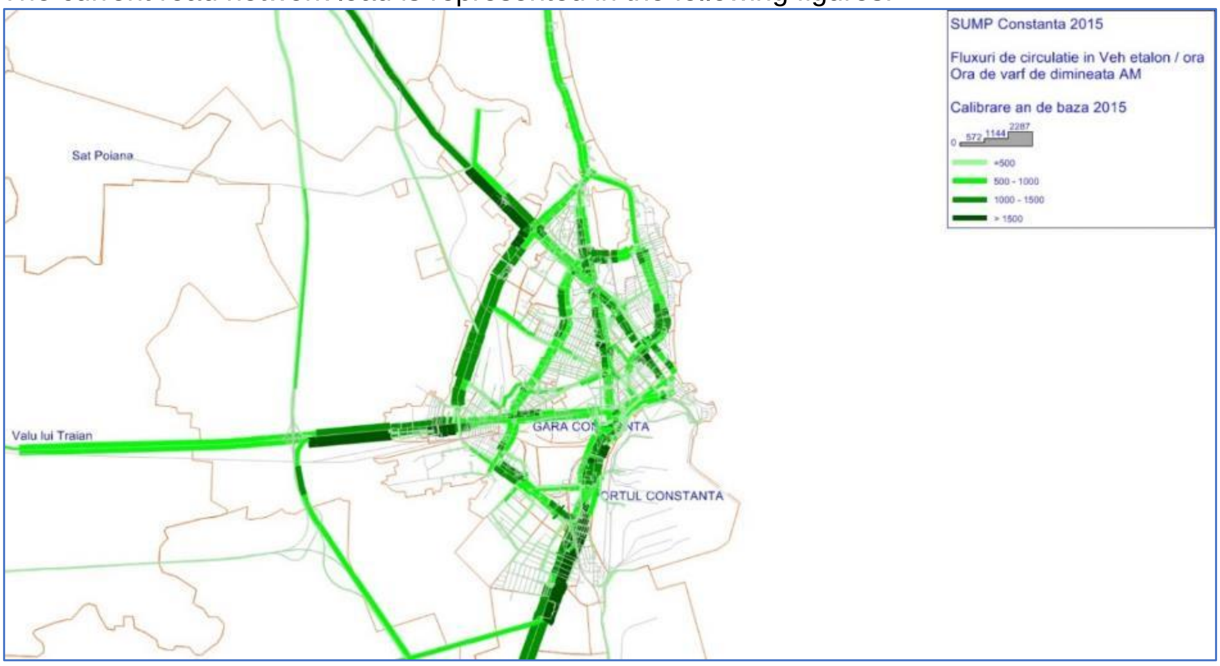


Figure 48. Traffic Volume Assignment, Base Year Model, PCUs, AM peak (for year 2015)

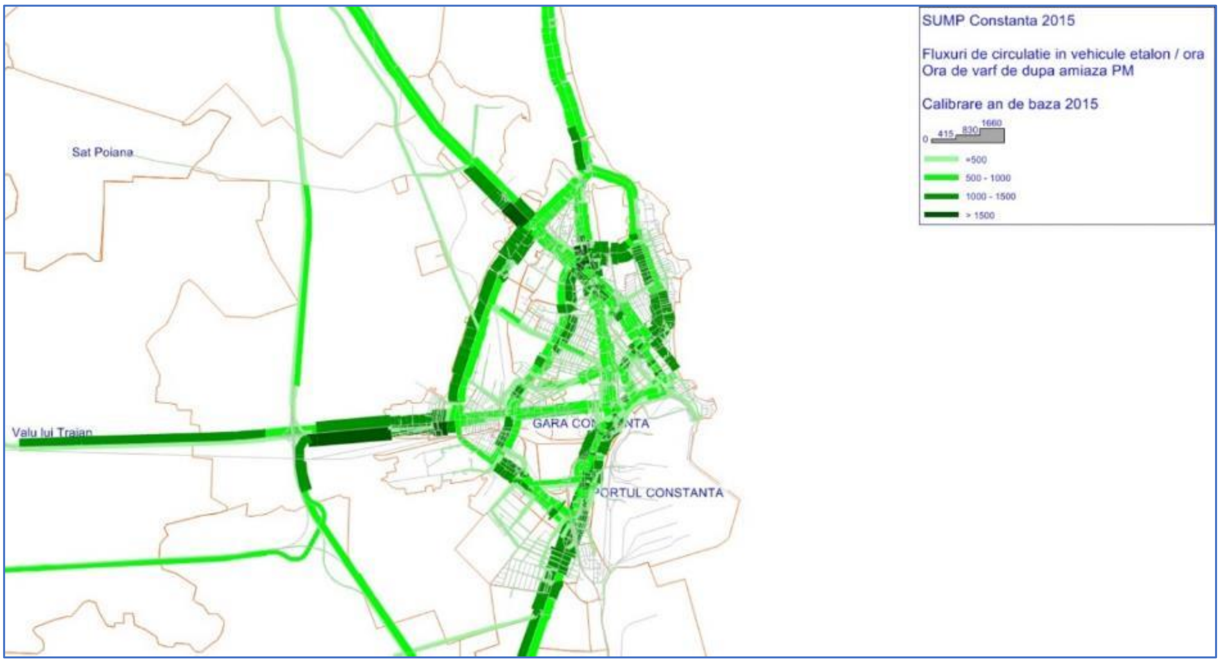


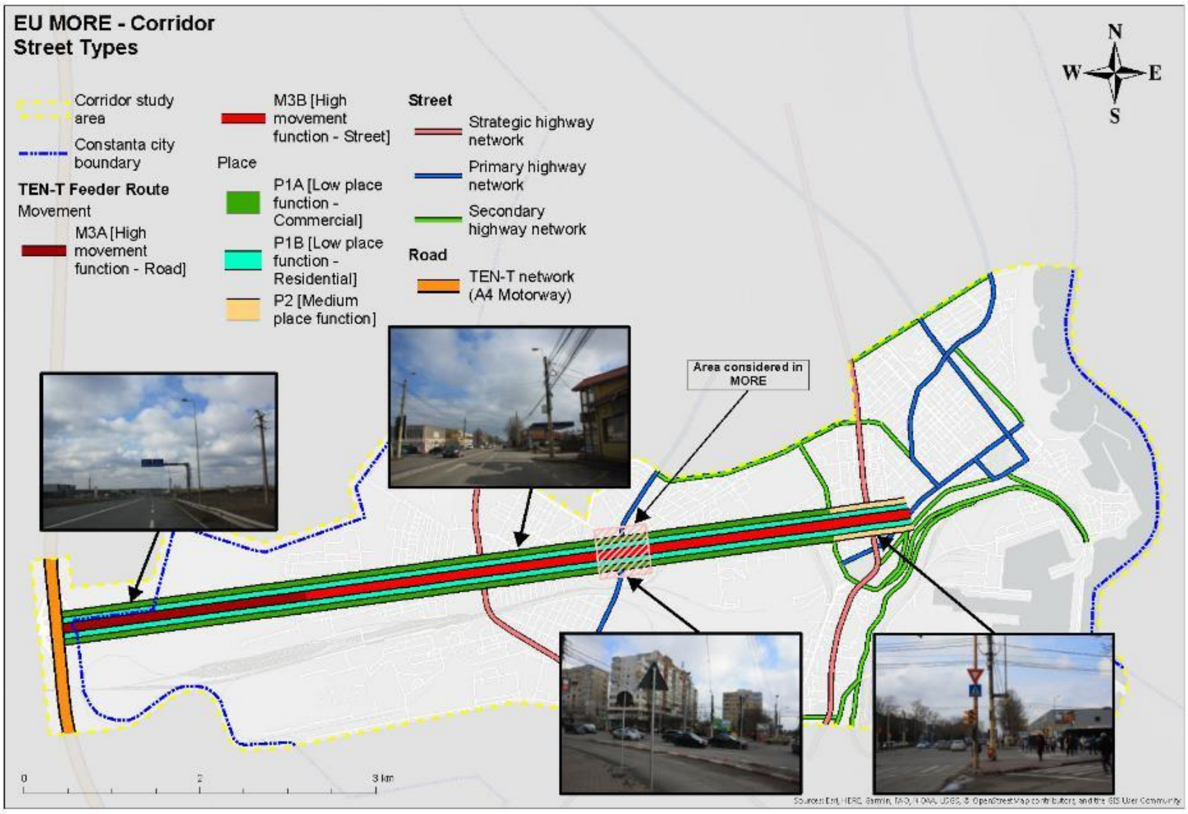
Figure 49. Traffic Volume Assignment, Base Year Model, PCUs, PM peak (for year 2015)

3.1.2 Stress Section Characteristics

The Stress Section approached in MORE is represented by the junction of I.C. Bratianu Boulevard with Dezrobirii and Cumpenei Streets, approximately 200 m on each arm of the junction (see the map below) and is one of the most congested section on the Feeder Route accommodating all types of traffic that creates many traffic conflicts between different road users.

The Stress Section is one of the busiest areas on the Feeder Route due to the fact that it accommodates around 4.000 residents of which 2.911 people are living in collective housing buildings/blocks of flats and more than 40 individual businesses like banks (4 units), medical units (9 units), beauty salons (4 units), food shops (3 units), Sportsbooks /Casinos (6 units), shopping mall (1 unit) etc.

The Stress Section is located at the crossroad of two most circulated streets in the City, respectively, I.C. Bratianu Boulevard and Cumpenei and Dezrobirii streets. These streets represent important arteries in the City street network ensuring the takeover of major flows of the City in the direction of SV-NE and making the connection between the national roads that cross the city (E87, DN3 and DN2A). This street section is part of the primary street network and ensures the connection with the Industrial Area, Constanta Port, A2 Motorway, the ring road of Constanta (A4), Mihail Kogalniceanu International Airport, Mamaia resort and the City Centre.



The map was created with the ESRI ArcGIS Pro Standard 2.2.0 application, EFL850542887 license

Figure 50. MORE Stress Area

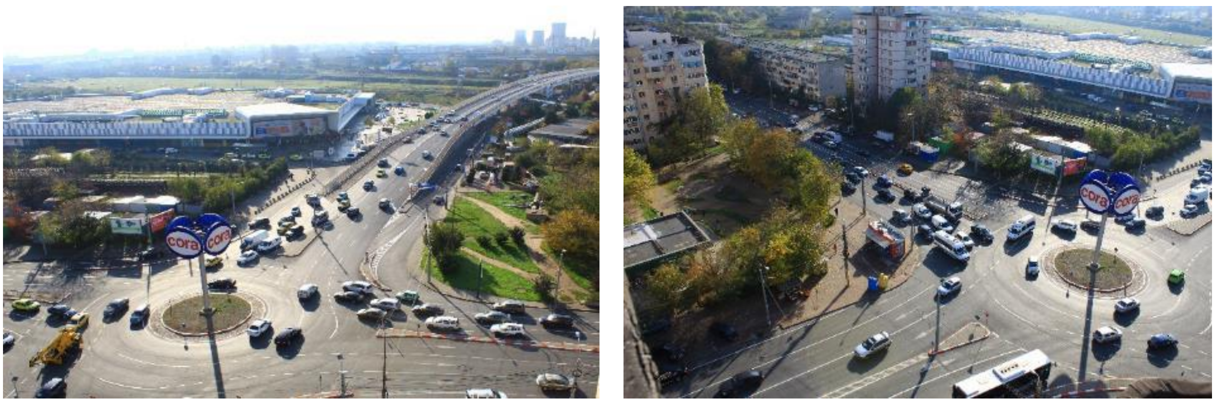


Figure 51. MORE Stress Area Aerial Photos

The Stress Section Area represent also an important public transport hub, including for the inter-county transport due to the fact that the area is well served by the local public transport network that ensures good links around the City and with high frequency. Three important local bus routes are covering the area, respectively no. 48 (see 2.1.1.2. section) and no. 102N (starting from the Industrial Area – CT BUS garages to the North of the City – Faleza Nord neighbourhood with a length of 17,5 km/route and an average frequency of 4/5 minutes) and no. 102P (starting from the Industrial Area – CT BUS garages to the Mamaia resort entrance/Mamaia Boulevard with a length of 18,9 km/route and an average frequency of 4/5 minutes).

According to the data collected in March 2020, around 8.195 travellers/day are using the local transport service in the Stress area.

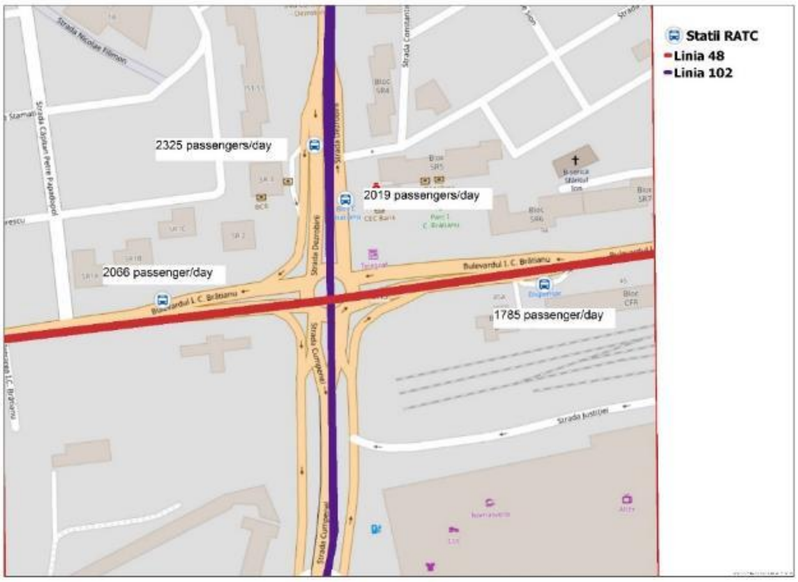


Figure 52. Locations of bus stops and number of passengers/day

Having in mind that the area is an important public transport hub and due to its place functions, the Stress Area is accessed by an important number of pedestrians.

For estimating the number of pedestrians using the area, we conducted a data collection exercise consisting in the establishment of 22 counting points, as presented in the picture below and we registered the number of pedestrians on the sidewalks and their travel direction, the number of people crossing the streets both legally and illegally between 6 AM and 10 PM on a normal working day (Thursday). After analysing the data, we noted that 37.295 used the area and we also identified the peak morning hours between 11:00-12:00, with a total of 3528 pedestrians and also the evening peak hours between 15:45-16:45, with a total of de 3713 pedestrians.

Figure 53. Pedestrian counting points

The total number of pedestrians registered at each counting point is presented in the chart below.

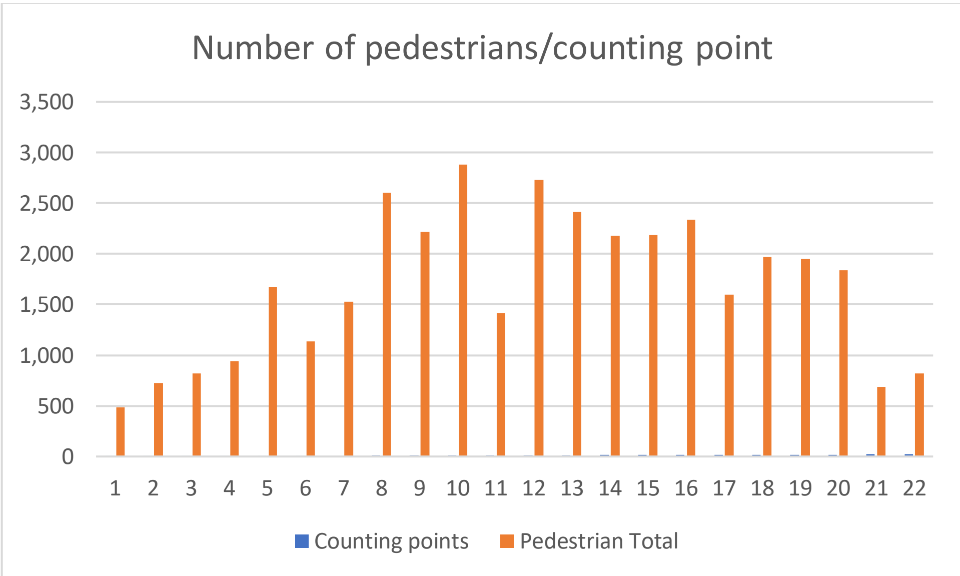


Figure 54. Pedestrian/counting point

As we can see from the data provided above the less used area is the one on the West side of the Stress Section Area, one of the reasons for this is the low place function both residential and commercial of this area, even though this can constitute an advantage when thinking at further improvements of the Area.

Another important aspect regarding to pedestrians is related to the illegal crossings, thus during the day that we had collected data a number of 61 people crossed the street illegally, both male and female, most of them with an age between 36-65 years old. Even though the percentage of people crossing the street illegally seems relatively small, around 0.16 % of all pedestrians using the area, there is still a big problem related to pedestrian safety, moreover due to the fact that the main causes of accidents on the Feeder Route are illegal crossings and not granting priority to pedestrians.

In order to discourage illegal crossing and for increasing the pedestrian safety, the municipality implemented a series of measures in the past period, as follows:

1. Repositioning the pedestrian crosswalks and moving them away from the junction;

2. Building of pedestrian isles at the middle of the street, due to the large width of the streets.

Figure 55. Improved pedestrian crossings with median isles

We also counted the stationary activities of people around the area by moving around the area and registering the activities people are involved in on a 30 minute time slot, looking on some predefined possible activities and also marking on a map their position, below you can see summarised these activities.

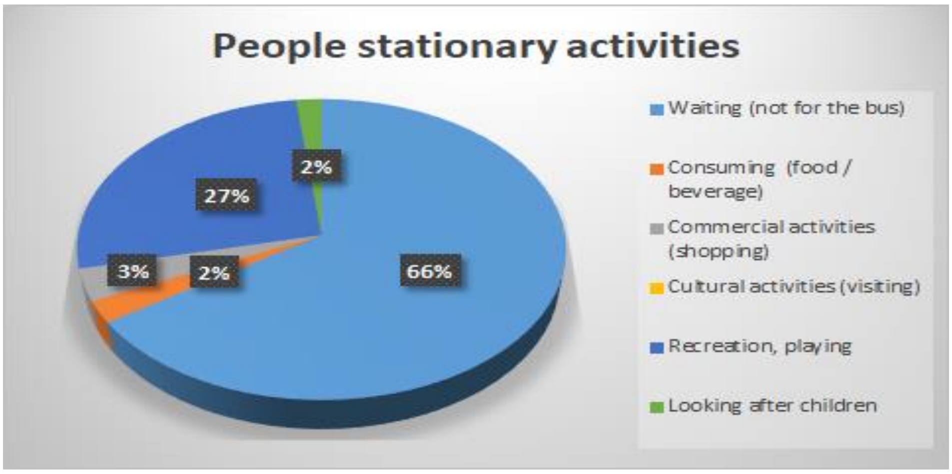


Figure 56. People stationary activities

Regarding the car traffic, the street infrastructure in the Stress Area does not provide any dedicates bus lanes or bicycles lanes, even though the space is pretty generous for this kind of infrastructure and the maximum speed limit is 50 km/h with some limitations when approaching the junction.

Below you can find a map presenting more in depth the traffic conditions in the area, where we can see numbers of lanes of each street and the vertical and horizontal street markings and signage.

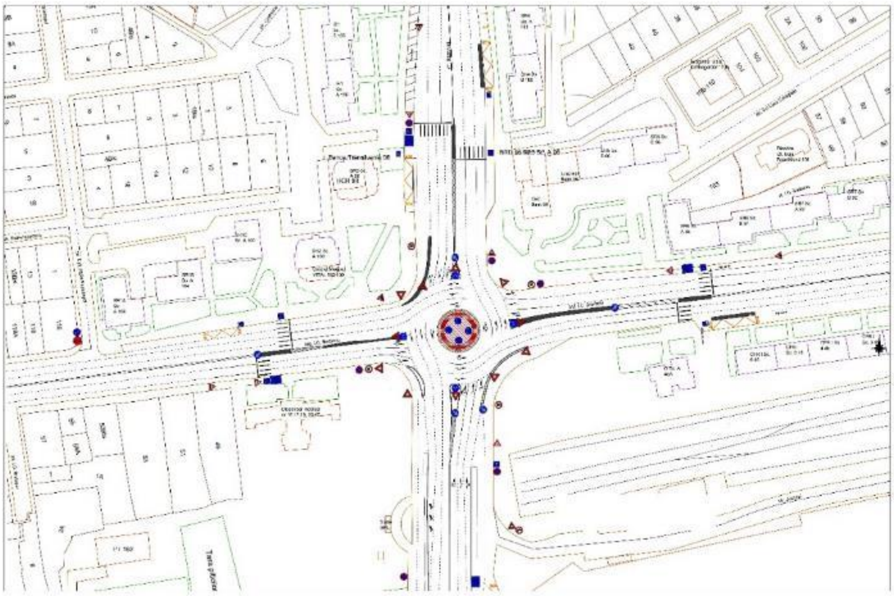


Figure 57. Stress Area traffic plan

In Constanta and of course in the Stress Section Area the traffic is dominated by private vehicles. According to our counting a number of 61.730 vehicles are entering the Stress Area during a one-day period from 6:00 AM to 10:00 PM. The counting registered bicycles (70), private vehicles /cars (57.229), light freight vehicles (3.383), heavy freight vehicles (255) and buses (793), the traffic composition is presented in the chart below.

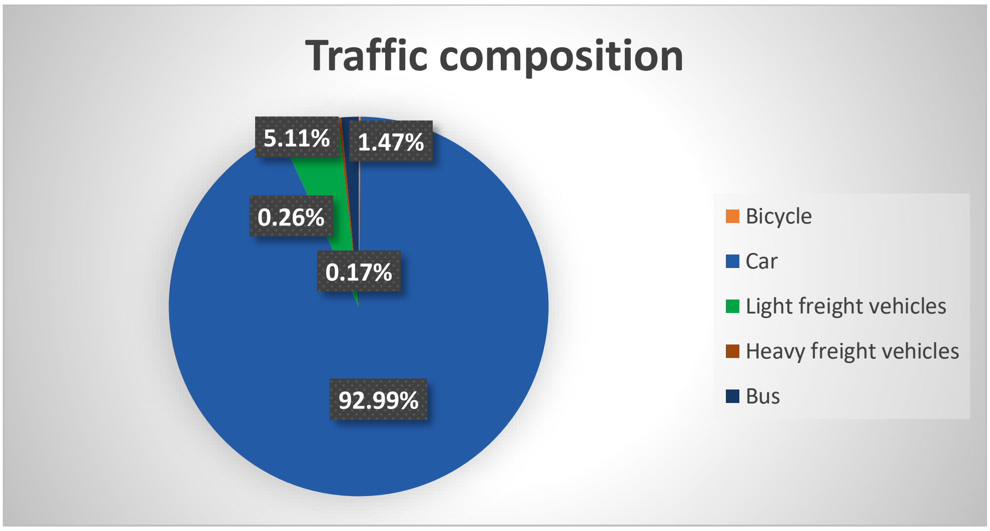


Figure 58. Stress Area traffic composition

The morning peak hour was identified between 07:15 AM and 08:15 AM, with a total number of 4.635 vehicles and the evening peak hour between 04:45 PM and 05:45 PM, with a total number 5.698 vehicles.

Parking inside the Stress Area is allowed only in special designated places, there are around 65 on street parking places as presented in Fig. no. 19: Stress Area traffic plan.

Even though the Local Police applied a number of 1897 fines in the last two years for illegal stopping and parking in the area, this is still an issue for the Stress Area.

Figure 59. Parking habits

Due to the intense usage of the Stress Area we can also identify some environmental issues, even though for the moment these issues are not so problematic in the future if considering the permanent increase of car ownership and usage these issues can represent real problems for people living and using this area.

After analysing the findings of the 2018 air quality assessment, we observed that there were some hours exceeding NO2 (hours exceeding for the values of 40 µg/mc - limit value for people health) and NOx (hourly and maximum hourly admissible values of 30 µg/mc – critical annual level for the protection of the greenery), but also exceeding PM10 for the hourly values, as shown in the figure below.

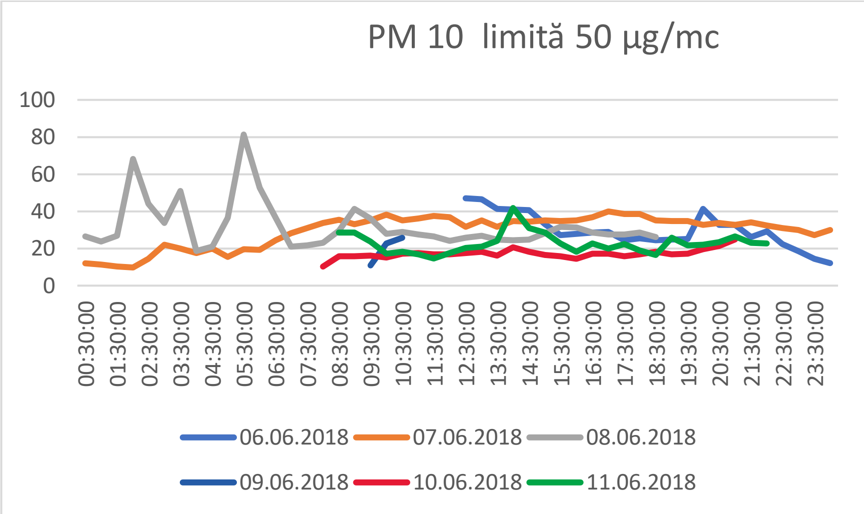


Figure 60. PM 10 emissions registered in the Stress Section Area

Regarding the noise emissions in the Stress Section Area you can see below an extract from the City noise map representing levels in the area.

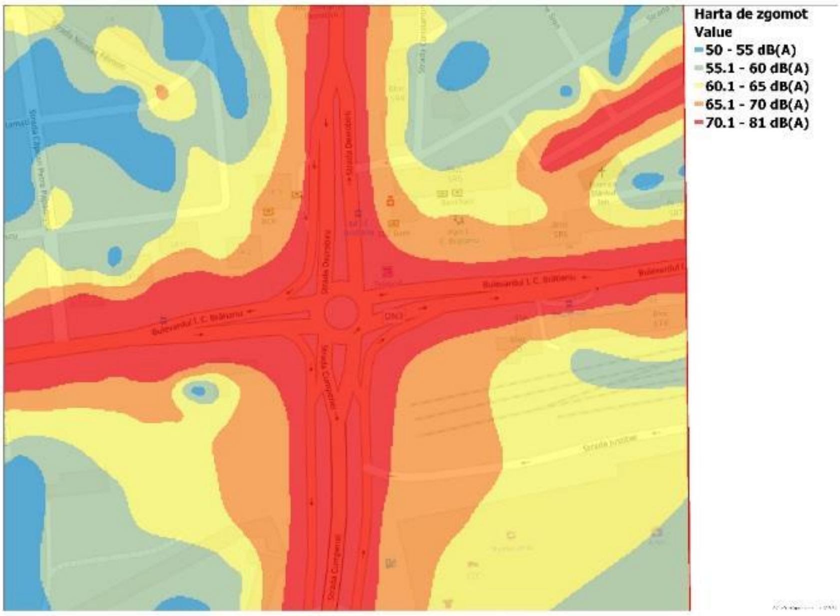


Figure 61. Noise emissions registered in the Stress Section Area

3.2 Future conditions in the Wider Impact Area

3.2.1 Transport supply

Future mobility developments

From a mobility perspective, the City is dominated by cars, the infrastructure is provided in order to accommodate as much cars as it can and when considering new developments or refurbishments, according to national legislation, design rules and the majority people perception, car traffic must be considered first.

Since the City adopted its first Sustainable Urban Mobility Plan (SUMP) in 2018, this perspective started to change and the local administration, who is in charge with the local transport infrastructure, started to think wider and to take into consideration all street users transport needs and putting people before cars when considering new improvements.

In this respect, a series of actions were developed by the City in order to create a more balanced way of using the street infrastructure by reallocating more space for pedestrians, public transport and also cyclists. There is a process under way looking to transform the transport infrastructure in Constanta by refurbishing some major boulevards and the City centre area in order to promote more sustainable ways of travel with the aim of reducing the pollution resulting from transport and improving the urban environment quality.

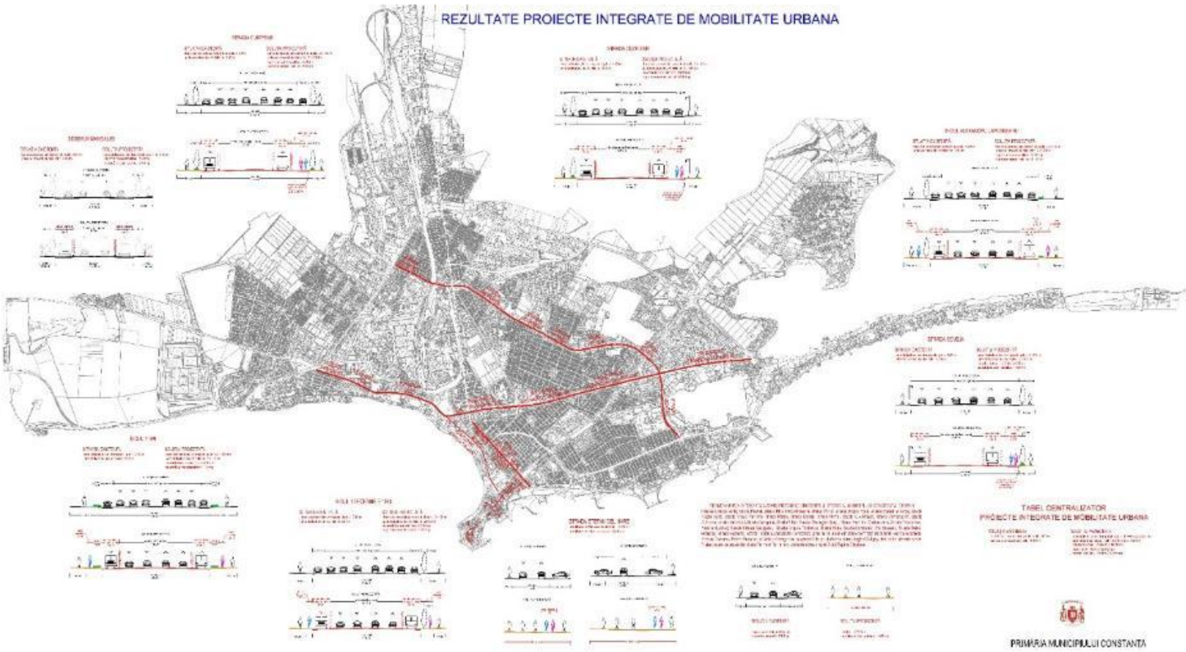


Figure 62. Constanta’s short-term Plan for road infrastructure redesigning

There are four projects already funded through the Regional Operational Programme 2014 - 2020 regarding the reallocation of street space in the City, for three of these projects the works will begin in the spring of 2021 and for the fourth one we estimate the autumn of 2021.

The implementation of these projects besides the transformation they will produce to the transport infrastructure like the creation of dedicated bus and cycle lanes, including the improvement of the footways, they will also produce a change of paradigm for the City administration and will induce a more sustainable behaviour for citizens and visitors.

Beside these projects, the City is also looking to improve its public transport service in this respect during 2019 - 2020 the transport operator's fleet was renewed by purchasing a number of 104 new ISUZU buses, with Euro VI emissions standard and a number of 18 Mercedes Benz urban buses, with Euro VI emissions standard (year 2020). The acquisition of the 104 ISUZU buses was made by Constanta Municipality, which benefited from a loan contract from the European Bank for Reconstruction and Development. These buses have been in operation since the end of 2020. The 18 city buses were also purchased by Constanta Municipality from the local budget and were made operational in the summer of 2020.

The city is also looking to implement at the outskirt of the City three Park and Ride facilities, thus creating the option for commuters from the neighbouring localities to park their cars when entering the City and to continue theirs travel using the public transport service.

Figure 63. Constanta's plan for Park&Ride facilities development

Another step towards the improvement of the public transport service is the creation of the Metropolitan Area Public Transport Association. The City of Constanta together with 4 surrounding localities constituted this Association with the aim of providing an integrated public transport service.

Considering all the above-mentioned actions we consider that in the next coming years the transport infrastructure and the public transport service will look a lot different than we know it today and the main focus will be on sustainable mobility rather than on increasing the car traffic capacity.

Future transport modes and infrastructure

Looking into the future we can assume that in the next couple of years the transport sector will suffer some major changes, new modes will emerge and be ready to use and new smart infrastructure will be in place.

Considering the EU targets settled in the Communication “Sustainable and Smart Mobility Strategy – putting European transport on track for the future” presented in December 2020, we can consider that **electrification** will constitute a major game changer in urban mobility.

Initial steps have already been implemented in Constanta regarding the charging infrastructure for electric vehicles, there are around 23 recharging station around the City and there are different projects for the extension of this infrastructure. These types of projects are supported by the National Government through dedicated funding from the Environment Fund Programme.

Another important aspect that is worth to be mentioned is that the municipality offers incentives to electrical vehicles users like free parking places and tax reduction.

Even though the price of electrical vehicles is still high and they cannot compete for the moment with fossil fuels cars, electrification must be taken into consideration when developing the future scenarios, especially the infrastructure provisions.

At the same time, Constanta has two projects under implementation phase in partnership with the Ministry of Public Works, Development and Administration regarding the acquisition of a number of 41 electric buses, 20 with a length of 12 m and 21 with a length of 10 m., and the related infrastructure, respectively 41 slow recharging stations, which will be located at the operator bus garage and 10 fast recharging stations which will be located on the routes that will be served by these electric buses.

Electrification of transport must be further promoted and taken up mostly due to the fact that Dobrogea Region[4] has one of the highest potentials of Romania in terms of wind electrical energy production and is estimated at 400-700 W/m2. Considering the coastal region and the continental platform of the Black Sea, the potential is even higher, with values exceeding 700 W/m2.

In respect to the photovoltaic potential of the Dobrogea region, the figures based on the average annual sum of the solar irradiation are showing a potential greater than 1400 kWh/m2.

[4] See PORTIS project ”Report on the already existing solar and wind farms”

For the Constanta region, the estimated values with the help of the PVGIS platform (Photovoltaic Geographical Information System) are showing that the solar potential of Constanta is estimated to be 3900 Wh./m2/day on horizontal plane or 4400 Wh./m2/day on the optimally inclined plane, which in case of Constanta is 33°.

Another important aspect regarding the transport sector electrification is related to the development of the inter-city / metropolitan railway service. There is a short-term Strategy developed at the national level regarding the development of the railway infrastructure 2021 - 2025 that emphasis the necessity of developing these kinds of services.

In the map below, we can see that Constanta is also considered for the implementation of the inter-city / metropolitan railway service. The aim for developing these kinds of services is to assure a shorter trip duration between the residential area and the working place and a fluent trip. The main objectives for implementing the intercity/metropolitan railway service is to create an attractive alternative to individual car transport, that is causing an overcrowding on the street/road networks. The overcrowding of the street/road networks is a main feature of all the metropolitan areas in Romania.

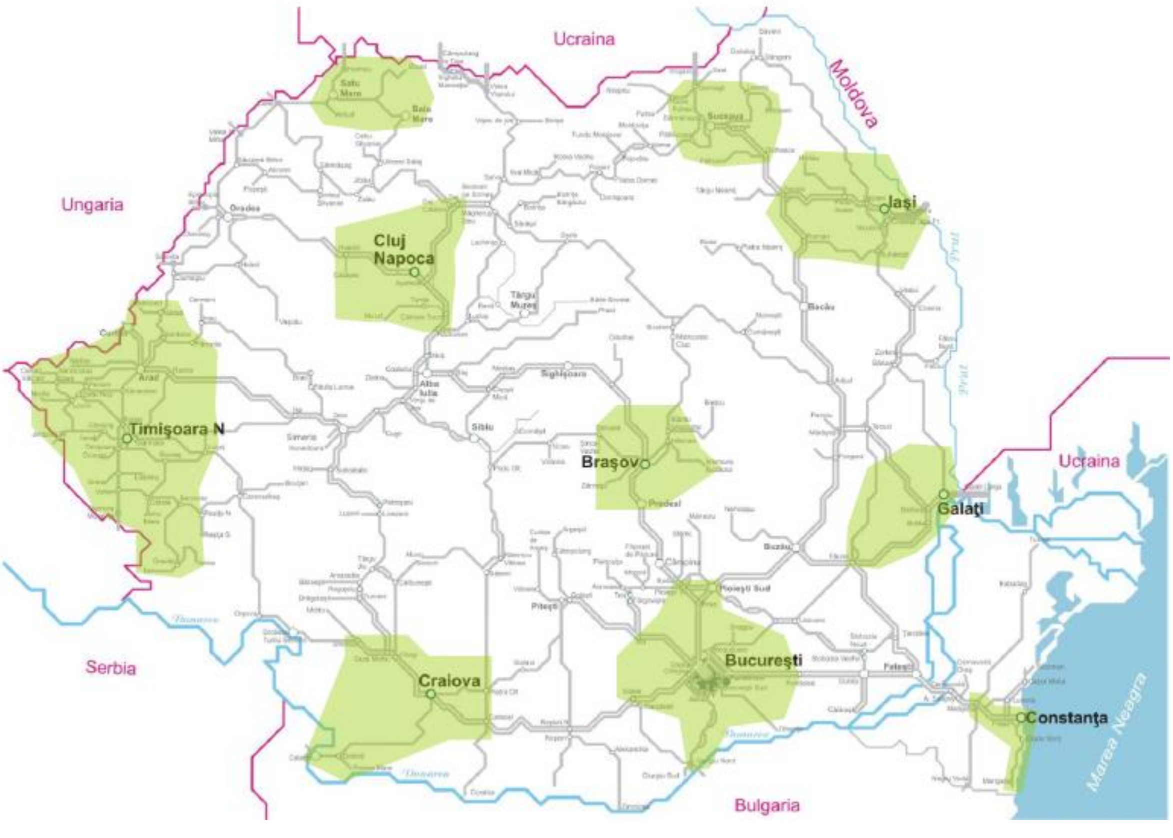


Figure 64. Romanian Metropolitan Areas considered for the development of Metropolitan railway services (source: Strategy regarding the development of the railway infrastructure 2021-2025)

Considering the experiences of other European countries (e.g. S-Bahn in Germany and RER in France), we can assume that these kinds of services will attract a considerable number of commuters that are now using their cars.

Micro-mobility[5] (e.g. shared bikes and electric scooters) is one of the fastest-growing modes of transport worldwide. These small, most of the time, electric-powered vehicles, can potentially connect different transport modes to make journeys quicker and easy - particularly trip stages perceived as too long to walk in lower-density areas with low Public Transport frequencies.

Micro-mobility has a potential to grow in Constanta and to constitute a real alternative to car traffic. In 2019 the City owned bike-sharing system (24 bike stations and 320 bikes) was launched and until September 2020 there were 13.364 users registered in the system and around 83.321 individual trips were made during the same period (in the winter season the system is not operational due to weather conditions). For the moment most people use the bicycle for leisure purposes and is not yet seen as a real alternative to cars, mostly due to the lack of specific infrastructure. We hope that in the near future, considering also the municipality actions regarding the creation of a network of bicycle lanes inside the City, bikes will constitute a real alternative to cars and must be taken into consideration when developing the scenarios for future conditions.

In the summer of 2020 three private enterprises introduced e-scooters for the first-time in the City that can be rented through a mobile application. For the moment we do not own the data regarding the usage of these e-scooters but we observed that these vehicles are very well used, especially around the City centre area.

Given their vulnerability and low-speed, micro-mobility is a challenge in terms of safety when circulating on the carriageway. On the other hand, the safety of pedestrians is negatively impacted where micro-vehicles are used and parked on sidewalks. To adapt the future and present infrastructure to micro-mobility vehicles it is vital to protect the sidewalks and to make sure micro-mobility users can ride safely without using the footways.[6]

Digitalisation is also a factor that needs to be taken into account when looking into the future. For the moment we can say that the City is in the inception phase regarding the use of digitalisation in transport and its uptake is absolutely necessary for promoting sustainability in this field.

Starting from the collection of data and using it in the day to day management of the street infrastructure and the City transport services, continuing with intelligent traffic management and finishing with the provision of data for general public, digitalisation will constitute an important game changer for the future.

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[5] See MORE Deliverable 3.1. Analysys of technological advances
[6] Idem.

3.2.2 Factors affecting future levels and patterns of demand for movement within the impact areas

In this chapter we will analyse the factors that may affect future levels and patterns of demand for movement within the area considered in MORE. These factors are the population evolution, the gross domestic product per capita, the vehicle fleet evolution and also the land use development inside.

Demographic forecast

The population of Constanta City is continuously decreasing, according to the National Institute for Statistics, in 2030 the City number of inhabitants will decrease with about 11.000 people compared with 2020 figures, approximately 3,5%. The main reasons for this decrease are migration, both internal and external and the negative population natural growth.

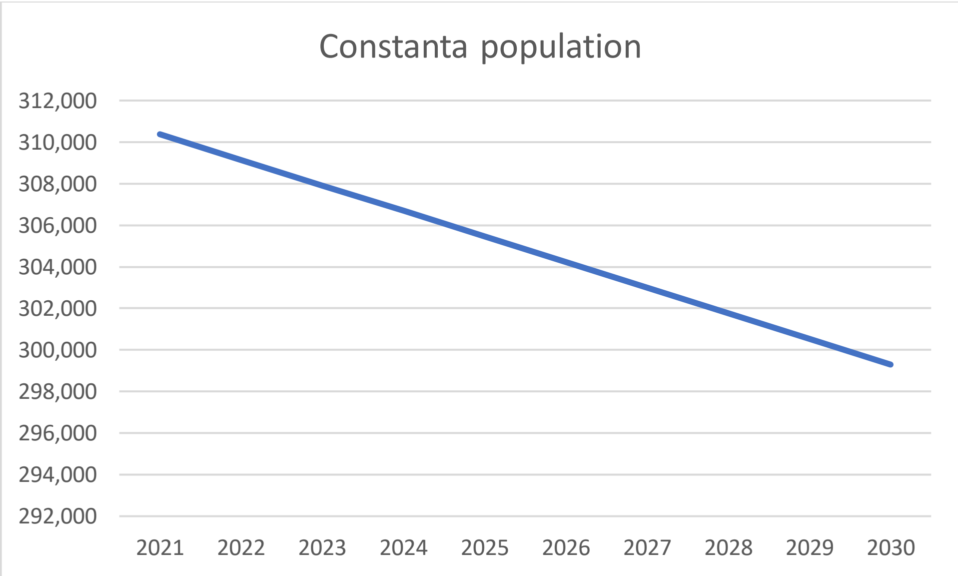


Figure 65. Population projection

By analysing the demography of Constanta Metropolitan Area, we can observe that even at the national level there is a decline in the number of people, at Constanta Metropolitan Area level the number of inhabitants is constantly growing, this indicating that the area represents an attraction pole, especially for the youth population.

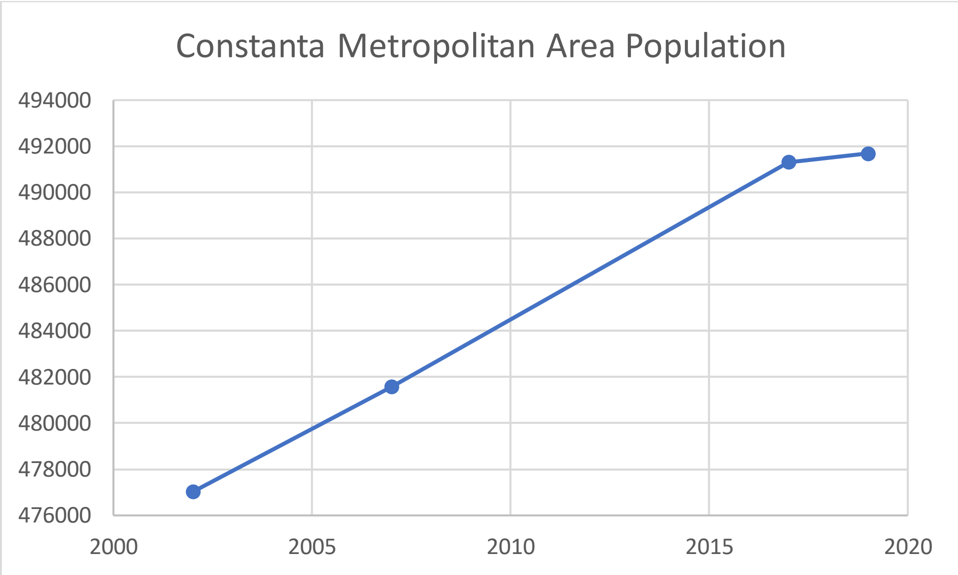


Figure 66. Past population change

Table 18. Past population change by area

Constanța Metropolitan Area Population				
Locality	**2002**	**2007**	**2017**	**2019**
CONSTANTA	**335425**	**328066**	**319266**	**316263 ↓**
EFORIE	9430	10113	11015	11037 ↑
MURFATLAR	11321	11678	11674	11606 ↑
NAVODARI	36594	38466	41375	41869 ↑
OVIDIU	13848	14731	15545	15705 ↑
TECHIRGHIOL	7145	7403	8025	8175 ↑
23 AUGUST	5191	5390	5711	5753 ↑
AGIGEA	5124	6076	7766	8089 ↑
CORBU	4846	5742	6261	6313 ↑
COSTINESTI	2638	2688	3157	3221 ↑
CUMPANA	9220	10693	13872	14562 ↑
LUMINA	6800	8396	10351	10816 ↑
MIHAIL KOGALNICEANU	10028	10176	10343	10239 ↑
POARTA ALBA	4805	5133	5583	5711 ↑

TUZLA	5916	6497	7095	7170 ↑
VALU LUI TRAIAN	8693	10320	14267	15163 ↑
Total	**477024**	**481568**	**491306**	**491692** ↑

An aspect that it is worth mentioning is that starting with the year 2000 a migration trend occurred and people from Constanta City started to move towards the neighbouring localities, especially to Agigea, Valu lui Traian, Cumpana or Ovidiu localities. In a very short period of time some of these localities almost doubled and sometime tripled their population, this generated a series of transformations in their profile, thus from units with predominantly rural specificity becoming small towns, with the status of districts of Constanta City and developing their residential function. This also creates additional pressure on the road and street infrastructure due to the need of commuting from these area to Constanta where most jobs, public institutions, educational, medical and leisure facilities are located.

Alongside this decrease in population there can be observed an ageing trend of the population, this will have a direct impact on the labour market and on the mobility needs and habits of the population. Thus, the infrastructure needs to be adapted to the needs of people with reduced mobility.

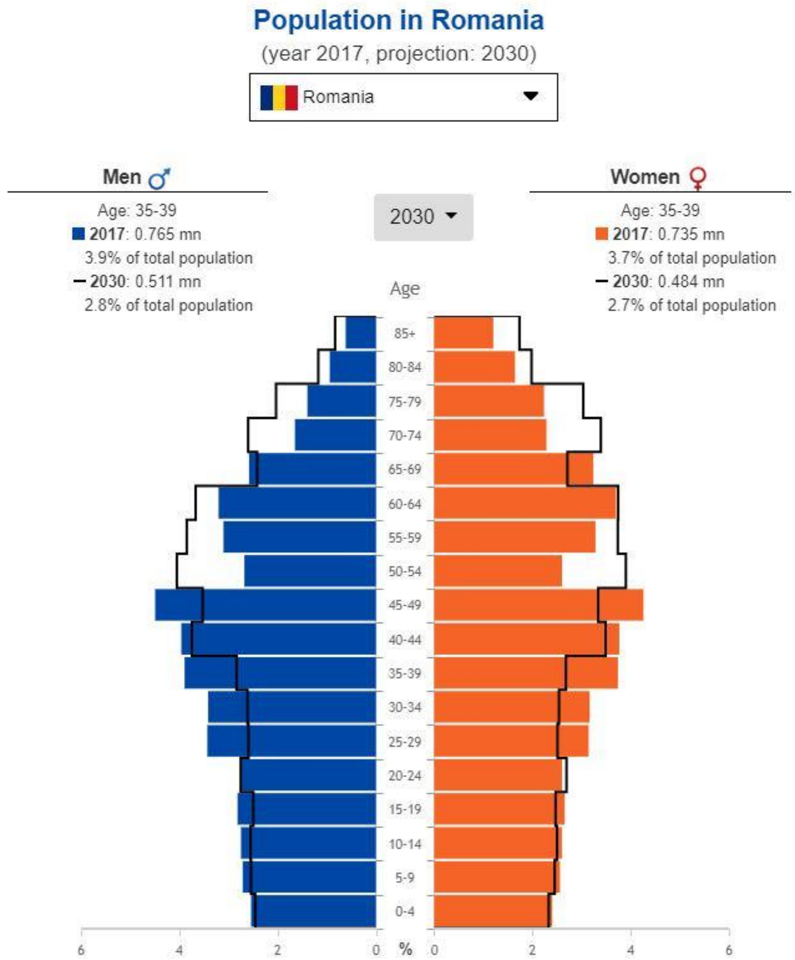


Figure 67. Demographic composition, Romania

The current analysis found in SUMP (with details for year 2015), reveals that 80% of trips are under 30 minutes in duration, which is consistent with the proportion of trips which are made solely within Constanta (internal – internal), with a modal split represented in the figure below:

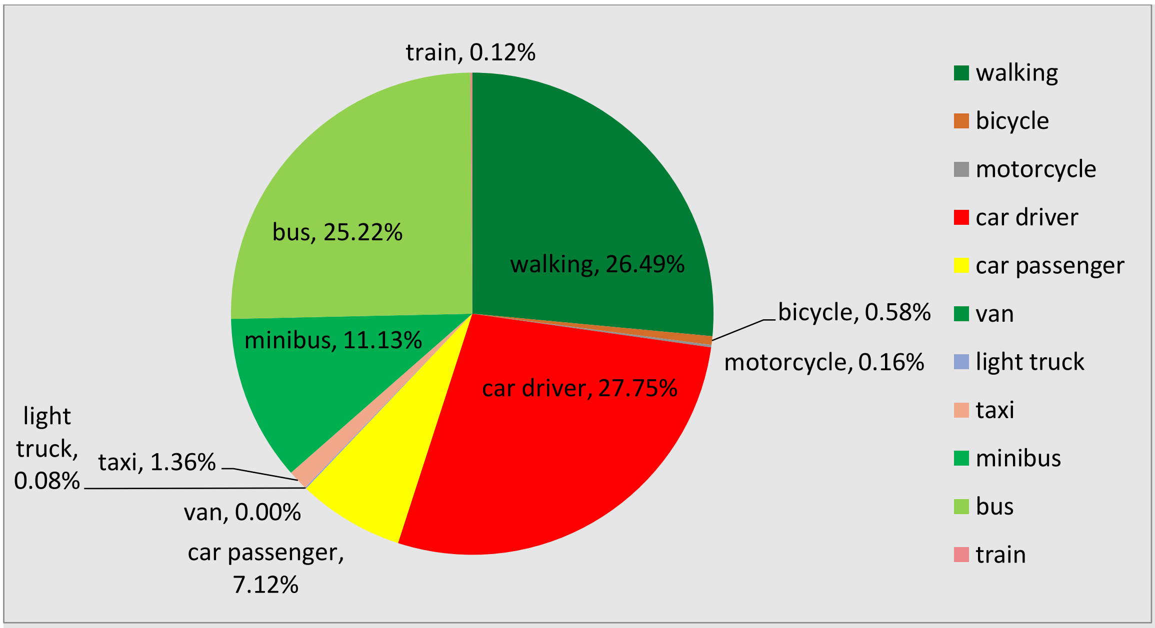


Figure 68. Modal split, Bucharest, 2015

We may conclude that with the passage of years, and the population aging (along, of course with the migration in other areas around Constanta city), the lengths of the trips will increase for the same purposes of travel. The modal split will heavily depend on the measures that will be implemented, also considering other developments in the area: residential areas, shopping or industrial developments. But it is foreseen that, in the lack of means to promote alternative modes of transport, the private car will increase in weight as there will be longer routes to be considered.

Labour market perspectives

The labour market will suffer some significant changes in the near future. In the report "Socio – economical analyse of the Occupation field"[7], published by the Romanian Ministry of Labour, there are identified two types of factors affecting the future development of the labour market. On one hand, there are the structural factors like the ageing structure of the fit to work population, the big weight of the inactive population in the total population, an unbalanced distribution of active population on economical branches and sectors, a high level of segmentation of the labour market.

On the other hand, there are disruptive factors that will shape the future of labour market like:

- **Population ageing** this will lead to a drop in the local human resources. A consequence of this, which we can already see today in the HORECA industry, is the attraction of migrant working force, especially from Asia and less developed countries.

[7] https://mmuncii.ro/j33/images/Documente/MMPS/Rapoarte_si_studii_MMPS/DPOCM/Analiza_socio-econonmica_domeniul_ocupare_2014-2020FazaIII.pdf

- **Labour force mobility (migration)** that can lead to depopulation of certain areas. The South – East Region is one of the leading regions in Romania from this point of view, most people migrating towards more developed countries from Europe.
- **Digital transformation and automatization** that will lead to the emergence of new markets and jobs but will also lead to net loss of working places in the markets that are affected by these factors, and of course new jobs in different more specialised markets. For sure these factors will also change the future employees that will have more independence, responsibility, creativity, technological knowledge, mathematical abilities, innovation and communication abilities (at distance and multicultural).

In the graphic below we can see the future occupations in Romania at the horizon of the year 2030.

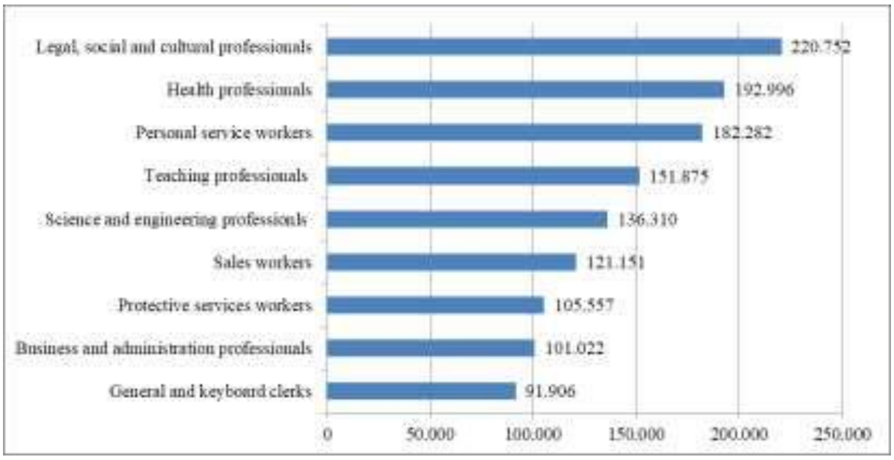


Figure 69. Future occupation in Romania, 2030 horizon (Source: cedefop)

Another aspect that will shape the future labour market with direct connection to the future mobility in the City is teleworking.

Telework is defined in the national legislation as “the form of work through which the employee, regularly and voluntarily, fulfils his attributions specific to the position, occupation or profession he holds, in another place than the work organized by the employer, at least one day a month, using information and communication technology”.

According to Eurostat, there are two types of telework at European level: people who usually work from home and people who occasionally work from home. Thus, for the first category, a percentage of 5% was registered, which has remained constant in past years.

However, in 2017 Romania was on the second last place in the European Union, with 0.4% of employees using the teleworking system, while in Western European countries the percentage was much higher (Netherlands 13.7%, Luxembourg 12.7%, Finland 12.3%).

In Romania, until 2018 there was no legislation implemented for the use of the teleworking system, this being one of the main reasons why the vast majority of employers (public and private entities) did not have the legal possibility to allow employees to use this type of work.

Teleworking is becoming more and more used by employers and employees as an alternative for working in the grounds of the employer. The system has advantages and disadvantages, but on the long run, market studies of the most successful companies showed that around 85% of them are allowing their employees to work remote, as long as the job is done.

Although at European level the average of teleworking, during the COVID 19 pandemic, is around 34%, in Romania the system is not used as it should. The percentage of people working remote was below 2% before the 2019 COVID 19 pandemics and it increased to approximately 18% during the pandemic period, with low desire to continue after this period.

More companies understood the utility and efficiency of the system and are looking to adopt it even after the pandemics restrictions. The national Government is also supporting this system with different incentives for private companies willing to take it further.

In this respect considering the technological development and also efficacy of teleworking we consider that this will be an important game changer for future mobility – reducing peak period commuting volumes.

Car ownership forecast

As we can see from the graph below the car ownership is increasing in Constanta county in the next years, this will put a pressure on the street and parking infrastructure.

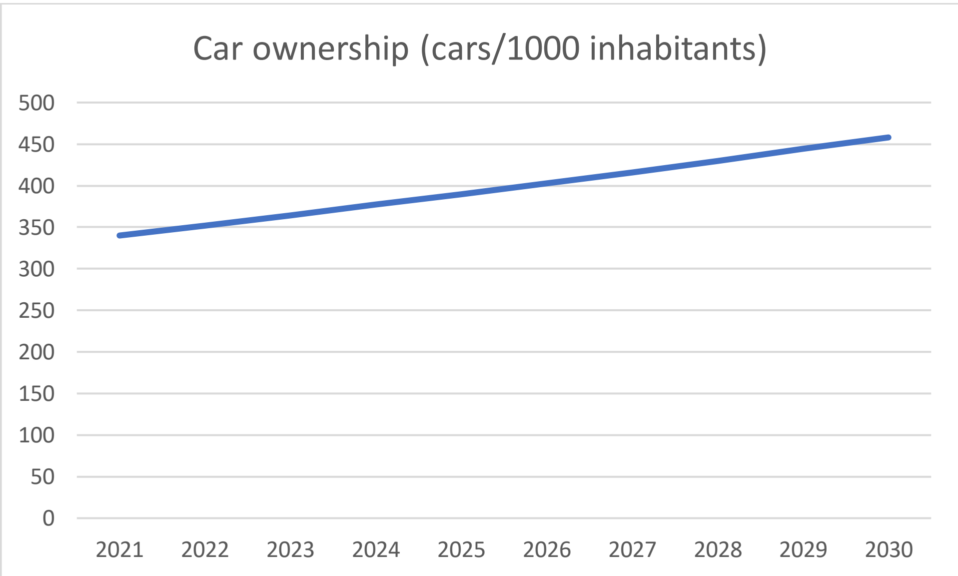


Figure 70. Car Ownership Projection

The increase in car ownership is mainly due to the increase in people income (see graph below) and the national policies regarding the car ownership taxations and also due to European policy regarding the import of second-hand cars.

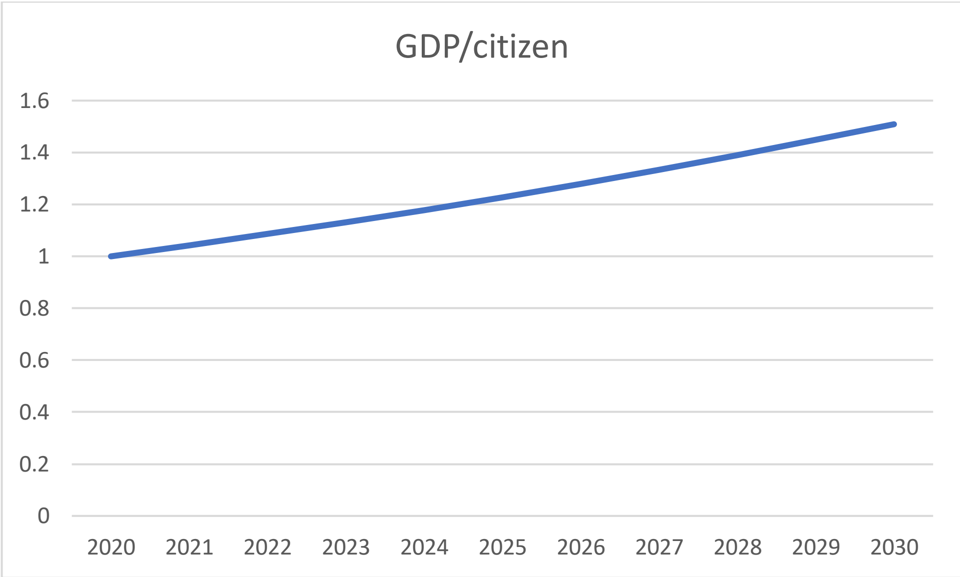


Figure 71. GDP Projection

Future land use development

In order to understand how the MORE impact area will look in the future from the perspective of land use, we analysed the Zonal Urban Planning documents that promotes large scale developments. In this respect, as we can see from the picture below, there are 2 major land use development proposed in the analysed area. These developments are looking to create 2 new neighbourhoods in the area with residential, commercial, educational and leisure functions. The necessary street infrastructure will also be provided through these investments and also the connection to the City street infrastructure.

These investments, will bring changes not only in the density of people living in the MORE Wider Impact Area, but will also bring new jobs and a set of new activities.

All these land use development will put additional pressure on the street network and considering that there are not too many alternative to the More Feeder Route, if not managed consistently can lead to congestion and all its negative effects.

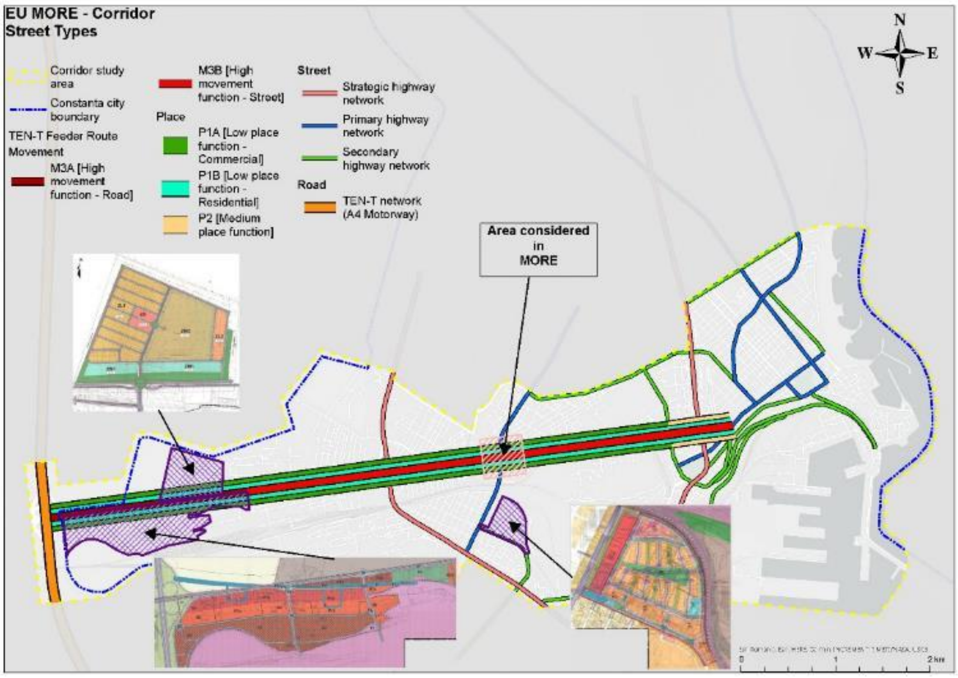


Figure 72. Feeder Route and section under stress

From the data collected in the year 2020 it resulted that the modal split changed in favour of private vehicles, as shown in the figure below:

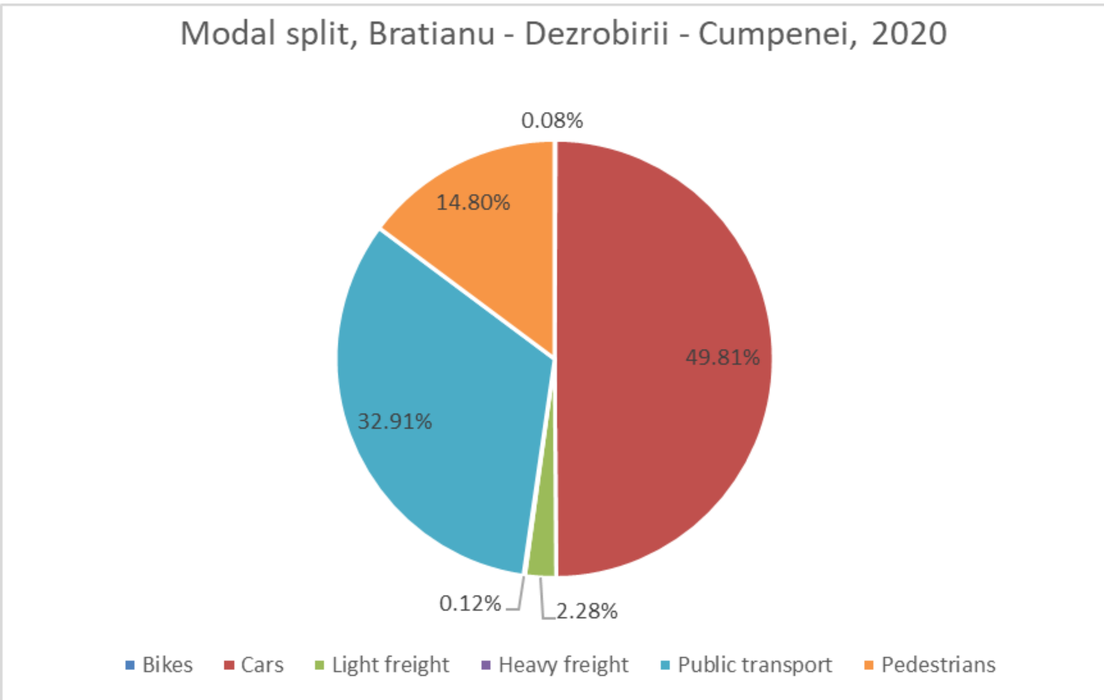


Figure 73. Modal split, Bratianu – Dezrobirii – Cumpenei, 2020

Considering the natural growth seen in the last 5 years to continue as it was, we may conclude that future demand in the year 2030 will look like this:

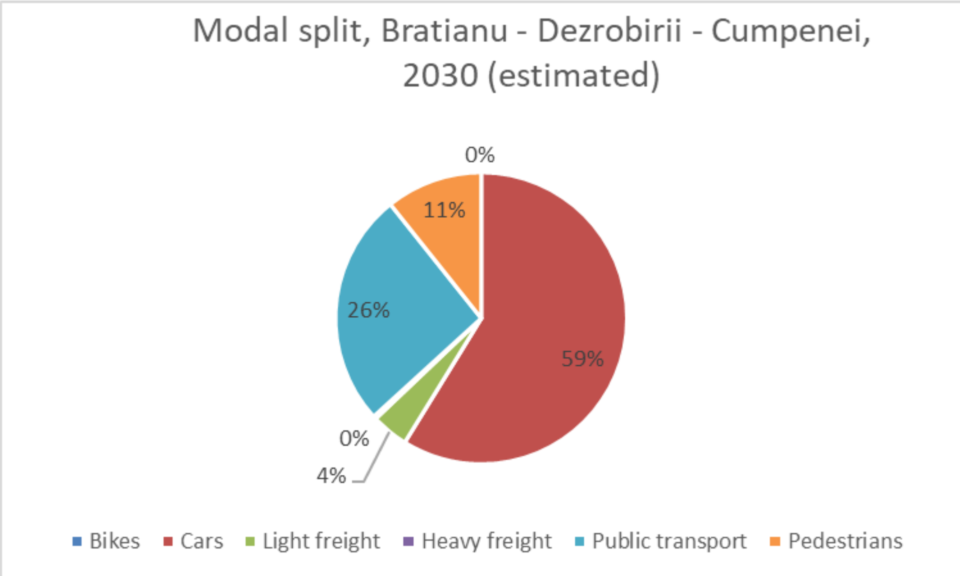


Figure 74. Modal split, Bratianu – Dezrobirii – Cumpenei, 2030 projection

3.3 Future patterns of demand in the Wider Impact Area and along the Feeder Route

Scenario Development

The City overall development vision is considering Constanta as an expanding European metropolis, growth pole and touristic area, with a solid and competitive economy and a living high level standard for all it's inhabitants.

The SUMP vision is to achieve a sustainable, safe, integrated and accessible to all transport system, connecting people and places, supporting economy, environment and quality of life, in the Constanta Growth Pole.

Starting from these two complementary visions we defined the main elements of the visions, respectively: increased accessibility; improved safety and security; better environment; increased economic efficiency; and enhanced quality of urban environment.
Afterwards, we tried to identify which factors can influence this desired vision at the Feeder Route level by taking into consideration all the elements of the vision and the factors in the contextual and transactional environment, as presented in the table below.

We used the following rating system for considering the factors in the contextual environment: Largest potential impact = +; Weak potential impact = -: High uncertainty = 0; Low uncertainty = X.

Table 19. City Mobility Vision

City mobility vision contextual and transactional environment		
	Contextual	Transactional
Non-technological	Geopolitics **(+/0)** Politics (+/0) European Union and National policies (+/X) European and National legislation (+/X) Demographics (+/0) Tourism (-/0) Social values/behaviour (+/0) Economic growth (+/0) Trade (-/0) Labour market (-/0) Environment (+/0) Health (+/0) Culture (+/0) Education (+/0) Land use development (+/0)	User groups Residents Tourists Media Academics NGOs Local politicians Developers
Transport	Car ownership (+/0) Micro-mobility (+/X) E-vehicles (+/0) Shared vehicles (+/X)	Public transport operators SUM Infrastructure (+/X) Integrated Metropolitan Transport SUM policies and regulation (Parking, access restriction…) (+/X)
Technological	Teleworking (+/0) MaaS (+/0) Teleservices (E-commerce) (+/0)	Traffic Management system (+/X) Data gathering Information provision Simulation

After considering all these elements we used the deductive method for building scenarios and we took into consideration the two major objectives proposed by the City visions, respectively environment and economic growth. And come with the following four scenarios:

- **Scenario 0 –** ‘Declining, car-oriented city – is a worst-case scenario considering that the City will develop in a frantic way without considering the environment and not achieving economic growth, which will lead to its attractiveness lose.
- **Scenario 1 – Sustainable City** – was constructed taken into consideration a considerable increase in the promotion and implementation of environment policies at the expense of the economic growth of the City.
- **Scenario 2 –** Pro-growth, car-oriented city’– was constructed taken into consideration an increase in the economic growth of the City without considering the need to diminish the negative impact on environment.
- **Scenario 3 – Resilient City** – was constructed as a balanced scenario that is considering the both the environment and is supporting the economic growth of the City.

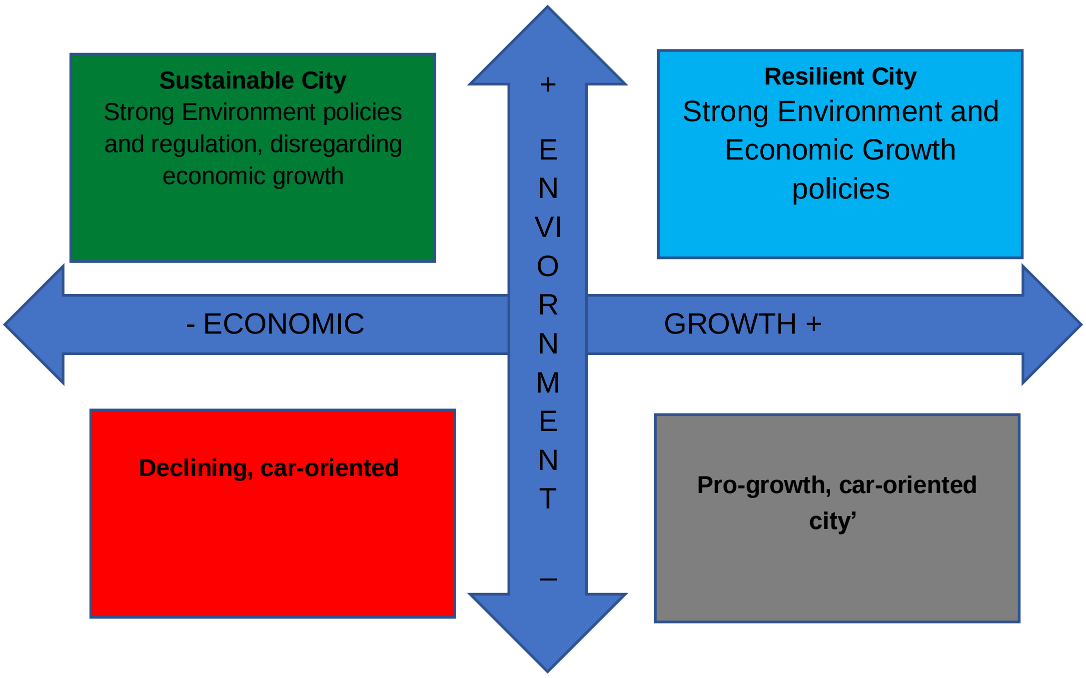


Figure 75. Visualisation of the four scenarios set against strategic priorities

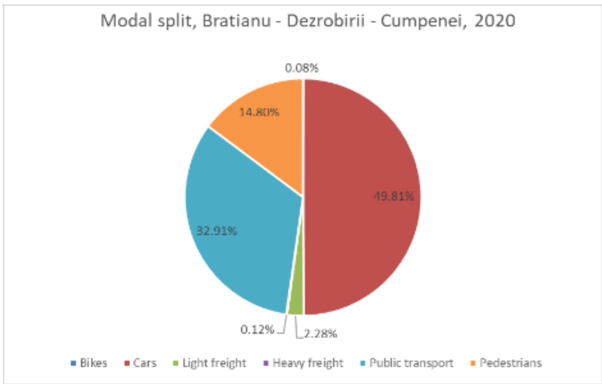
Scenario 0 – Declining, car-oriented
In this scenario the City will suffer from bad environment and negative economic growth. The population will decrease and will follow the actual trend of ageing and migration, especially to the neighbouring localities.

The European, National and local policies will disregard both the environment and the economic growth. Thus, the economy will suffer and the GDP per capita will decrease leading to less businesses and jobs.

People will not change their social behaviour, especially regarding the use of personal vehicles, they will have a car centric behaviour, leading to an increase in the car ownership and a waste of public space.

There will be an increase in the GHG and CO2 emissions leading to a bad environment and slowly to the City will lose its attractiveness as a tourism destination.

In this case, we can envisage that the current trend will continue. The total traffic volume will increase by 27%. The private car share is foreseen to grow from 49,81% (in the year 2020) to 58.79% (in the year 2030), while the public transport will decrease from 32,91% to 26,04%. The modal share will change like this:



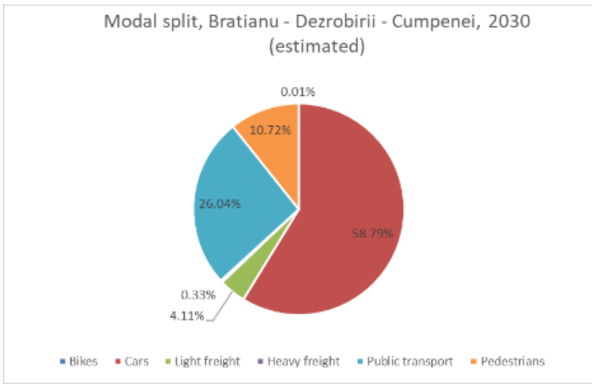


Figure 76. Scenario 0 - Modal split projected changes 2020-2030

Scenario 1 – Sustainable City

In this scenario we considered that the City will have a good quality of the environment but will not support economic growth.

Demographic change will follow the foreseen trend, due to good environment people will be healthier and live longer. Clean environment will also attract more old people to come and live in the City. These factors will then lead to an ageing population.
Tourism will increase and will attract more people from the elder generation and due to its seasonality will not support the economy of the City.

Environmental policies will be largely introduced and enforced in the City but will affect the local business that cannot adapt to the new rules imposed.

The City will succeed in providing the infrastructure for alternative travel modes and due to the taxation on pollution (differentiated parking prices, vehicle access regulation, pollution taxes on cars etc.) people will tend to use more sustainable travel modes (public transport, bicycle, walking) that will lead to a decrease in car ownership and a supplementary pressure on the public transport service.

In scenario 1, we can envisage that the modal split will shift towards public transport. The total traffic volume will increase by 22%, to accommodate the new travel demand. Considering that the public transport will increase in attractiveness, the total traffic increase will not be the same as for Scenario 0 (having in mind the capacity of public transport vehicles). The private car share is foreseen to shrink from 49,81% (in the year 2020) to 46.59% (in the year 2030), while the public transport will increase from 32,91% to 37,24%. The modal share will change like this:

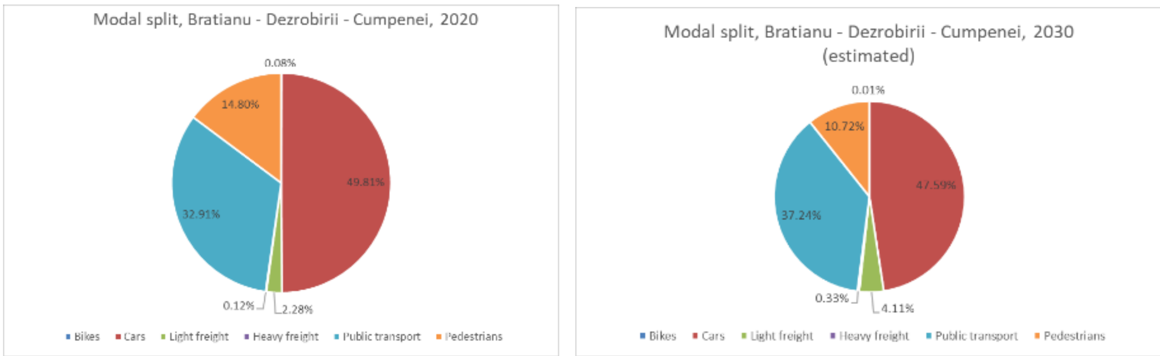


Figure 77. Scenario 1 - Modal split projected changes 2020-2030

Scenario 2 – Pro-growth, car-oriented city'

The City will support the economic growth disregarding the environmental policies.
The economy of the City will improve thus leading to more business and jobs, this will attract more people in the City, which will lead to an increase in population due to the new opportunities arisen.

Digitalisation will be embedded in all the economic activities, including in the public sector and will support the economic growth.

More economic opportunities will lead to an increase in people income and due to the lack of taxation of polluting vehicles the number of cars will continue to grow.
People will not change their mobility behaviour and will continue to have a car centric behaviour.

Scenario 2 foresee an increase in economic activity, hence an increase in mobility needs. The increase will be seen in freight vehicles, but also in private car usage, as there will be no restrictions for these. However, the junction that we analyse will probably reach its maximum capacity, hence forcing some travellers to reconsider the transport mode (or route choice). Also, the municipality will have to implement some measures to address the congestions in the area. Therefore, we foresee an increase in total traffic volume, but somehow limited to the capacity of the area. The estimated increase will be by 29%. The private car share is foreseen to grow from 49,81% (in the year 2020) to 56.97% (in the year 2030), the freight vehicles will increase from 0,09% to 7.46%, while the public transport will decrease from 32,91% to 27,31%. The modal share will change like this:

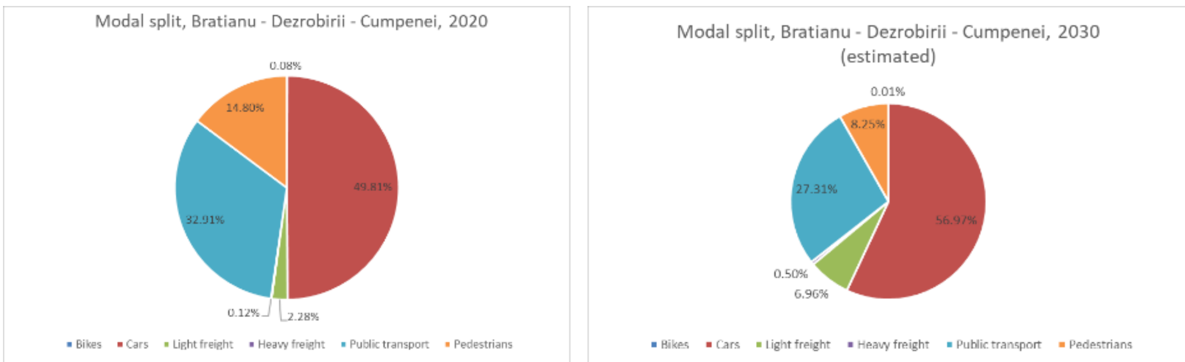


Figure 78. Scenario 2 - Modal split projected changes 2020-2030

Scenario 3 – Resilient City

The City promotes both environmental and economic growth policies, with special focus on innovation and digital transformation. The business sector is very diverse and dynamic providing the necessary framework for people to have good access to jobs, education and training and preformat services.

The population is thriving and the City is capable of attracting young people due to the improved educational system and due to the increased number of jobs.

The social and cultural behaviour of people will be completely changed and focused on economic and energy efficiency and more aware of the benefices of a clean environment. Thus people will have a sharing mentality and will use more clean transport modes.

The need for travel in order to obtain different goods or services will decrease due to good internet connectivity and Digitalisation. Teleworking will be fully implemented in the proper sectors of economy.

In scenario 4, we can envisage that the modal split will shift towards public transport. The total traffic volume will increase by 20%. The private car share is foreseen to shrink from 49,81% (in the year 2020) to 44.39% (in the year 2030), while the public transport will increase from 32,91% to 40,21%. There will also be an increase in bikes usage. The modal share will change like this:

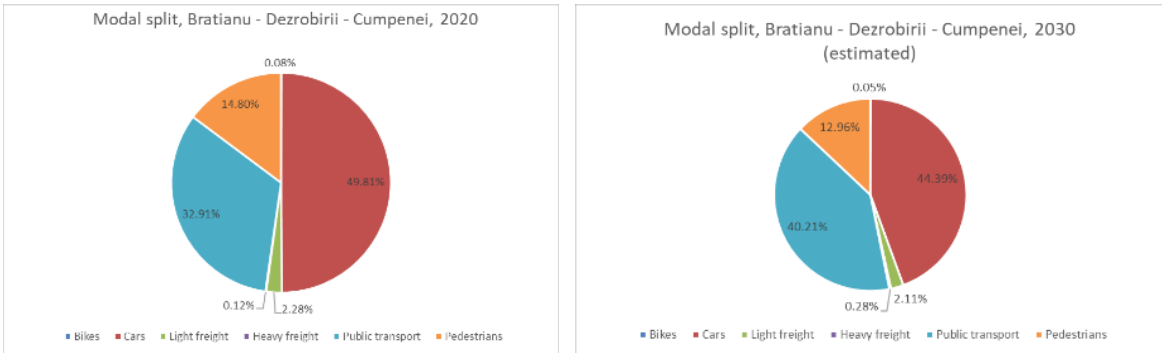


Figure 79. Scenario 3 - Modal split projected changes 2020-2030

Table 20. Key Performance Indicators

	Accessibility	Safe and Secure	Environment	Economic efficiency		Quality of urban environment		
Indicators	Private vehicle Kilometres by road vehicles	Reduction in (pedestrian) accidents	Reduction in CO2 Emissions	Journey Time by private vehicles	Journey Time by public vehicles	PT mode share	Walking mode share	Cycling mode share
Target	To decrease	To reduce	To maintain / to reduce	To maintain	To reduce (by 15%)	To increase	To maintain	To increase
Business as Usual	Private Vehicle AM peak: 286,943 vkms PM peak: 255,621 vkms	226 of pedestrian injury accidents	Current CO2 emissions for the Growth Pole are at 1261kg per capita per annum	Average journey time by private vehicle users during the AM and PM peak hours is 17.8 min and 16.1 min minutes.	Average journey time by all public transport modes during the AM and PM peak hours is 33.3 min and 34.0 min	Total public transport modal share during the AM and PM peak hours is currently 32.4% and 31.2 %	It is estimated that for the AM and PM peak hours 21.9% and 17.3 % of trips are undertaken by walking	It is estimated that during the AM and PM peak hours 1.2% and 2.0% of trips are undertaken by cycling
Declining, car-oriented	--	--	--	+	+	+	-	-
Environmental City	++	+	++	--	++	+	++	+
Pro-growth, car-oriented city’	--	-	--	++	++	-	-	-
Resilient City	++	++	++	-	++	++	++	++

Significant improvement = ++

Neutral = 0

Significant deterioration = --

3.4 Future Conditions on the Stress under Section

Expected characteristics

The Stress Section will suffer some significant changes in the future due to the new land use development foreseen (see Chapter 3.2) and due to the intention the city has to modernise the area.

Regarding the new land use developments, a new neighbourhood will emerge near the Stress Area on a surface of around 17 ha. In this new built up area there will be developed new collective housing buildings, new commercial and services business, and new education and leisure facilities.

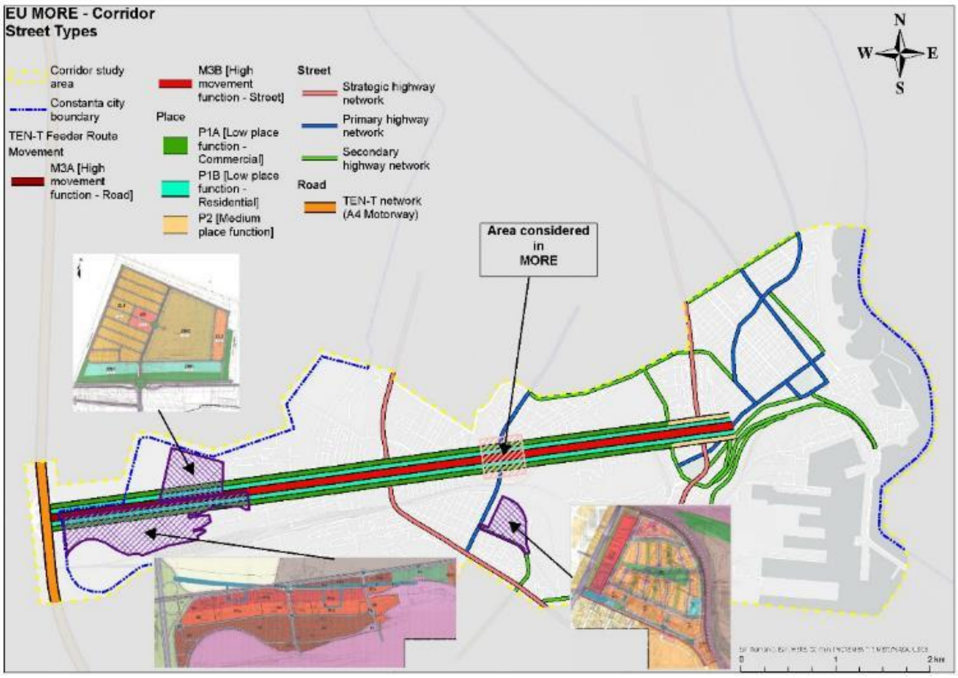


Figure 80. Future Land Use

A considerable number of people will be attracted in this area, considering the proposed designs, we assume the new neighbourhood will have around 3000 inhabitants. This development will create a supplementary pressure on the street network especially in peak hours even if we will consider only the number of new inhabitants and not taking into account the number of travels resulted from the other activities in the area.

The City has also plans for the modernisation of I.C. Bratianu Boulevard (the Feeder Route) and to transform it completely into a sustainable street with bus lanes, cycle paths and improved sidewalks. The public lighting and green spaces will also be modernized and the Feeder route will be equipped with SMART bus stations and urban furniture, including the infrastructure for EV charging.

3.5 Design brief for Future Conditions

The designs objectives for Future Conditions in the Stress Area should take into consideration the high level and operational objectives of the SUMP, respectively:

Table 21. Design Objectives for Future Conditions

High Level Objectives	Operational Objectives
1. **ACCESSIBILITY** – Ensure all citizens are offered transport options that enable access to key destinations and services	- Increase number of people with good access to public transport services to major attractors - Increase the percentage of fully accessible public transport vehicles - Reduce bus journey times along key corridors of the highway network - Increase frequency of bus services - Increase density of the cycle network - Increase accessibility for pedestrians (quality of surface, crossings and obstructions) - Reduce the number of vehicles searching for a car parking space - Increase engagement with socially excluded groups
2. **SAFETY AND SECURITY**	- Reduce fatal and serious accidents - Improve pedestrian safety - Increase the awareness level on safety and security issues - Reduce the number of inappropriately parked vehicles
3. **ENVIRONMENT** – Reduce air and noise pollution, greenhouse gas emissions and energy consumption	- Reduce CO, NOx, VOCs, PM10 and CO2 emissions - Reduce noise and vibration levels - No net loss of biodiversity. Improve biodiversity where possible - No reduction in site integrity of Natura 2000 sites - Net reduction in risk of water and ground pollution through the design of new infrastructure - Reduce material use and waste production - Increase percentage of environmentally friendly vehicles
4. **ECONOMIC EFFICIENCY** – Improve the efficiency and cost-effectiveness of the transportation of persons and goods	- Increase pedestrian area - Increase the awareness level on alternative modes of transport - Increase non-car mode share - Reduction of journey time - Minimise congestion - Reduce vehicle operating costs (maintenance)
5. **QUALITY OF URBAN ENVIRONMENT** - Contribute to enhancing the attractiveness and quality of the urban environment and urban design for the benefits of citizens, the	- Rebalance the use of highway space to reduce dominance by private car - Protect and enhance cultural heritage - Increase the sustainable mobility awareness level

economy and society as a whole	

These objectives must be embedded in the design options for Future Stress Section and must put people first when considering new designs for the area.

Table 22. People-orientated provisions for different user groups

Users	Provisions
Pedestrians	- convenient sidewalks (widths, barriers and surface) - increase the number of crossings - clear wayfinding - street furniture - green spaces, including for shade - public lighting - adapting the infrastructure to the needs of people with reduce mobility, especially for people with disabilities - reduce the noise and pollution, including the provision of environment information - increased enforcement of the law
Public transport	- increase the PT frequency, including by introducing bus lanes on the Feeder Route and priority in traffic (traffic management system) - clean and energy efficiency fleet - improve the bus stations (seating and roofing) - providing information (information panels and mobile application) - increase Bus stops accessibility, especially by improving the sidewalk infrastructure - accessible taxi ranks - clean taxi vehicles
Cycling and Micro-mobility	- dedicated infrastructure - proper pavements - lighting - proper street signals and road markings - safe parking - renting places
Cars	- Reduce speed - Clear road markings and signs - Create infrastructure for recharging EV - Traffic management system - Vehicle speed detection - Better enforcement

The measures proposed to be tested in Vissim are the following:

Scenario 0 (Sc0) - Car-oriented city [lower traffic volumes: peak and off-peak)] & Scenario 2 (Sc2) - Pro-growth, car-oriented [higher traffic volumes: peak and off-peak]

DO1Sc0: Construct a flyover, north-south (more space to do that in this direction, than east-west)

DO1Sc2: Construct a flyover, north-south (more space to do that in this direction, than east-west); Increase parking and loading provision

DO2Sc0: Signalise the existing roundabout; add pedestrian phase

DO2Sc2: Signalise the existing roundabout; provide pedestrian subways or overbridges; Increase parking and loading provision

DO3Sc0: Remove roundabout and create a signalised junction at a cross roads; add pedestrian phase

DO3Sc2: Remove roundabout and create a signalised junction at a cross roads; provide pedestrian subways or overbridges; Increase parking and loading provision

Scenario 1 (Sc1) - Sustainable city & Scenario 3 (Sc3) - Resilient City

DO4Sc1: Signalise the existing roundabout; add pedestrian phase; introduce public transport and cycle lanes; implement bike sharing points instead of private car parking places; move bus stops close to junction

DO4Sc3: Signalise the existing roundabout; add pedestrian phase; introduce public transport and cycle lanes; Implement bike sharing points instead of private car parking places; move bus stops close to junction

DO5Sc1: Replace roundabout with signalised junction, with pedestrian phase; move bus stops close to junction; reduce overall number of traffic lanes; use the space reclaimed from the carriageway and junction area to provide new civic buildings and green public spaces

DO5Sc3: Replace roundabout with signalised junction, with pedestrian phase; move bus stops close to junction; reduce overall number of traffic lanes; use the space reclaimed from the carriageway and junction area to provide new civic buildings and green public spaces

Also, to make relevant data comparison, we envisage to make the following evaluations:

- Peak vs Off-peak
- Sc0 vs Sc2; or Sc1 vs Sc2 movement levels

4 MALMO - Design Methodology for future conditions

4.1 Summary of current conditions along the Feeder Route

4.1.1 Background

The corridor chosen as the study area stretches from the inner city of Malmö, adjacent to Malmö central station and the University in a north-easterly direction towards the highway and functional TEN-T link of E6/E20. The TEN-T corridor stretches along the outer ring of the city. There are nine intersections in total where the TEN-T corridor connects with city streets network of Malmö.

Figure 81. Study area (green) and its relation to the main TEN-T network corridors in Malmö (pink)

The study area is defined by the feeder route of Västkustvägen together with adjacent roads and streets, connecting the northern parts of the inner city, with the TEN-T corridor. The feeder route is one of three from the north connecting the city of Malmö.

The corridor has been defined and classified into segments using the Movement and Place Typology (Transport for London). The segments have been divided up into nine parts, each representing different mobility and place functions.

4.1.2 Feeder route characteristics

The feeder route characteristics were addressed in D5.1. An overview of the feeder route segments is presented below.

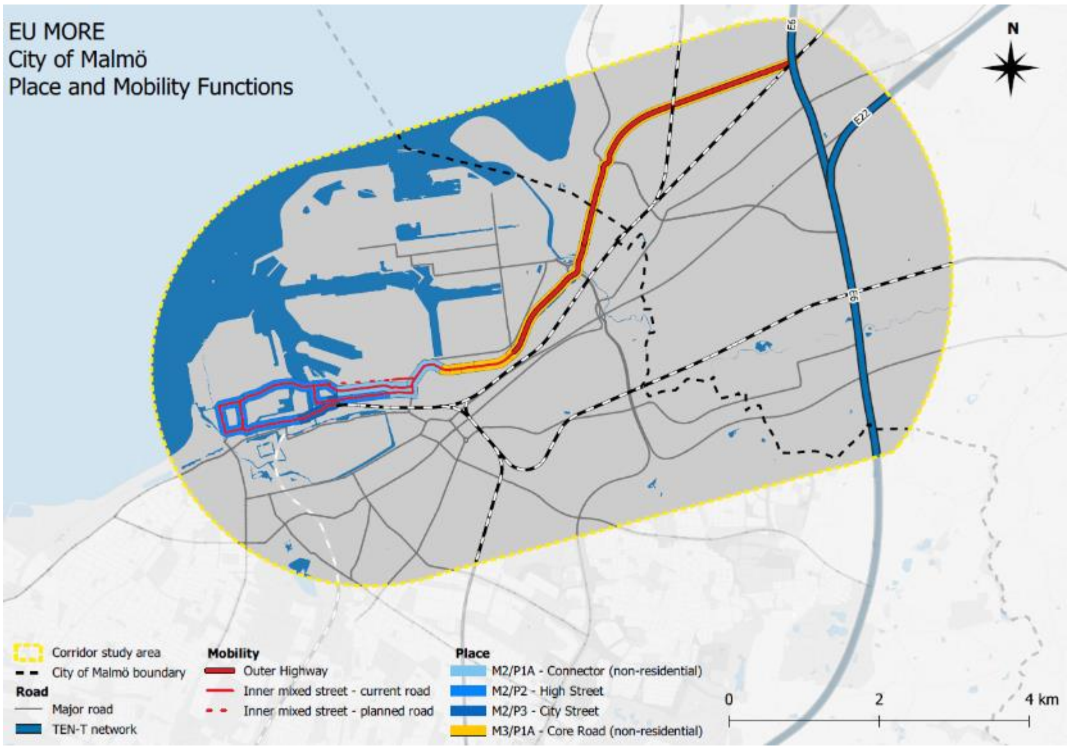


Figure 82. Corridor definitions

Table 23. Corridor definition table

Segment name and number		Segment type	Characteristics	Intersections
1	**Arlöv ring**	M3A / P1A	Controlled-access highway, 110 km/h	No street level intersections
2	**Arlöv - Spillepengen**	M3A / P1A	Mainly controlled-access highway, 70 km/h	One signalled intersection
3	**Spillepengen - Sjölundaviadukten**	M3A / P1A	Mainly controlled-access highway, 70 km/h, bicycle lane	One intersection without signalling
4	**Sjölundaviadukten - Frihamnsviadukten**	M3A / P1A	Mainly controlled-access highway, 70 km/h, bicycle lane	One intersection without signalling
5	**Frihamnsviadukten**	M2 / P1A	Major road, connector, 50 km/h	Multiple signalled
6	**Jörgen Kocksgatan**	M2 / P1A	Major road, connector, 40 km/h	Multiple, no signals
7	**Hans Michelsensgatan**	M2 / P2	Major road, connector, 40 km/h, moderate place character	Multiple, no signals
8	**Carlsgatan**	M2 / P2	Major road, connector, 40 km/h, moderate place character	Multiple, no signals

9	**Malmö C**	M3B / P3	Major street, 40 km/h, high mobility, central station	Multiple, signalled

4.1.3 Current traffic flows and modal shares

The corridor, stretching from Universitetsbron in the central city, towards the European route 6, carries different amounts of traffic. The main traffic mode along the corridor is private motorised vehicles and the traffic intensity varies along the route. In the central city, the traffic flow along Hans Michelsensgatan and Carlsgatan are approximately 11 000 and 16 000 vehicles per day. By *Spillepengen*, by the municipal border, the traffic flow for the feeder route is approximately 21 000 vehicles.

Table 24. Traffic flow (motor-vehicles per average weekday) in different corridor sections

Index	Corridor section (today)	Traffic flow	Peak hour
1	Hans Michelsensgatan by Skeppsbron	11000	1200
2	Jörgen Kocksgatan by Navigationsgatan	15000	1600
3	Carlsgatan by Venusgatan	9000	1000
4	Carlsgatan by Frihamnsallén	16000	1800
5	Västkustvägen by Grimsbygatan	18000	1800
6	Västkustvägen by Spillepengen	21000	2400
7	Västkustägen by Hakegatan	19000	2100
8	Västkustvägen north of Malmövägen	13000	N/A

The corridor section with index 2 will be part of Hans Michelsensgatan in the future when the area of Nyhamnen is rebuilt, while Jörgen Kocksgatan will be more of a green street – prioritising pedestrians and bicyclists.

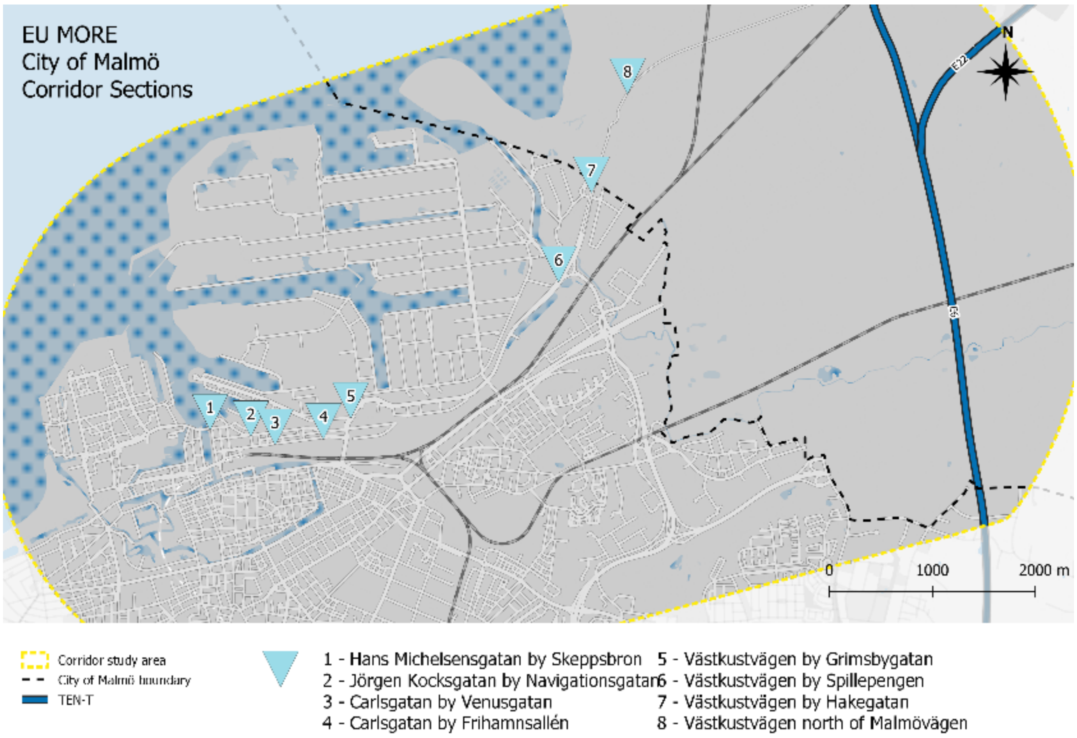


Figure 83. Overview of indexed corridor section along the feeder route.

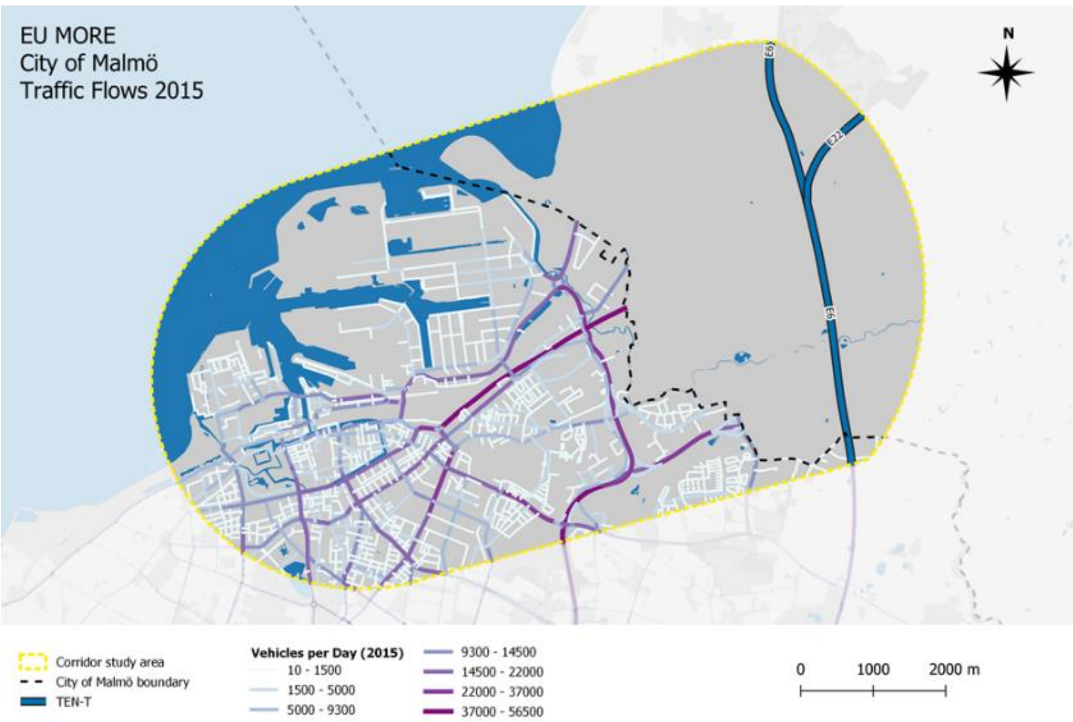


Figure 84. Estimated traffic flow in the wider impact area. Only Malmö street network included.

Figure 85. Bus traffic in the corridor. Different colours represent different bus routes

Table 25. Total heavy traffic by the intersection per average day at Hakegatan (north of Spillepengen)

Total number of heavy vehicles without a trailer	1700
Total number of heavy vehicles with a trailer	1500

The modal split for the city of Malmö is shown in the figure below. However, the commuting volumes to the Western harbour, that partly use the main feeder route travel by car by higher modal shares.

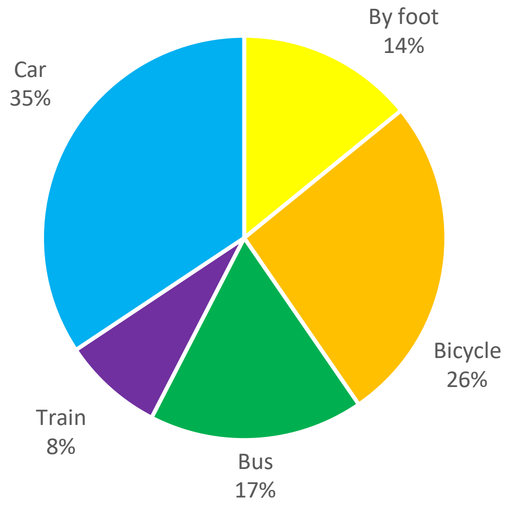


Figure 86. Modal split for transport in Malmö, whole municipality

The exact modal share for the feeder route corridor is dependent on the corridor definitions. Västkustvägen carries mainly cars. Buses and bicycles incorporate only a fraction of the total travel (< 5 %). However, by including the main railway, the modal shares changes to the benefit of rail travel, see the table below.

Table 26. Modal split for feeder route including railway

Car	Bicycle	Train	Bus
22 000	400	56 000	5 000
27 %	< 1 %	68 %	5 %

4.2 Future conditions in the Wider Impact Area

The extent of the wider impact area is represented in the Figure below. Its boundaries stretch from the sea in the north and 6 km south. The area is restricted by highway E6 in the east and includes Western Harbour in the west, respectively. The Wider Impact Area covers the most central parts of Malmö as well as the city's North Eastern suburbs.

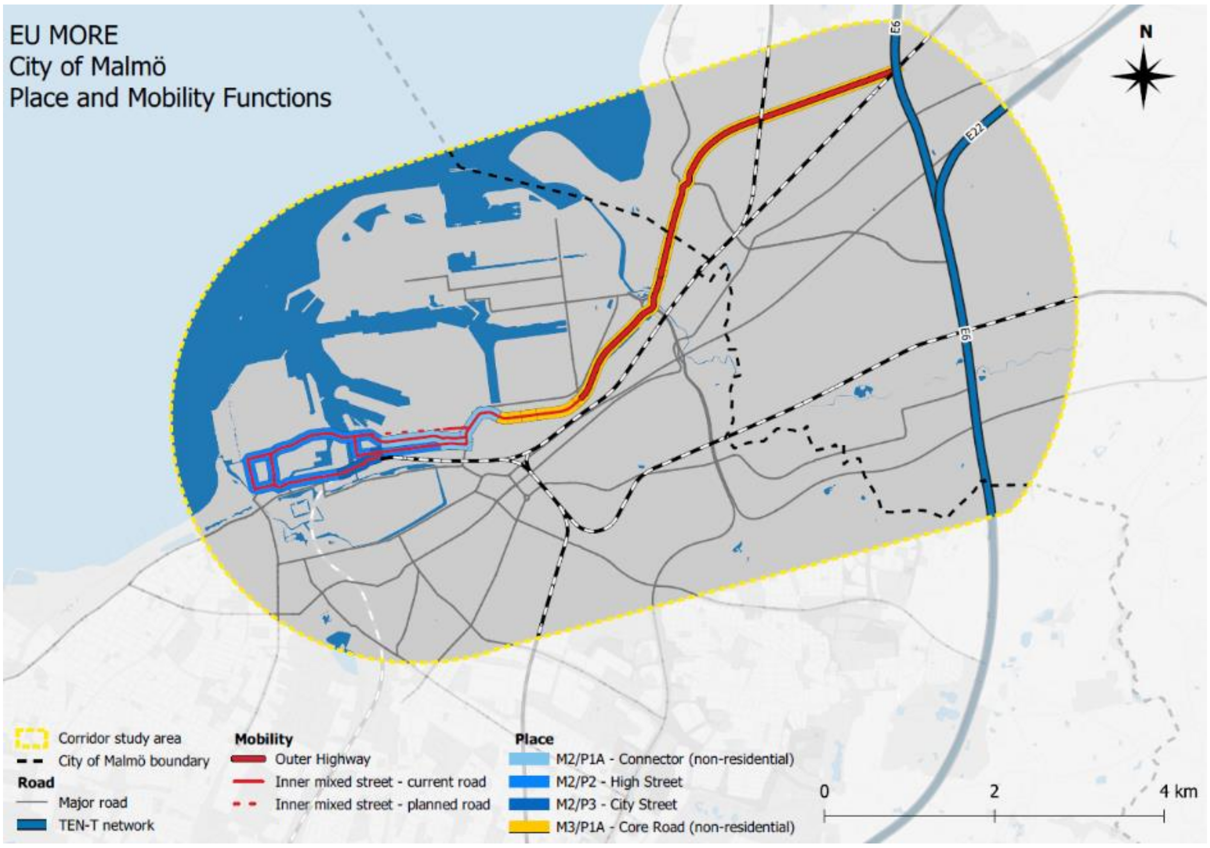


Figure 87. Wider Impact Area (WIA) is marked in dashed yellow.

4.2.1 Transport Supply of the Wider Impact Area

Over the next decade, Malmö will undergo changes of great magnitude. Apart from the development of Nyhamnen, the city will make investments in the project *Big city package*. The project includes redesigning several streets both in the central parts and outer parts of the city, improving the infrastructure for public transport. Four bus lines will have BRT-like (*Bus Rapid Transit*) standards and will be an addition to a current bus line with that standard. Apart from infrastructure investment, this means the development of almost 27 000 dwellings. The infrastructure and housing projects are to be completed by 2031 and 2035, respectively.

Another part in the densification of Malmö is that when Nyhamnen is ready, the city will continue to expand into Mellersta Hamnen, the area just east of Nyhamnen. This will likely put the transportation system around the feeder route and stress section, but also the wider impact area, under further pressure.

This chapter covers the future development of the transport supply in the wider impact area. However, to give a more complete picture of the situation, current conditions are integrated into the descriptions.

Street network

As most western cities, development of the transportation infrastructure in Malmö was car-focused since the mid-1900s. Adding to that, one of the first manufactured cars in Sweden was built in Malmö. Even though small by international measures, Malmö is today Sweden's third most populated city. This means that by Swedish standards, the city contains several heavily trafficked roads, including within the central parts.

The wider impact area (WIA) covers different types of city zones. The very east of the WIA covers suburban areas, fields and industries together with national highways. In the northern parts of the WIA lies the port area with a coarse street network mainly used by heavy traffic to access the different operations in the area. In the southern and western areas of the WIA, the street network has the characteristics of a larger western city, being narrow and highly trafficked. Some older parts of the city are non-accessible to motorised traffic.

As described in the summary of current conditions, Nyhamnen is today an industry-focused area that will undergo great development over the next decades. With the development of Nyhamnen and its increase in activities, businesses and residents, an increase in person movement capacity is necessary to cope with the new prerequisites.

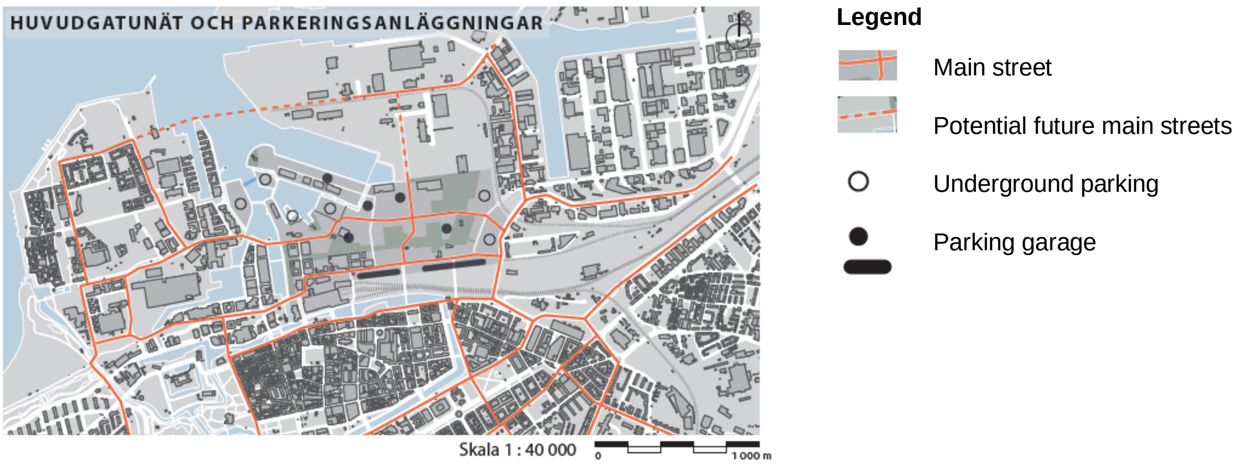


Figure 88. Future main street network of the W.I.A (Masterplan Nyhamnen, City of Malmö)

Within Nyhamnen, the Hans Michelsensgatan will be extended and rebuilt to the main street that connects Västra Hamnen with Västkustvägen. The street will prioritise accessibility and mobility with lanes for car, bus, bike and pedestrians on both sides of the street. At the same time, the street is planned to be green and liveable with room for shops, cafés and people. This is a part of the work the City of Malmö is doing with the development of urbanised main roads. Urbanised main roads must be designed in a way that contribute to reaching the goals of a changed modal split for the inhabitants and commuters, and to create a more accessible and attractive city. Taking a holistic approach, both regarding whole road stretches and streetscapes from façade to façade, is crucial for how well the transformation of existing main roads into urbanised main roads will succeed.

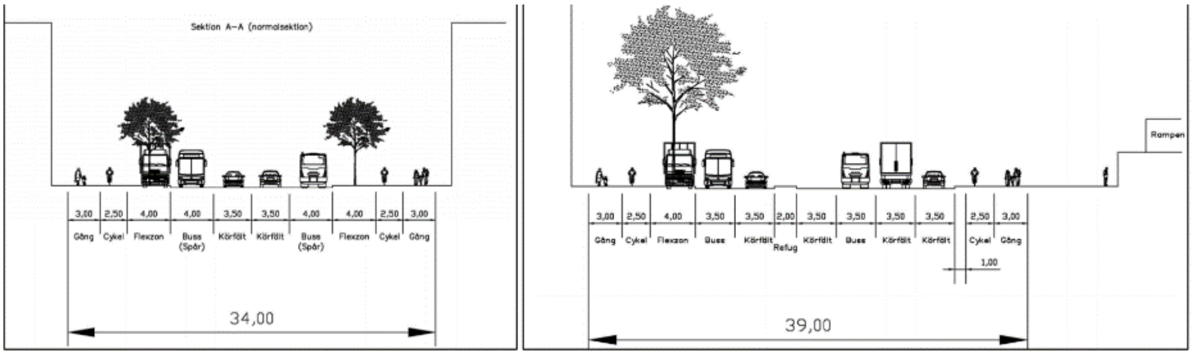


Figure 89. Suggestions for transport modes' future dedicated rooms on Hans Michelsensgatan. Standard section to the left, the section for larger crossings to the right. (Detailed development plan Smörkajen, City of Malmö).

Malmö has a high modal share of cycling in its transportation system. Most of the central parts of the city within the WIA can be accessed by cycle paths that are separated from motorized traffic. Inspired by the Netherlands and Denmark, the city has recently proposed building six "supercycle routes" in the city, improving the bicycle accessibility even more.

Figure 90. Cycle paths today in Malmö within the Wider Impact Area.

The network for bicyclists and pedestrians will run along all the streets developed in Nyhamnen, with additions of green streets and bridges over both water and railyard for walking and biking, see below.

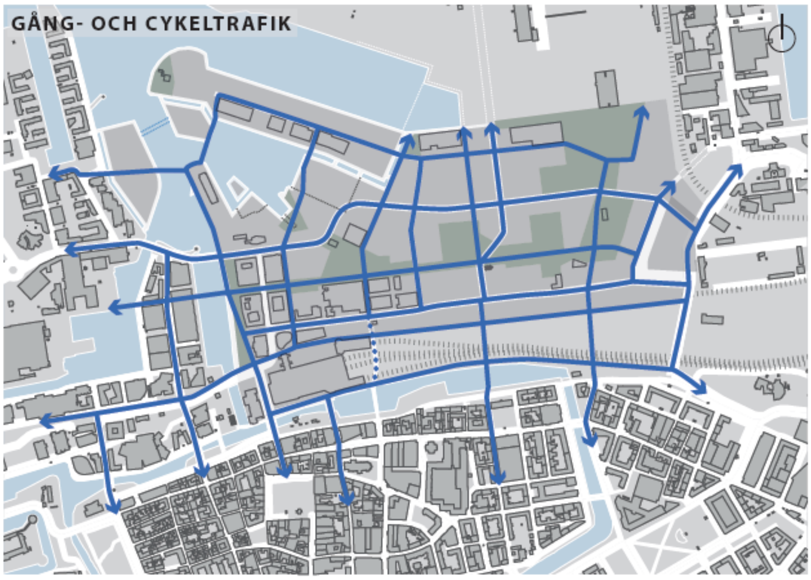


Figure 91. Network for bicycle and pedestrian traffic in a developed Nyhamnen area. (Masterplan Nyhamnen, City of Malmö)

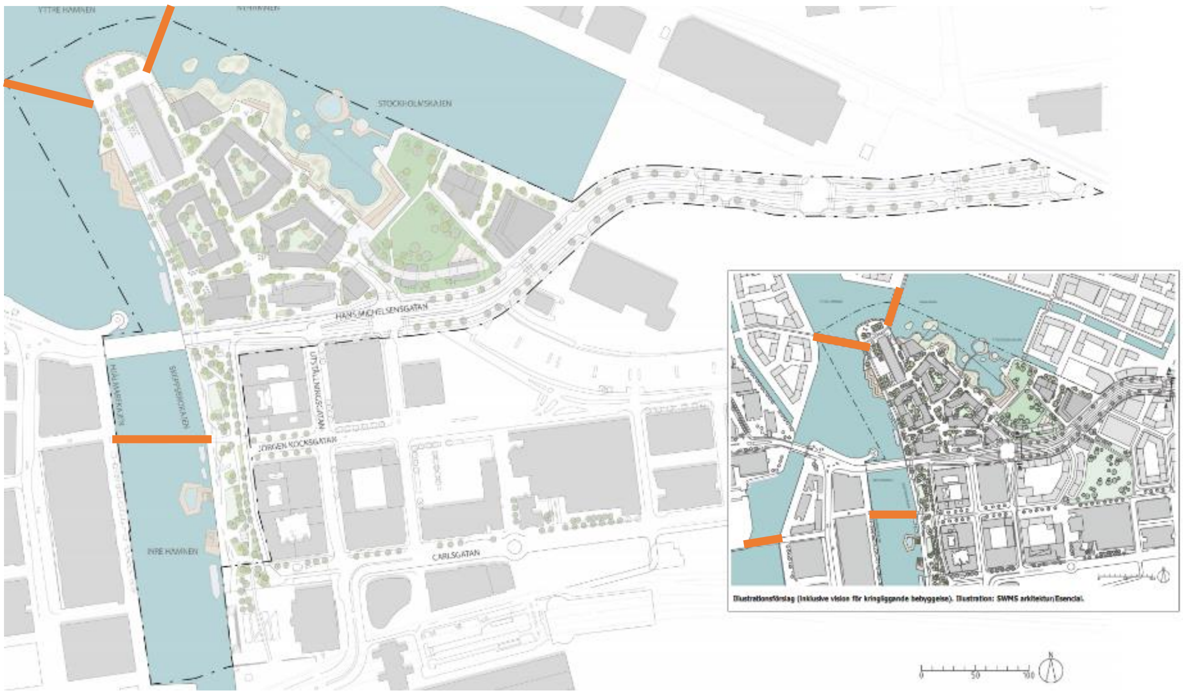


Figure 92. Overview of Smörkajen. New bridge connections are marked in orange. (Detailed development plan Smörkajen, City of Malmö)

Apart from the more traditional modes on the Malmö street network, a new player has emerged over the last years: e-scooters. These are flexible in their use, as they can be picked up and left at any location in the city. While this is a great advantage of the e-scooters, it also causes great challenges for the city authorities when blocking pathways, littering the pavements for e.g. people with visual impairments or other disabilities.

Coping with the new mode is a matter of resources. As of next year, the City of Malmö plans on charging the scooter companies a fee of circa €175 per year and vehicle together with applying for a permit for each vehicle. The decision is currently pending the county administrative board decision. What impact this will have on the supply of e-scooters in Malmö is yet not certain.

Local public transportation system

Both city and regional buses are, during non-pandemic conditions, a popular mode of transport, having dedicated lanes along some streets in Malmö. For city traffic, Malmö has 8 main bus lines and 5 complimentary bus lines. The main lines traffic between more populated residential areas and the city centre and aim to be as direct as possible. The complementary lines do not operate as frequent or over an as big part of the day as the main lines, while they focus on connecting different urban areas. The lines do not necessarily go through the city centres or via the main bus stations.

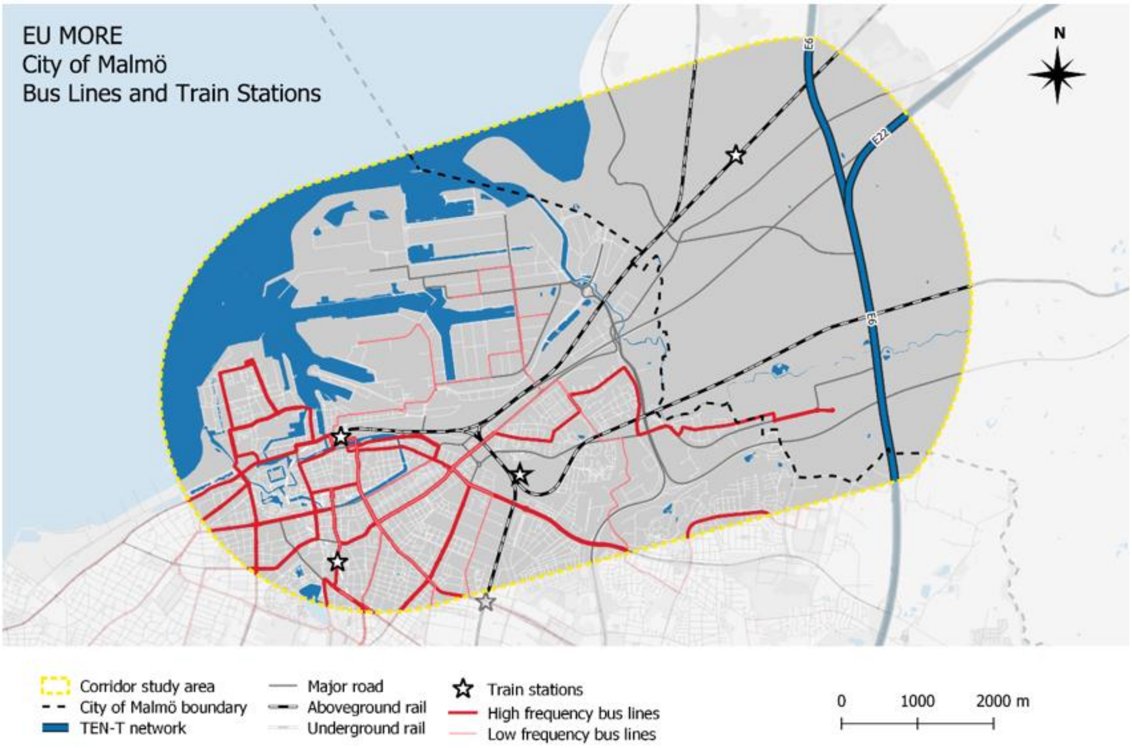


Figure 93. Current condition of bus lines and train stations within the Wider Impact Area

Among the main bus lines, line 5 has different characteristics than the rest. This is the so-called Malmö Express, which has BRT (Bus Rapid Transit) -like characteristics. This includes all-door boarding and alighting, longer vehicles and dedicated bus lanes. The bus is also completely electric.

Figure 94. MEX, main bus line 5

The most trafficked bus lines go through the western and central parts of Malmö. Some go onwards to the eastern, suburban, areas. There are bus lines in the harbour zone in the north, these are part of the less trafficked, complementary, lines.

In 2010, the underground railway tunnel of *Citytunneln* was opened for traffic. This connects Malmö Central Station with the southern station *Triangeln*. From there the railway goes underground to the station *Hyllie* before it connects to *Öresundsbron* and Denmark (including Copenhagen Airport).

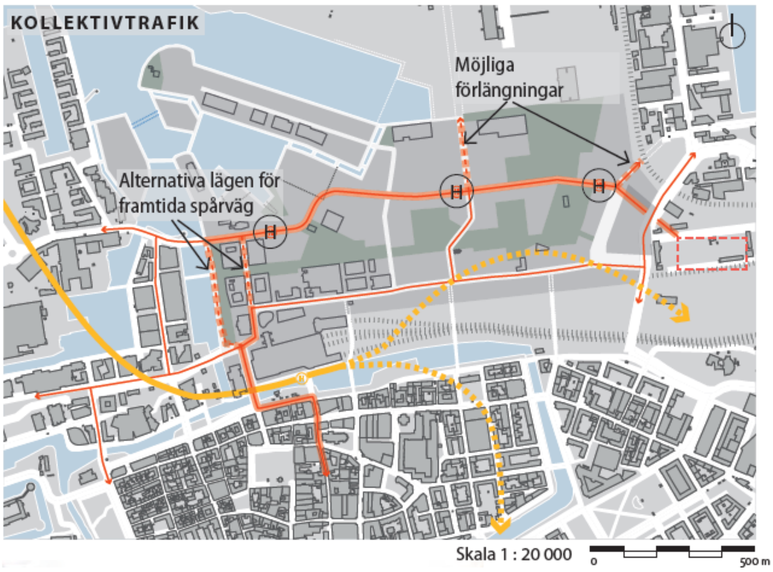
As of 2018, another section of the Malmö railways was opened for passenger traffic. This connects three new train stations in Malmö with each other and the rest of the railway network. This means easier means of transportation to, from and within Malmö, including the eastern areas.

Over the next decade, big investments and changes are to come for the public transport network of Malmö with the Malmö Express. Today, only bus line 5 has these characteristics but an additional 4 lines will be developed to this standard. With the investment, the city has a vision to:

"[…] break barriers between the different parts and citizens of the city. The increased accessibility gives a more unified and equal city and the lines are a distinct part in the green, integrated and attractive city of the future."

Figure 95. The new network of MEX in Malmö. (AFRY)

The line MEX 2 is to be finished by 2027, apart from the Nyhamnen segment that will be finished by 2031 at the latest. A concept study has been conducted for each of the MEX lines, including MEX 2. However, with many other investigations and plans for Nyhamnen, the specific segments for the area have not been included in the study.



Legend

- Public transport corridor
- Bus line
- Öresund Metro
- Public transport depot location
- (H) Public transport stop

Figure 96. Public transport situation in a developed Nyhamnen. (Masterplan Nyhamnen, City of Malmö)

Regional public transportation system

In the year 2000, the bridge *Öresundsbron* was opened, connecting Sweden and Denmark through both rail and road-bound transportation with a fixed link for the first time. Great potential was presented to the cities of Malmö and Copenhagen that together with surrounding cities in both countries could form the border exceeding region of *Greater Copenhagen*. This meant possibilities of a joint labour market, enabling an exchange of competence between both sides of the ocean.

Apart from having a local impact, the railway network in Malmö plays a major role in connecting the city to the Swedish railway network, as well as the Danish and European. Within the direct vicinity of the Wider Impact Area, there is a total of four train stations, see Figure below. This consists of the Malmö Central Station, the underground Triangel Station, Burlöv Station in the northeast together with Östervärn and Rosengård stations in the east.

With Malmö central station as an important node in the railway system of Sweden, and Malmö being the largest city and labour market of the region, the wider impact area is affected by the changes in the regional transportation system.

In short term, the railway segment called *Lommabanan* is to be opened for passenger traffic already at the end of 2020. It will connect Malmö with new areas by rail and shorten some travel times for existing origins and destinations. A total of 38 commuter trains and 20-25 goods trains will traffic the link every day. A second phase of the project is underway, with new siding tracks and a new station in an adjacent community. This will enable even more passenger and goods traffic into the wider impact area and Nyhamnen.

Apart from new links in the railroad system, changes are being made to the stress section between Lund and Malmö. Being the main link for all Swedish railroad traffic going to and from the mid and southern parts of Europe, this is a critical stretch of railroad. To improve capacity and resilience in the railroad network, work is currently done to increase the number of tracks from 2 to 4.

Figure 97. Lommabanan (north of Malmö C) and planned train stations when the second phase is completed. (City of Malmö website)

Metro

Today, the capacity of Öresundsbron has started to become insufficient to handle the trips via train on the bridge. With the approaching opening of Fehrmarn Belt tunnel, more train traffic is anticipated, and new measures could be needed to solve the looming congestion.

To further develop the region of *Greater Copenhagen* as well as to cope with the capacity issues, the *Öresund Metro* is currently being investigated. The metro, connecting Malmö to the Copenhagen underground system, is supposedly cut the travel time from the respective cities' main station by almost half, from 40 minutes today to 23 minutes in the future. Apart from stopping at Malmö C, another metro station localisation is being investigated.

Figure 98. Potential future connection of the Öresund Metro. (Öresundsmetron)

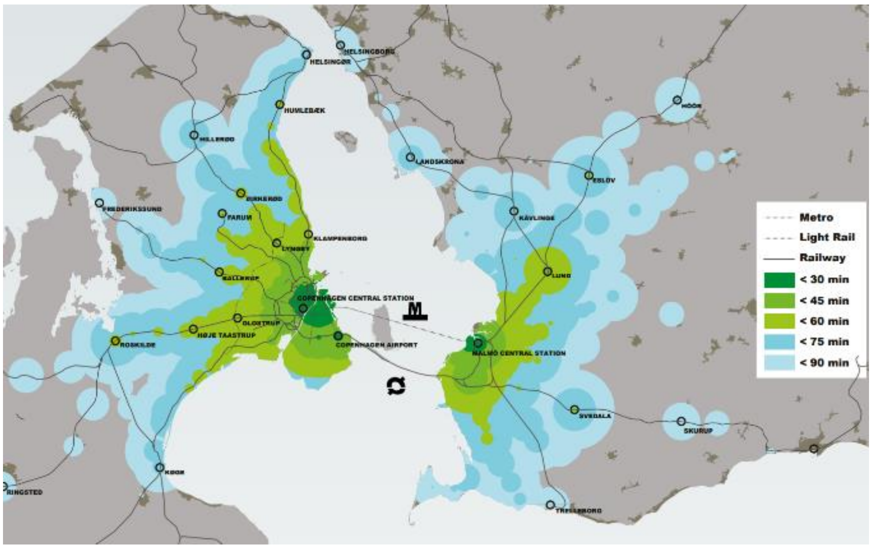


Figure 99. Travel time with an Öresund Metro (Öresundsmetron)

According to calculations, reducing travel times with an Öresund Metro and making more efficient connections, the catchment area within 60 minutes from Copenhagen Central Station or Malmö Central Station across Öresund will grow by one million up to a total of 2.3 million people in 2035. Consequently, the joint labour market will increase. Furthermore, the number of workplaces within 60 minutes travel will rise from 800,000 to 1.3 million. This will make the Greater Copenhagen region even more attractive for businesses, investment and highly skilled labour.

Future trends in the transport supply

In addition to conventional transport means that are going to be present in the wider impact area in the future, new trends are emerging. The amount of potentially revolutionary technologies is vast, and a small sample is introduced below.

Dynamic road use, where changing the road capacity over the day's hours by dynamically allocating the needed road space can mean having an extra lane during peak hour traffic or additional space for events during the weekends. This could also be used to have dynamic bus lane road markings along the feeder route.

Autonomous vehicles are often mentioned as a strong player in the future of transportation supply. The technology aims to increase traffic safety, promote shared vehicle use, decrease private car ownership and decrease the car parking areas in and outside of the cities. However, it could also lead to most commuters being uninterested in ride-sharing, hence periodic peak vehicle flows can increase. This could increase traffic congestion over the next 30 years.

Another possible addition in the future vehicle fleet is drones. If not transporting people, the drones can have an impact on the transport system when replacing road-based logistics with airborne deliveries. An obstacle is flying in restricted air space.

Apart from physical infrastructure and vehicle development, new models of transportation services are making an entrance to the market including Mobility as a Service (MaaS) and Shared Mobility.

The Malmö-based team in the MORE project have the ambition to develop this type of scenario, including more radical and innovative trends of the future transportation system. The uncertainties are however too great to deliver a credible model in the present time.

4.2.2 Gating and mobility hubs

Currently, the City of Malmö is investigating introducing mobility hubs and gating. Even though being different from each other, the measures aim to decrease car traffic and queues along sections that are under stress. In the models and results presented below (mobility and sustainability), these measures are not included.

Placement of the mobility hubs will be investigated by integrating them into modelling. Apart from only introducing them in the simulations, further measures are needed to make a change from a car to bike or bus and continue the trip to the destination. For example, the parking fees in the destination areas (Nyhamnen or Västra Hamnen) need to be increased to favour the mobility hubs. Beyond parking fees, other measures could need introducing in the whole of the central urban area to enable significant use of the hubs. Mobility hubs can be placed in more places in Malmö than just along the corridor.

Gating is another option that could be part of a solution to reducing peak hour traffic queues etc. A case study performed by DYNNIQ has been conducted have reported to the MORE organization. Further verification and additional studies are currently being performed by the City of Malmö.

One challenge for the use of gating in Malmö is the size of the city. There are only a few parts of the city where there are enough traffic signals following each other to create enough of an effect. Regarding the use of gating on the feeder route, caution is needed not to disturb the flow from the TEN-T network for goods traffic with an origin or destination in Norra hamnen. The harbour area has been declared a matter of national interest, hence gating measures further up along the feeder route could be a disturbing element.

4.2.3 Impacts on future transport supply due to COVID-19

The worldwide outbreak of COVID-19 has deeply affected the world as we know it, from a personal level to our society as a whole. In attempts at reducing the spread of the virus, different measures have been taken in different regions and countries. To avoid being infected by the virus, a lot of people have single-handedly switched their means of transport from public transit to car or bike.

The impact on mobility and potential on future transport supply due to the pandemic is difficult to anticipate for each city and country. Differences in national and local policymaking and restrictions make areas hard to compare with each other.

According to Google, there are declines in activity in stores, transit stations and workplaces in Malmö. This confirms that fewer people are commuting to work every day with public transit and that fewer people work from their office. The biggest increase in activity can be seen for parks. However, since the baseline data is from the winter in Sweden, this is not an anomaly.

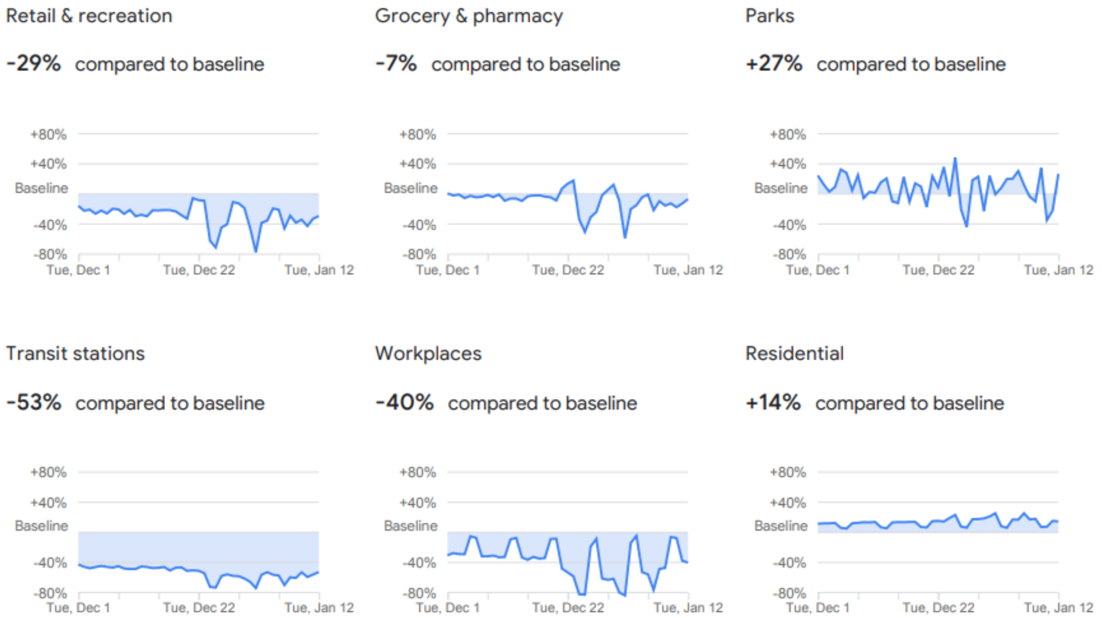


Figure 100. Mobility report for Malmö Municipality. Baseline data is the median value for the corresponding day of the week during the 5-week period Jan 3 – Feb 6 2020 (Google, 2020). [Data downloaded 2021-01-18]

While several cities in Europe have use the initial decrease in car traffic on their streets as a chance to develop temporary bike lanes, Malmö has not. Rather than policymakers being inactive, this is due to the already extensive bicycle network.

It is important to note that being able to have a choice to not travel to work is a privilege and many people lack that option. Some professions, critical to the upholding of our communities, still require physical presence and therefore transportation. While those who can be advised to stay home during a new peak in virus spreading, it is important to ensure that there is sufficient space in buses, coaches and trains. A study from Malmö University (2020), confirms this and indicates that women overall, and Malmö residents in low-income areas have continued commuting during the pandemic as they have less opportunity to work from home due to their professions.

With more people working from home as a consequence of the virus, commuting car traffic will decrease. In a longer perspective, this could mean a need for less room for car traffic. This is an exceptional chance to shift focus on city streets from the current vehicle mobility to people-focused liveability qualities.

It seems as if the pandemic is here to stay for a while longer, with a current second wave of contagion. The virus' impact on the transportation demand and supply needs to be assessed continuously to adapt on all levels, from public transport operators to city and regional organizations.

4.2.4 Influential factors of future transportation demand

Malmö is today the home for almost 350 000 citizens. While being Sweden's third-largest city, it is the fastest-growing city in the country due to i.e. high birth rates and immigration.

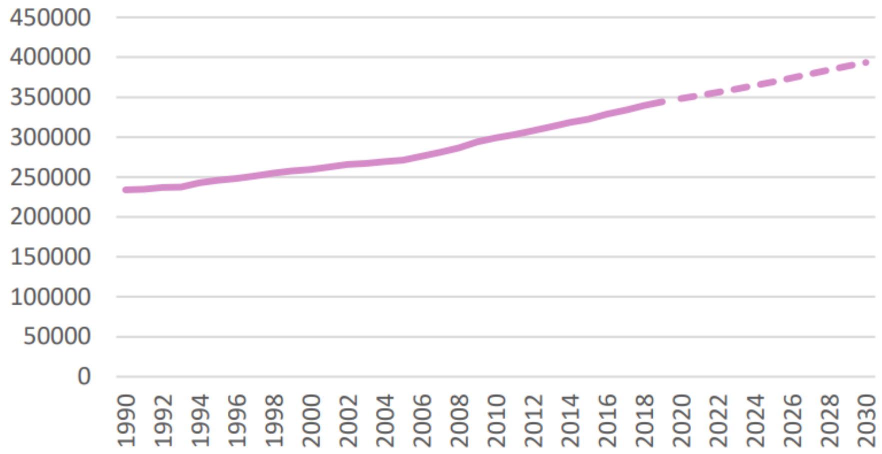


Figure 101. Population growth from 1990 to today (full line) and prognosis of future growth (dashed line) (City of Malmö)

While dealing with the population growth (being approximately 400 000 by 2030) and simultaneously sustaining the fertile agricultural land around the city, Malmö is undergoing densification of the city structure. More residents in the same area give the potential for a sustainable society with more close-by service functions, shops and a better supply of e.g. public transit. However, densification is likely to put the transportation network under further stress. More people need to travel within the same area and on the same available road space. This calls for a more optimised use of the transportation network.

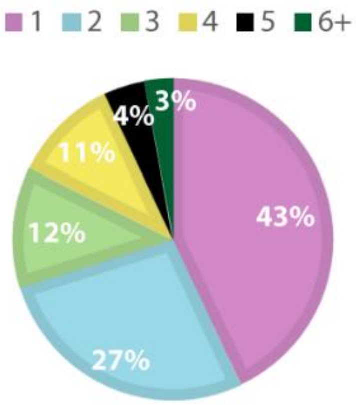


Figure 102. Share of the expected increase in the number of households depending on size. For example, 43% of the new households between 2020 and 2030 are expected to be single households. (City of Malmö)

The one- and two-person households are the most common in today's Malmö. This is due to the low average age of the city's population. Even though households are small, it is likely that a household still has one or more cars. This means households of all sizes contribute to car ownership and car flow on the streets.

E-commerce is continuously growing in the world, also in Sweden. By 2019, e-commerce in Sweden (excluding foreign commerce) stood for nearly 11% of the nation's retail revenue, with several large players in internet shopping. With the recent establishment of Amazon in the country, the questions are how big of a share of Sweden's current e-commerce the giant will take from competitors, and if the total share of e-commerce will increase due to its entrance. With the outbreak of Covid-19, the Swedish Trade Federation assesses that with the future return of everyday life, e-commerce will see a big upswing. This will be both to an increased habit of digital presence, as well as a reservation of undertaking physical shopping.

It is difficult to foresee what impacts this can have on city centres and shopping centres. Less physical shopping means there will be fewer trips to the cities. If these trips are not replaced by other leisure trips, less traffic will pass into the city centres, both by the actual visitors as well as the staff working in shops etc.

4.3 Future patterns of demand in the Wider Impact Area and along the Feeder Route

For the future demand patterns, models have been developed for the wider impact area and the feeder route. They represent scenarios that focus on more car-oriented accessibility, or on sustainable modes of transport or place qualities.

Figure 103. The area of Nyhamnen, today and future conditions, looking towards the southwest. Area of study represented by the yellow arrow. (Masterplan Nyhamnen, City of Malmö)

To predict the future demand in the transportation network, prognoses and simulations have been made in several steps. This is described further in report *D5.1 - Case Study Design Methodology (Current Conditions)*. That report also introduces gating and mobility hubs in the modelling. These measures have not been included in the scenarios described in this chapter.

Concluding, the majority of the traffic movements increase will be due to Nyhamnen development. The development of the area means building of new parks, schools and pre-schools together with:

- 7 000 – 9 000 *new* dwellings
- 12 000 – 16 000 *new* working places

Apart from the Nyhamnen development, the Västra Hamnen area (west of Nyhamnen) will continue to become a complete urban area. Approximately, this means an increase of circa 6000 residents together with a similar increase in job opportunities.

4.3.1 Traffic and urban planning visions

In Malmö's work with MORE, different visions of the future conditions have been defined. These are in line with the visions developed in EU project CREATE and have been translated into Mobility (Car-oriented city), Sustainability (Sustainable mobility city) and Liveability (City of places).

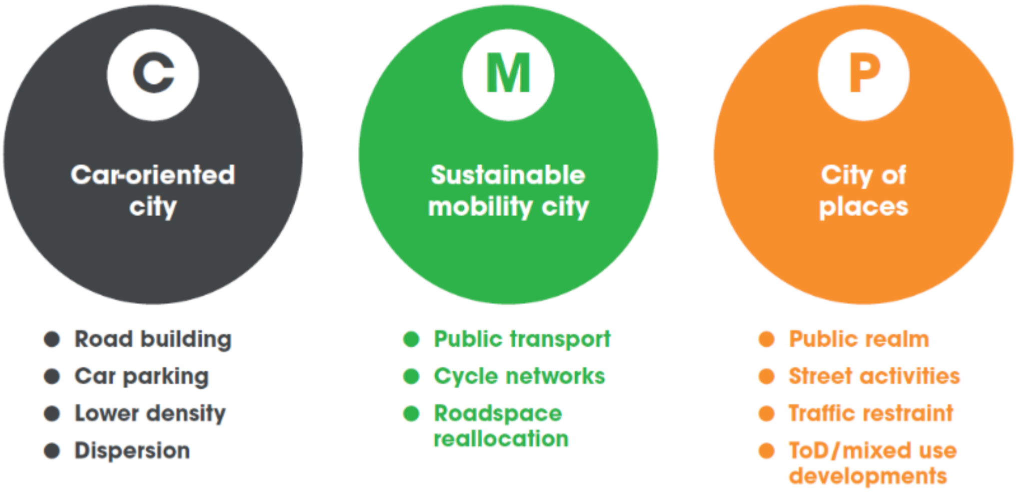


Figure 104. The main concept of the three visions mobility, sustainability and liveability, also called phase one, two and three in the EU-founded project CREATE.

The visions represent different approaches of traffic and urban planning, which includes different traffic mode priorities and estimated modal shares. The mobility and sustainability scenarios are more conventional in terms of modelling, using existing city models to explore the future demand of the stress section and wider impact area. This includes models for motorized traffic, public transport and bicycles.

Pedestrian flow measures and models are not available for Malmö. Instead, assumptions have been made for the pedestrians in relation to bicycle numbers and the sections' location. For example, in the western parts of the area with denser land use structure including housing and workplaces, the number of pedestrians are assumed to be equal to the number of bicyclists passing by. The more east in the Nyhamnen area you get, the less likely is it to have high pedestrian flows. In the most transport-focused and highway-like sections, pedestrian flows are barely existing due to lack of infrastructure as well as attractive origins and destinations.

The estimated transport demands of Mobility and Sustainability are presented in this chapter. The Liveability scenario is bolder in its predictions of projected modal shares, traffic flows and less available road space for cars in favour of pedestrians.

4.3.2 Mobility: Business As Usual

The Business-As-Usual (BAU) scenario is the possible outcome when no active measures are used to transition from a more car-favouring transport planning to favour more sustainable modes. The scenario has its base in the travel survey data conducted in 2018 (RVU2018) and uses those modal shares in the model base for the future scenario. The scenario uses two lanes in each direction for general traffic to cope with the high flow of motorized vehicles.

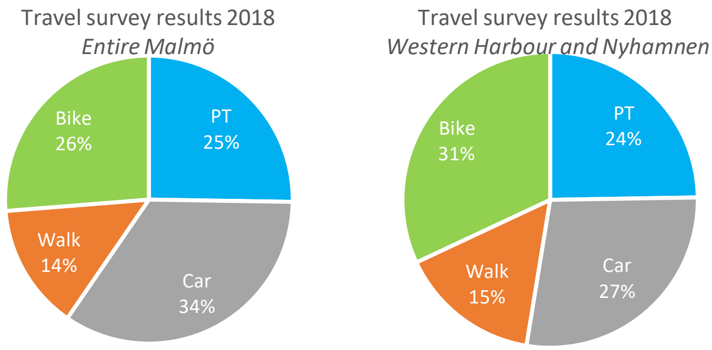


Figure 105. Travel survey results for entire Malmö and the urban area where the feeder route connects to the inner parts of the city (Nyhamnen)

Table 27. Estimated traffic flows per average weekday in different corridor sections by 2040 (Sustainability scenario). Change from today's levels (if available) in parentheses

Corridor section Mobility (2040)	Traffic flow	Peak hour	Bicycles	PT users	Pedestrians
Hans Michelsensgatan by Skeppsbron	14 000 (+24%)	1 500 (+28%)	3 000 (+1400%)	0 (±0%)	3 000
Jörgen Kocksgatan by Navigationsgatan	24 000 (+57%)	2 500 (+54%)	5 000 (+1550%)	2 000 (±0%)	5 000
Carlsgatan by Venusgatan	18 000 (+99%)	1 800 (+80%)	2 000 (+900%)	6 000 (+200%)	2 000
Carlsgatan by Frihamnsallén	29 000 (+79%)	3 100 (+77%)	3 000 (+650%)	6 000 (+200%)	750
Västkustvägen by Grimsbygatan	31 000 (+77%)	2 800 (+60%)	6 000 (+250%)	4 000 (+33%)	100
Västkustvägen by Spillepengen	32 000 (+55%)	3 100 (+29%)	1 000 (±0%)	3 000 (-25%)	100
Västkustvägen by Hakegatan	26 000 (+41%)	3 000 (45%)	1 000 (±0%)	3 000 (-25%)	100
Västkustvägen north of Malmövägen	18 000 (+43%)	N/A	N/A	2 000 (±0%)	N/A

Looking into the specific results of the traffic flow of the mobility scenario, there are increases in traffic flow in all parts of Nyhamnen. The biggest change can be seen on Carlsgatan. This is due to that most trips heading to the south of the city or even south of the city, use this link, causing a much larger flow than today. The central station area is also an area with many attractive destinations. The change in the west of the stress section, on Hans Michelsensgatan by Skeppsbron, contains the smallest increase of the corridor sections, likely due to that most of the new traffic has its origin or destination in Nyhamnen and lack of future capacity west of the section.

Table 28. Traffic flow and modal split for feeder route for the mobility scenario

Mobility scenario	Car		Bicycle		Bus	
	Traffic flow (2040)	Change	Traffic flow (2040)	Change	Traffic flow (2040)	Change
Vehicle flow	35 000	(+58%)	6 000	(+223%)	9 000	(+180%)
Modal share	71%	(-11%)	12%	(+5%)	17%	(+6%)

The projected vehicle flow 2040 compared to the situation today be seen below. While the northern parts of the feeder route have increased vehicles flow of 8 000 to 11 000 vehicles per day, the traffic increase is heavy on other links in the wider impact area. The biggest changes can be seen on the inner ring road, with a total of 16 000 additional vehicles per day according to the model. A large increase in traffic is also to be expected in the Nyhamnen area, along with and around the future conditions stress section.

Figure 106. Difference between mobility-scenario 2040 and today. Red indicating an increase in vehicle traffic flow.

Table 29. Total heavy traffic by the intersection per average day at Hakegatan (north of Spillepengen) in both Mobility and Sustainability scenarios

Heavy vehicles Mobility/Sustainability scenario	Traffic flow (2040)	Change
Total number of heavy vehicles without a trailer	2 000	(+21%)
Total number of heavy vehicles with a trailer	1 900	(+21%)

According to the mobility model, the traffic flow of heavy vehicles will increase by over 20%. The point of measure is placed north of Spillepengen. The increase is likely to not go far into

Nyhamnen, as the heavy vehicle generating operations are located north of it in the harbour area.

4.3.3 Sustainability: Sustainable urban mobility plan

The city council of Malmö has adopted a sustainable urban mobility plan (SUMP) to describe the holistic planning approach towards promoting a sustainable and climate-neutral transportation system in the city. The plan sets out for example an objective-based planning approach towards the future modal split of the transportation system in the city and how future commuting can be done sustainably.

In the SUMP, each city area has a modal share objective of its own. Also, SUMP objectives for commuters to Malmö on a city-level. The SUMP scenario in this report uses the plan developed by the City of Malmö in 2016 and the modal share objectives by 2030 are presented in the figure below.

For trips within the urban area, Nyhamnen is more ambitious than for Malmö as a whole. The share of both public transport and walking are higher for Nyhamnen, while car trips are aimed towards decrease. The objectives for modal share when commuting to Malmö as a whole from the SUMP are in line with the Nyhamnen masterplan objectives. This means half of the commuting trips are done by car. As a big portion of the commuting traffic to Western Harbour goes via the feeder route and Nyhamnen, this will impact the traffic along the street going through the area.

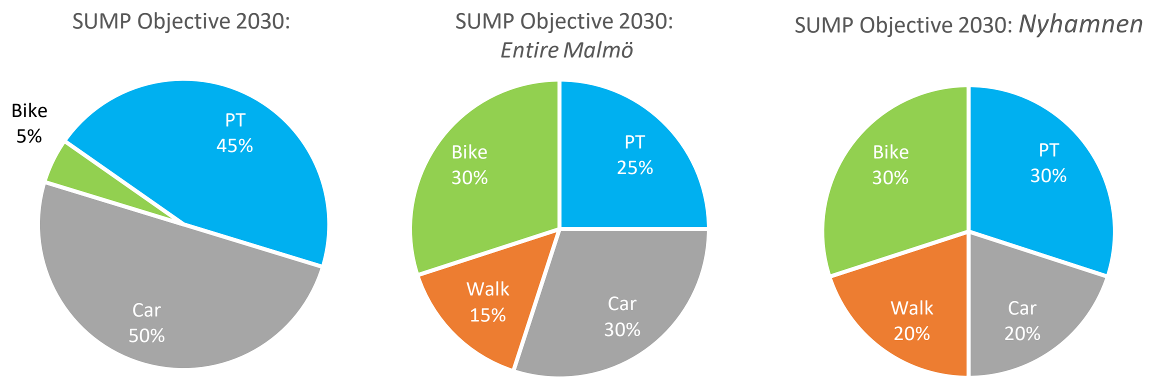


Figure 107. The modal share objectives of the areas Nyhamnen and Västra hamnen. The modal shares represent all trips that the residents make within, to/from and outside of the area(s).

Further east along the corridor, the objectives of Nyhamnen are no longer representative of the infrastructure and urban environment present. Approaching the TEN-T network there are no dwellings or city-like supply of stores, service etc. Instead, it will still be a more industrial and mobility-focused area. This shift in character means that other modal shares will be used for the outskirts of the city.

Table 30. Estimated traffic flows per average weekday in different corridor sections by 2040 (Sustainability scenario). Change from today's levels (if available) in parentheses

Corridor section - Sustainability (2040)	Traffic flow	Peak hour	Bicycles	PT users	Pedestrians
Hans Michelsensgatan by Skeppsbron	11 000 (-3%)	1 000 (-15%)	4 000 (+1900%)	0 (±0%)	4 000
Jörgen Kocksgatan by Navigationsgatan	20 000 (+30%)	1 800 (+11%)	6 000 (+1900%)	3 000 (+50%)	6 000
Carlsgatan by Venusgatan	15 000 (+66%)	1 300 (+30%)	2 500 (+1150%)	10 000 (+400%)	2 500
Carlsgatan by Frihamnsallén	25 000 (+54%)	2 400 (+37%)	4 000 (+900%)	10 000 (+400%)	1 000
Västkustvägen by Grimsbygatan	26 000 (+49%)	1 900 (+9%)	7 000 (+310%)	7 000 (+130%)	100
Västkustvägen by Spillepengen	27 000 (+30%)	2 500 (+4%)	2 000 (+100%)	6 000 (+50%)	100
Västkustägen by Hakegatan	22 000 (+19%)	2 400 (+16%)	2 000 (+100%)	6 000 (+50%)	100
Västkustvägen north of Malmövägen	15 000 (+19%)	N/A	N/A	3 000 (+50%)	

Overall, the traffic volumes along the feeder route are lower in the sustainability scenario than in the mobility scenario. This is largely due to the less car-dominated modal split in this. There are still major increases along the streets, especially in the western, more centrally located. The exception is by Skeppsbron, where the area of Nyhamnen ends and a bridge connects. Here, the lack of capacity creates a big resistance in the route choice of the model, leading to the traffic decreasing from today's levels.

Earlier tables show the *person* flow relating to bicycles, PT and pedestrians. Details relating to *traffic* flow of cars, show the number of vehicles, is indicated below. Using average car occupancy, a comparison between the person flow in both scenarios can be made. This shows an average of 1100 persons more per day and section in the mobility scenario. The sections on the street Carlsgatan, where several bus lines will run, the total person flow is higher in the sustainability scenario.

Table 31. Traffic flow and modal split for feeder route for the sustainability scenario

Sustainability scenario	Car		Bicycle		Bus	
	Traffic flow (2040)	Change	Traffic flow (2040)	Change	Traffic flow (2040)	Change
Vehicle flow	30 000	(+37%)	7 000	(+294%)	10 000	(+206%)
Modal share	65%	(-17%)	15%	(+9%)	20%	(+9%)

The results above show and a large increase in bicycles and public transport, but also the car. As most of the feeder route is not within a densely populated urban area, different modal shares are used than in in the central parts of Nyhamnen. This means a large portion of the traffic is commuting to or from the area or surrounding, hence having a higher car traffic share.

Since there are less dwelling and offices in the area, there are also fewer trips being made using public transport.

Figure 108. Difference between sustainability-scenario 2040 and today. Red indicating an increase in vehicle traffic flow

The future demand in the sustainability scenario is presented above. The increase in daily vehicle traffic flow is less than in the mobility scenario, however still significant. Just as in the mobility scenario the biggest increase from today is seen on the inner ring road, the feeder route and the major link in the central parts of Malmö.

The sustainability scenario does not take a more sustainable approach to the Norra hamnen, where there are several business activities connected to the harbour that generate heavy traffic. This means that estimated heavy vehicle traffic grows equally from today to 2040 by both the mobility and sustainability scenario.

4.3.4 Liveability

While the two scenarios described above are more or less conventional from a traffic perspective in the development of a new urban area, the liveability scenario aims to have a more radical approach to the share of space that pedestrians and activities can use on the streets. This means that car accessibility could need to be reduced and a liveability scenario should put the people first, enabling an active life in a healthy community.

There are challenges in modelling such a scenario, as knowledge regarding available infrastructure, capacity and design linking to pedestrian experience and demand. To ensure space for pedestrians and stationary activities along the streets of Nyhamnen, the model uses different measures to see how the through traffic behaves. The trips within the area could be subject to change if the environment is more pleasant and calm, however this is not possible to take into account in the model.

A selection of the factors that are included in the liveability scenario is:

- Introduction of mobility hubs. To make the hubs an attractive choice, the model includes a raise of parking fees in Nyhamnen and Västra hamnen by approx. €10 per day.
- Tighter space for motorized vehicles to instead prioritize sidewalks.
- A new bridge from Norra hamnen via Nyhamnen onwards to Västra hamnen, reducing the need to through traffic along the stress section.
- A penalty for using the corridor stress section for through traffic.

Working the liveability scenario into a model is currently underway.

4.4 Future Conditions on the Stress Section

4.4.1 Brief description of expected future stress section characteristics

The future stress section will have characteristics far from the current situation of Hans Michelsensgatan. The structure of the buildings and blocks will be dense and high, enabling effective densification of a new and attractive urban area. However, this gives the section plenty of challenges. As can be seen by the future patterns of demand in the figures below, more traffic movements are to be expected due to the new urban area, impacting an already near-congested street during peak hours.

Figure 109. The area of Nyhamnen with future development. Area of study represented by the yellow arrow. (Masterplan Nyhamnen, City of Malmö)

The stress section consists of the street Hans Michelsensgatan.

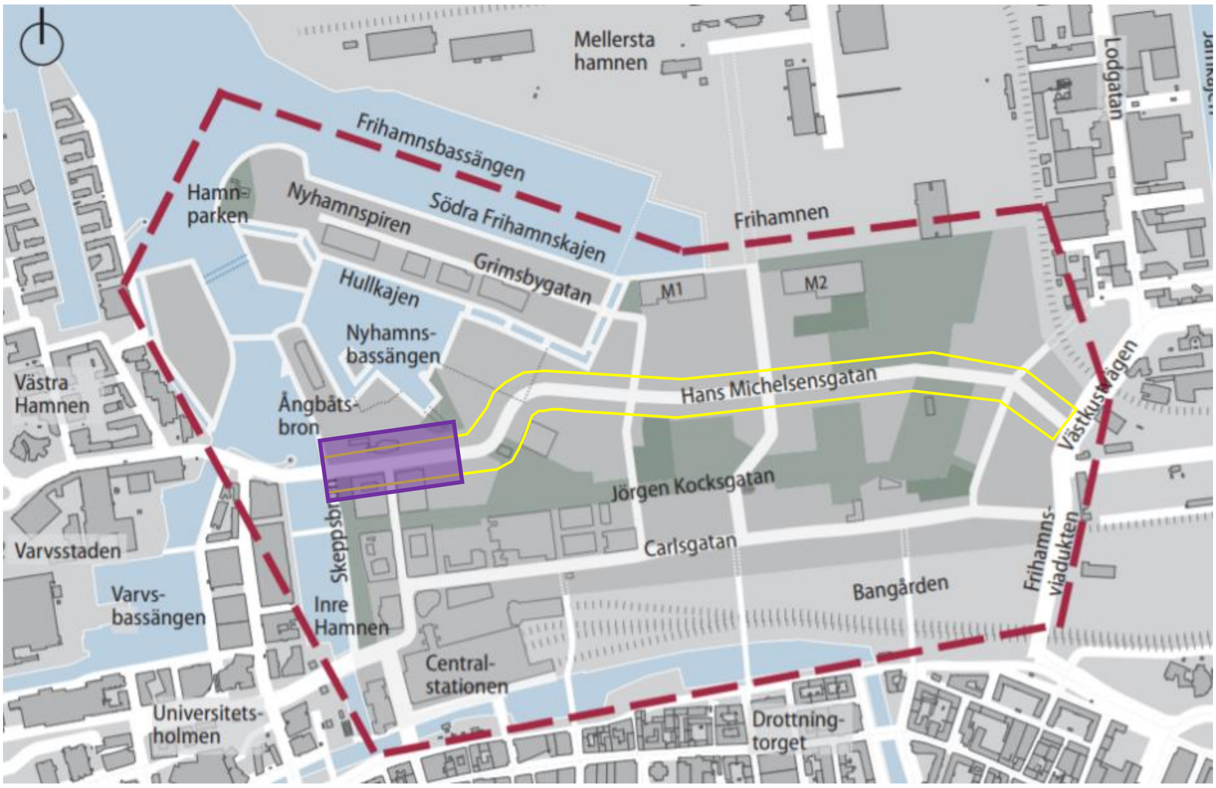


Figure 110. Stress section in focus during the design activities marked with purple square

4.4.2 Expected movement demands

As discussed previously in the report, the outbreak of COVID-19 changes the way traffic demand looks currently and might have long-going effects as well. Peaks during morning and afternoon commuting will most likely also decrease in magnitude. All of the things mentioned affect the transportation system as a whole, but also separate links such as the future conditions stress section.

The gating and mobility hubs can decrease peak hour traffic flow along the corridor and thereby also along the stress section. However, it is not certain, as the demand could arise from other nearby links in the transportation network. This tells us that physical and monetary measures could be needed to restrain additional traffic coming into the stress section.

Except for traffic flows of motorized modes and bicycles into consideration, the flow of pedestrians around the future condition stress section will increase substantially. The region expects a doubling of train passengers, meaning a similar increase of pedestrians around Malmö Central stations. A large portion of the new pedestrians will have the area around the future stress section as a destination. The pedestrians do not always need a fixed destination and can sometimes instead stroll around the neighbourhood, giving that there are place-related qualities in the surroundings.

4.5 Place-related demands: Plans

From the masterplan of Nyhamnen, locations for potential different activities can be seen below.

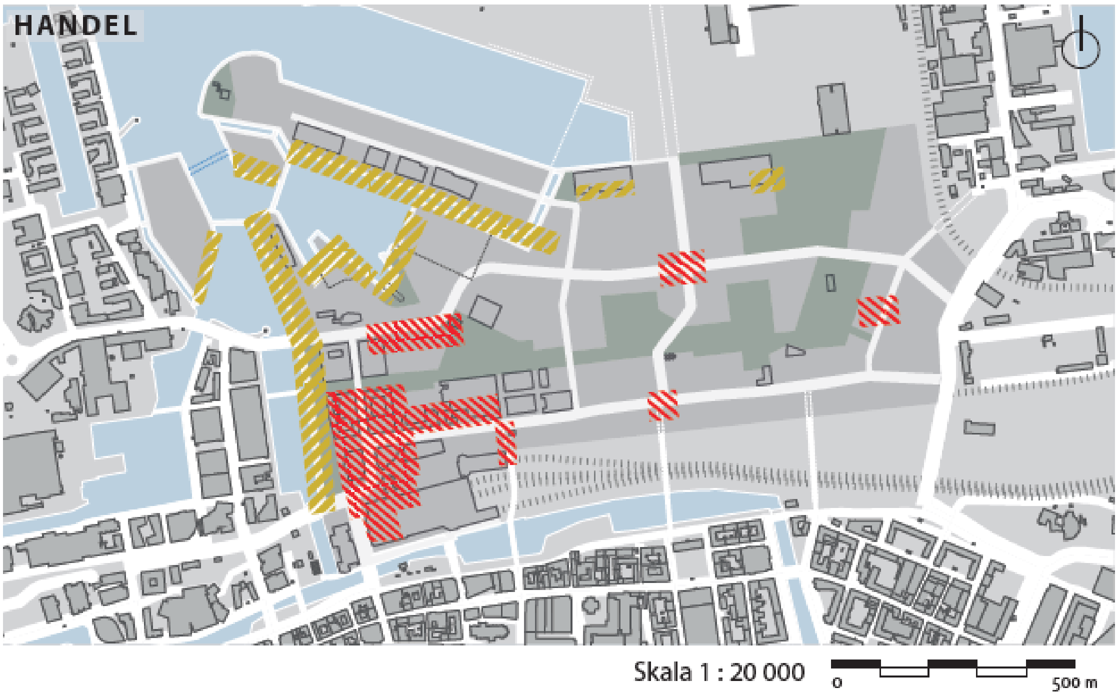


Figure 111. Overview of Nyhamnen shop locations (red) and tourism/leisure activities (yellow). The rest of the area will include mixed-use of offices, housing, schools and other activities. (Masterplan Nyhamnen, City of Malmö)

Most of the shop locations are located in the direct vicinity of the Malmö Central Station. The masterplan aims to have shops and activities in the bottom of throughout the Nyhamnen area, but with a higher density close Malmö C. This enables Malmö C to be the place in the city where most residents and workers within 1 kilometre. The tourist activities are mostly placed along the waterfront of Nyhamnen.

Except for commerce and tourism, other place-related qualities that will be introduced in around the future conditions stress section are:

- Several schools and pre-schools;
- Greenery, that will be concentrated in the middle of Nyhamnen. Along with this comes that green space is shared, being used as both a schoolyard and a park for the Nyhamnen residents and visitors;
- Sports centre;
- Shared space street.

Place-related qualities are important to create a pleasant environment in Nyhamnen. However, these qualities could take a beating due to barrier effects caused by highly trafficked main streets that the stress section is part of.

4.5.1 Place-related demands: Dialogue Project

During the fall of 2020, Malmö has conducted extensive dialogue projects as input in co-creation processes of future urban planning. This section of the report is a summary of how results show what citizens want and need to enjoy their urban life and street environment.

Background

While having mainly industry and logistic facilities and lacking residents, we have seen that the current conditions of Nyhamnen are far from the type of urban area that it will be in the future.

To engage and explore the views and opinions of Malmö inhabitants, dialogue has been gathered at 6 reference areas spread across the central parts of the city. The reference areas were chosen with regards to their respective characteristics representing mobility, sustainability and liveability, the latter being linked to place-related demands. Most of the reference areas chosen to have high traffic flow and dense land use structure by Malmö standards to resemble the future main streets of Nyhamnen.

In addition to the people study on the streets, another study focused on what lessons can be learned from the development of Västra hamnen, the urban area west of the future stress section being developed from the beginning of the millennia and onwards. Here, the focus was the real estate companies' and other businesses' opinions on what they believe are beneficial or necessary to promote their establishments.

Methodology

Apart from answering on more open questions, such as "*What do you like/want to change about this street?*", the respondents had to choose between key-value words that they best thought described their experience of the street they were currently on. This enabled an easy-to-understand approach which made the survey accessible for citizens without any prior knowledge of traffic and urban planning.

The words, developed together with officials in the fields of citizen participation as well as traffic and urban planning, have values are covered within the three scenarios/visions mobility, sustainability and liveability. The scenarios have been described in detail chapter *3*.

Each scenario has four key-value words, shown below. Each corner and colour represent one of the scenarios. Among the 12 key-value words, each respondent got to choose 3 words on how they *experience the street today* and how they *want to experience the street in the future.*

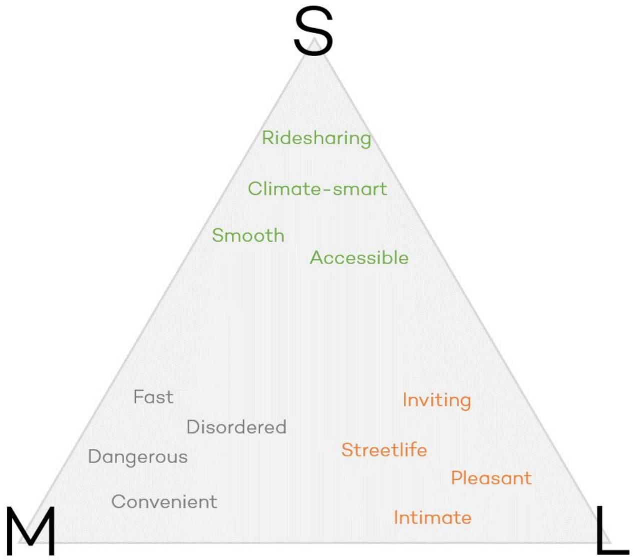


Figure 112. Key-value words and their representation in a "value triangle". S=Sustainability, M=Mobility, L= Liveability.

Results and conclusions

Having nearly 1300 respondents, the results were that places with high mobility characteristics lacked qualities that contribute to *place-related* functions. The majority of the asked citizens had come to the street on foot, but most of the pedestrians were also frequent users of public transport, bike and car.

When asked how the street should change, *liveability* qualities were predominantly asked for. When the places already had liveability characteristics, there were little to almost no change asked for. The citizens ask for streets that are including and pleasant to move and stay along.

A strong example of what both the people of Malmö and the local businesses ask for in their current and future streets is life and activity. If the current reference street already had this, it was a big positive. If the location was lacking those qualities during most hours of the day, this was seen as something negative and subject to change.

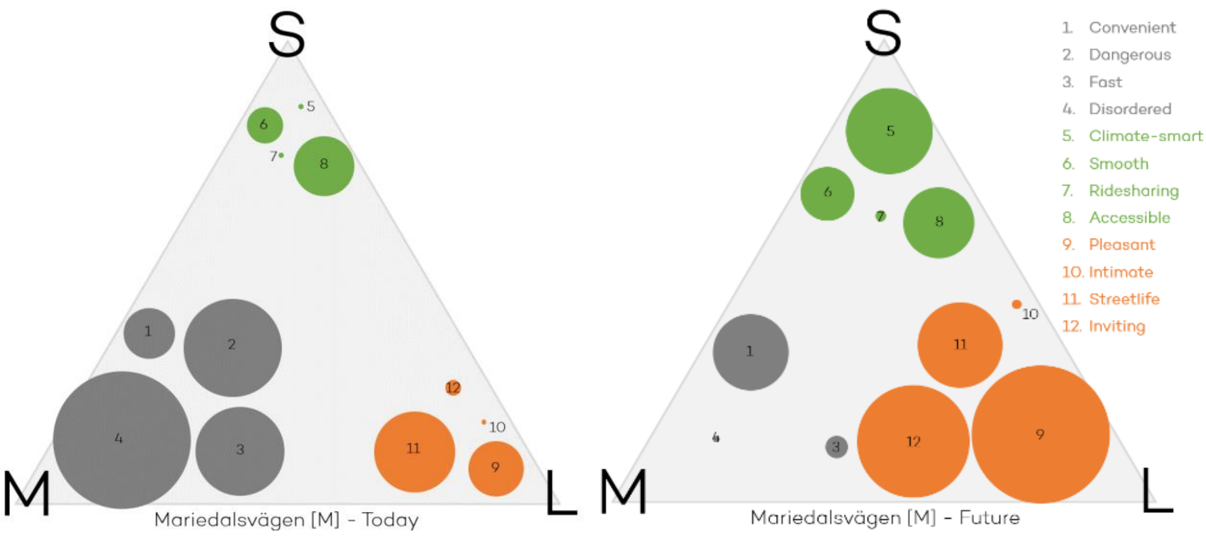


Figure 113. Key-value words for a typical Mobility-street, both for how it is experience today (left) and how citizens want to experience it in the future (right).

As shown above, the desired transition into a more liveability-oriented city is evident. The left triangle represents today's street, which is a street without dedicated bike lanes, narrow pathways and car traffic in high flows and speeds. The right triangle shows that citizens demand a more pleasant and inviting urban environment, giving space to more climate-friendly modes of transport instead of a fast and dangerous tempo of motorized traffic. In the reference streets that were initially classed as liveability-streets, the desired transition is less apparent.

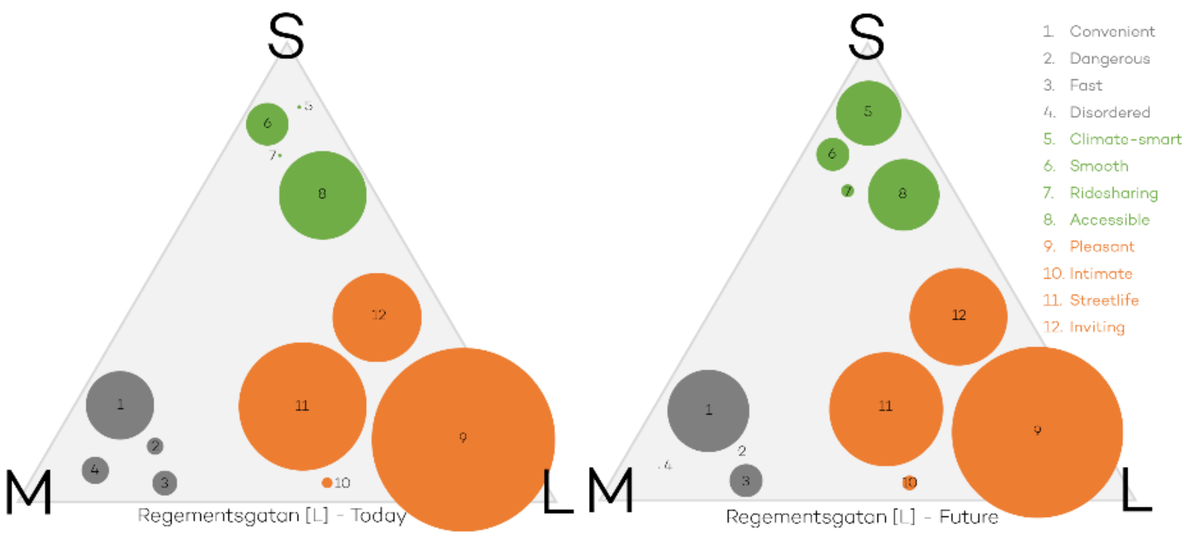


Figure 114. Key-value words for a typical Liveability-street, both for how it is experienced today (left) and how citizens want to experience it in the future (right).

In contrast, these triangles are based on the qualities of a current Liveability-street. Here, the present and future representations are almost identical. The street Regementsgatan is lined with trees and broad sidewalks with plenty of local shops and cafés. A common response during the dialogue activities here was to keep the design and environment as it is, rather than changing anything at all. Conflicts between the different street users exist, however citizens are not as disturbed by this as they are delighted of greenery, inviting facades and plenty of space for the people instead of the cars.

The citizens of Malmö have spoken. When living, moving by foot, conversing and meeting their friends and family, the street should represent qualities that promote these behaviours. If objectives are to develop an urban area having city life and with a pulse in Nyhamnen and along the feeder corridor, this poses a conflict between mobility and liveability values.

4.6 Design brief for Future Conditions

Malmö's case study is different from other cities in the MORE project, as the area along with parts of the feeder route and the entire future condition stress sections does not currently have urban qualities and will be developed over the next decades. There are however design objectives of the area represented in master plans both for the entire Malmö progress and for the Nyhamnen area specifically. In addition to the master plans, the SUMP accounts for several sustainability goals connected to traffic development in Malmö.

4.6.1 Design objectives and user group priorities

In MORE, Malmö has chosen to work with three main scenarios for the future conditions of the stress section in Nyhamn. The scenarios have been the foundation of the traffic models forecasting and will continue to play an important part in future designs. Each scenario takes the plans above into consideration for the design brief while emphasizing in different parts of the transport system user needs.

A considerable effort has been made to make assumptions on population growth, network development, and behavioral change as realistic as possible for the three main scenarios. They are based on political choices, are slightly more extreme but believable and within reach. Thus, regardless of the simulated scenario, all forecasts point towards challenging future vehicle flows along the feeder corridor and the future conditions stress section.

Well aware that traffic flows will be demanding in the future, there is an additional equally important aspect to consider. As the city becomes denser and linked together by new buildings and connections, the pedestrian perspective becomes increasingly important – not least because of the contribution to urban life pedestrians provide. Having simultaneously a traffic-centered perspective (to avoid congestion and queues) when planning the area poses risks for future conflicts.

A brief outline of scenario objectives is described in the sub-chapters below. These are to be seen as guidelines when engaging with planners and stakeholders in future design workshops using the MORE-developed tools. The sessions will be welcome to new and innovative proposals as well. In addition to the three main scenarios presented, we aim to develop a fourth scenario, balancing between the other three. The fourth scenario will work as a compromise, bringing together a well-rounded solution from the original designs. Furthermore, Malmö aims to create a fifth, high-tech scenario, where autonomous vehicles, advanced information technology, and new behavioral patterns create new transportation possibilities. The three main scenarios and the fourth more “balanced” scenario will be simulated in Vissim. An effort will be made to simulate the high-tech scenario in Vissim, but the feasibility of this is still unclear.

Simulations will also be made for traffic flows representing different time windows, such as peak traffic, mid-day traffic and evening hours. If there are significant differences between morning and afternoon peak traffic, they will also be studied separately.

4.6.2 Mobility Scenario

In the Mobility scenario, traffic planning will continue to be car-favouring, extrapolating the current modal share and giving plenty of spaces for car and goods traffic hence coping with increase of motorized flows. While increasing accessibility for some (including deliveries and parking), noise and barrier effects are to be expected. The future patterns of demand show increases in general traffic flow, also during peak hours where the current situation has problems with congestion and queues for through traffic.

To cope with the intense flows of traffic and create possibilities for on-street parking and bays for loading and unloading as well as two lanes in each direction for general traffic.

4.6.3 Sustainability Scenario

Based on Sustainable Urban Mobility Plan (SUMP) modal objectives (among others), this scenario is all for promoting mobility in a sustainable, more carbon-efficient way. In the modelling of transport demand, this is evident with a large increase in PT user and bicycle flows along the streets. However, as the commuting traffic (both going to and through the Nyhamnen streets) still has a high share of car traffic, flows risk continuing causing issues with congestion.

The area should be characterized by a constant proximity to public transport as well as having a bicycle- and pedestrian-friendly structure. However, public transportation and bicycling having good prerequisites can be conflicting to both cars and pedestrians.

As primary elements for future design options, dedicated lanes for public transport as well as for cycling should be used.

The sustainability scenario is the most representative of the City of Malmö policies in urban and traffic planning. Apart from the SUMP, it is also the most in line with the masterplans of the entire city and Nyhamnen area.

4.6.4 Liveability Scenario

This scenario focuses on the local urban life of the area and adjacent streets. The promoting of the city environment makes it possible to have people strolling along wider sidewalks, stopping by at a café or local store to make errands. However, great measures are needed to redirect through traffic efficiently and create incitements for residents and workers in the area to use other modes of transport.

The modelling of pedestrian flows is limited in terms of previous work, e.g. how it changes depending on available infrastructure and supply of street activities. However, the dialogue project supports that even though the flows are uncertain, the people along liveability streets *experience* the street as more pleasant thanks to certain elements.

As main elements to be used in the liveability design scenario are broad sidewalks, trees and cafés.

4.7 Timelines for design and appraisal

The timeline for the remaining parts of the tools 4.1 – 4.4 is presented below. There are still uncertainties due to the continued outbreak of COVID-19, especially regarding the series of physical workshops that are planned during the first three months of 2021. A change of schedule on this matter could affect when the appraisal tool can be assessed.

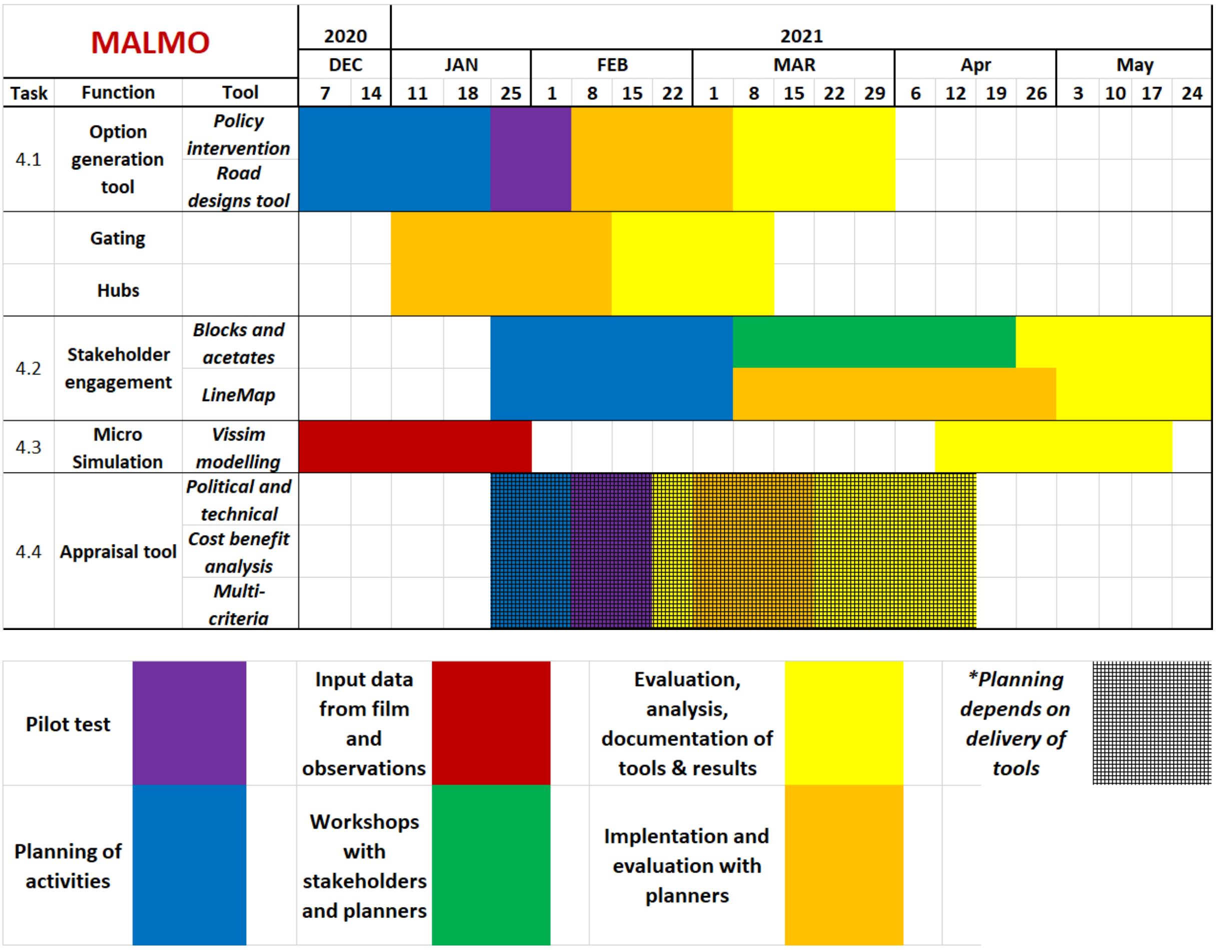


Figure 115. Timeline for design and appraisal of options for Malmö

5 LISBON - Design Methodology for future conditions

5.1 Summary of current conditions along the Feeder Route

In the following subchapters will be made a brief summary of the main characteristics of the section under analysis, that will be used to develop the model for future scenarios. Some current features such as demography and economic activities will be related with kerbside activities and traffic and pedestrian movements in order to calculate a relation that will allow to foresee future levels of demand accordingly with scenario evolution. Street design and user perception will also be highlighted in order to set out the current major issues that need to be addressed and to propose the best possible suggestions to improve the public space quality in the future.

The following analysis and characterizations will be made:

- Movement and place functions
- Demography
- Economic activities
- Kerbside activities
- Public Transport
- Traffic movements
- Pedestrian movements
- Infrastructure design
- Street users' perception of the section

5.1.1 Movement and Place functions

Firstly it is important to understand the Lisbon feeder route within the context of the TEN-T network.

Lisbon's urban feeder route is included in the Atlantic corridor that connects Europe's South-Western regions towards the centre of the European Continent, linking several ports from the Iberian Peninsula towards central Europe.

Figure 116. TEN-T Network

Figure 117. Connection between Lisbon and the TEN-T Network (Atlantic corridor)

The entrance into Lisbon is done through the E90 highway, which connects the south and the north of Portugal.

Within the urban boundaries, Lisbon's **Urban Feeder Route** starts in the neighbouring municipality of Loures as a motorway (Complementary Network defined in the National Road Plan), gradually reducing the car predominance as we get further from the TEN-T network and closer to Lisbon's centre.

The corridor serves as a major access to the Port of Lisbon but also as an important urban commuting road along the eastern waterfront of the city, densely inhabited and with heavy services sector, especially in the north part. It's also an important Public Transport (bus and taxi) route, with little or no parking on each side. Along the corridor, the axis presents different typology and crossing zones with very diversified functions:

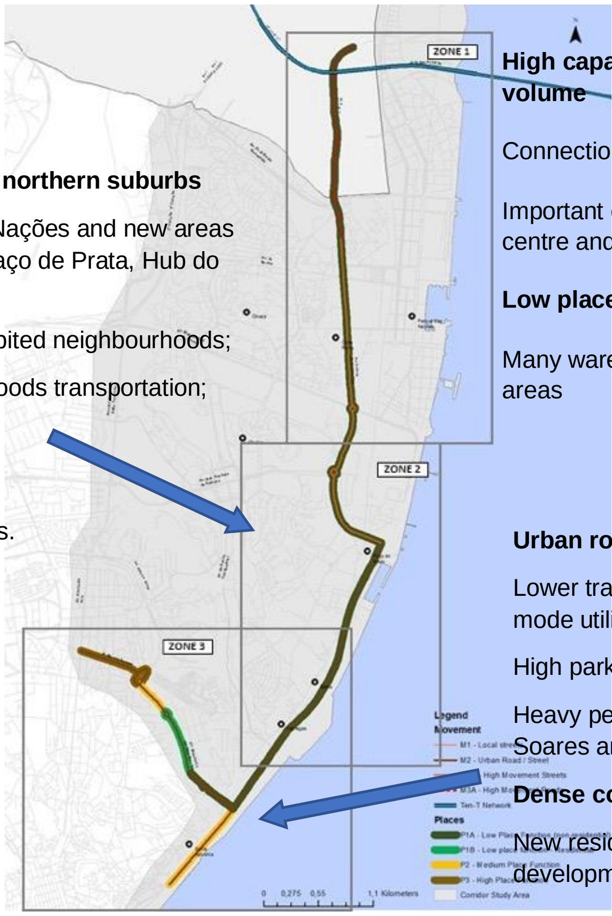


Figure 118. Place and Movement functions in the feeder route

The stress section includes Rua Morais Soares that connects Praça (Square) Paiva Couceiro to Praça do Chile. Praça Paiva Couceiro, given its relevance in the community as well as its place´s diversity is also included in the analysis.

The length of this section is around 1125m (Rua Morais Soares' section - 685 meters, plus a perimeter of 440 meters around Praça Paiva Couceiro).

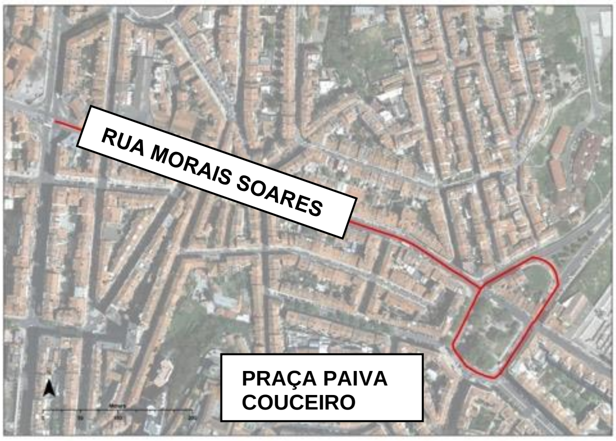


Figure 119. Stress Section

This map shows the section under analysis, some points of interest around its influence area as well as where the movements that use Rua Morais Soares can be distributed, assuming the ability of this street to spread many movement flows.

Rua Morais Soares is one of the most important roads that connect the east part of the city, and the movements that come from the TEN-T network to the city centre, namely the business and historic centre. Besides its importance in the road network, it is also a very dense commercial and service zone. It generates high levels of demand, attracting large flows of people throughout the day on different transport modes, causing several double parking problems, and with a high pedestrian flow pressure, despite the lack of comfortable and appealing conditions to walk.

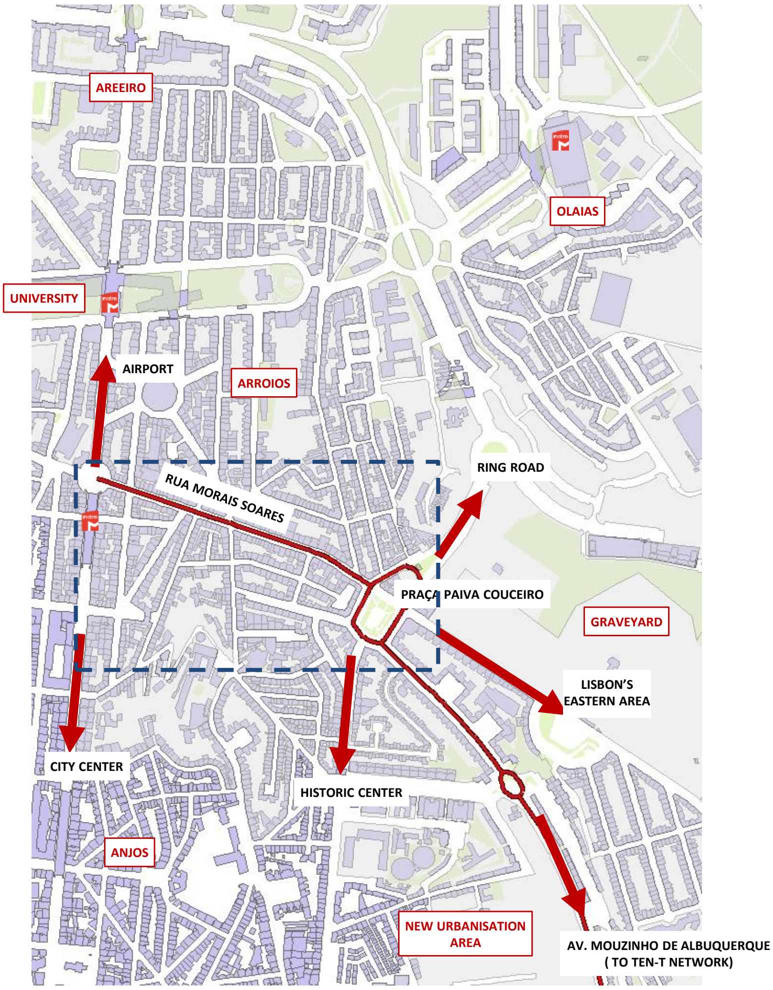


Figure 120. Location of the stress section under study and its surroundings

5.1.2 Demography

Figure 121 below shows the buildings within a buffer of 500 meters around the section with the corresponding number of residents. The divisions correspond to the subsections used by the last census to identify some demographic and economic characteristics and will also be used to define population evolution that will, afterwards, be used to foresee the consequences of future scenarios.

Since the sections have different levels of users, i.e. those passing through and others staying in the area, two buffers of 100 and 500 meters around the section were considered, which will allow the definition of different levels of access to the street. The first buffer will be used to identify demand levels of kerbside and shop users and the second one, which has a broader reach, will be used to define local traffic and pedestrian movements.

According to the last census in 2011, in the inner section, which corresponds to a buffer of around 100 meters around the section, lives 6,300 people. Considering a buffer of around 500 meters, the population rises to 32,000.

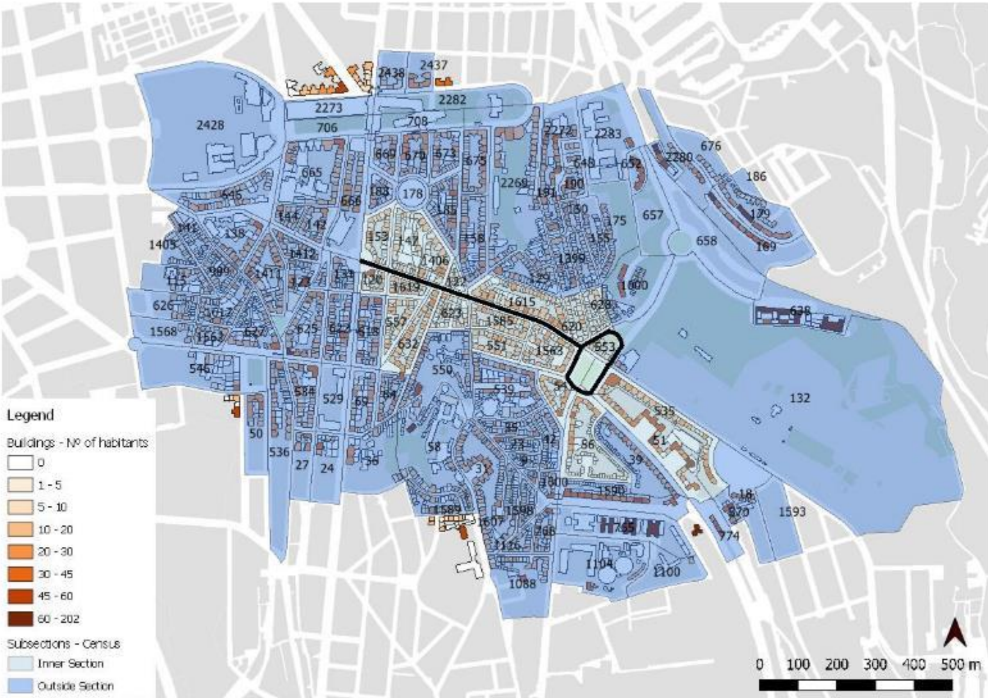


Figure 121. Population distribution around the section (Source: Census 2011)

The subsections were used as zones for the local movements of the traffic.

5.1.3 Economic Activities

In terms of economic activities, an identification and characterization work was done that currently exist in the analysed section. This area has a strong component of commerce and daily services, having a total number of 174 commercial and service establishments, the largest part (56%) of which is dedicated to commerce, like groceries, specialized food stores and common daily products.

In the following map, the type of store or services are individually identified.

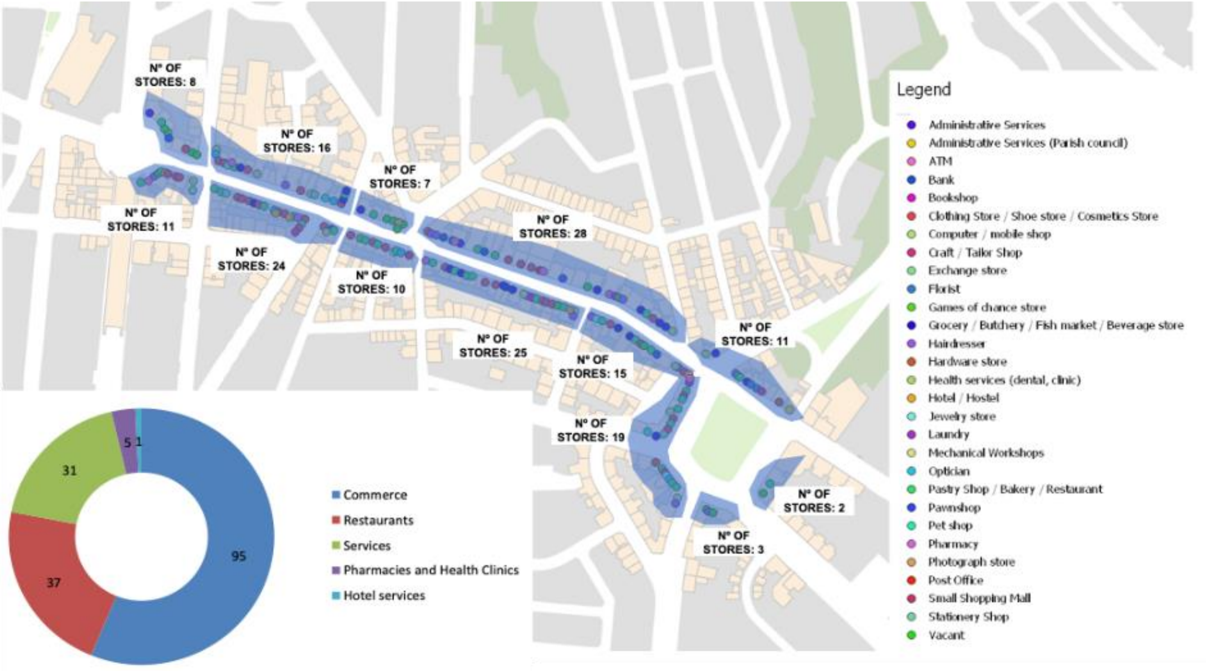


Figure 122. Number and type of stores/commerce

The number and type of stores will help identify the main origin/attraction zones which will be useful to understand place and kerbside activities. Besides, the relation between the number of stores as well as the number of parked vehicles will help to identify the number of stores by demand of load/unload parking and low rotation metered parking. With this number, it will be possible to define future parking demands according to the adopted scenario.

Figure 123 below shows the shop users' demand distributed by section. This calculation took into account a demand reference value by type of store by hour, differentiated by time period. These values will be used to support current pedestrian modelling and also to define stores' demand evolution, which will be essential to foresee public space and kerbside needs.

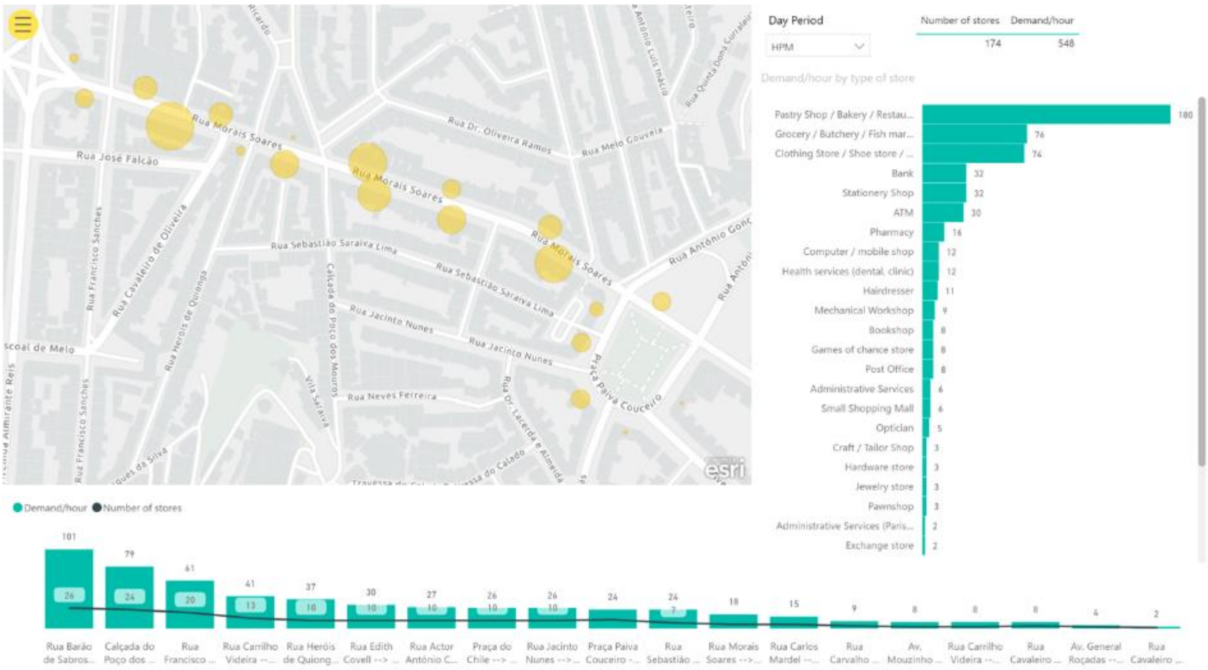


Figure 123. Place activities characterization (morning peak hour)

5.1.4 Kerbside Activities

<u>Parking Areas</u>

The analysis of the parking activities allowed to find a relation between the number of parking users and the number of stores and population living in the street's immediate surrounding. To achieve this objective, two main steps were followed:

- Identification of the parking patterns differentiating between high rotation parking users – load/unload (until 90 minutes) and metered parking (until 120 minutes), which may be considered as commerce supply and clients – and low rotation metered parking (higher than 120 minutes), which may be considered as residents' parking for the population living in the immediate street's surrounding;
- Definition of an average relation between parking demand and commerce activity and population. This relation may be used for the quantification of future demand, according with the scenarios' evolution.

The following two figures show parking behaviour, i.e. the volume of parked vehicles along the day (from 8:00 until 18:00), the average parked time and some characteristics of the parking spaces, namely their location and how long they are vacant, in percentages.

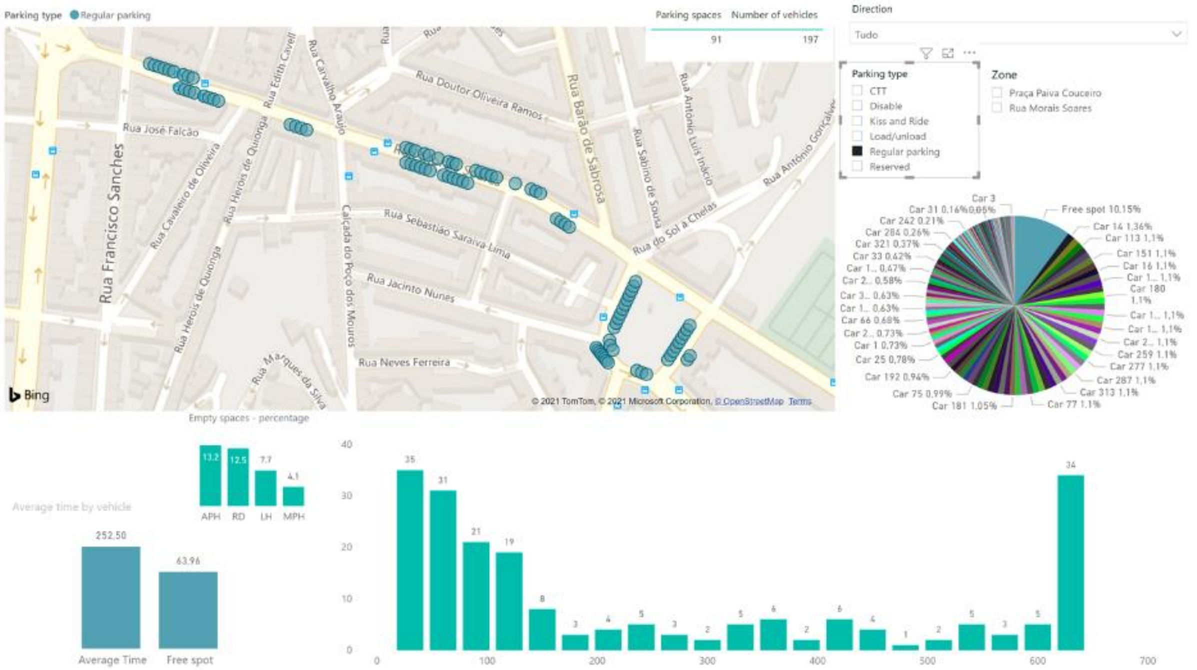


Figure 124. Metered parking characteristics

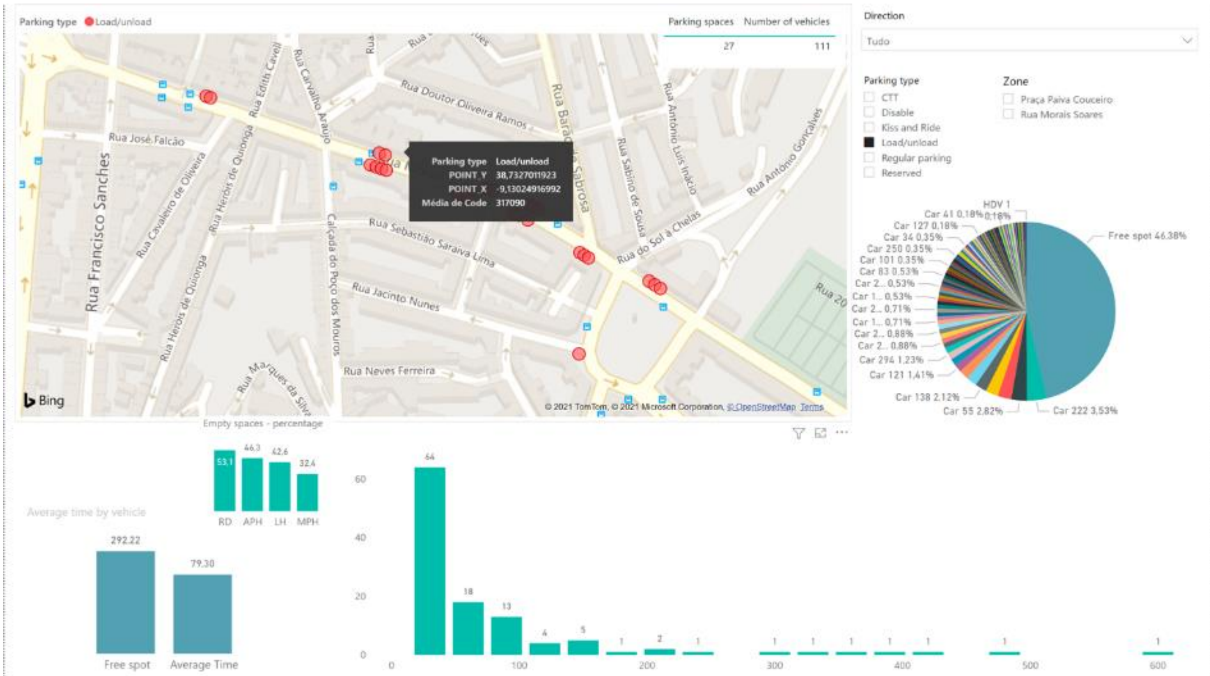


Figure 125. Load / unload parking characteristics

Considering the above-referred assumptions, the following relations were calculated to use in the future scenarios' quantification:

- **1 long term parked vehicle by each 15,4 residents, per day;**
- **1 load / unload operation by 1,6 stores, per day;**
- **1,32 parking clients by each store (considering double parking), per day;**

- **0,59 parking clients by each store (without considering double parking), per day.**

5.1.5 Public Transport

This section assumes a high relevance in the city's bus network, due to its location between the east and west sides of the city, serving as a confluence point of five bus lines that spread all over town, connecting Lisbon's east, centre, southwest and north areas.

Figure 126 below shows the number of passengers by bus stop during the morning peak hour. The number of boarding passengers assumes a very relevant point of origin and destination for the street users.

In terms of subway offer, the section under analysis is served directly by the green line through Arroios station. However, this subway station is currently closed for works (estimated to reopen in 2021) and the nearby station of Alameda, served by green and red lines, works as an alternative. Currently, one of the most important pedestrian flows is clearly influenced by Alameda Station. In a short term, with the Arroios subway station reopening, these flows should be transferred to this station.

Figure 126. Number of bus validations by bus stops, morning peak hour

Considering the number of validations, and the population within a buffer of 500 meters around the bus stops, a relation between population and bus users was calculated for the three time periods:

- **30,2 residents generate 1 public bus user, morning peak hour;**
- **36,9 residents generate 1 public bus user, lunch hour;**
- **29,2 residents generate 1 public bus user, afternoon peak hour;**

5.1.6 Demand Characterization

In order to be aware of the section's utilization by traffic and pedestrians, counts were performed in two week days in order to know the main flows and movement patterns along three time periods (morning, lunch and afternoon).

Based on the counting, the section's network was modelled using PTV Visum, both for traffic and pedestrians in order to develop different transport modes' OD matrices for the current situation that could be extrapolated for future scenarios.

The adopted methodology is described below, namely the development of the traffic and pedestrian models and their main conclusions.

Traffic Volume

According to the survey work the peak periods are between 8 and 9 AM, 12:15 PM and 1:15 PM and 5 to 6 PM. Despite the large capacity of the street, none of these periods have a huge traffic flow volume, despite some congestion problems that exist mostly due to abusive double parking. The following figure shows rounded traffic volumes in both ways in the three periods.

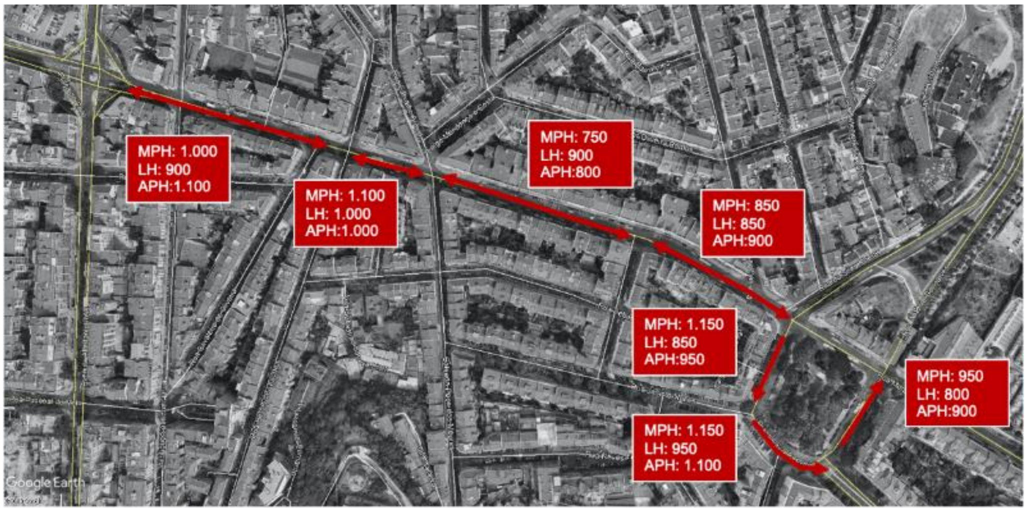


Figure 127. Total Traffic volume by time periods

According to the observed volumes of movement by each transport mode, Clearly, the car is the most used vehicle in the section, with around 80% of the total transport modes.

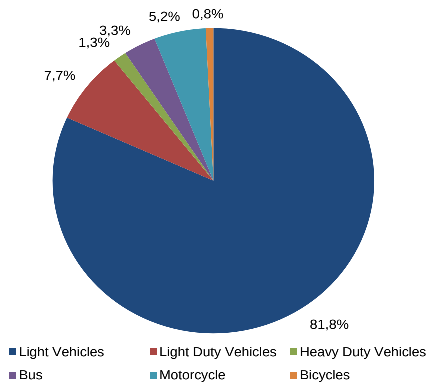


Figure 128. Modal share in the section under study

With the results from the counting, a traffic model was developed and calibrated with the objective of obtaining a relation between the existing population and the traffic movements. Considering this objective the demography sections were adopted to the model zoning as to take advantage of the existing demographic data, which will derive a correlation between these two variables that could be used to evaluate future scenarios. Figure 129 shows the traffic model zoning, considering an aggregation of the subsections used for the demographic analysis within a buffer around 500 meters around the section (which was considered as local movements). The network's design used for the traffic modelling is shown in Figure 130.

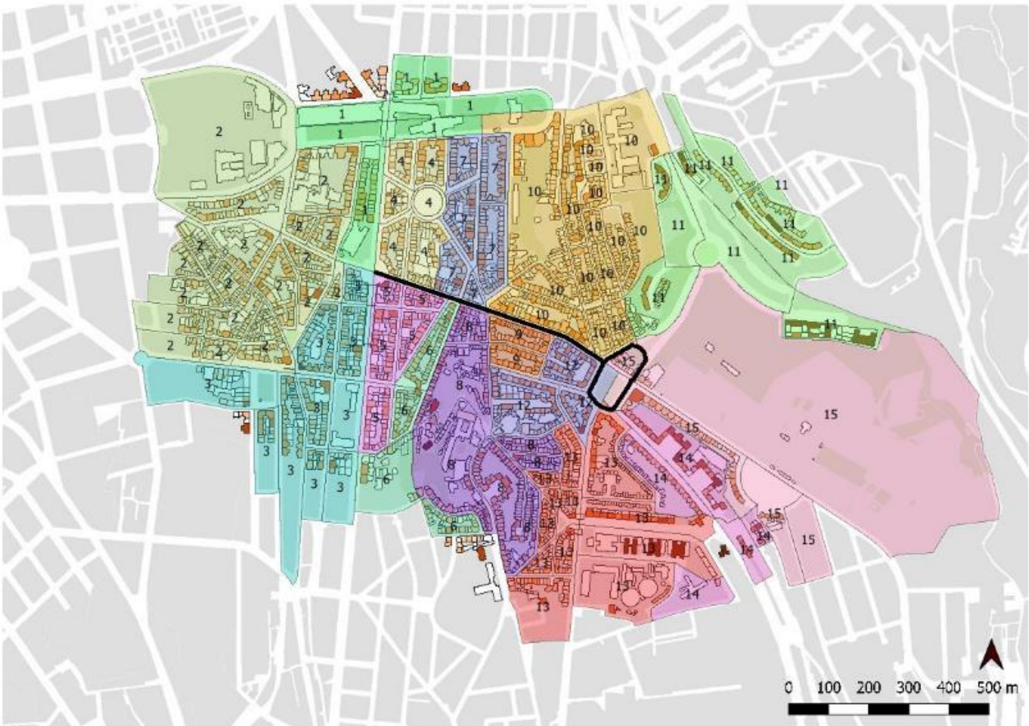


Figure 129. Traffic model zoning

Figure 130. Traffic model's network design

However, to obtain a relation between transport mode use and the number of residents, two different traffic segments were assumed:

- one with a wider scope which is the crossing traffic and has a much larger influence area;
- another one with a smaller influence area related with the local traffic.

Based on this assumption, the effects of the population evolution were analysed in two distinct ways:

- <u>Crossing traffic:</u>
    - A comparison was made between the developed section's traffic model and the existing city's traffic model developed in 2014, of which zones are on a macro level. For the city's model, the area of influence was identified, having then identified the number of residents living in those zones in 2014 (around 600,000 habitants);
    - The population was extrapolated until 2019 in order to be compared with the current situation. According with the existing forecast models, the population under the influence area increased by 2,300 habitants;
    - Since the original macro zones and the new model zones are not equivalent, a correspondence between both zoning was established. In this way, zones 1, 2, 3, 11, 13, 14 and 15 were considered like external zones and responsible for the crossing traffic. The city's model population was assigned to these zones as to allow to foresee the influence of the population on future travel patterns;
    - From the section's model, the trips between external zones were highlighted which allowed to have a comparable matrix between both time periods. According with

the results, there was a total increase of 130 private vehicles[8] trips from 2014 to 2019.
  - The comparison between both models helped to define a correlation between traffic and demand patterns based in the population variation. Each demographic change in the zones 1, 2, 3, 11, 13, 14, 15 will have impacts in the crossing traffic.
  - Each 2,300 inhabitants increase results in 130 private vehicles growth on the matrix.

- <u>Local traffic:</u>
  - To obtain a relation between the number of residents and the use of each transport mode for local access, a simpler methodology was followed. Since the model was developed for each transport mode and day period, a relation between each zone's attraction/generation and its correspondent population was defined.
  - Figure 131, as an example, shows the developed traffic model for car in the morning peak hour. A relation between the zones 4, 5, 6, 7, 8, 9, 10 and 12 population and their origin/attraction capacity was defined for all the transport modes and day periods.

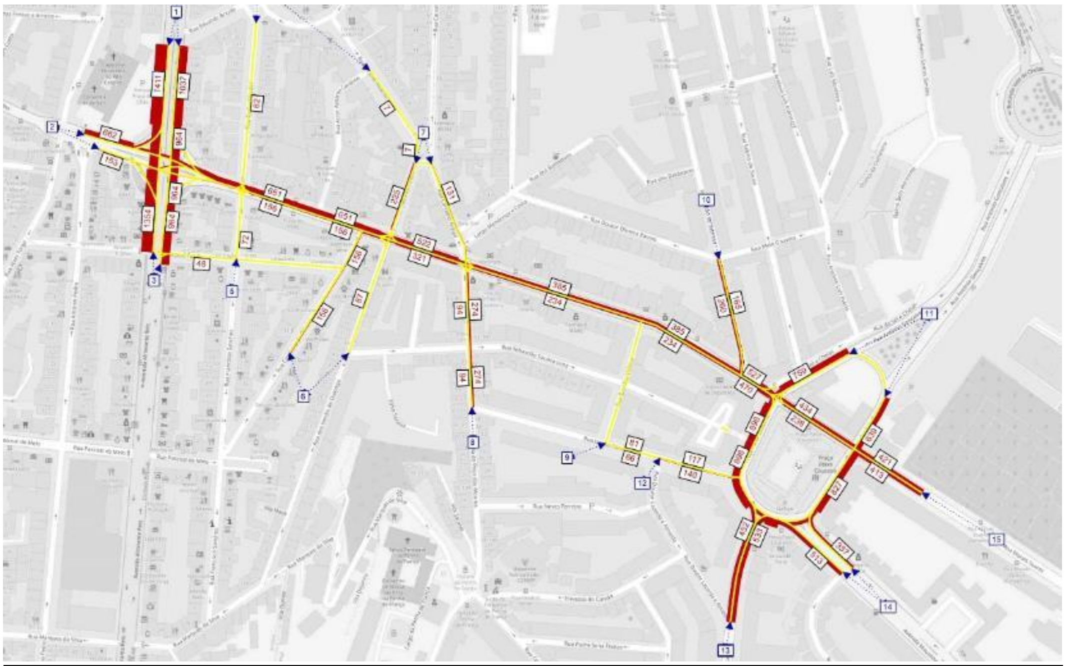


Figure 131. Section's traffic model, car, morning peak hour, 2019

The table below shows how many residents are necessary to originate one trip by transport mode, segregated by time period. These relations will be the basis for the future forecasting.

8 It was considered private vehicles since the 2014 city's traffic model doesn't make any distinction between private transport modes. The modal split obtained in the counting will be applied to this ratio.

Table 32. Relation between the number of residents and originated trips per hour, morning peak hour

Vehicles	Morning peak hour
Car	14,2
Light duty vehicles	110,4
Heavy duty vehicles	277
Motorcycles	258
Bicycles	1.240

<u>Pedestrian volume, flows, mobility patterns</u>

In order to know the main pedestrian flows and movements, on December 11th and 12th, local counting for pedestrian crossings were made in the same periods as the traffic ones.

Considering the three periods, afternoon peak hour counted more 25% pedestrians than the morning peak period and 11% more pedestrians than the lunch peak period.

According to the pedestrian counting, sections 1 and 2 and the west side of section 3 are the most overloaded areas, which may be justified by the strong connections between Rua Morais Soares' north and south zones which, use this street as a crossing point. In these sections, often, a peak period of 500 to 600 pedestrian per hour and per sidewalk is reached.

Figure 132. Pedestrian movements along the section, afternoon peak hour – Wednesday 11th December 2019

In a similar methodology as the adopted for the traffic movements, the pedestrian movements were also modelled based on the realized counting. However, since the pedestrian behaviours are more irregular, the zoning is more complex as Figure 133 may show below.

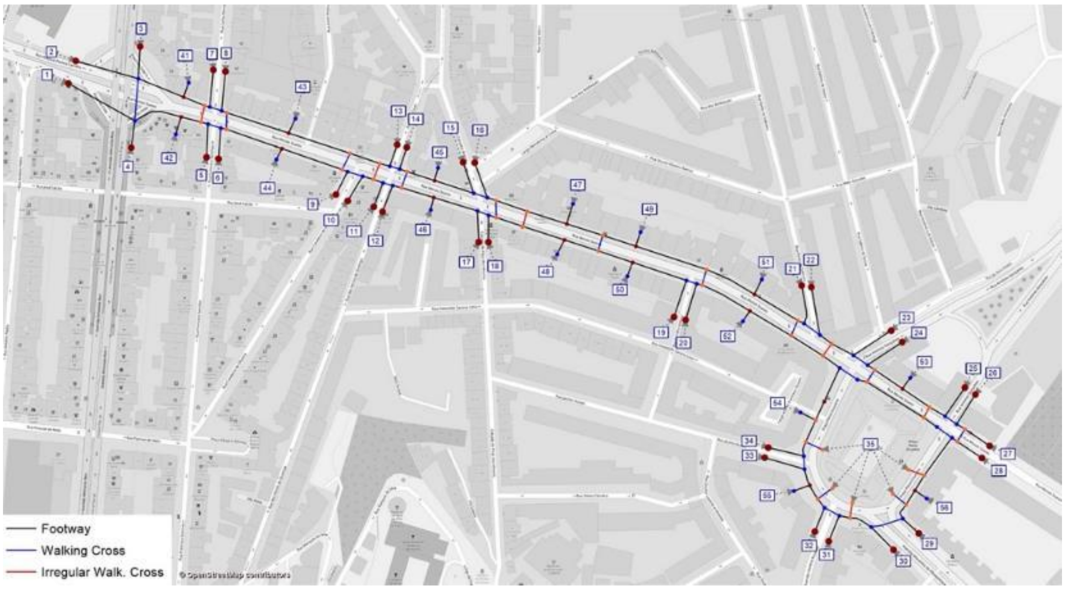


Figure 133. Pedestrian modelling, zoning

The objective of this modelling is to, as was done for the local traffic movements, get a relation between local population and the number of pedestrian movements. To do this, the buildings within a buffer of 500 meters were selected and assigned to each model zone as shown in the figure below.

Figure 134. Pedestrian model, assignment of buildings to zones

Considering the values generated by the modelling process (shown below in Figure 135) and the zones' population number, was possible to calculate the following relations:

- **Morning peak period: 1 movement generated by each 6,90 habitants**

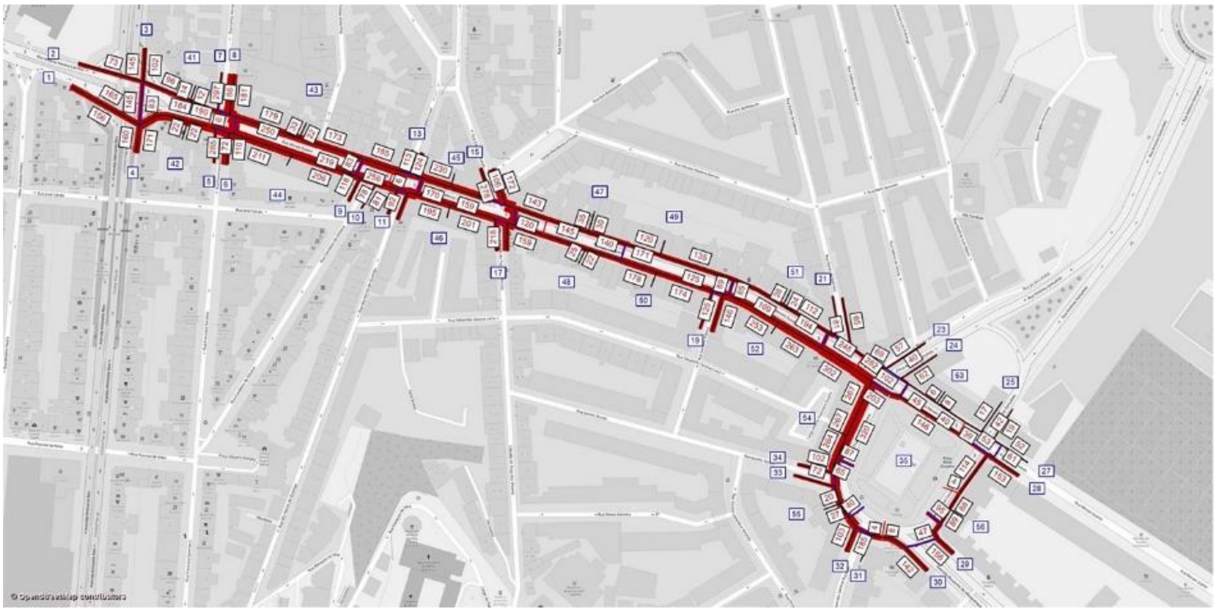


Figure 135. Pedestrian modelling, 2019, morning peak hour

<u>Modal Split</u>

Besides counting, a survey was made to residents/visitors of the street as well as to shopkeepers. One of the questions was about the used transport mode to move to the section. The values presented in the following figure may help to review and constrain the above referred relations' values.

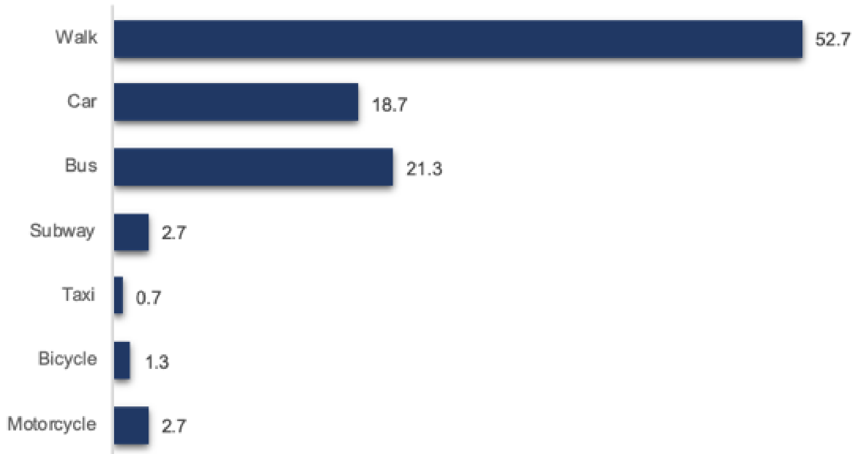


Figure 136. Mobility patterns' survey - Modal split

5.1.7 Infrastructure and supply characterization

Number of lanes

This section has a very homogeneous number of lanes along Rua Morais Soares in contrast with Praça Paiva Couceiro, that has different number of lanes in different sections.

The following figures show the number of lanes and respective directions in Rua Morais Soares, Praça Paiva Couceiro and in the cross-cutting streets that access to them.

There is only one bus lane in operation, although there is an intention of implementing two bus lanes in Rua Morais Soares, one in each direction.

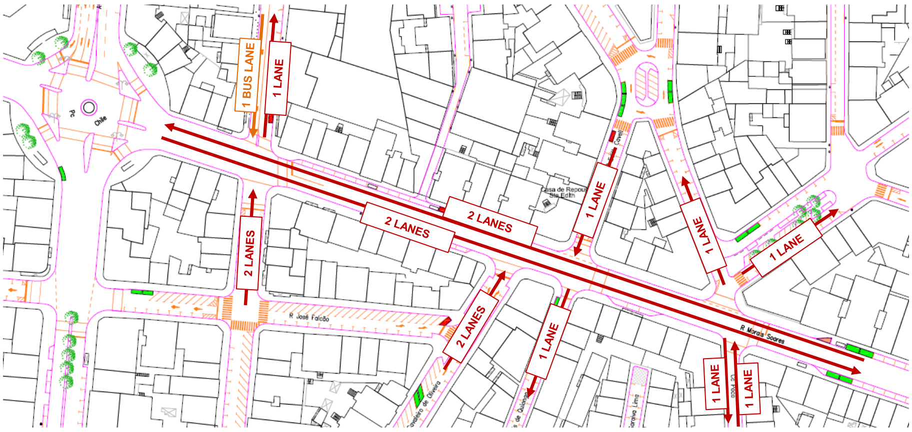


Figure 137. Number of lanes in Rua Morais Soares and in the traversing streets (Section between Praça do Chile and Calçada Poço dos Mouros)

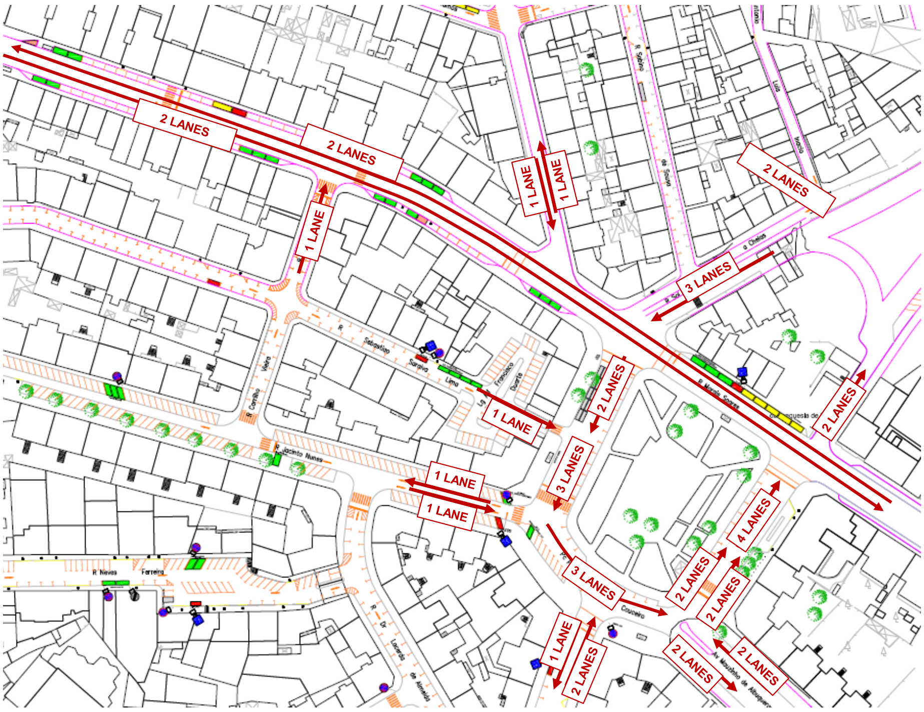


Figure 138. Number of lanes in Rua Morais Soares and Praça Paiva Couceiro and in the traversing streets

Pedestrian available space

Rua Morais Soares street profile is mostly dedicated to traffic flow and parking bays. The sidewalks are usually very narrow, frequently with less than 1,80 meters, which is clearly insufficient for the large number of pedestrians that use the street. Often, the sidewalks are occupied by several objects, like traffic signs, garbage bins and, frequently, shops' furniture shortens the sidewalk width and creates obstacles for people walking.

Other problem in this section, which relates to the limited area provided for the people, is the lack of spaces available for people to rest and meet and the absence of shade, which is not adequate for the high flow and demand generated by the street's diversity. Besides this, many street users are elder or have mobility problems, and require more comfortable walkways and places to stay.

The following figure is illustrative of the usual street profile along the corridor.

Figure 139. Cross-section of Rua Morais Soares between Calçada Poço dos Mouros and Rua Carrilho Videira

In Praça Paiva Couceiro, the characteristics are very different, especially because the available space is much larger, despite vehicles (flow and parking) being massively present, all around the square. The road contours a garden in the middle of the square that has a lot of places for people to stay, with shade, whereas the other side of the road has large sidewalks that are used to install esplanade and other stores' furniture.

However, Praça Paiva Couceiro is the crossing point of two important city's ring roads which causes heavy traffic flows. This, combined with a wide street profile around the garden, invites higher speed driving, enhances conflicts between vehicles and pedestrians and increases, for instance, pedestrian crossing insecurity and noise problems.

It may be said that despite the large sidewalks that exist here, complemented by places to stay and sit, with plenty of trees to provide shade in both sides of the square, the width of the street causes a great barrier for people, especially considering the age and mobility conditions of most of the people who use this place.

The following figure shows a cross-section that demonstrates these considerations.

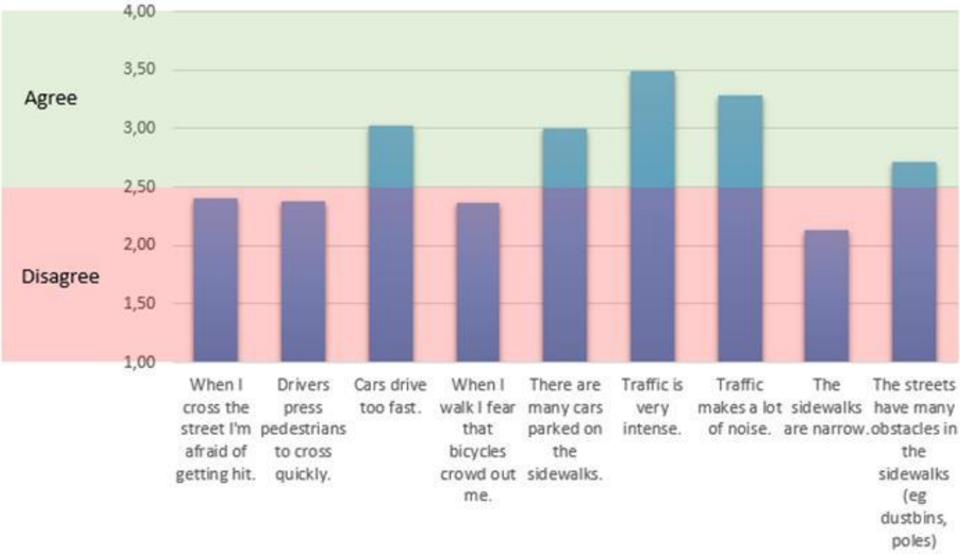
Figure 140. Cross-section of Praça Paiva Couceiro between Rua Morais Soares and Rua Jacinto Nunes

5.1.8 Zone's perception

Besides counting, a survey was made to residents/visitors of the street as well as to shopkeepers. The survey was made by 150 street users, 120 visitors, 30 residents, and 50 shopkeepers, with the aim of gathering data about their mobility patterns but also their perception about different section's aspects.

Several statements were elaborated about the area under study. The interviewees had to agree or disagree in a 1 to 4 scale, in which the 1 means "totally disagree" and 4 "totally agree".

Regarding road traffic, the interviewees agreed that the vehicle speed is too fast, the traffic volume is too high, the street is too noisy and there is too many cars parked/stopped on sidewalks. In a safety level, there is a common sense of security in the street and the lightning is good. Regarding pedestrian accessibility there were more diverse opinions about the sidewalks width, despite most of the people agree that there were too many obstacles in the sidewalks. Other very important characteristic is the lack of places to rest.



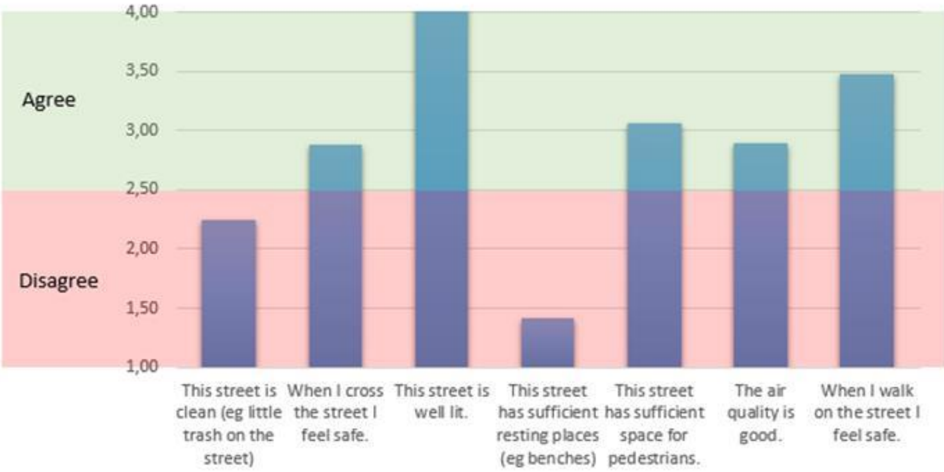


Figure 141. Mobility patterns' survey - perception about the zone

5.1.9 Analysis summary

The table below shows a brief summary of the adopted relations referred in this chapter, differentiated by subject.

Table 33. Summary of the calculated relations, morning peak hour

	Morning peak hour
Crossing Traffic movements	
Car	1 mov. per 21 hab.
Light Duty Vehicle	1 mov. per 222 hab.
Heavy duty vehicles	1 mov. per 1.316 hab.
Motorcycle	1 mov. per 329 hab.
Bicycle	1 mov. per 2.139 hab.
Local traffic movements:	
Car	1 mov. per 14,2 hab.
Light Duty Vehicle	1 mov. per 110 hab.
Heavy duty vehicles	1 mov. per 277 hab.
Motorcycle	1 mov. per 258 hab.
Bicycle	1 mov. per 1.240 hab.
Pedestrian movements:	
Pedestrian	1 mov. per 6,9 hab.
Public transport:	
PT Users	1 mov. per 30,2 hab.
Kerbside activities	
Residents parking	1 long term parked vehicle by each 15,4 residents
Load / unload operation	1 load / unload operation by 1,6 stores
Clients	1,32 parked vehicles by store (considering double parking) 0,59 parked vehicle by store (without considering double parking)

5.2 Future conditions in the Wider Impact Area

In the current chapter, an overall identification of the variables that are used to forecast future patterns of demand is made. The following variables are considered in all forecast scenarios with different implications in the model:

- Demographic evolution:
  - The demographic evolution will support the future demand model since all the transport modes' use are based on the current demand which is correlated with the current demographic conditions as well as in the number of services located within the street's immediate boundaries. The Eurostat projections shown in the current chapter will be used as the basis of the demographic evolution defined by each scenario.
- Land use development in the section's influence area;
  - The land use developments within the section's influence area will have a major impact in the demand model. Vale de Santo Antonio's urbanization plan, as well as the traffic restrictions in the city center should have a big impact on the crossing traffic. The reopening of the Estação de Arroios should also have a significative impact in the pedestrian flows.
- Additional transport modes

  In a long term period, some additional transport modes should arise and incrementally increase their significance. In this chapter, some of the most expectable ones are identified, being some of them considered already in the traffic's model or/and in the future microsimulation model.

5.2.1 Factors affecting future levels and patterns of demand

In this chapter, the factors that are traditionally used to forecast future patterns of demand are going to be analysed. Among the considered factors are demographic (population and its age structure and populational density), economy (GDP evolution) and employment rates.

Demographic analysis

The demographic evolution study was based on the "Demographic scenarios for the EU" (2019), being considered three of the scenarios that were developed on this study: (i) Central scenario, (ii) Zero International Migration (ZIM), (iii) High immigration scenario. The below graphic shows the behaviour of the population living around a buffer of 500 meters around the section under analysis considering the above mentioned growth rates.

According with the last census projected for the current situation, in a buffer of 500 meters around the zone, currently lives a population of 32.000 habitants. All the EU Demographic scenarios, for the following 30 years, project a population reduction: 2% for the heavy migration scenario, 4% for the baseline scenario and 8% for the no migration scenario.

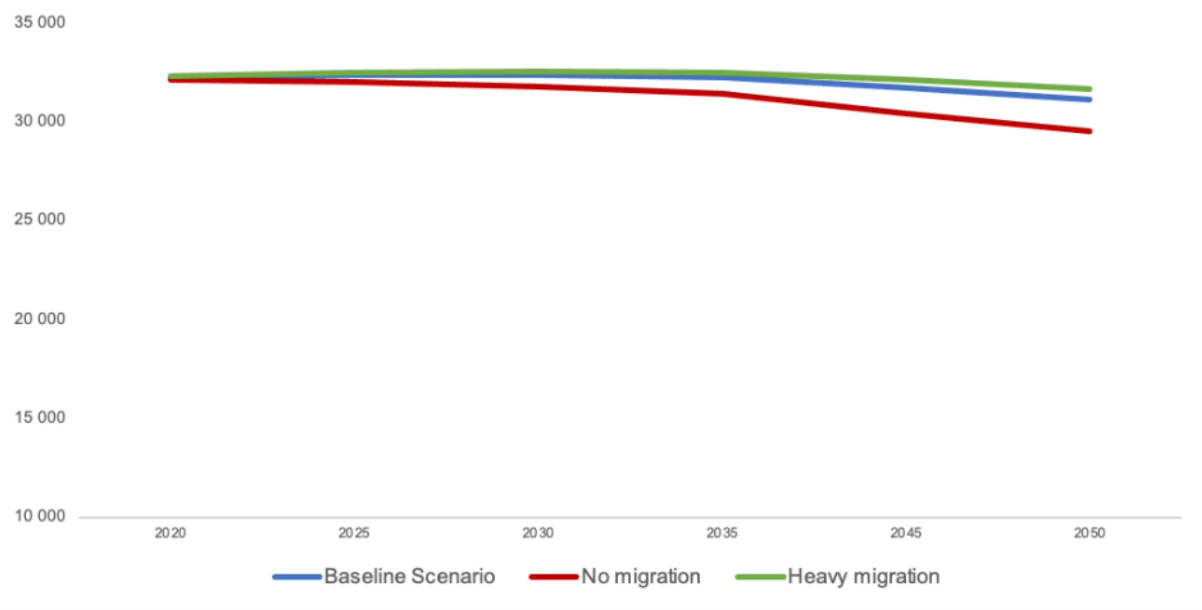


Figure 142. Population forecast for the period between 2020 and 2050[9]

Considering the baseline scenario demographic evolution, the population density evolution around the section was evaluated. Population projection was made, considering subsections' data used in the last census that allowed to identify if any significant change occurs between 2020 and 2030. However, as may be observed in the next figure, there shouldn't occur major changes in the zone which remain very densely populated.

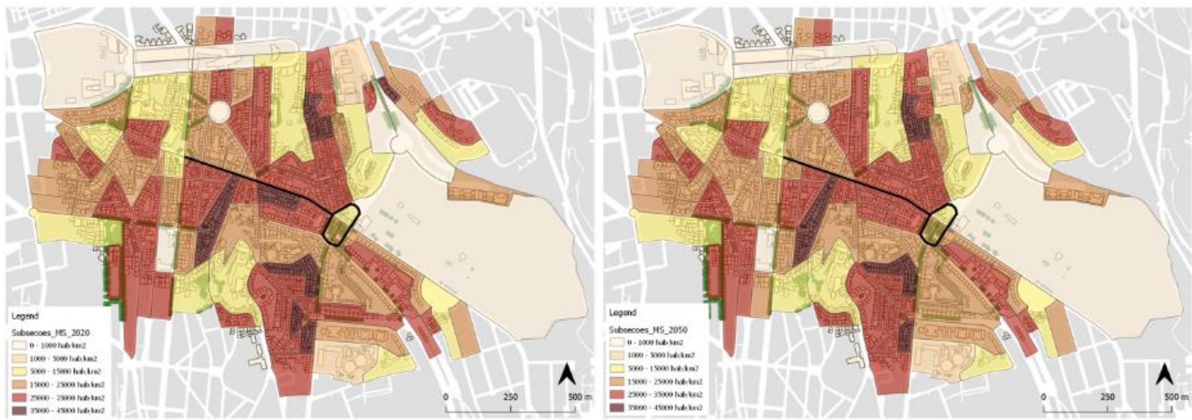


Figure 143. Population density evolution (2020 - 2050)

[9] Source: Demographic scenarios for the EU, 2019

Although the number of total population won't suffer a high impact, the age structure will be significantly different. The figures below show the current age structure for the population around the analysed area and its evolution until 2050, according with the baseline scenario's statistics by the European Commission.

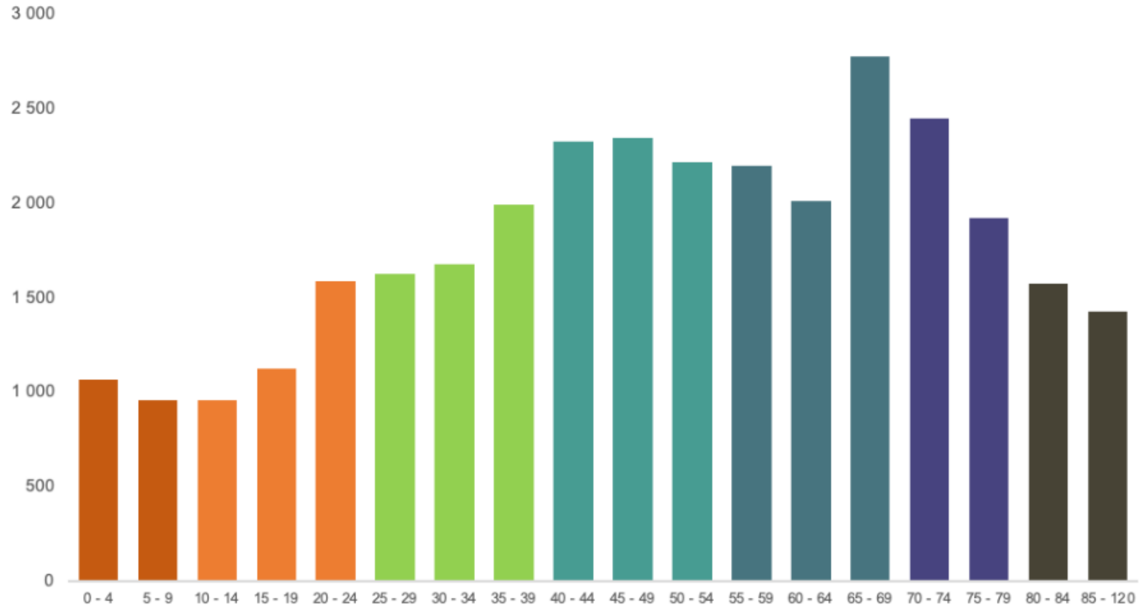


Figure 144. Age structure population for a buffer of 500 m around the section, 2020[10]

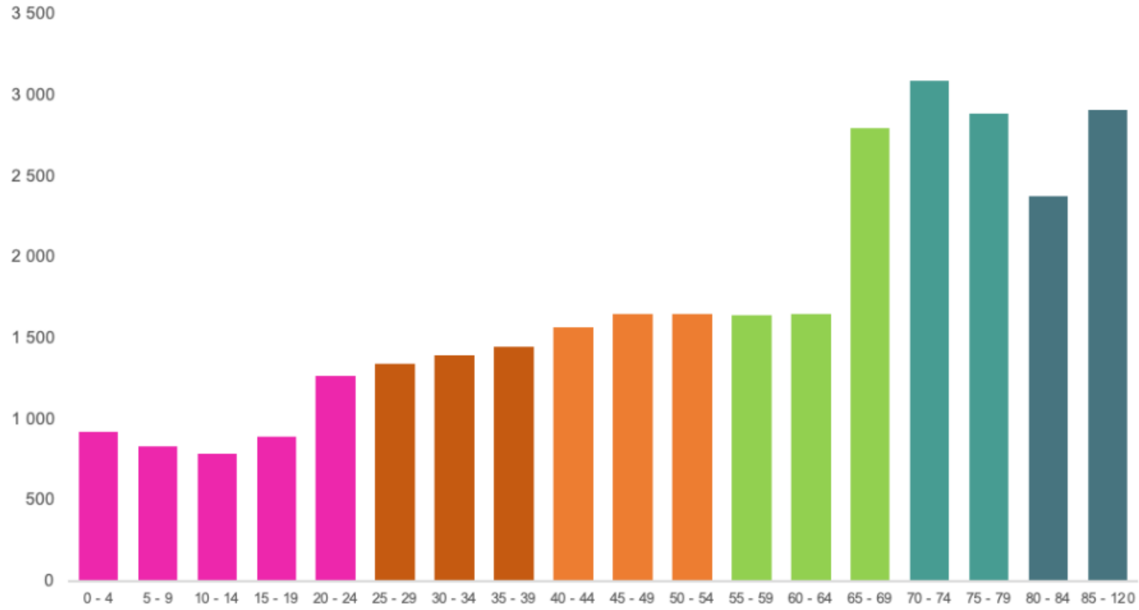


Figure 145. Age structure population for a buffer of 500 m around the section, 2050

[10] Eurostat projections 2020 – 2050 (https://ec.europa.eu/eurostat/data/database)

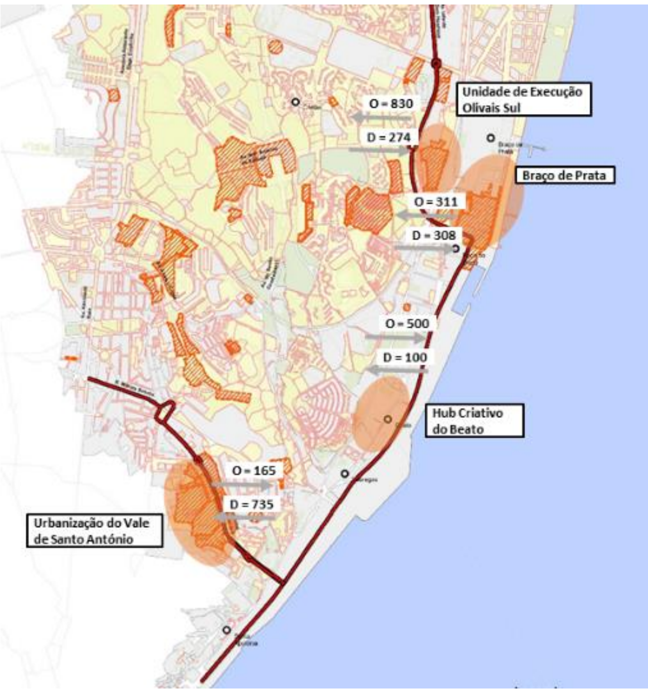
The graphs show that the area is populated by an ageing population with low values of young residents. As long as time goes by, this tendency exacerbates, increasing the gap between older and younger population.

Land Use

Besides demographic evolution, land use changes will occur that will influence mobility patterns and flows and will eventually cause a change in the area's demographic characteristics. Among the considered changes are an urbanization and requalification of several land plots, interventions in the subway line and also a creation of several restrictions in the vehicle access to the city centre, which may have a significant impact in the section under study.

In the following, a detailed explanation of each one of the measures is made.

Interventions



Braço de Prata:

Construction of a residential area with nearly 500 flats, associated with public space requalification.

Vale de Santo Antonio's Urbanisation Plan:

477.000 m2 intervention area, to urbanize and construct a new residential (3150 flats) and new shopping areas; Most of these new flats will be integrated in Lisbon municipality' Low Rents program.

Hub Criativo do Beato:

Reconversion of a former army factory complex, with 35.000 m^2, aiming to develop a new business centre related to technology, innovation and creative industries

Consequences

Demography

It is expected that Vale de Santo Antonio will significantly increase the population (between 6,000 and 9,000 habitants), attracting families and youngsters to the area encouraging a generational turnover. The proximity with Hub Creativo do Beato which is being built to be an innovative and ecological business centre focused in the development of start-up companies, may help to attract a younger generation to the zone.

Braço de Prata shouldn't have a major impact in the section's demography.

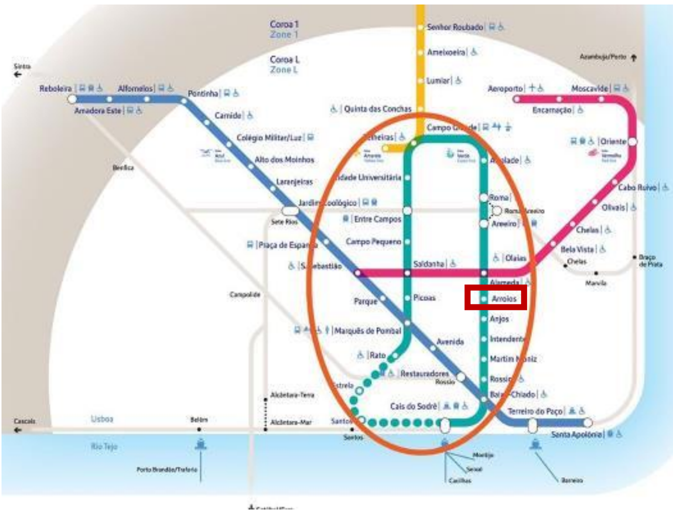
Economic vitality

Both Vale de Santo António, with new shopping areas, as well as Hub Criativo do Beato should contribute to a renewal of commerce and businesses. The created services and commerce should be more oriented for daily and proximity consumption than other type of activities that could attract people from other parts of the city.

Mobility

According with the foreseen values, the total implementation these three plots will be responsible for a huge traffic increase, from 1,800 vehicles to around 3,300 vehicles (afternoon peak hour). However, public transport should be reinforced and the demand for other active modes, as well as new transport modes, may increase significantly due to younger generations that are expected to live and use these zones.

Interventions



<u>Change in the subway lines</u>

Creation of a circular service in the city's centre. This will increase the number of services and the headway and will allow a better connection between the city and its surroundings.

<u>Arroios subway station reopening</u>

This station that serves directly the stress section is closed for works to extend its platform. It is planned to reopen in 2021.

Consequences

<u>Demography</u>

The interventions in the subway network are not expected to have significant influence in demographic changes since it is not a new station but a renovated one.

<u>Economic vitality</u>

With the subway network's longer and faster range, some economic activities near the station may suffer a positive impact. However, since this is not a new station and the area is covered by a good bus network it is not expected to provide a major impact by itself.

<u>Mobility</u>

The station's reopening will change current pedestrian flows, since many people that currently cross the section in direction to Alameda's station will move to Arroios. In terms of modal split, a significant number of bus users should be transferred for the subway. Car and ride sharing modes should reduce slightly.

Interventions	
	<u>Downtown restrictions</u> It was announced in the beginning of 2020, that the historic downtown area of Baixa-Chiado would have restricted vehicle access until August 2020. This measure had the intention of reducing 40% of the daily vehicles in the downtown given priority to public transport, pedestrians and active modes. However, due to Covid 19, this measure had to be postponed but it still remains as a priority for a near future.

Consequences
<u>Demography</u> The implementation of this measures shouldn't have any significant impact on the street's demography. <u>Economic vitality</u> It is not expected that the implementation of this measures would have any significant impact on the street's economic vitality. However, in the medium term, this intervention may boost a new vision of mobility, encourage the use of other active modes, having positive impacts on the street's activity. <u>Mobility</u> It is hard to forecast the impacts on the section's traffic due to the implementation of these restrictions. However, since the restriction in the city centre is more focused in the crossing traffic, Rua Morais Soares and Praça Paiva Couceiro may suffer a significant road traffic increase since they are alternative axes for the movements between the centre and the eastern side of the city.

Besides, the above referred measures there are some intentions to implement directly in the section under study, but which are not yet clearly defined and, for that reason, are not detailed:

- Creation of a parking lot in Praça Paiva Couceiro's underground, that could solve some lack of offer for customers but mainly for residents;

- Elimination of road traffic on the west side of Praça Paiva Couceiro, transforming it in a continuous pedestrian road. The road on the east side, which is currently a one way road, has to be transformed into a two way one. The implementation of this intervention could reduce traffic speed, improve safety for pedestrians and create a continuous space between the square and the sidewalk, in contrast with the current situation that gives the feeling of being on an island.

Figure 146. Potential move to eliminate road traffic on the west side of Praça Paiva Couceiro

5.2.2 Additional Transport Modes

Besides evaluating future mobility patterns based on demographic and economic factors, it will also be evaluated the impacts of new type of transport modes that currently don't exist or, at least, aren't broadly used. Among several new transport modes that may appear in the near future, the following five may be the ones that may cause a major impact on mobility in a short and medium term:

- Automated driving – this will reduce parking needs which will allow to create more space for pedestrians and other transport modes. However, it probably will increase congestion and reduce public transport use. Safety for vulnerable users would improve.
- Electrification of vehicles - the use of electric vehicles increases which, when cheaper than combustion vehicles, may invite people to use car which may increase congestion. Noise and emission levels reduce.
- Use of drones to deliver freight or even 3D printing - may have a positive impact in the number of load/unloading operations and use of public space.
- Use of smart traffic optimization (UTOPIA) - increase public transport attraction by giving priority at intersections
- Creation of parking slots, or intelligent kerbside management – Efficient use of parking, especially for load/unload operations, which may allow to increase public space using those parking spots, during some periods. This may allow to increase the place's attractiveness, inviting street users to use those places (restaurants, stores, rest places).

In the next chapters, it will be analyzed how the new technologies can be accommodated in different scenarios and their impacts on mobility patterns.

5.3 Future patterns of demand in the Wider Impact Area and along the Feeder Route

The current chapter will describe four different scenarios for the section, each one with their own characteristics and impacts on demography, local economy and mobility. Each scenario will foresee mobility demand, considering, as basis, the known demand values described in Chapter 5.1, as well as the current demography and its evolution identified in chapter 5.2. Each variable evolution will be defined according to each scenario's characteristics, depending on what is expected to occur. These variables will be used on the traffic and pedestrian models.

5.3.1 Scenarios' Development

In order to forecast what future patterns of demand along the section under analysis are going to be, four scenarios were developed. Each scenario is a picture of one possible future set of circumstances to which the proposed set of measures for the section have to consider. The scenarios describe possible futures where the contextual environment is significant different leading to varying impacts and consequences in mobility that should be take into account.

The developed scenarios aim to create 4 different community visions, based on the type of population or zone users and in generational characteristics in which the technology and some imposed restrictions may perform a central role.

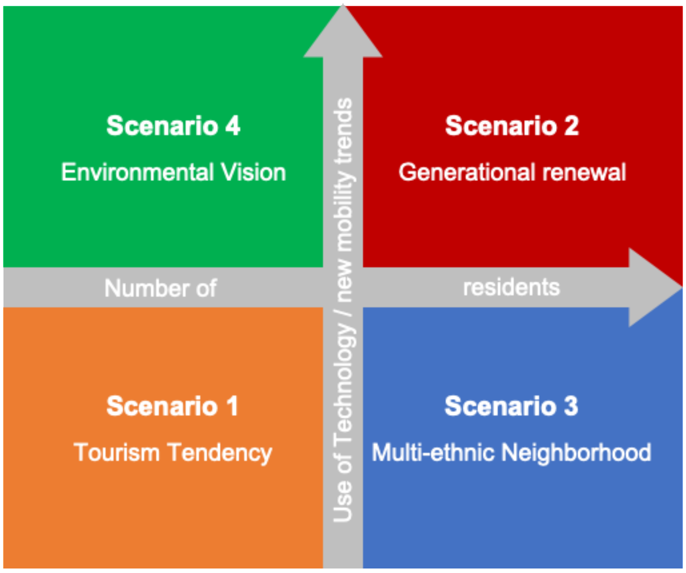


Figure 147. Considered scenarios for the section under study

As to work on the above-referred scenarios' development a list of factors was identified and separated into two groups: transactional and contextual. The transactional environment considers "The group of actors with whom the city conducts transactions (and over which the city has some influence)"[11]. The contextual environmental consists of "factors over which the city has little or no influence but which have the capacity to affect the city significantly. This may be other countries' policies, environmental changes, technological advances, socio-economic shifts, migration, developments in the energy sector etc."[12]

[11] Deliverable 3.3: Future scenarios for TEN-T feeder routes
[12] Idem

In the following table, a list of elements, segregated by the contextual and transactional environments, identifies which ones would have the largest potential effects and those which are more uncertain.

Table 34. List of elements in the contextual and transactional environments

Contextual Environment	Transactional environment
National politics – Greatest uncertainty	Mobility Measures - Largest potential effect
Employment Politics – Greatest uncertainty	Housing policy* - Largest potential effect
Climate - Greatest uncertainty	Real estate developers* - Largest potential effect
Environmental Accords	Safety - Largest potential effect
Public Investment - Greatest uncertainty	Freight transport and parking - Largest potential effect
Health - Greatest uncertainty	Technological tools implementation - Largest potential effect
Export/Import - Greatest uncertainty	Public Transport Operators
Population ageing – Largest potential effect	Taxis and other private transport operators - Largest potential effect
Socio-demographic profile - Largest potential effect	Micro-mobility operators
Macroeconomy - Greatest uncertainty	Associations
Technological Development - Largest potential effect	Healthcare investments*
Aviation Industry - Largest potential effect	Land Development*
Energy - Largest potential effect	Electric vehicles usage
Property prices - Largest potential effect	Residents
Social and work behaviors - Largest potential effect	
Tourism - Largest potential effect	

After identifying the list of transactional and contextual environments it was chosen the following list as the most relevant drivers of change that would have a higher impact on the street:

- Demographic and population ageing;
- Tourism
- Social habits or behaviour
- Commerce
- Technological developments
- Employment
- Cost of living

For each one of these elements, two different directions to change were devised. Then, three or four statements were written as to underly a narrative that might explain this set of changes.

The next step after writing alternative storylines, was to combine them to develop a full scenario, looking to distribute elements with the largest potential effects and/or greatest uncertainty as evenly across the scenarios as possible. The association of the storylines allowed to develop 4 scenarios based on four contextual environments with very different impacts on mobility:

- **Scenario 1** is based on tourism growth, which will help to redefine existing commerce and services in the street section and its impacts on demography and economy.
- **Scenario 2** relies on the success of some housing policies and the emergence of some clusters of technology start-up companies in the zone's area of influence, that will attract a younger generation to live in the section.
- **Scenario 3** assumes a significant increase in immigrant population moving to this section, and surrounding areas, changing the type of commerce and rejuvenating the residents.
- **Scenario 4** considers the hypothesis of large restrictions to combustion vehicles circulating in the city center and its surroundings and the progressive transformation that can occur in the economy and demography in this area.

Below, each scenario is described, through the association of storylines written for each of drivers of change with largest impact.

<u>Scenario 1 – Tourism Tendency</u>

- Lack of capacity to attract young population and, simultaneously, AirBnb grows and consequently cost of living too. This effect will, in a medium term, decrease population.
- Airport increases capacity by 50% - tourism grows as well as Airbnb;
- Due to Covid-19, real estate prices reduce. This will be exploited by foreign investment, without intention to live in the area but to build hotels, guest houses or high-income resident houses. In a medium term this type of investment will increase the living costs, becoming inaccessible to younger generations and families;
- The neighbourhood becomes trendy or hipster, due to tourism demand, which will attract also visitors on weekends. Some expensive stores open.
- Cost of living, especially rent prices, increases leading to a gentrification of the zone. Due to this, some low income and traditional stores will close, and some house rents may become unaffordable to most habitants. In this context, the sense of identity with the neighborhood may be lost.
- Lower traffic in the rush hours but higher traffic volume in off peak periods. Some touristic and traditionally disorganized transport modes like tuk tuks grow. Tourism buses become common.
- Due to ride sharing and taxis use increase, and lower demographic levels, parking residents demand will reduce. In contrast, some hotels as well as some exclusive stores will open, demanding space to park around them to their customers.

Scenario 2 – Generational renewal

- Low rent program is a success, which allow to attract young people to live in the area, taking advantage of the universities and companies hubs are created in the surroundings.
- Creation of employment hubs near the section continuously supports start-up companies in the city.
- Rise of teleworking. Number of journeys, especially during rush hours will decrease. However, younger generations, which are traditionally more able to do teleworking, rather live outside the city due to the cost of living and to avoid daily commute.
- Home deliveries users have a high increase, demanding increasingly faster deliveries, which the existing traditional stores may not be able to follow, leading to their decline;
- Younger generations with lower average income, which won't be attractive to some expensive stores;
- Parking demand for residents will reduce, since younger generations don't appear to attach as much importance to car owning. However, for families, the perception of the need to own at least one car by household will remain which will still make pressure on parking demand. On the other hand, the increasing use of transport modes sharing will increase the demand for parking of those transport modes (car, scooters, bicycles, etc.)
- Parking for customers and load/unloading demand will reduce since some traditional stores will close.
- Taking advantage of lower rents, several vacant building spaces will be recovered and modernized, increasing zone's attractiveness for younger generations;
- Automated driving increases, which reduces parking needs and, consequently, space for pedestrian and active modes becomes available. However, autonomous vehicles tend to move instead of parking which may increase traffic volume. However, it is expected that safety for vulnerable users increases.
- Use of drones to deliver freight or even 3D printing may have a positive impact in the number of load/unloading operations and use of public space.

Scenario 3 – Multi-ethnic neighborhood

- Number of immigrants grows in the area, slowly substituting older residents. However, following the tendency of the last years, as long as immigration population rises, types of commerce also changes, losing the authenticity of the street commerce.
- As long as immigration grows, the population renews and families with children live there.
- The zone becomes multi-cultural and multi-ethnic;
- Traditional stores are progressively replaced by conveniency, cheap and varying quality stores and also by stores dedicated to sell ethnic products.
- Commerce is more focused in local supply and less attractive for population from outside in a daily basis; In contrast, during weekends, the neighborhood has capacity to attract visitors to its stores and restaurants.
- Stores' differentiation declines, decreasing their capacity to attract daily users from other places;

- The residents usually don't own a car, so parking pressure for residents will reduce. However, parking demand for customers and load/unloading operations increases.
- The use of public transport increases substantially.
- Curiously, the rise of families and the kind of stores will boost some traditional behaviour, through the local commerce attending, use of active modes, like walking and riding bicycle, the use of public space to live in community.
- Emergence of some tension between the existing and new residents.

Scenario 4 – Environmental Vision

- Several restrictions for combustion vehicles are imposed in the city centre and its surroundings (inclusively in the street under study), in conjunction with a strong public transport reinforcement;
- The zone becomes more attractive for a population from upper and upper-medium class, not relying on car;
- Cost of living, especially rent prices, increases leading to a gentrification of the zone which conducts to the closing of some cheap and traditional stores and some house rents may become unaffordable to most inhabitants.
- The zone becomes less attractive to families whom, most likely, will live in other zones.
- The type of commerce slowly changes for a mixture of stores for daily local supply, and also some art galleries and expensive stores will open, being able to attract weekend visitors. However, the sense of neighborhood's authenticity will disappear.
- Hotels or Hostels will arise.
- Some stores and hotels will demand parking space for costumers and load/unloading operations. Possibly parking pressure on weekends will be higher.
- The use of ride sharing increase significantly, as well as active modes. Parking demand for ride sharing, car sharing, bicycles or other micro-mobility systems will rise. The use of public transport may reduce.
- The use and own of electric vehicles will increase significantly, since circulation and parking of electric vehicles is usually much less restricted. If, in a short term, residents parking pressure reduces, in a medium term it will possibly grow again and with another type of requirement as public chargers.
- Automated driving increases, which reduce parking needs and, consequently, space for pedestrian and active modes becomes available. However, autonomous vehicles tend to move instead of parking which may increase traffic volume. However, it is expected that safety for vulnerable users increases.
- Creation of parking slots, or intelligent kerbside management, especially for load/unloading operations, which may allow to increase public space using those parking spots, during some time of day periods. This may allow to increase the place's attractiveness, inviting street users to use those places (restaurants, stores, rest places)
- Use of drones to deliver freight or even 3D printing may have a positive impact in the number of load/unload operations and use of public space.

The following graph aims to provide a list of elements that may change with the progression of the scenarios. The graphic bars correspond to a relative impact in each element, either positive or negative change. For instance, it is expected that scenario 2 would have a greater impact in online commerce than the other three scenarios, especially scenario 1, which obliges to do a more detailed analysis about load/unloading bays for this type of activity.

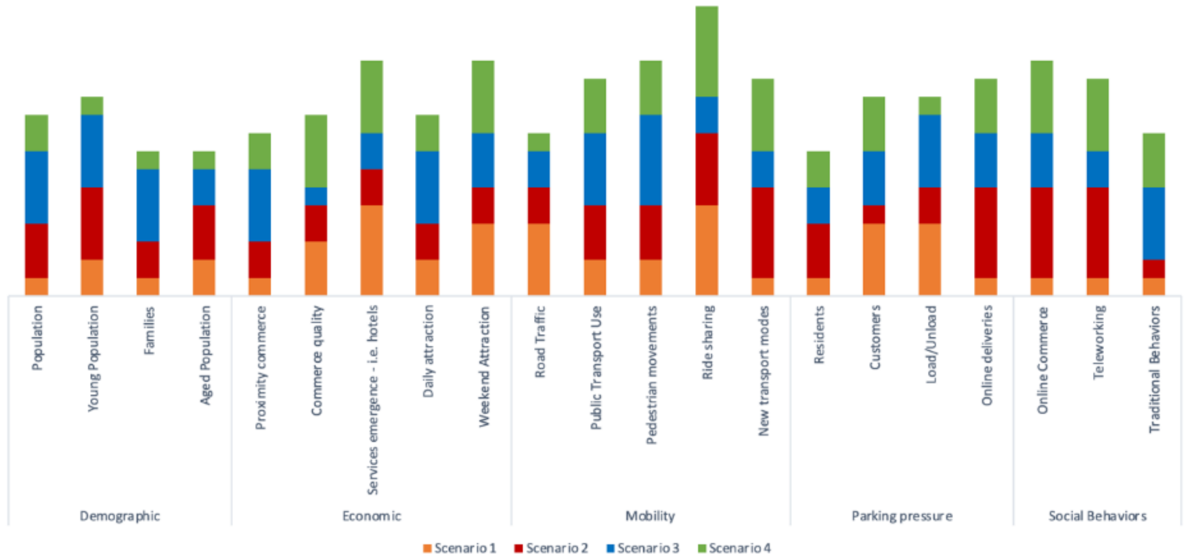


Figure 148. List of elements with the potential impacts of each scenario

The table below provides a summary of the contextual environment to which the scenario relates, considering demography, economy and social behaviours, and a list of the foreseen consequences for parking and mobility within the section, that results from the changes in each scenario.

Table 35. Summary of scenarios and its consequences in parking and mobility

Scenario 1 Tourism Tendency	Scenario 2 Generational renewal	Scenario 3 Multi-ethnic neighborhood	Scenario 4 Environmental Vision
CONTEXTUAL ENVIRONMENT			
Demography Low number of residents No generational renewal Economy Capacity to attract weekend visitors New hotels and expensive stores Social Behaviors Neighborhood's identity is lost Sense of community doesn't exist	Demography Number of residents increases Mixture between younger residents and existing and older residents Economy Lack of capacity to attract daily visitors Street is not attractive for some high income and/or traditional stores Social Behaviors Rise of teleworking and online commerce The neighborhood will be seen as passage than as a local to stay and live	Demography Number of residents increases significantly Generation renewal and number of families and children increases Economy Traditional and oldest stores will be replaced by a mixture of conveniency and ethnic products stores New stores won't be attractive for daily visitors but will be used by the community Social Behaviors Neighborhood will be seen as place to be used by the community	Demography Number of residents falls Zone become attractive for a very specific type of population Economy Hotels, and mixture of daily consumption and exclusive stores will arise Weekend attractivity will be high Social Behaviors Neighborhood's identity is lost Residents use local stores for daily needs, but a sense of community is not created.
MOBILITY AND PARKING CONSEQUENCES			
Parking Low pressure for residents parking High parking demand for costumers and load/unload processes Ride sharing parking places should be needed Mobility Road traffic becomes more congested, due to the rise of some touristic transport modes like tuk-tuk but also mini and larger buses. Pedestrian mobility is not so demanding. Demand for active modes and new transport modes is low. Buses, as public transport, aren't attractive.	Parking Medium pressure for residents parking Low parking demand for costumers and load/unload processes Ride sharing parking places should be needed as well as parking for motorcycles and active modes (sharing and personal vehicle) Mobility Low road traffic in short term, increasing in the medium term due to ride sharing systems and new transport modes like autonomous vehicles Pedestrian mobility reduce its importance due to the street's lower ability to attract Demand for active modes and new transport modes is very high. Buses, will be progressively substituted by alternative and new transport modes	Parking Low pressure for residents parking High parking demand for costumers and load/unloading processes Medium parking demand for active modes (sharing and personal vehicle) Mobility Low road traffic. Pedestrian mobility is very important since local commerce and the use of public space will be the heart of the community. Demand for active modes is high. Buses and public transport have a very significant demand.	Parking Low pressure for residents parking, which may increase over time due to electric vehicles. High parking demand for costumers and load/unload processes Ride sharing parking places should be needed. Mobility Low road traffic, although it should rise due to increase of electric vehicles use Pedestrian mobility has a higher importance in weekend than on weekdays. Demand for active modes is medium. Buses and public transport may have a high demand in a short term that could be replaced progressively by alternative and new transport modes.

5.3.2 Forecasting models

Since there isn't any forecasted model for the city of Lisbon, a list of mobility policies for the following years was identified, which will support the choice of a forecast model and the formulation of range of design objectives that will be used to assess the scenarios' effects in the area.

Table 36. Future potential mobility policies

City Vision	Objectives	Impacts on stress section
Vision 0	Elimination of number of deaths caused by traffic accidents.	Due to the large number of serious accidents in the area, this objective should have a large impact in the section.
Speed limit to 30 km/h	Intention to reduce speed limit to 30km/h in most of the roads in the city.	The section under study is included in this objective. This would allow to increase safety on street.
Modal shift	The current modal share in Lisbon is car (46%), Public Transport (22%), Walking (30%), Others (2%). Until 2030 the objective is to reduce car use to 34% and increase cycling and micro-mobility to 10%.	A large percentage of the users of the section under study, walk or use public transport. However, the percentage of people who use bicycle or other active modes is very low, especially for lack of infrastructure, high average traffic speed and abusive second lane parking.
Larger public spaces	There is an intention of the municipality to offer larger public spaces, withdrawing some space from cars. One of the most visible measures is the intention of closing the city centre to crossing traffic.	This may be an objective in the section under study, considering and eventual sidewalk enlargement, and a better exploitation of the "Praça Paiva Couceiro". The closing of the city centre to traffic may have a negative impact in the section.
Higher usage of electric vehicles	National and local policy to create tax and parking incentives in order to promote a shift from combustion vehicles to electric vehicles	Great impact in noise levels. If the costs of travelling in electric vehicles are significantly lower than combustion vehicles it may conduct to an increase of traffic flows as well as a large demand of public parking.
Improve pedestrian accessibility	Policy that consists in implementing better walking conditions as well as accessible sidewalks.	Due to this section's existing sidewalks and public space poor quality, this policy suits perfectly to the area needs.

5.4 Future Conditions on the Stress Section

5.4.1 Introduction

Considering the model's development, the demand's evolution for each transport mode was foreseen according to the expected scenarios' results. So, for each scenario, some place characteristics were forecasted, such as the population evolution by age group and the number of stores, which were then combined with the expected transport modes' demand evolution and walking values.

In the following figure, the chosen methodology is illustrated which defines the future patterns of movement and place activities and how the variables are correlated between them.

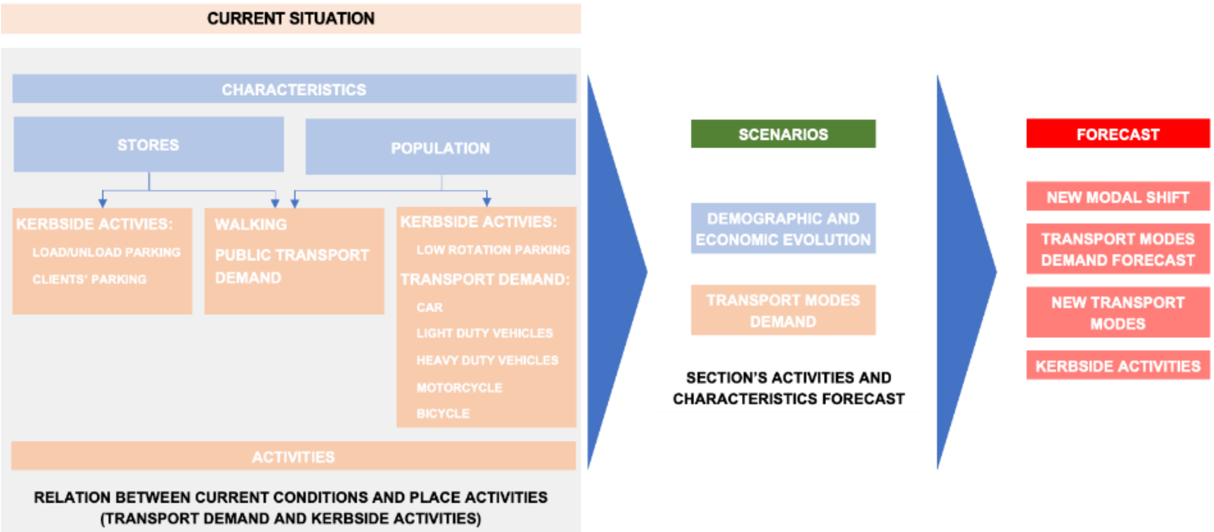


Figure 149. Model's methodology

To forecast the population for the following years, the current population's age structure around the section was used, drawing from the Eurostat projections. Afterwards, according to the scenarios' characteristics, the values were changed in order to result in a new age structure in the project's horizon year with implication in the street's mobility and place activities.

The following table shows the CAGR considered by the Eurostat projections, as well as the CAGR pondered in each scenario by time period which took into account their demographic structure.

Table 37. CAGR - Population's age structure

Age structure	2021 - 2025	2026 - 2030	2031- 2040	2041 - 2050
Eurostat projections				
0-19	-0,97%	-0,84%	-0,39%	-0,47%
20-39	-0,81%	-0,50%	-0,83%	-0,80%
40-59	-0,62%	-1,36%	-1,63%	-0,65%
60-79	1,57%	0,91%	0,71%	-0,79%
>=80	1,31%	2,20%	2,21%	1,73%
Scenario 1				
0-19	-2,59%	-2,47%	-2,02%	-2,59%
20-39	-2,31%	-2,00%	-2,33%	-2,30%
40-59	-0,44%	-1,80%	-2,63%	-0,44%
60-79	1,32%	1,32%	1,40%	1,32%
>=80	0,31%	0,31%	0,31%	0,31%
Scenario 2				
0-19	-0,47%	0,09%	0,86%	0,90%
20-39	1,07%	1,18%	0,17%	-0,42%
40-59	-1,50%	-1,73%	-1,01%	0,91%
60-79	1,45%	0,53%	0,09%	-1,60%
>=80	0,81%	1,95%	2,21%	1,73%
Scenario 3				
0-19	2,78%	2,53%	2,36%	1,49%
20-39	1,82%	2,50%	2,54%	2,90%
40-59	-0,87%	-0,61%	-0,01%	1,39%
60-79	-1,43%	-1,84%	-1,54%	-1,93%
>=80	-0,69%	-0,80%	-0,79%	-1,48%
Scenario 4				
0-19	-2,59%	-2,47%	-2,02%	-2,10%
20-39	-1,81%	-2,00%	-2,33%	-2,30%
40-59	0,06%	-0,80%	-1,63%	-1,15%
60-79	1,57%	1,41%	1,65%	0,03%
>=80	0,31%	1,20%	1,21%	1,73%

A similar process was adopted to calculate future demand patterns for the transport modes. First, the relation between the section's current demographic and economic characteristics and transport modes' use was assessed. Then a demand evolution was defined for each transport mode as well as for the kerbside activities, namely parking patterns by the number of stores and residents. In the Appendices the adopted values by scenario, in the morning peak period, are shown.

The adopted methodology allowed to forecast and relate demographic and economic characteristics with the demand for transport mode. In the following figures, is shown a global vision about these variables in the section, in the morning peak period in 2040.

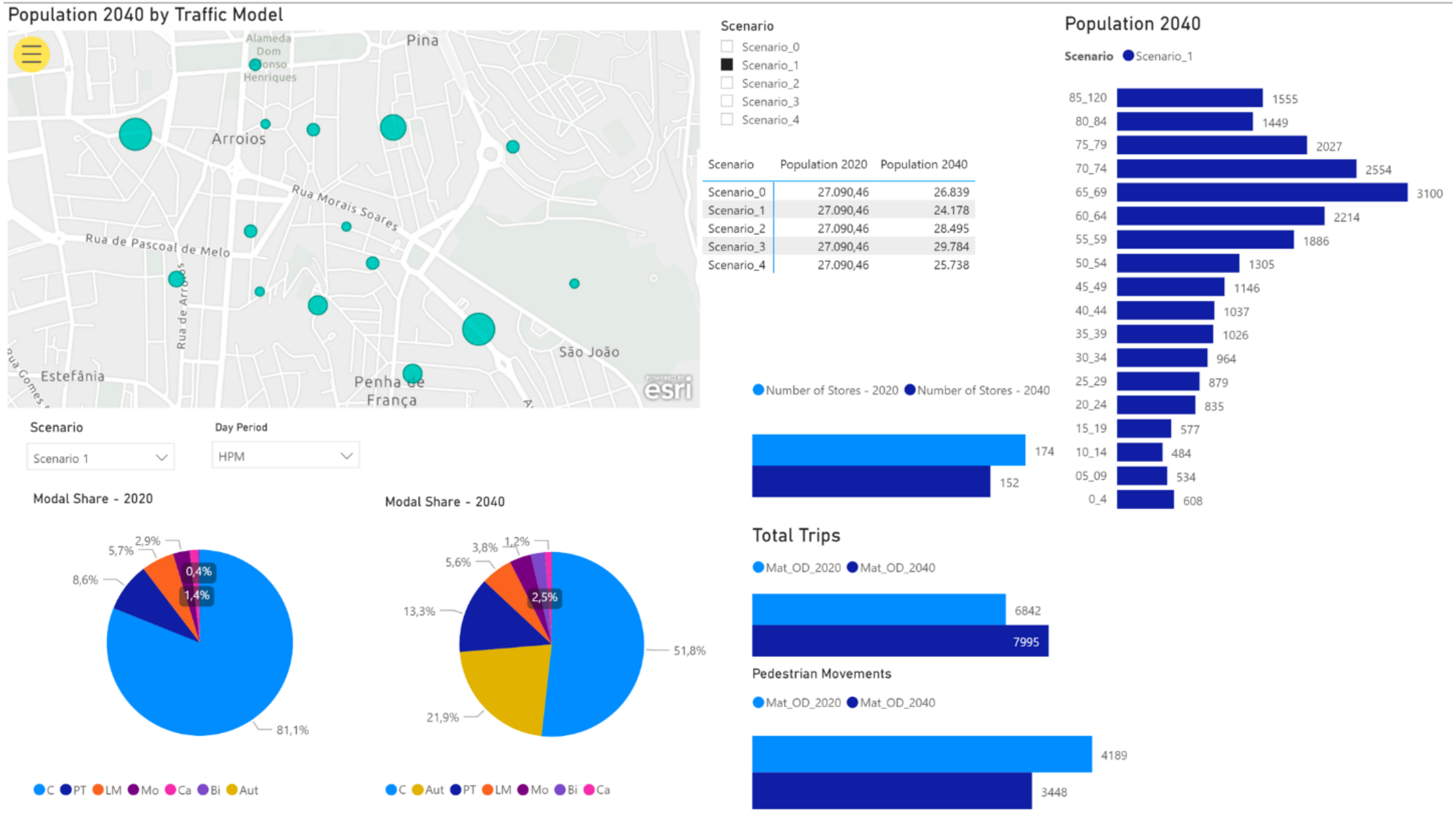


Figure 150. Demand model results, morning peak period, scenario 1

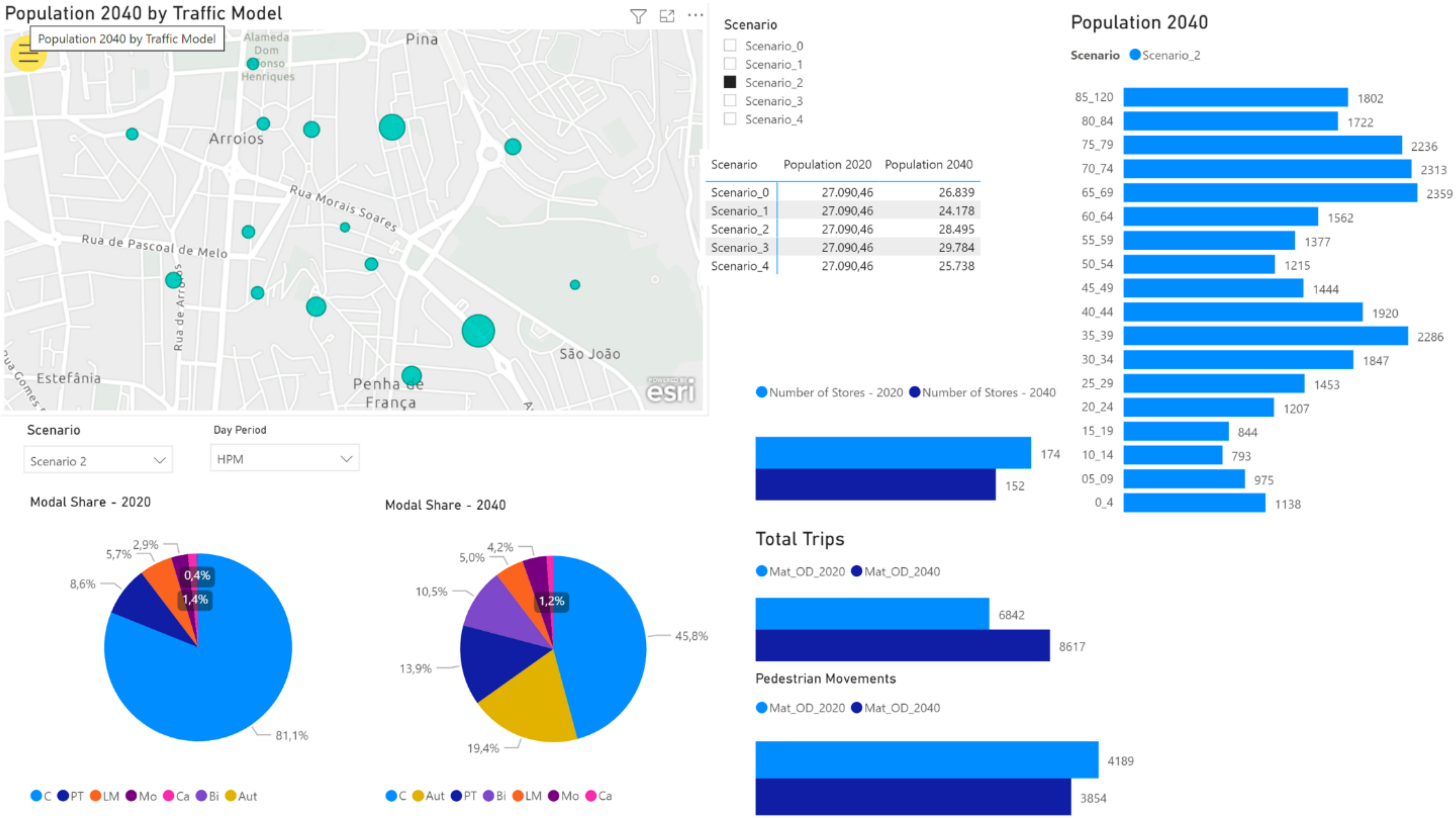


Figure 151. Demand model results, morning peak period, scenario 2

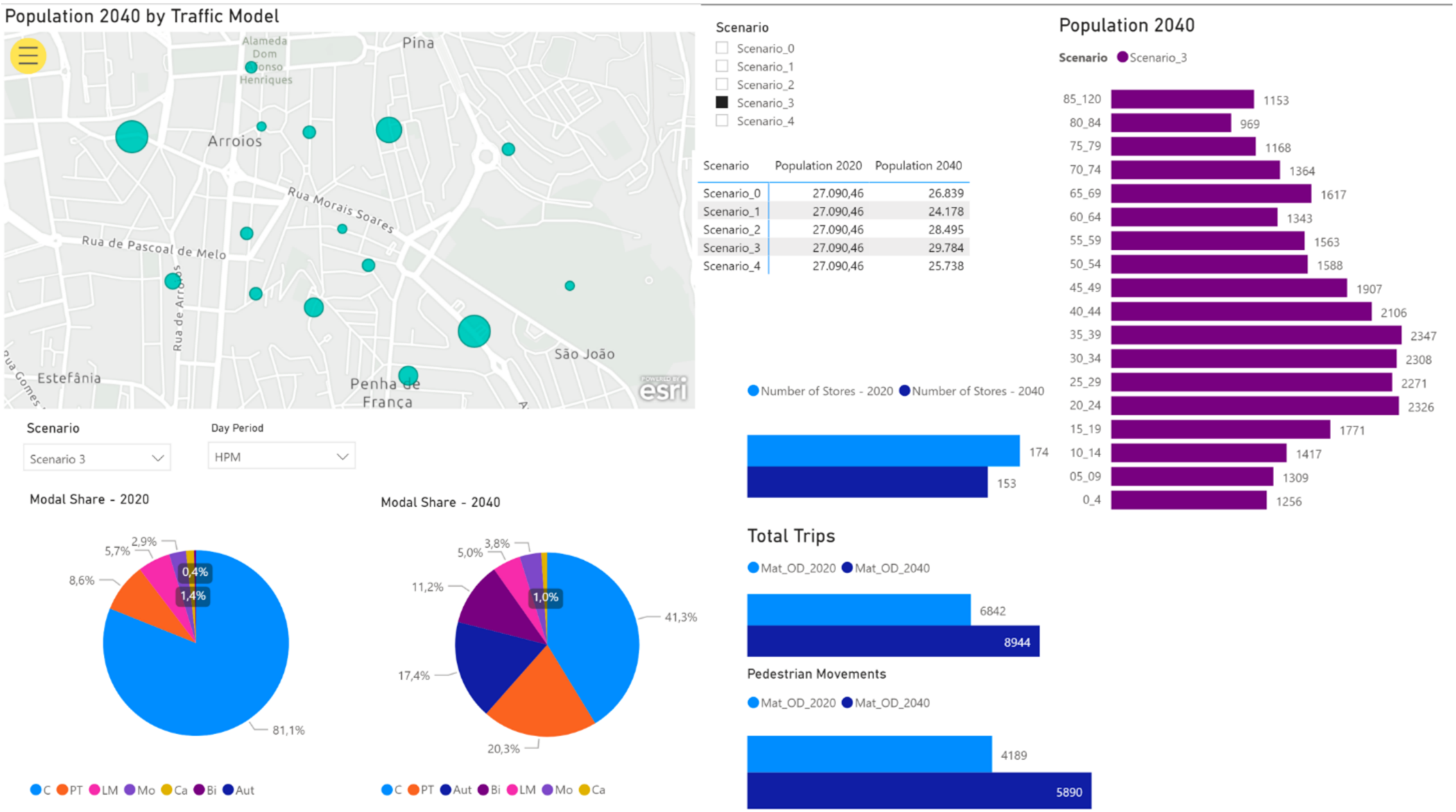


Figure 152. Demand model results, morning peak period, scenario 3

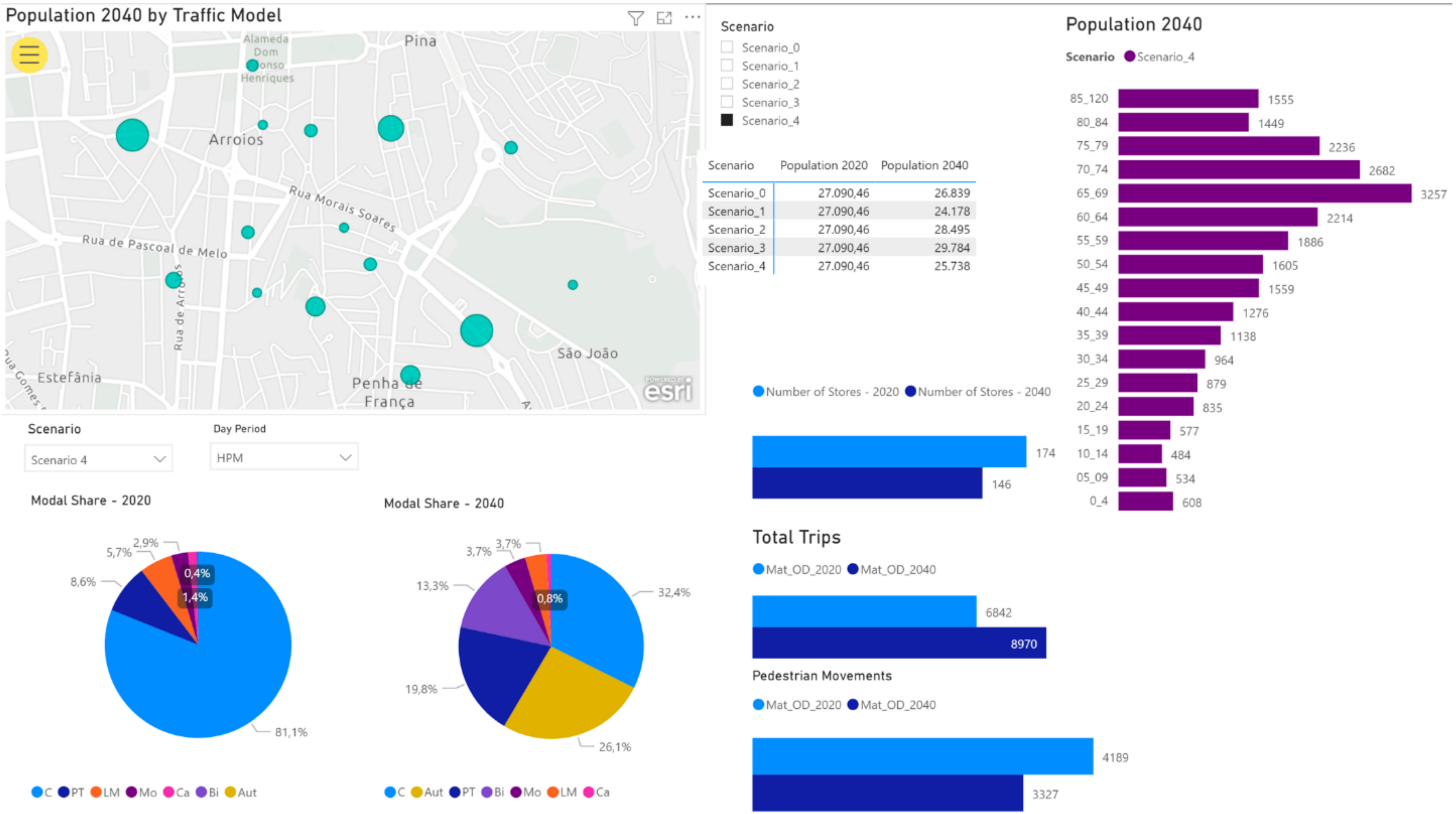
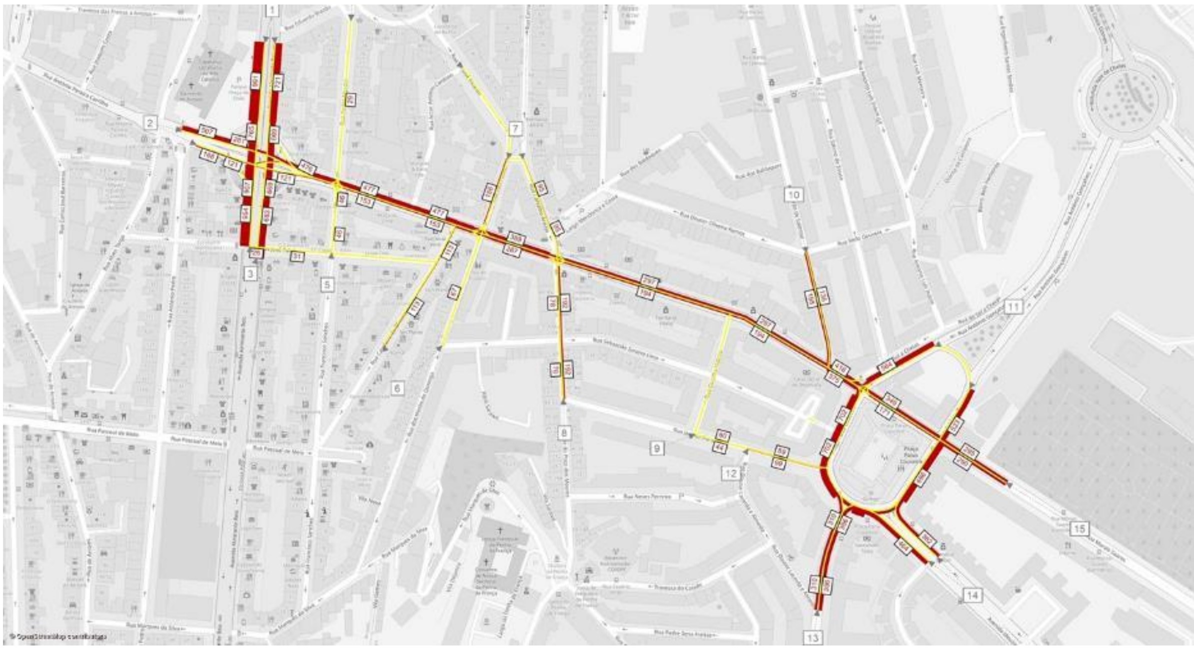
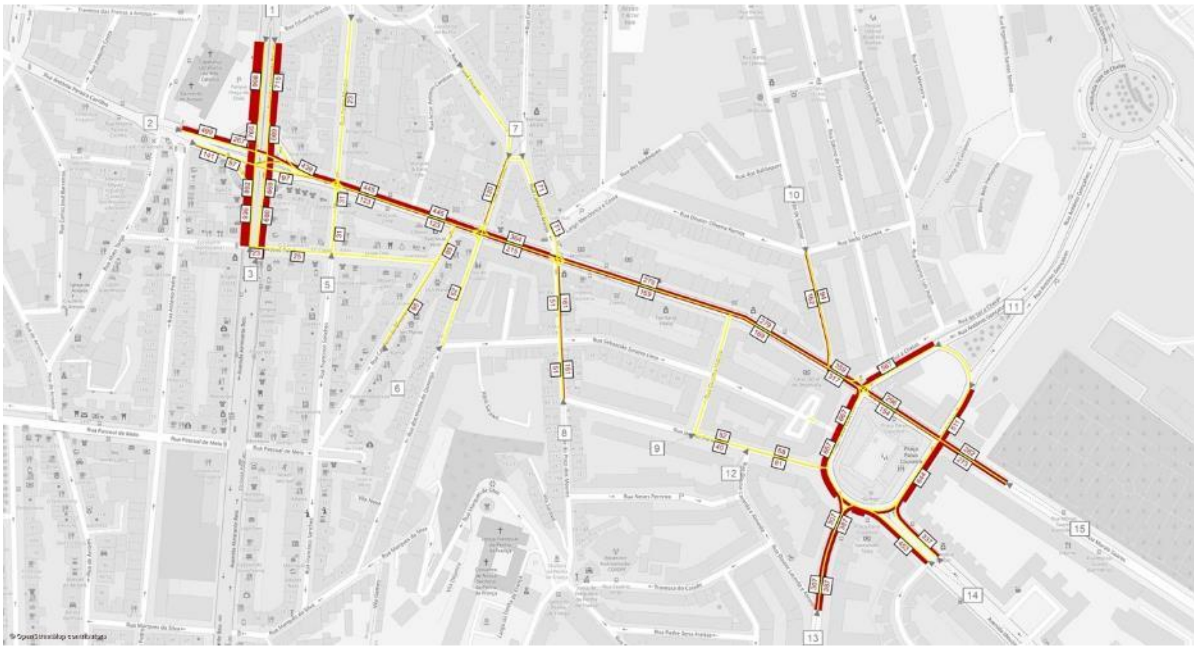


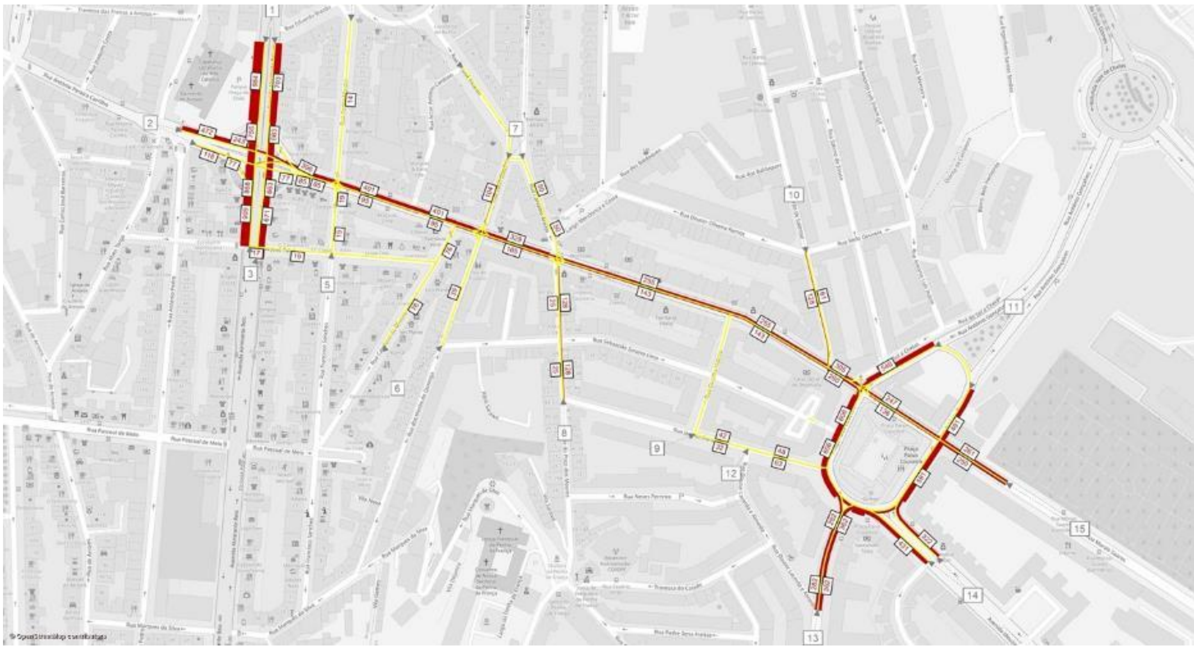
Figure 153. Demand model results, morning peak period, scenario 4

The calculated values allowed to develop Origin-Destination (OD) matrices for all the transport modes, which will then be used for the microsimulation. The matrices for the morning peak period are shown in the Appendices.

As an example, the following figures show the traffic simulation, after the assignment of the developed OD matrices, using PTV Visum, which allow to identify the movements' distribution in 2040 by car, bicycle and pedestrian.

Scenario 1

Scenario 2


Scenario 3



Scenario 4

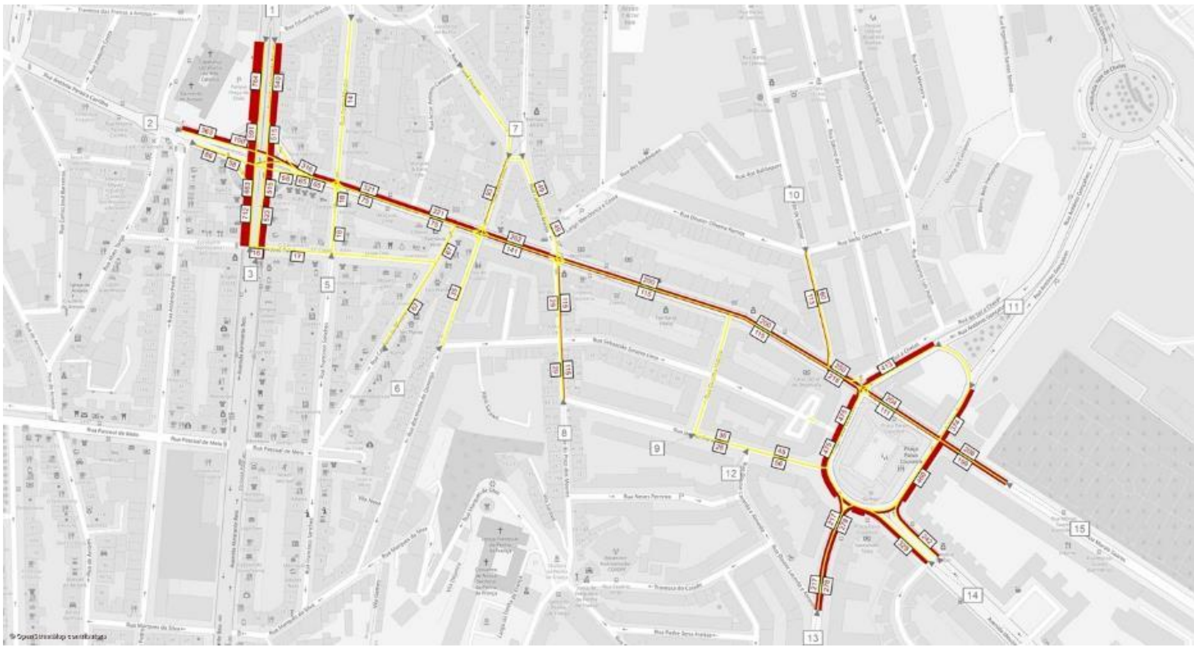


Figure 154. Car movements, morning peak period, Scenarios 1 to 4, 2040

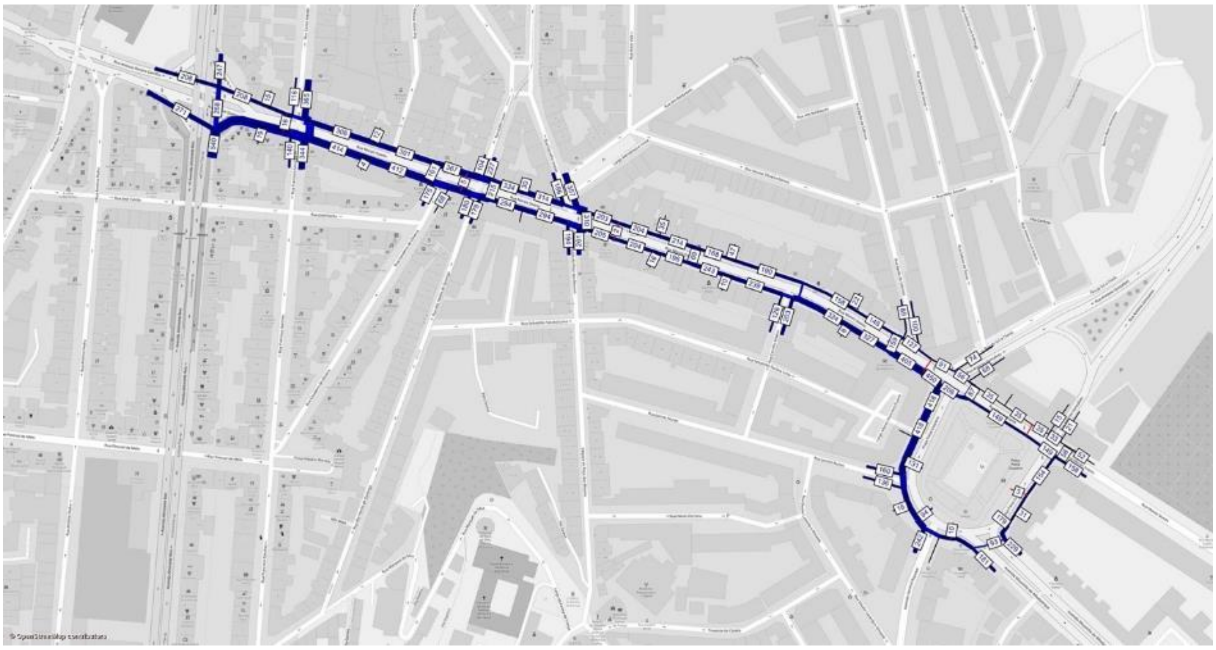
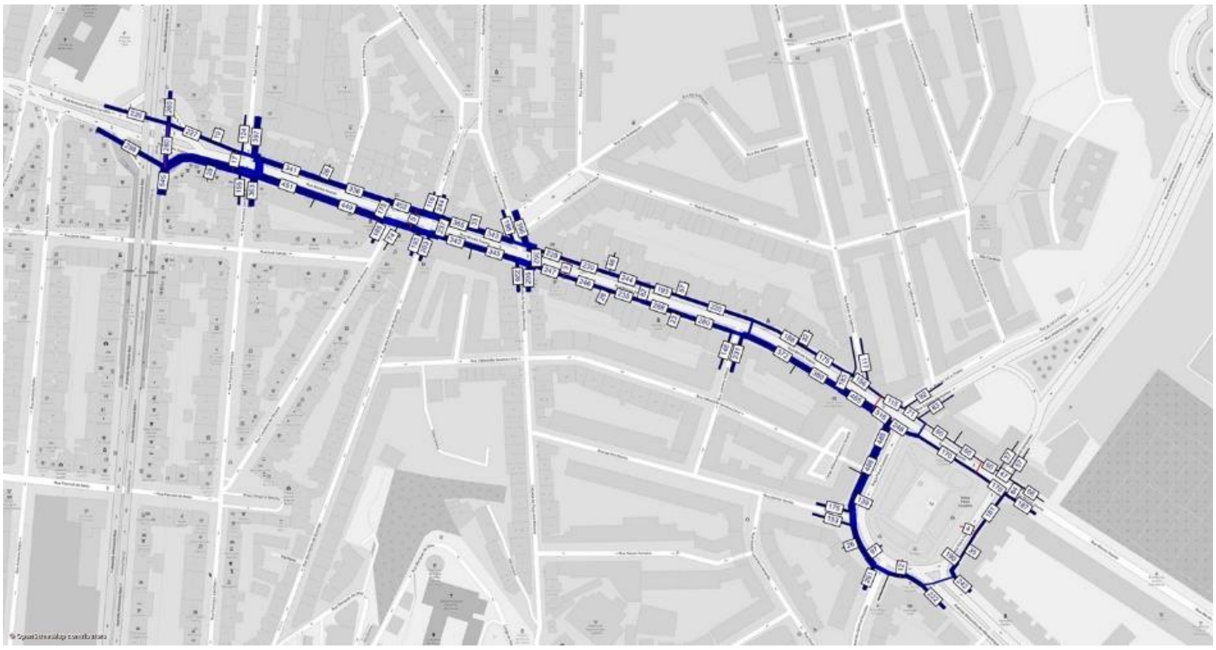
Scenario 1

Scenario 2

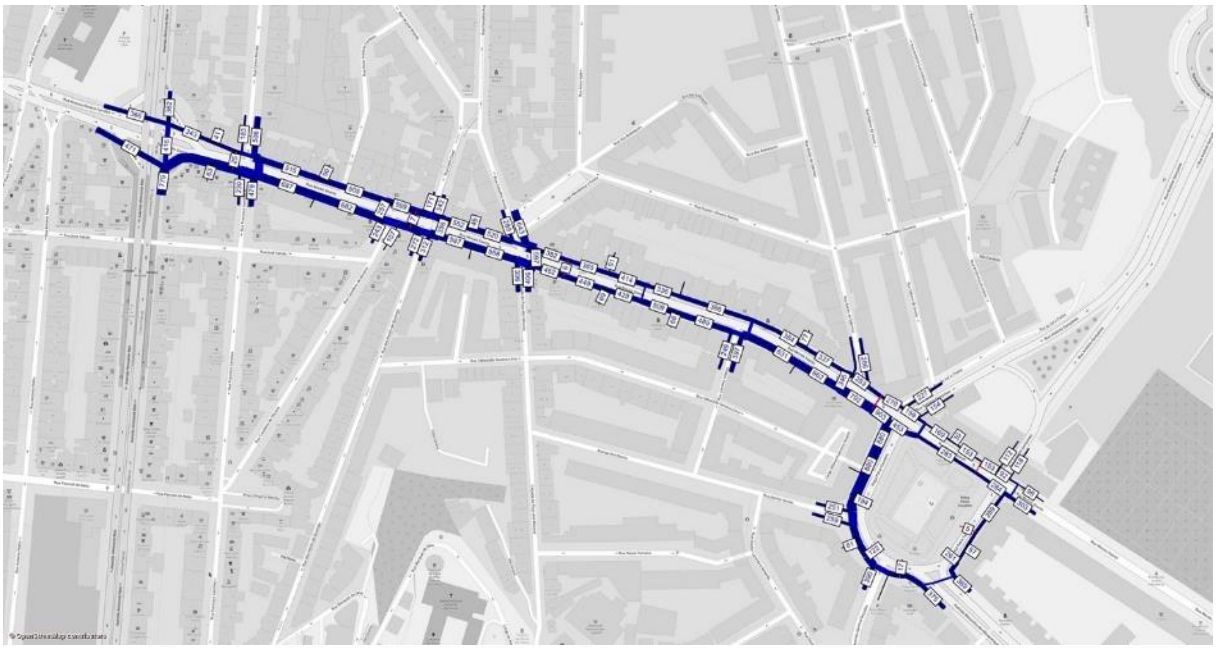

Scenario 3

Scenario 4


Figure 155. Bicycle movements, morning peak period, Scenarios 1 to 4, 2040

Scenario 1

Scenario 2


Scenario 3



Scenario 4

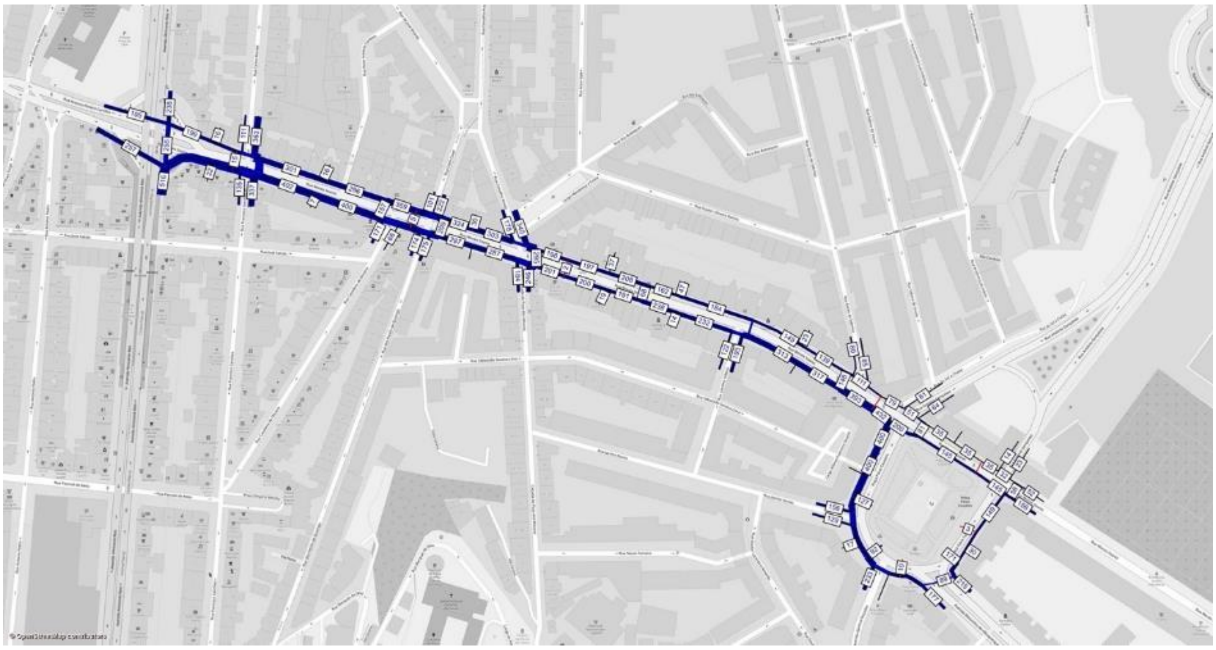


Figure 156. Pedestrian movements, morning peak period, Scenarios 1 to 4, 2040

5.4.2 Kerbside activities

Besides the development of the demand model for pedestrians and traffic, the kerbside activities evolution until 2040 was also considered. This forecast considered the unit values for residents, clients and load/unloading parking bays, for the current situation, which were foreseen according to each scenario's characteristics and correlated with the number of residents and stores in 2040.

For metered parking, two simulations were made:

- One considered residents parking, double parking and clients parking and whether in future their needs would suit the existing number of metered parking bays. Considering this analysis, is possible to observe that in current situation, the number of available metered parking is not enough to cover all the residents and clients' parking needs.
- Another that only considered residents and clients parking to foreseen future demand.

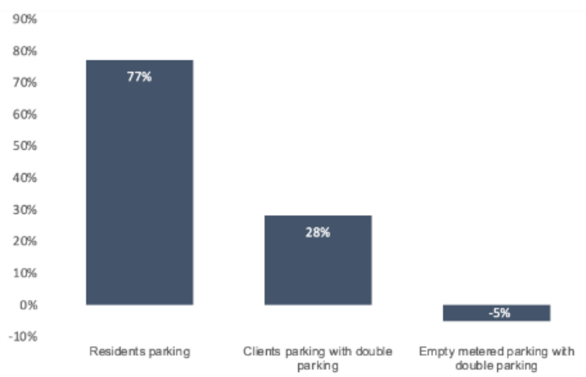
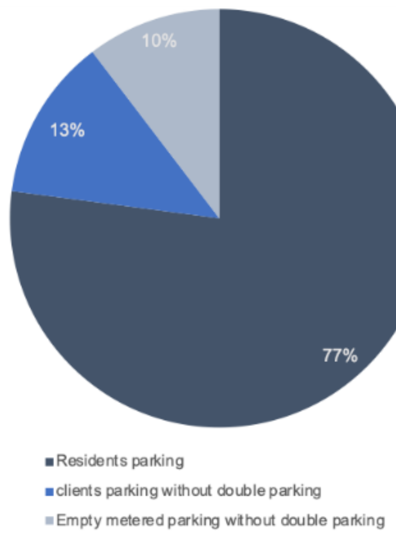
For load/unloading parking, it was considered only the vehicles that are parked in the load/unloading bays up to 90 minutes, considering all the others as illegal and not measured for this analysis.

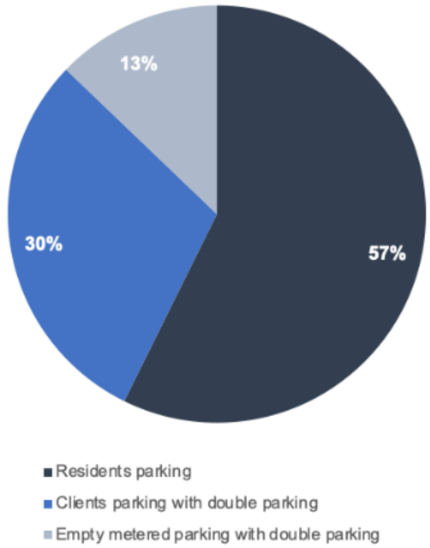
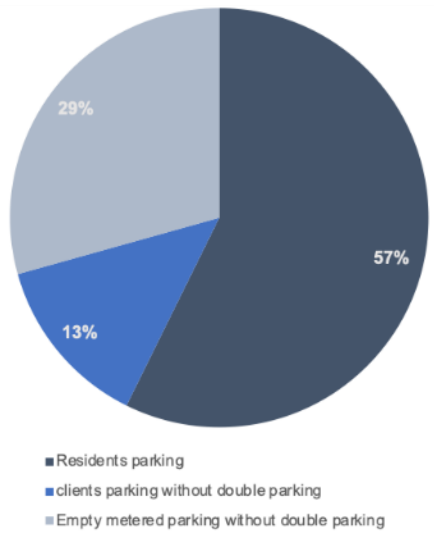
In order to calculate total parked time, the following average parked times were defined:

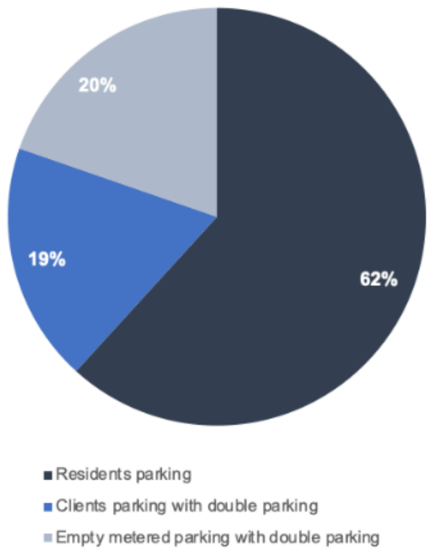
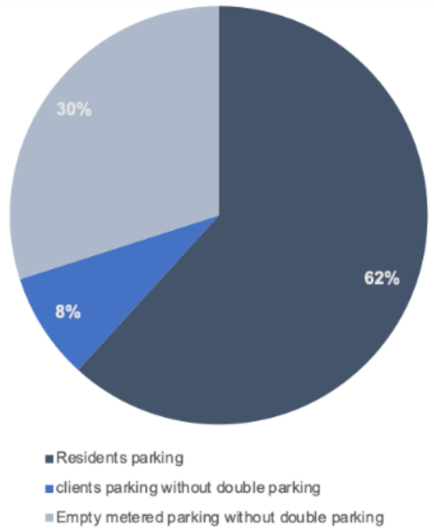
- Residents' parking: 453 minutes
- Clients' parking: 67 minutes
- Load/unloading operations: 52 minutes

The following table allows us to compare the percentage of empty and occupied spaces, in current and future scenarios, by parking type, considering the total number of the respective number of existing metered parking and load/unloading bays during a weekday from 8 AM to 6 PM, which corresponds to the counting period.

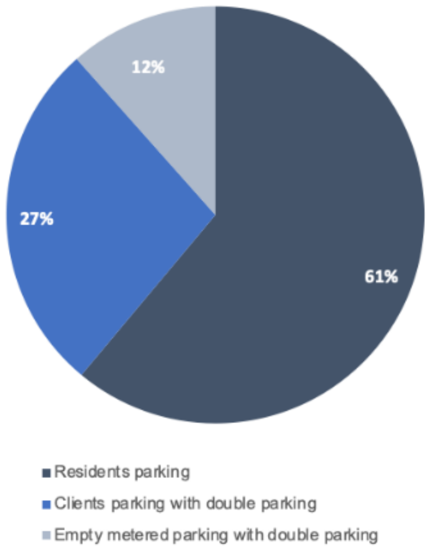
According with the obtained results, especially if the double-parking occurrences are considered, is expected that metered parking may be overwhelmed, in contrast with the load/unloading parking that seems to be misused.

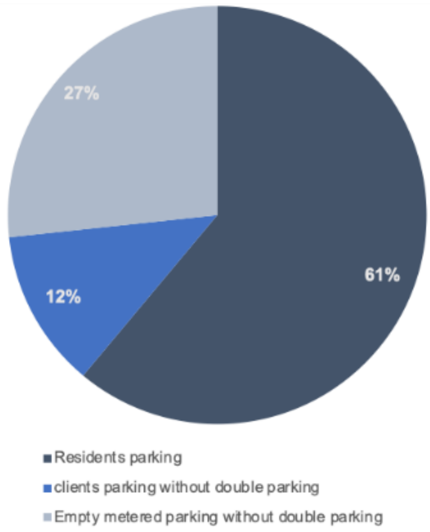
Metered Parking	
Current Situation - 2020	
residents + clients + double parking	**residents + clients**
	

Scenario 1 - 2040	
residents + clients + double parking	**residents + clients**
	

Scenario 2 - 2040	
residents + clients + double parking	**residents + clients**
	

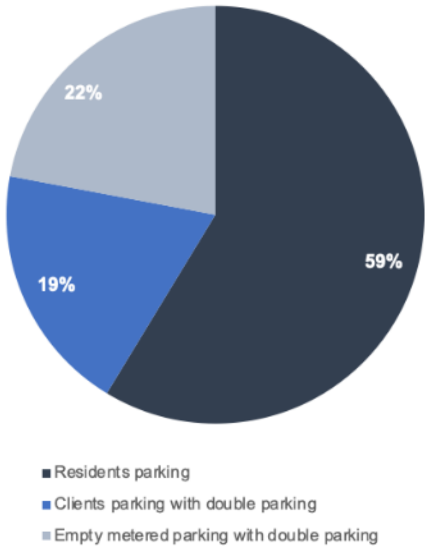
Scenario 3 - 2040	
residents + clients + double parking	**residents + clients**





Scenario 4 - 2040

residents + clients + double parking	residents + clients



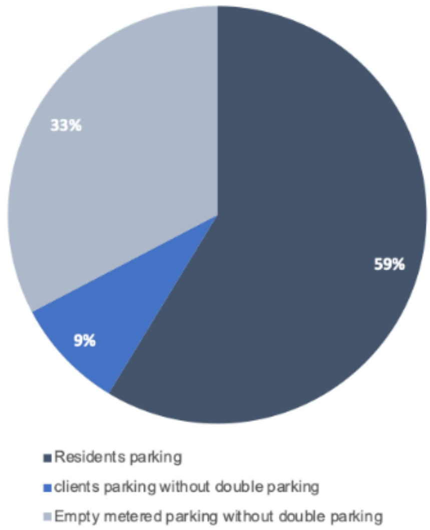
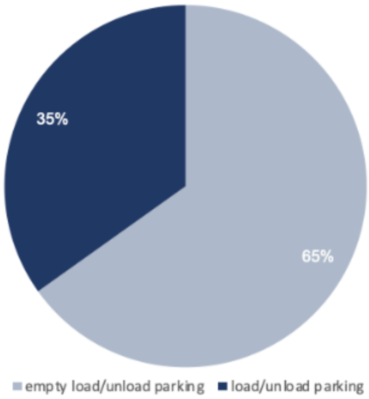


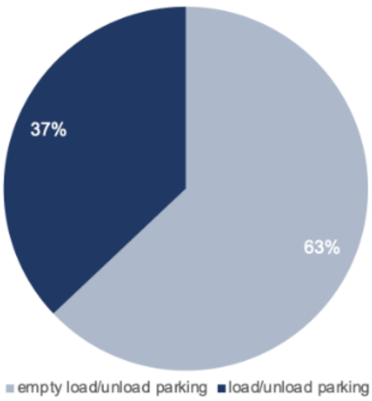
Figure 157. Metered parking time distribution across the 4 scenarios, 2040

Load/Unloading Parking

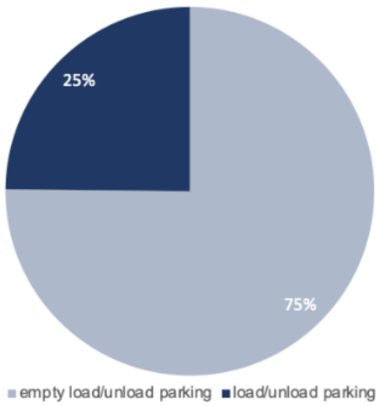
Current Situation - 2020



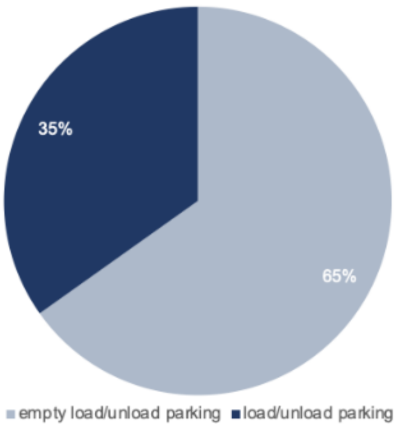
Scenario 1 - 2040



Scenario 2 - 2040



Scenario 3 - 2040



Scenario 4 - 2040

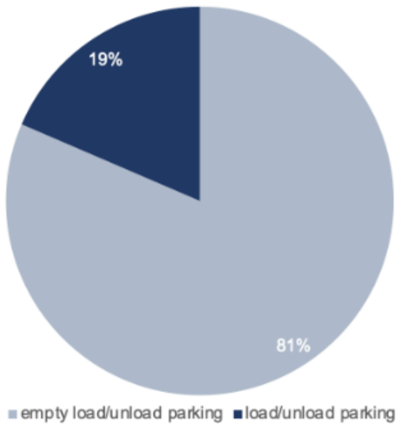


Figure 158. Load/unload parking time distribution[13]

[13] Current situation's value is different than the one shown in Figure 125, because in this analysis, only the vehicles parked until a maximum of 90 minutes are represented.

5.5 Design brief for Future Conditions

Taking into consideration the main issues identified as well as the municipal policy context, some suggestions, segregated by categories, are listed in this chapter. These suggestions will be taken forward as part of the design exercise and undergo further analysis and simulation.

5.5.1 Design objectives

The following table shows a summary of the existing conditions, which problems were detected and identifies a list of possible solutions to implement in the future and that should be analysed.

Table 38. Comparison between existing situation and future conditions to be analysed

Pedestrians
Current Conditions
Sidewalks with high demand, with very diverse place activities and use of street: visitors, residents, access to public transport; Narrow sidewalks with several obstacles and lack of places to rest; Very low conditions for a comfortable walk, especially for elderly and disabled people
Future Conditions
Enlarge sidewalks and create places to rest; Create accessible sidewalks; create a continuity between Praça Paiva Couceiro and the western sidewalk
Traffic
Current Conditions
Existence of 2x2 lanes with congestion situation due to the practice of double parking; Despite the average speed is not high, there are occurrences of speeding above the limit which poses safety concerns
Future Conditions
Reduce the number of lanes, which may reduce double parking occurrences and reduce the speed limit. The impact on public transport circulation need to be analysed
Public Transport
Current Conditions
High demand in almost day periods; Delays due, mostly, to double parking
Future Conditions
Study the impact of reducing lanes on bus circulation; Implement traffic lights' new technology to give priority to buses at intersections
Cycling and micro-mobility systems
Current Conditions
Very low demand and very unsafe conditions to use a bicycle due to some high-speed vehicles and double parking. Complete lack of places to park a bicycle
Future Conditions
Analyse the need of building a cycle lane, since it is a zone with potential cycling growth. However, maybe lowering speed limit is enough to improve its demand; Implement places to park the bicycles in the street and square
Motorcyclists

Current Conditions
Transport mode with tendency to increase; lack of parking places to motorcyclists; abusive parking in improper places as sidewalks
Future Conditions
Increase the number of parking places for motorcyclists
Parking
Current Conditions
Heavy parking pressure from residents, visitors and shopkeepers; prevalence of double-parking; Lack of low parking rotation places, with a very high average parking time on metered parking bays; Load/unloading parking bays stay empty for long time during the day
Future Conditions
Improve parking organization; Promote load/unloading operations in some day periods with a scheme of time slots; Take advantage of some of these load/unloading bays to increment places for low rotation parking spaces; Analyse a scheme of implementing diagonal parking, increasing parking capacity in some places, and remove parking bays in other places to enlarge sidewalks/create places to stay and rest; Analyse the needs of creating places to autonomous vehicles and drones deliveries

5.5.2 Traffweb results

Traffweb is currently on public consultation and has been used in the municipality's social media channels as well as in the parish council newsletter and has received so far 152 suggestions from public participation. The following table shows a summary of the most important comments. The existence of double parking and the sidewalks' width and bad quality are the most commented. However, the number of comments asking to maintain the number of lanes and the existing parking bays increased significantly immediately after the implementation of a pop-up cycle lane in the avenue perpendicular to Rua Morais Soares, in Avenida Almirante Reis.

Table 39. Traffweb results

Comments	Citations (percentage)
Lack of bicycles parking	3.6%
Too much double parking	14.3%
Lack of quality of sidewalks – too narrow, lot of obstacles, and inadequate pavement especially for aged population	23.6%
Traffic lights on this street must be reviewed at all intersections especially for walkers	2.1%
Too much congestion	1.4%
Too much noise and pollution	3.6%
Lack of short length parking spaces – to customers and load/unload operations	7.1%
Lack of green spaces and trees	5.7%
Use of Bicycle is unsafe – double parking, buses frequency – a cycle lane should be installed	5.7%
Reduce the number of lanes in the street – most of the times, one lane is used for double parking	3.6%
Very low public space quality. Unsafe to some pedestrians	5.0%
Recover the tram line	1.4%
Lack of places to rest in the kerbside	0.7%
Lack of parking places for residents	10.7%
Maintain the number of lanes	7.1%
Parking in Praça Paiva Couceiro is disorganized creating unsafe situations for pedestrians	2.9%
Reinforce public transport headway	1.4%

5.5.3 Work plan – application of design tools

Our action plan for the following months can be found below setting out how each of the tools developed in MORE (road space option design tools, street design toolkit, Linemap, VISSIM, road space appraisal tool) will be applied.

Table 40 Work plan – application of design tools

Task Ref	Function	Tool	Feb 15	Feb 22	Mar 1	Mar 8	Mar 15	Mar 22	Mar 29	Apr 5	Apr 12	Apr 19	Apr 26	May 3	May 10	May 17	May 24	May 31	EVENT WHERE TOOL USED	Who will be present at meeting
4,1	Option generation tool	Policy intervention tool																		
4,1	Option generation	Road designs tool																		
4,2	Stakeholder engagement	Internal meeting / focus group with other departments					■	■	■										Internal meeting / Focus group	municipality experts team / parish councils / representatives of pedestrians and disabled people
4,2	Stakeholder engagement	Blocks and acetates									■	■							Design days (dependent of COVID situation - don't believe it will be possible before April)	municipality experts team / representatives of residents/shopkeepers from the design section / lobby groups
4,2	Stakeholder engagement	LineMap					■	■	■	■			■	■	■				Internal use after conclusions of design days/focus groups It will be also used to draw suggestions and send to focus groups' participants	Internal use and validation
4,2	Stakeholder engagement	TraffWeb	■	■	■	■													Still online. 160 participants until now	
4,3	Micro Simulation	Vissim modelling (upgraded)			■	■	■	■	■	■	■	■	■	■	■	■				
4,4	Appraisal tool	Political and technical assessment														■	■	■		
4,4	Appraisal tool	Cost benefit analysis														■	■	■		
4,4	Appraisal tool	Multi-criteria analysis														■	■	■		

6 LONDON - Design Methodology for future conditions

6.1 Summary of current conditions along the Urban Feeder Route

6.1.1 Feeder Route Characteristics

Using the TfL developed Movement and Place scale for roads and streets categorisation, the entire length of the Urban Feeder Route is considered “M3”, having strategic importance for movement. Nearly all the Urban Feeder Route is “P1” – local significance for place – except for the stress section in New Cross, where there are many shops, cafés and restaurants and where Goldsmiths College is located, making this section “P2”.

For MORE, we have created a distinction between high movement function on the outer “road” section of the corridor (M3A) and on the inner urban “street” section (M3B). We also distinguish between low place function on commercial/non-residential streets (P1A) and on residential streets (P1B). This is primarily to reflect the difference in frontages between these street types, with P1A streets more likely to have active frontages requiring loading/unloading and servicing activity. This is reflected in the figure below.

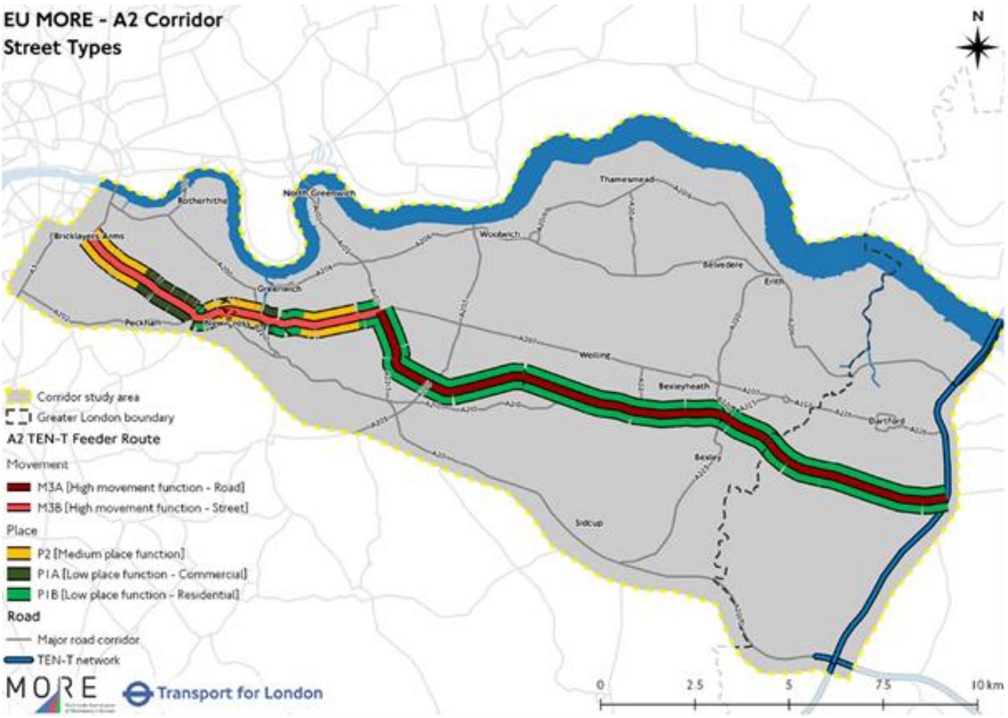


Figure 159. Street type categories of the Feeder Route

6.1.2 Supply: Current Provision for Movement

The map below shows the entire length of the A2 TEN-T corridor in London from Bricklayers Arms in Southwark to the M25 Boundary in Kent to the east. Old Kent Road has been highlighted on this map for context and which our design brief for future conditions will focus on.

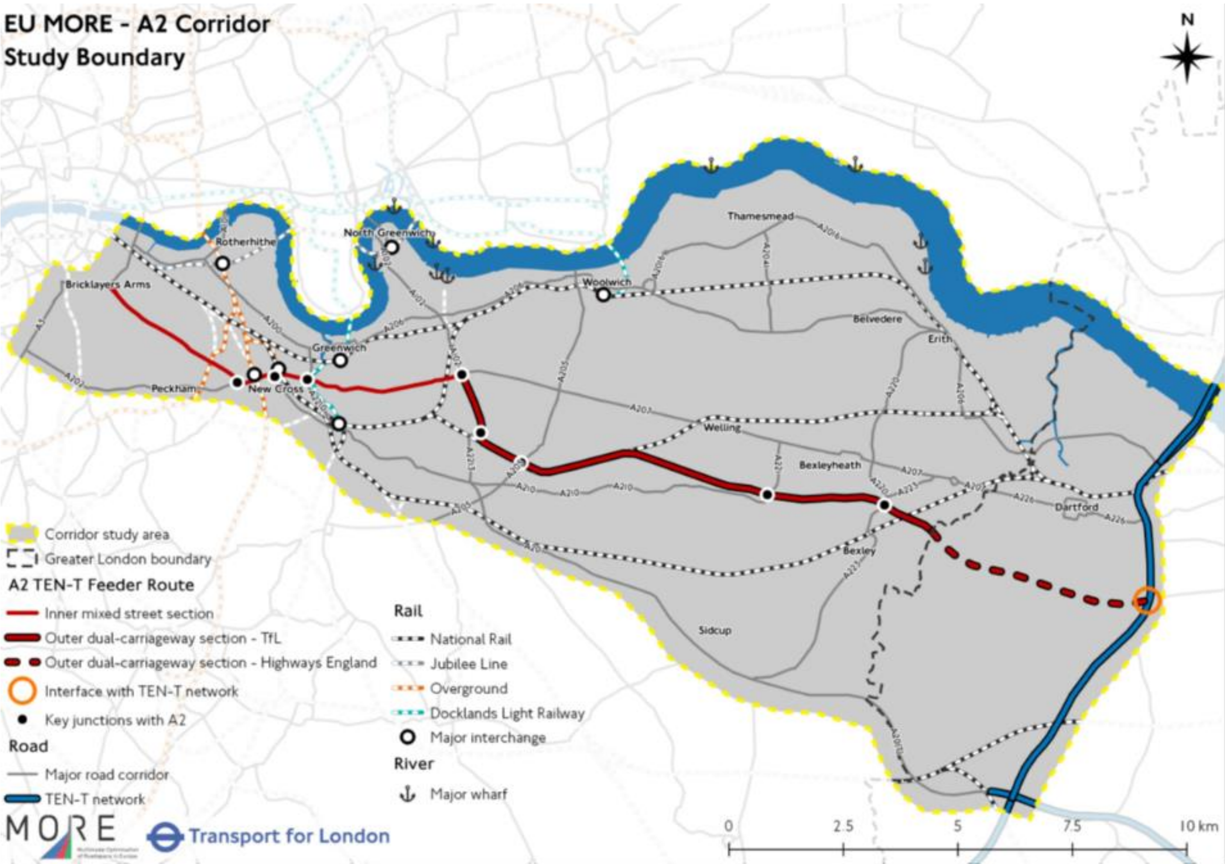


Figure 160. The wider study area

We have defined our 'wider study area' boundary, which includes a number of other routes for movement of people and goods along a similar alignment and between different areas along the A2 corridor in the map above.

The A2016, A20, A202 and A210 around Lewisham are existing routes that are already capable of serving high volumes of traffic, including freight, some of which might be able to accommodate additional traffic currently using the Urban Feeder Route. We also analysed bus flows on routes in the wider study area which are also significant (e.g. the A207 and A210 around Eltham).

Several rail lines serve the same corridor, running from the southeast of England into and through central London. These could provide alternative public transport options for people currently travelling on the Urban Feeder Route and some of these lines can also be used for freight.

To the north of the study area, the river Thames carries both passenger services and freight vessels and could therefore serve as an alternative, parallel route for some traffic on the Urban Feeder Route. A number of wharves on both the north and south banks of the river exist in east London. We have mapped the wharves with the greatest capacity for handling goods.

The Thames represents the northern boundary of our study area. This provides alternative river, rail and road routes within the study area to the north of the Urban Feeder Route.

The A20, along with the Sidcup rail line represent the southern boundary of our study area. This provides alternative rail and road routes within the study area to the south of the Urban Feeder Route.

6.2 Future conditions in the Wider Impact Area

6.2.1 Factors effecting future levels and patterns of demand for movement

The extent of the wider impact area can be seen in the figure below. The purpose of this section is to outline conventional, and some unconventional, drivers of demand such as demographic, economic and levels of service through transport supply that are expected to affect future patterns of demand.

The reference case forecast from TfL's new strategic demand model, MoTiON, has been used to present the demand and network forecasting assumptions for 2041 factors.

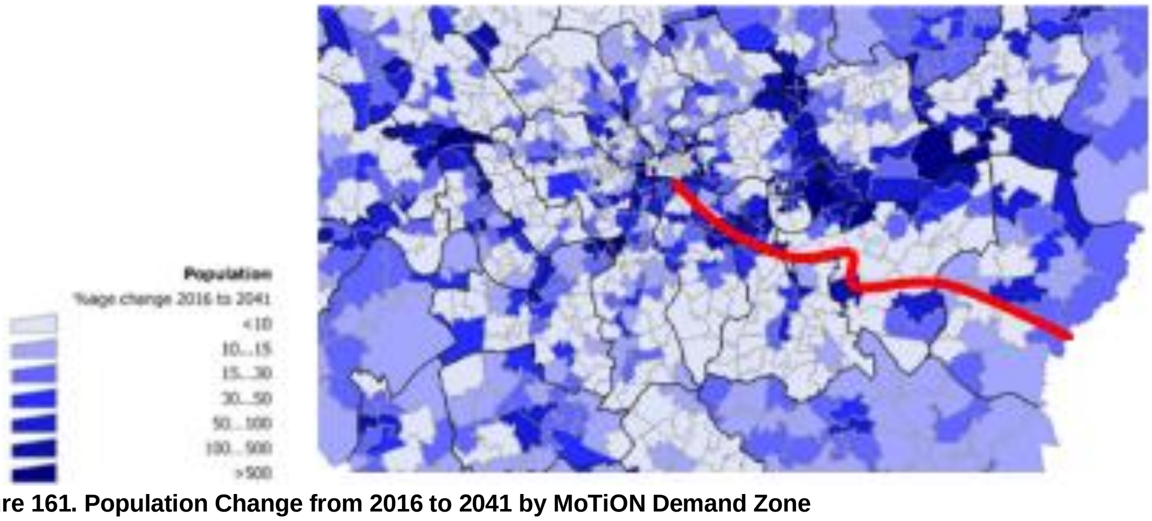


Figure 161. Population Change from 2016 to 2041 by MoTiON Demand Zone

a) Demographic factors

Demographic factors have a primary role in impacting travel demand. Whilst this represents the starkest percentage population change set to occur North of the river in East London, there are small pockets of intense growth predicted around Old Kent Road in Southwark, a concentration in the northern edge of the borough of Southwark around Canada Water/ Surrey Quays and areas of Eltham and Bexleyheath in Greenwich. More modest population growth is seen in the outer London borough of Bexley in areas parallel to the A2 feeder route.

As the map highlights above, intense population growth is predicted in line with areas designated as Opportunity Areas (OAs) by the Mayor in the London Plan[14]. Thirty-eight OAs have been identified across London with opportunity to accommodate large scale development and growth. Within the wider impact area of the A2, Elephant and Castle, Old Kent Road and Canada Water are all designated OAs, with the scale of this anticipated growth reflected in the figure above. Whilst great opportunity for growth exists in these areas, these should be supported by and embedded in the relevant strategic policy direction, consider the enabling infrastructure to support such ambitions and be coordinated and planned for by Greater London Authority and London Boroughs.

b) Employment

The 2011 employment figures produced by the GLA are scaled so that they are consistent with the level of employment in the 2011 Census and then growth is applied. For London as a whole, employment growth is expected to be in the range of 20% from 2016 levels.

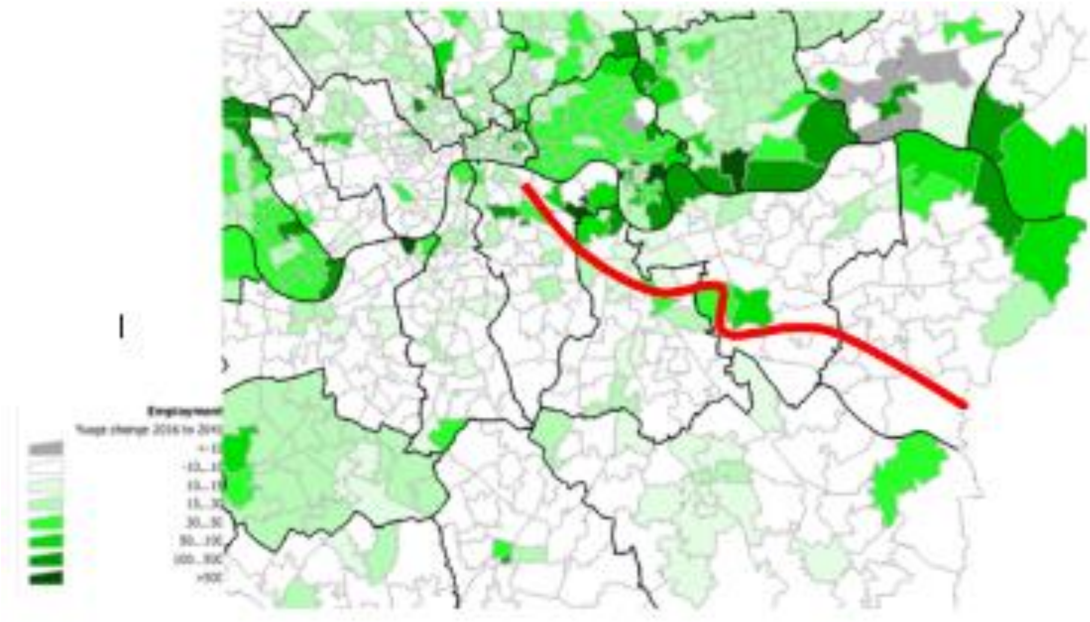


Figure 162. Employment change from 2016 to 2041 by MoTiON Demand Zone

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[14] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/opportunity-areas/opportunity-areas

The map above shows the most substantial change in employment in the wider impact area to be directly north of the A2 feeder route in a small pocket of the borough of Southwark and Lewisham around Canada Water/ Surrey Quays and Deptford. Further employment growth can be seen along the feeder route in Eltham in Greenwich.

The table below identifies the projected changes within employment by sector between each of the boroughs along the feeder route where Southwark is highlighted as having the greatest change over all as the map above also indicates, with the table suggesting this is mostly due to a significant change in blue-collar employment in the borough.

Table 41. Change in employment categories from 2016 to 2041

Borough/ Sector	White-Collar	Blue-Collar	Retail	Service
Southwark	23%	44%	14%	32%
Lewisham	15%	17%	2%	17%
Greenwich	15%	17%	17%	18%
Bexley	13%	19%	7%	12%

c) Land Use patterns and densities

Growth in Retail Floorspace has been taken from the “Consumer Expenditure and Comparison Goods Floorspace Need In London” report by the GLA from October 2017. The report outlines the methodology to forecast retail floorspace requirements at the borough level in the GLA. The process assesses the projected growth in household expenditure, growth in online shopping and the shift to larger retail centres away from town centres at the expense of smaller high streets.

The table below highlights the change in each of the boroughs along the A2 Feeder route which shows modest growth in all boroughs, the highest in Greenwich.

Table 42. Change in Retail Floor Space from 2016 to 2041 in A2 Feeder Route Boroughs

London Borough	2016	2041	%age Growth
Bexley	344,000	376,000	9.3%
Greenwich	386,000	445,000	15.4%
Lewisham	411,000	417,000	1.6%
Southwark	384,000	435,000	13.3%

Flexible working is a concept that has been around for 20 years or more, however it is not easily defined and encompasses a number of working arrangements. The rising cost of office space, particularly in central London, may have initially driven employers to offer flexible working practices to reduce the number of desks per head, and continues to be a relevant factor.

Evidence from the GLA supports the view that employment in office sectors has grown much more rapidly than office stock in recent years, with a decline in the ratio of floorspace to number of workers. This would tend to suggest that office stock in London is being used much more intensively, through new working practices such as hot-desking and remote working. Legislation giving eligible employees the right to request flexible working was also implemented progressively up to 2014. A scenario, termed Remote Revolution, one of five developed by TfL looks at the likely development of these trends accelerating as a result of the pandemic, with technology changing how people live, work and travel.[15]

d) Economic factors

The recovery from the 2008 financial crisis has been slow, with a short-term impact on unemployment but a longer-term impact on wages. Real earnings are still below pre-crisis levels. Austerity, welfare cuts and slow wage growth coupled with rising house prices and rent mean that affordability is low and disposable incomes are being squeezed. This has led to significant changes in London's labour market as households have sought to mitigate this fall in income.

Austerity has hit household budgets, especially since 2015 with London households in the poorest 30% facing a cumulative loss of net income of >5%. Families, disabled people and social housing tenants have been disproportionately affected by welfare cuts. The benefits cap disproportionately affects London due to high housing and childcare costs.

Value of Time (VOT) and Vehicle Operating Cost parameters are important factors to consider in relation to the impact on travel demand and mode choice. Growth in GDP per capita is linked to the value of time (how people weigh up monetary costs versus time) in our strategic model. As values of time increase, individuals make choices based less on the monetary cost of travel (e.g. fares and fuel costs) and more on the amount of time it takes to make a journey. This leads to an increase in the use of more expensive but faster modes.

Growth in VOT and Vehicle Operating Cost parameters are defined by the WebTAG May 2019 databook and the Growth factor applied to VOT from 2016 to 2041 has been set at 1.47.

Fuel costs and vehicle efficiency are an important component in the cost of travel by car, as well as increased costs of driving in London due to policy interventions such as the Ultra-Low Emission Zone and congestion charging in a bid to improve air quality. Vehicle efficiency has shown some improvement over the last decade and forecasts show a steady continuation of this trend as the vehicle fleet changes. The combined effect of an increase in fuel efficiency that is lower than the forecast increase in fuel prices, gives an overall forecast of a small increase in the cost of fuel per kilometre. However, as incomes rise the relative cost of car use falls over time.

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[15] https://content.tfl.gov.uk/travel-in-london-report-13.pdf

e) Long-term trends in travel behaviour and drivers of demand

Since 2000, London's population growth has led to an increased demand for travel, indeed in the last ten years London's population has grown by over a million people. Over this time, public transport use has grown, often at a more rapid rate than the population, alongside a consistent shift in mode share away from the private car towards public transport, walking and cycling. This primarily reflects transport policy, strong population growth and concentrated employment growth in the centre of London. Our central case for the future of London therefore assumes high population growth, record numbers of homes and little change to London's economy, technology or travel behaviour.

However, the last five years have been characterised by significant and unexpected changes to these trends and hence travel demand in London. While London's employment remains buoyant, the economic structure of employment has been changing rapidly. With continued uncertainty in some parts of the economy, a prolonged squeeze on personal disposable incomes owing to slow wage growth and increasing housing costs and a slowing of the rate of population growth, public transport growth has levelled off. Total travel demand in London has been flat for the last three years. Bus demand began to fall in 2014 and the number of bus journeys made in 2018 (3.7 million per day) is now lower than it was in 2008. Growth in rail demand has also slowed since 2015.

We have seen Residents' trip rates decline by 15 per cent since 2013/14 driven by a decline in discretionary trips. Meanwhile, in some parts of London there have been increases in road traffic. At the same time, other societal and technological changes are taking place (e.g. flexible working, online shopping and services and the sharing economy) that have potential implications for travel demand patterns.

Evidence shows that over the longer term, Londoners are spending more of their leisure time at home. This shows that even the households with the highest incomes are travelling less frequently for leisure, this is also reflected in shopping trips, and that a squeeze on disposable incomes may not be the only factor driving the decline.

The growth of the sharing economy and changing preferences could begin to impact travel demand. The largest sector in the UK's sharing economy is peer-to-peer transport services such as Uber, FreeNow etc and London has the highest activity in the sharing economy with over 70 per cent of the population users. If sharing services continue to grow, they could begin to impact public transport demand, particularly Bus.

The continuing role of technology in enabling new and attractive models of mobility, especially app-based, coupled with changing preferences and expectations with on-demand culture, could mean that sharing services become more attractive than ownership in the future. Understanding these trends and gauging likely future ones is therefore of key interest for future planning.

The outbreak of Covid-19 presents a new level of uncertainty associated with travel demand in the short- and long-term. It is possible that the virus could accelerate a number of the trends that are emerging, for example increased flexible working, a decline in demand for discretionary travel and public transport. Mitigation measures put in place could demonstrate that, for some companies, working from home is more viable than previously thought and could offer savings to businesses. The virus could accelerate current moves towards provision of less office space per employee. For both commuting and discretionary travel, the extent of travel restrictions will have an impact and people may choose to live more locally if the virus stays in circulation. Discretionary travel is likely to be further affected by lower economic output and there may be a greater move towards internet shopping rather than in-store shopping. Private transport may be regarded as cleaner or safer than public transport in the longer term, putting further pressure on TfL in terms of achieving strategic aims such as the active, efficient and sustainable mode share.

At this point in the pandemic, there is a very broad range of plausible scenarios for London's Future. TfL have therefore developed five scenarios for future travel in London, based on the elements of the three scenarios used in this report to forecast travel demand set out in section 1.3.2. Details of these can be found in the Travel in London Report 13[16].

While economic factors are considered to be the primary drivers of travel demand (and recent travel demand change), technological and societal factors could be acting as secondary or tertiary drivers that interact with the primary drivers to create the effects being seen. The rapidity of change in these technological and societal factors in recent years, in combination with traditional factors affecting travel demand, may have facilitated changes in society.

6.2.2 Transport Supply

This section will focus on new modes as an addition to the transport supply that have been considered in the design methodology for the future situation of the TEN-T feeder route.

The modes presented below have been taken into consideration following extensive research, literature review and the MORE deliverable D3.1 with projected demand estimates for these modes outlined in the following section. It is important to note however, that whilst we expect these modes may play a part of the transport mix in 2041, there is considerable progress still to be made on establishing the regulatory framework under which these modes will operate and pending primary legislation changes required to enable some modes, such as e-scooters, to operate legally.

a) Public Transport Investment

There are a number of key assumptions for London-wide changes to the public transport network that are included in the reference case modelling forecasts for 2041. These changes represent the committed and funded schemes TfL have outlined in the most recent Business Plan to the mid-2020s. However, it should be noted this is not limited to further external funding sources coming forward to support growth in the area within the time period of the current

[16] https://content.tfl.gov.uk/travel-in-london-report-13.pdf

business plan and beyond. Some of the assumed changes to public transport that are directly related to transport supply in the wider impact area are:

- London Overground – electrification and extension of Gospel Oak to Barking Riverside, replacement stock, new trains on West Anglia and Watford DC services and improved frequency on most lines
- DLR - changes due to opening of Elizabeth line and roll out of new trains by 2026
- Bus – These forecasts include changes (net reductions) in bus capacity from 2016-2026 agreed with public transport service planning. This results in a reduction in operated km in Central / Inner London and an increase in Outer London
- National Rail Schemes: various enhancements such as Thameslink, HS2, Great Western route modernisation and improvements associated with new franchise awards

The figures below show the extent of the assumed bus and rail capacity changes with regards to the A2 feeder route and the wider impact area. Following a Central London Bus Review[17], Bus capacity reduction was planned for the Inner London area, which includes Old Kent Road and New Cross in the AM peak with increases in seated capacity beyond Greenwich and the outer London area in the period to 2024/25 as set out in the TfL Business Plan[18]. The total number of operated kilometres in inner London is proposed to be reduced in response to falling demand, however TfL will continue to adjust the network in response to demand with enhancements targeted, and contributions actively sought, where demand can best be driven to support growth areas and town centres within this time frame and beyond.

[17] https://consultations.tfl.gov.uk/buses/central-london/
[18] http://content.tfl.gov.uk/tfl-business-plan-2019.pdf

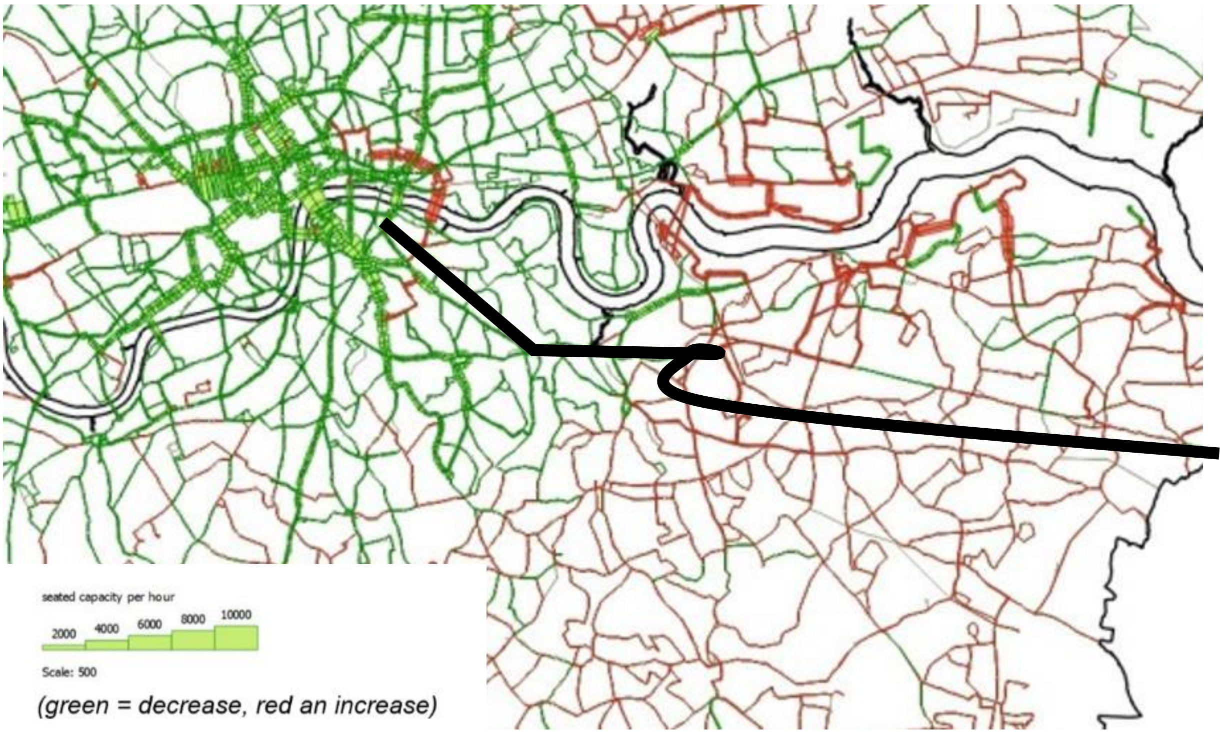

Figure 163. Bus Capacity Changes in the AM peak from 2016 to 2041. Old Kent Road has capacity for 2000 people per hour in the TfL reference case assumptions, based on current funded schemes in the TfL Business Plan.

The opposite is true for the planned rail capacity with significant seated capacity increases through Old Kent Road and at the strategic rail stations in New Cross, this continues to a lesser extent through Lee and Bexley on route to Dartford to the southern extent of the A2 feeder route. It is important to note these planned capacity increases may also provide an opportunity for increased freight services, at higher speeds, to come forward through private operators which could reduce road-based freight demand, depending on capacity. Current plans funded and confirmed through the TfL Business Plan does show the rail line through Welling, just to the north of the feeder route, sees a minor reduction in capacity.

Silvertown Tunnel, a twin-bore road tunnel under the Thames in east London that will link Silvertown to the Greenwich Peninsula, is also set to open from 2025[19]. The scheme, included in the reference case model outputs, will improve the reliability and resilience of the wider road network, with the potential to reduce freight flows currently using the A2 Feeder Route.

[19] https://tfl.gov.uk/travel-information/improvements-and-projects/silvertown-tunnel

Figure 164. Rail Capacity increase in the AM peak from 2016 to 2041. Red is an increase, Green a decrease. Total Capacity per hour is 6000 along Old Kent Road with current funded and planned schemes in the TfL Business Plan.

b) E-Scooters

E-scooters are currently illegal for use in any public place the UK, however they are legal to sell, and demand for these vehicles is growing, with strong sales from UK retailers recorded. We have seen significant growth, and reports of issues caused by, the rapidly growing rental markets in other cities across the world.

To provide additional transport options during the Covid-19 recovery, it was announced by the Department for Transport (DfT) in May 2020 that planned trials of rental e-scooters would be brought forward, from 2021 to the of summer 2020. The DfT will gather evidence from trials to inform future policy advice and legislation on the legal status of e-scooters. Guidance has been provided by government that any trial must adhere to:

- E-scooters will require insurance and riders will need at least a provisional driver's licence
- E-scooters will have a maximum speed of 15.5mph (but could be lower if a trial area decides to implement a lower limit)
- E-scooters will not be allowed on the pavement

At the end of 2020, TfL and London Councils launched a procurement process to select up to three operators to run a 12-month trial of rental e-scooters in London. The trial, which is planned to start in Spring 2021, will provide critical data for TfL, London Councils and the London boroughs to understand the impacts of these vehicles on London's goals, including Vision Zero, a shift to walking, cycling and public transport, zero emission targets and the Mayor's Healthy Streets approach. This data and learning will be shared with the Department for Transport as it looks to bring in new legislation in this field.

In the longer term, for these types of services to become viable transport choices in London, new powers would be needed to enable a whole-city approach to planning, licencing and deployment. With millions of daily trips in London crossing borough boundaries, a unified approach would help deliver a more seamless experience for customers, a more attractive market for operators and avoid a fragmented market where rules and requirements vary between local authorities. The ability to cap operator and scooter numbers and set basic parameters for responsible use (e.g. around where they can and cannot be parked) is commonplace in cities in other countries and will be vital to prevent deployment of dockless vehicles (be that shared bikes, e-bikes or e-scooters) becoming dangerous and unmanageable in London.

c) Connected and Autonomous Vehicles (CAVs)

Automated driving, as cited in Deliverable 3.1 by Dynniq, is no longer a futuristic dream but becoming a reality with much of the literature citing widespread roll out of advanced CAVs from 2030. TfL recognise the potential benefits from CAV rollout including significant road safety and accessibility improvements but also the potential risks CAVs bring in achieving the Mayor's Transport Strategy (MTS) target of primarily reducing private car use in London. Shared usage of CAVs is likely to be the most sustainable way of harnessing this technology in London, however TfL are keen to work with organisations running CAV trials in London to understand the opportunities, risks and challenges they present.

It is not yet clear how CAVs will deploy, but UK Government backed consultations are underway to un-pick the many legal and regulatory challenges that present themselves in this space. Details of all London trials past and present, as well as the Guidance trialling organisations must adhere to in London can be found at tfl.gov.uk/corporate/publications-and-reports/connected-and-autonomous-vehicles.

d) Autonomous River Barges

London was founded on the Thames and the river continues to play a key part in the city's success today. While its role has evolved over time, with large parts of the historic docks now converted to thriving commercial and residential neighbourhoods, the Thames remains a vital transport corridor for people and freight through the heart of London.

Maximising usage of the Thames will make a vital contribution to achieving the central aim of the Mayor's Transport Strategy for 80 per cent of all trips in London to be made on foot, by cycle or using public transport. River services are already well established on the Thames for the construction and waste industry but more recently we've seen further uptake by major logistics providers as part of their sustainability commitments.[20]

The Thames Estuary Growth Board Action Plan[21] also supports this view, their work aims to maximise the benefits, potential and opportunities of the waterway and the land, communities, places and businesses that are bound to it. They have a clear directive to improve and increase use of the river to carry more passengers and freight of all types.

With logistics companies now recognising the use of the river as a sustainable and efficient transport mode, it is only reasonable to consider that much like the automotive industry, the marine industry will also undergo a shift towards full autonomy in the future. It is reported this trend is well underway already, both in the open seas as well as inland with an expectation that full autonomy will be rolled out from 2035.[22]

Yara Birkeland is one of the world's most developed trials of a fully battery powered freight shipping solution prepared for autonomous operation[23]. However, the project notes the biggest challenges to the commercialisation of the vessel has been the on land autonomous logistics which requires simplified solutions before testing portside can begin. Closer to home, the UK has a test bed of autonomous boat technology off the coast of Portsmouth[24], demonstrating the growing investment in the autonomous operations of the marine industry and potential presence in the UK, and London, by 2041.

e) Drones

It is important to note that drones are regulated by the Civil Aviation Authority and TfL to date has had no input into aviation regulation. That said, drones are being used in London and so they should not be immediately overlooked and some organisations, as outlined below, including TfL are utilising them for certain purposes.

In 2017 the Metropolitan Police Service (MPS) trialled them to search for missing people and suspects and more recently to monitor road users and traffic offences[25]. Slightly further afield, and in the wake of the COVID-19 pandemic, the case for drones in the medical industry has strengthened. The NHS have announced a six-month trial, just outside of London in Chelmsford, backed by the UK Space Agency to fly non-medical items such as PPE in the first instance with an ambition to eventually carry COVID-19 samples and blood tests[26]. TfL have also utilised drones for Engineering and construction purposes, details of which can be found on the TfL website [27]

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[20] https://dhlguide.co.uk/riverboat-thames-service/
[21] https://thamesestuary.org.uk/wp-content/uploads/2020/07/TE_Action_Plan101.pdf
[22] https://www.septentrio.com/en/insights/top-3-positioning-challenges-autonomous-marine-navigation
[23] https://www.yara.com/news-and-media/press-kits/yara-birkeland-press-kit/
[24] https://www.southampton.ac.uk/news/2017/07/autonomous-systems-service.page
[25] https://www.theguardian.com/uk-news/2019/jul/08/met-become-first-uk-force-deploy-drone-monitor-road-users
[26] https://www.mse.nhs.uk/latest-news/nhs-drone-trial-set-to-take-flight-1537/
[27] https://tfl.gov.uk/info-for/suppliers-and-contractors/remobilisation-technology-and-innovation

Drone technology has multiple challenges to overcome including those in the regulatory, liability and security space. TfL will continue to monitor this evolving space and ensure that solutions work for London where we have the ability to influence direction.

A key trend in the expected supply of digital and connected transport modes in 2041 is the overarching requirement for data sharing as a necessity for planning and managing future road space. Future technologies blur the lines between the physical and the digital world, enabling us to interact and use data to solve problems in new ways. These technologies are expected to be supported by new digital infrastructure such as 5G & future networks, artificial intelligence (AI) and internet of things (IoT) that make the internet faster, provide lots of data, and allow us to process these large amounts of data quickly. Our ambition is to ensure these are transparent, designed around the needs of Londoners and meet the highest standards for all Londoners, including privacy and cyber security. More information on the emerging technology charter for London can be found at: https://www.london.gov.uk/publications/emerging-technology-charter-london

6.3 Future patterns of demand in the Wider Impact Area and along the Feeder Route

6.3.1 Mode Share

The pie chart below depicts the change in mode share between the base year of the strategic model (2016) and the reference case for 2041. There are some minor differences in the outputs, for example the reference case for 2041 loses 2 percentage points for walking mode share from base year, from 33% to 31%, which can be explained by a higher uptake in cycling. The graphic also shows the same percentage increase for cycling mode share from 4% in the base year to almost 7% in the Reference case year. Public Transport mode share largely stays the same between both years, with decreases observed for Car drivers, Car passengers and PHV services by 1 percentage point each.

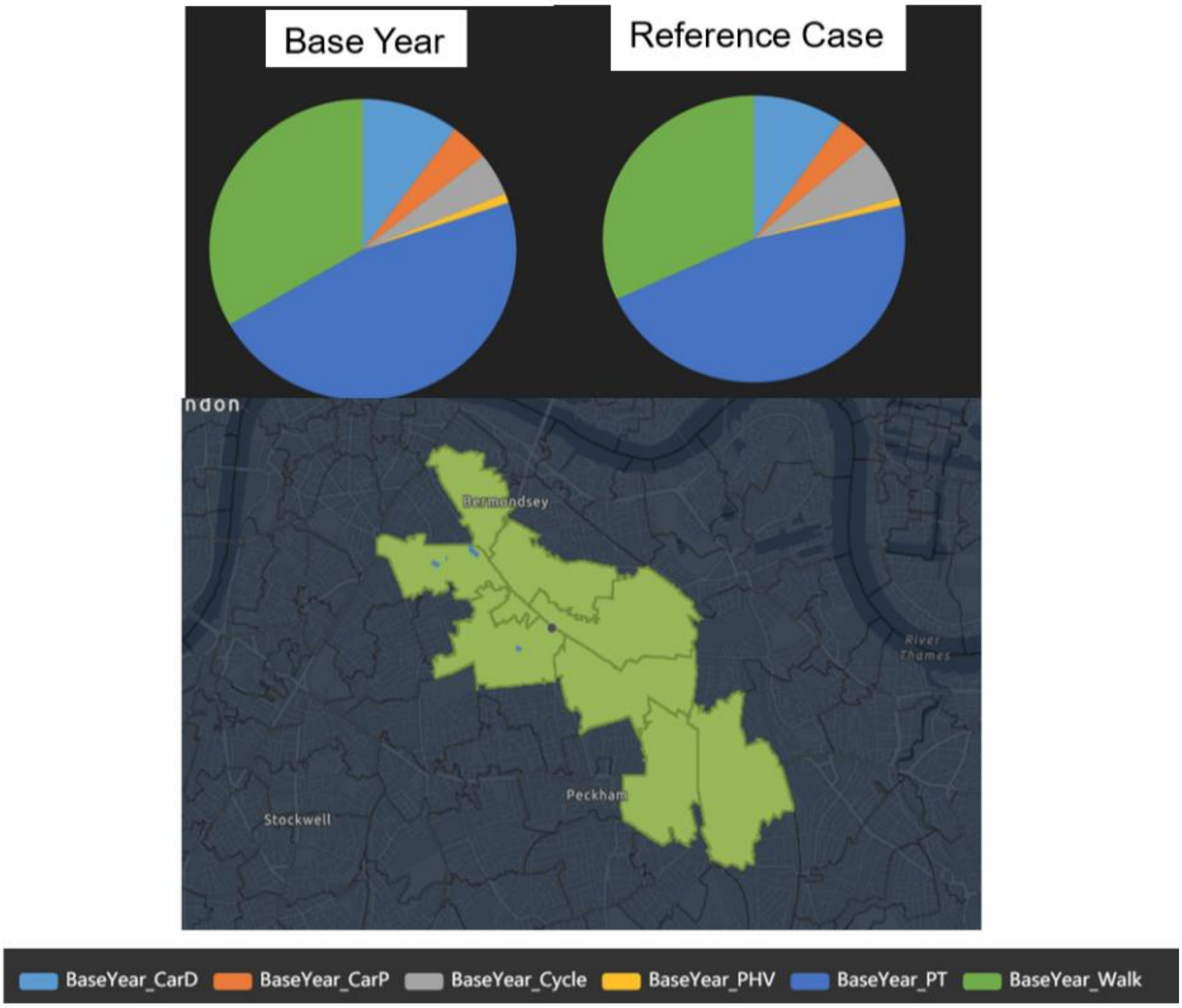


Figure 165. OKR 2041 Mode Share- Base Year vs Reference Case

6.3.2 Modal Demand

The information presented in this section sets out the strategic modelling forecasts for the expected modal demand in 2041 compared to the 2016 Base Year, reference case and TfL Scenarios.

TfL conducted research in 2019 which investigated emerging trends and how these could develop into different futures. The output of this work was three scenarios, none of which was to be considered more likely, desirable or plausible than others. Their main purpose was to better define the 'envelope of uncertainty' affecting our medium- to long-term plans.

'Innovating London', 'Rebalancing London' and 'Accelerating London' were the three scenarios that resulted and demonstrated three alternatives to the future assumed in our central case, with a nominal timeline of 2041.

- **Innovating London** is the story of London reinventing itself as a young, urban innovator, where technology changes how people live and work, but leaves some behind.
- **Rebalancing London** is the story of a more equal but ageing society with lower economic growth, that focuses on self-sufficiency and liveability as world power moves east.
- **Accelerating London** is the story of an ever-growing, expanding London which acts as the beating heart of the world financial system, but struggles to deliver a high quality of life for all.

It was also deemed necessary to conduct a fourth Scenario, titled PT+, given the reference case does not include the Bakerloo Line Upgrade and Extension (BLUE) to Lewisham, due to the scheme being currently unfunded in the TfL Business Plan, with two proposed stations on Old Kent Road and the 'Metro-isation' of south London.

Public Transport

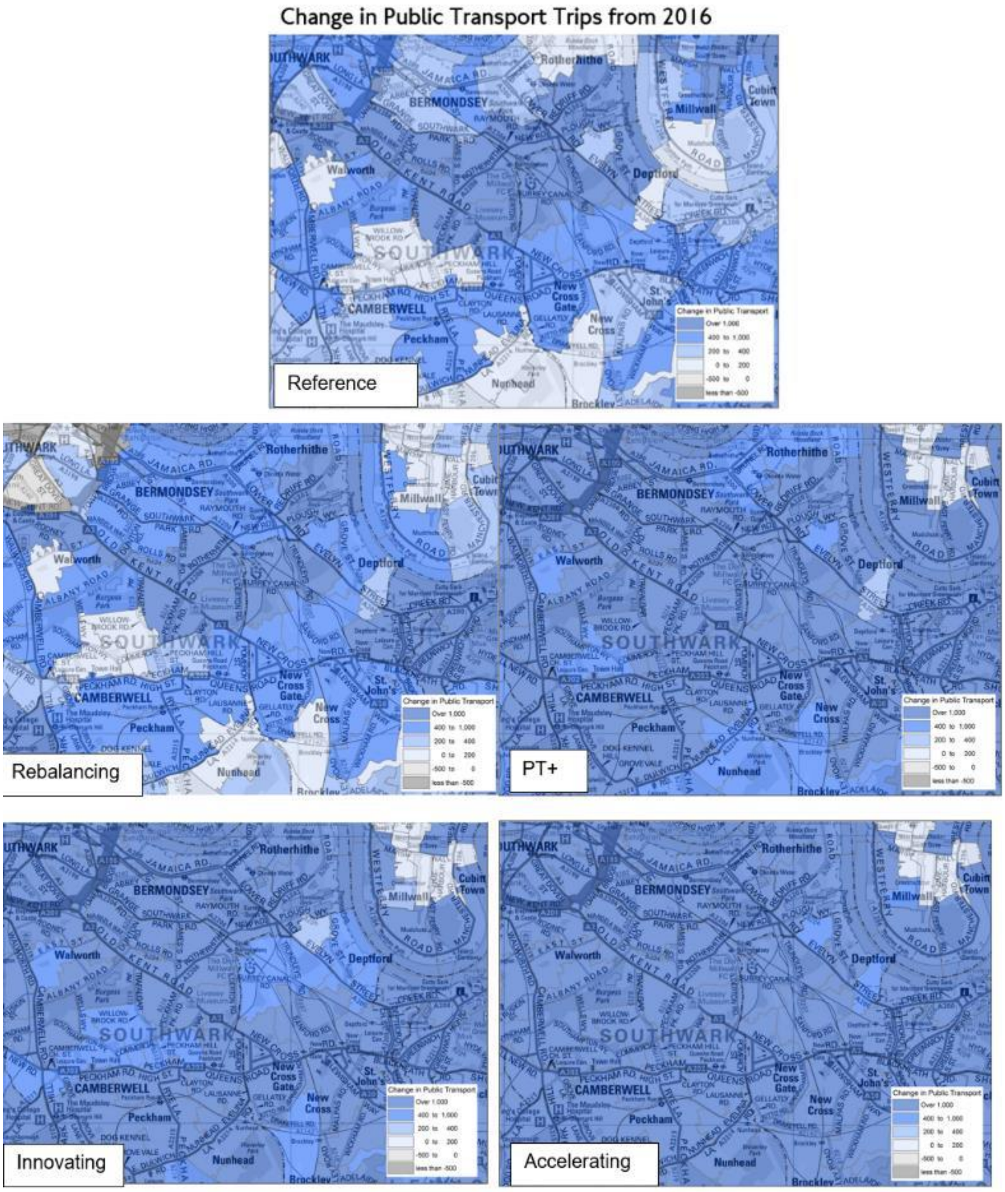


Figure 166. Change in Public transport trips from 2016 to 2041 for each scenario

The map shows a concentration of over 1,000 more public transport trips than in 2016 along the stress section of OKR and linked to the secondary Opportunity Area of Surrey Quays, north easterly from OKR. As the 2041 reference case model does not include the extension of the Bakerloo Line from Lambeth North, it should be noted that the majority change in these trips is anticipated to be made by Bus.

The wider study area sees similarly high change in Public Transport trips to the north western side of OKR around Walworth and to the southern extent of OKR in New Cross and Peckham. However, it is Accelerating London that appears to have the most impact on change in public transport trips with increases over 1000 along the length of the corridor and the wider impact area. This is due to population and employment levels soaring at a greater rate as forecast in this scenario which results in constant overcrowding on transport services as well the road network congestion worsening. The PT+ scenario then also has the second greatest increase in trips from 2016 along the corridor length and in the immediate vicinity.

a) Walking

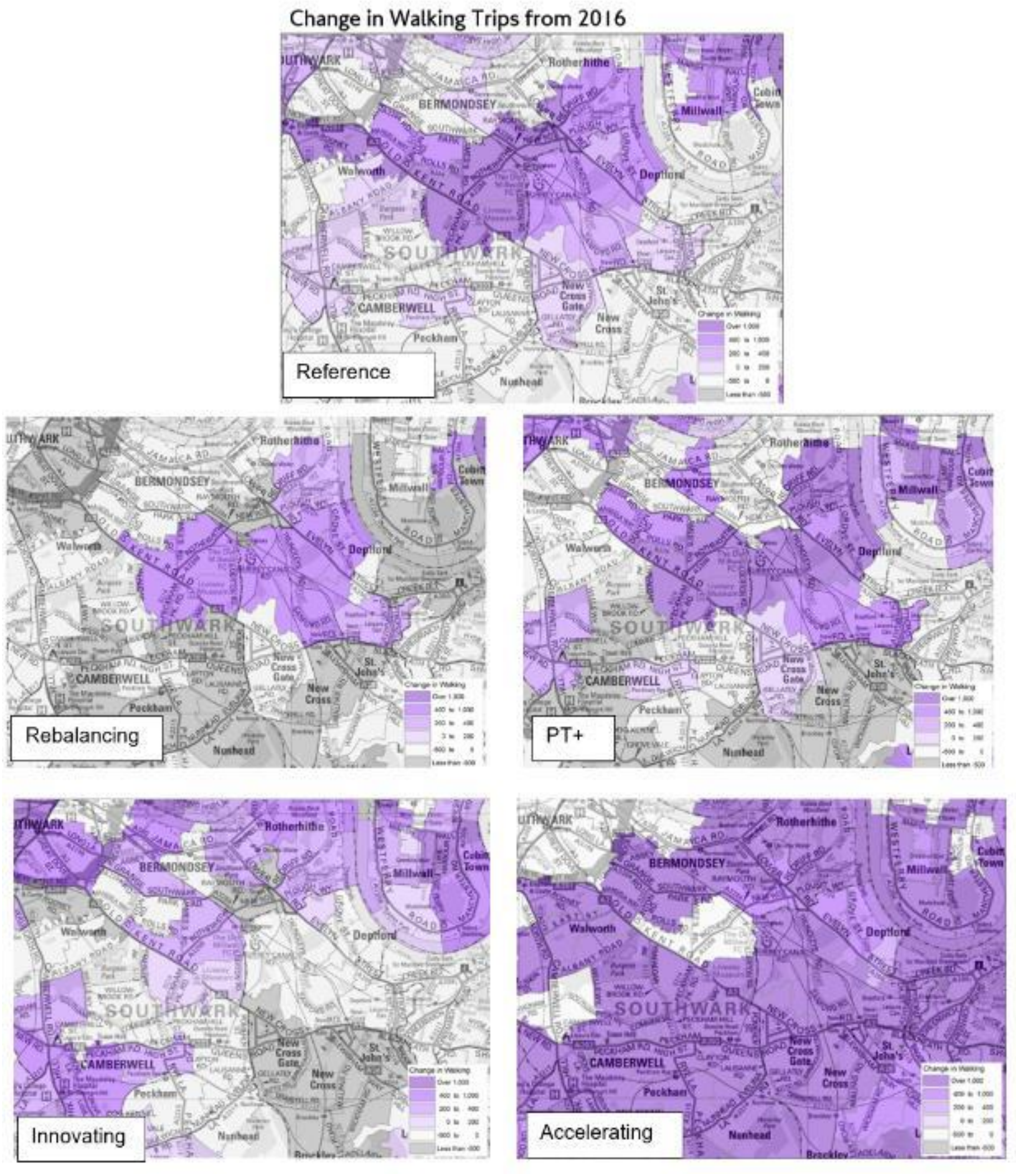


Figure 167. Change in Walking Trips from 2016 to 2041 for each scenario

There is more selective growth in walking trips, compared to PT trips above in each of the scenarios, albeit for Accelerating London whereby there is significant growth of over 1000 more trips in most zones in the immediate vicinity and wider impact area of OKR. PT+ and Reference case scenarios show the most intense growth behind Accelerating with is particularly concentrated to OKR zones, again with over 1000 more trips emphasising the anticipated change in conditions from what currently exists.

b) Cycling

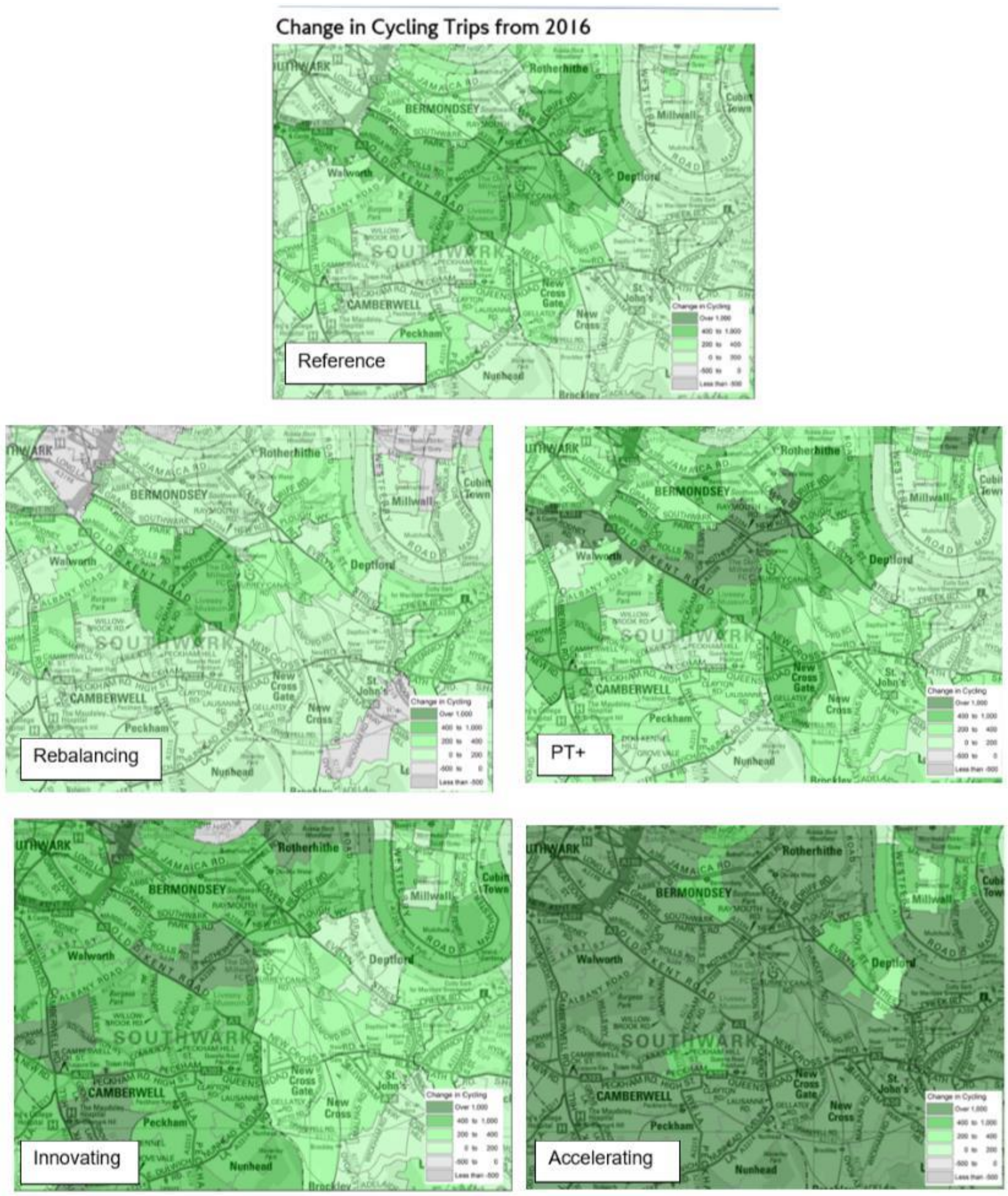


Figure 168. Change in cycling trips from 2016 to 2041 for each scenario

Growth in cycling trips shows a much broader spread across the wider impact area in all scenarios, much like that seen in PT trips. The reference case sees 400-1000 more trips along most of the length of OKR, and the stress section, and is particularly focussed and extending beyond the North Eastern side of the section to Surrey Quays. PT+, Innovating and Accelerating all see over 1000 cycling trips on OKR, particularly where Rotherhithe New Road intersects to OKR. The rebalancing scenario sees the lowest growth of all in the wider impact area, but still modest growth in the concentrated area of OKR where Rotherhithe New Road intersects as was seen in most scenarios. This could be due to an ageing but active population with a focus on localism. This scenario leads to increasing numbers of people living and working locally with good use of high streets and a range of leisure opportunities available locally that enables active travel.

c) Car, Private Hire Vehicles (PHV) and Taxi

The reference case shows a modest increase in trips in the vicinity of OKR and New Cross of 0-200, there are concentrated pockets of growth directly within OKR zones up 1000 trip growth around Peckham Park Road and to a lesser extent towards Rotherhithe and Surrey Quays. Highest growth is seen in Rebalancing scenario with intense (over 1000 trip growth) around OKR, Surrey Quays and Deptford and most of the wider impact area seeing 400-1000 growth in trips. The Innovating London scenario sees the second highest, mainly concentrated towards the south west of OKR in Walworth, Peckham, Camberwell and Nunhead with growth in trips between 200-1000. Accelerating has the least growth in trips on OKR, only a small zone of 0-200 trips leading to Peckham Park Road and Alderton Road around Livesey Museum. A large section of the northern end of OKR sees a reduction in trips of around -500 in Acceleration London.

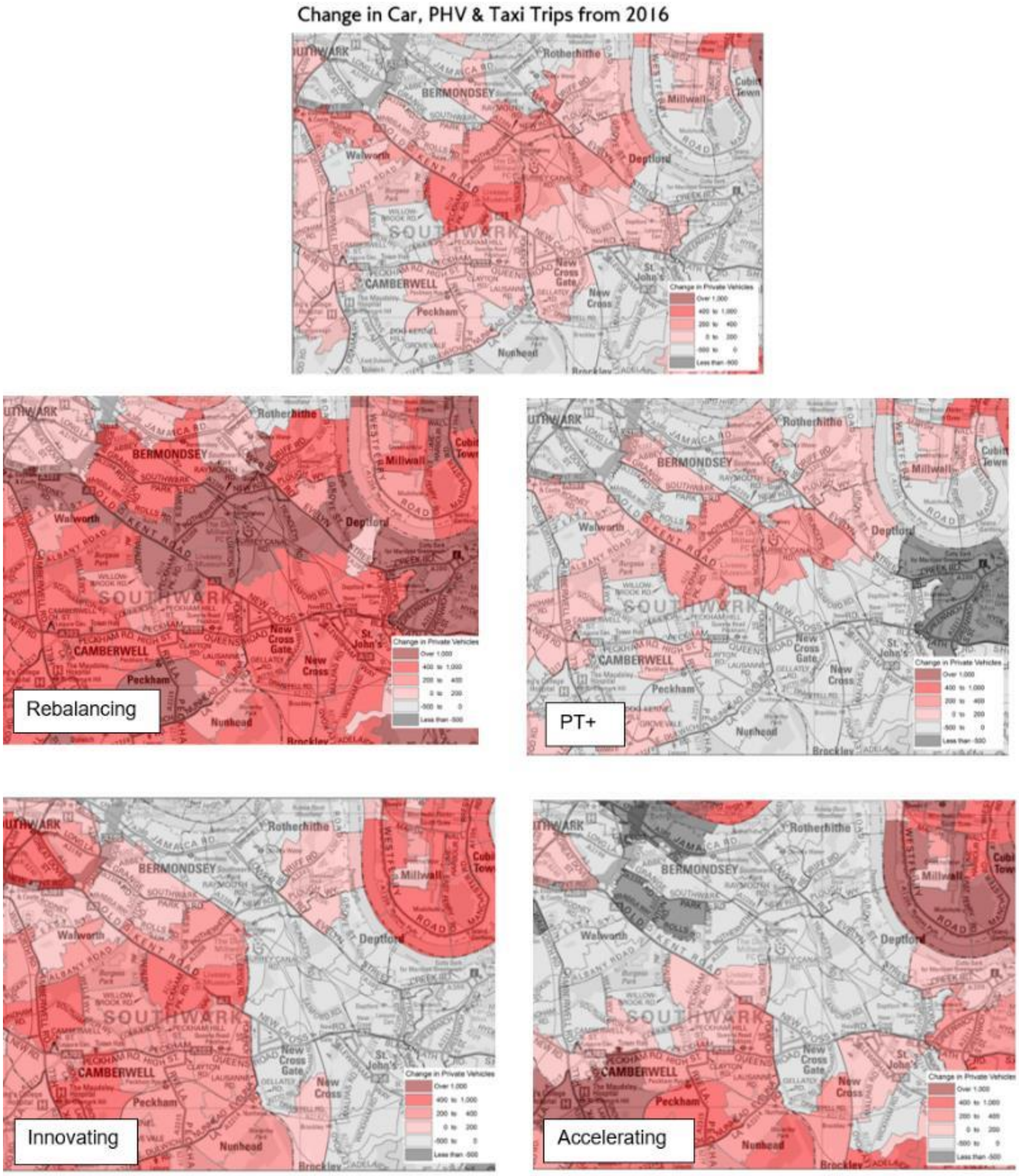


Figure 169. Change in Car, PHV & Taxi Trips from 2016 to 2041 in all scenarios

d) Freight- to include information on autonomous barges and drones (not modelled)

The PT+ and Reference case scenarios below show identical trends of a modest increase in freight trips between 0-200 with distinct pockets of growth between 400-1000 trios in Walworth and Rotherhithe New Road just south of Bermondsey. The Rebalancing scenario can be interpreted as expected with people living and working locally and making good use of high streets. The Innovating and accelerating scenarios show broad growth across all zones in the wider impact area with increases of 0-200 trips, both have high levels of LGV growth due to higher online shopping and density of living.

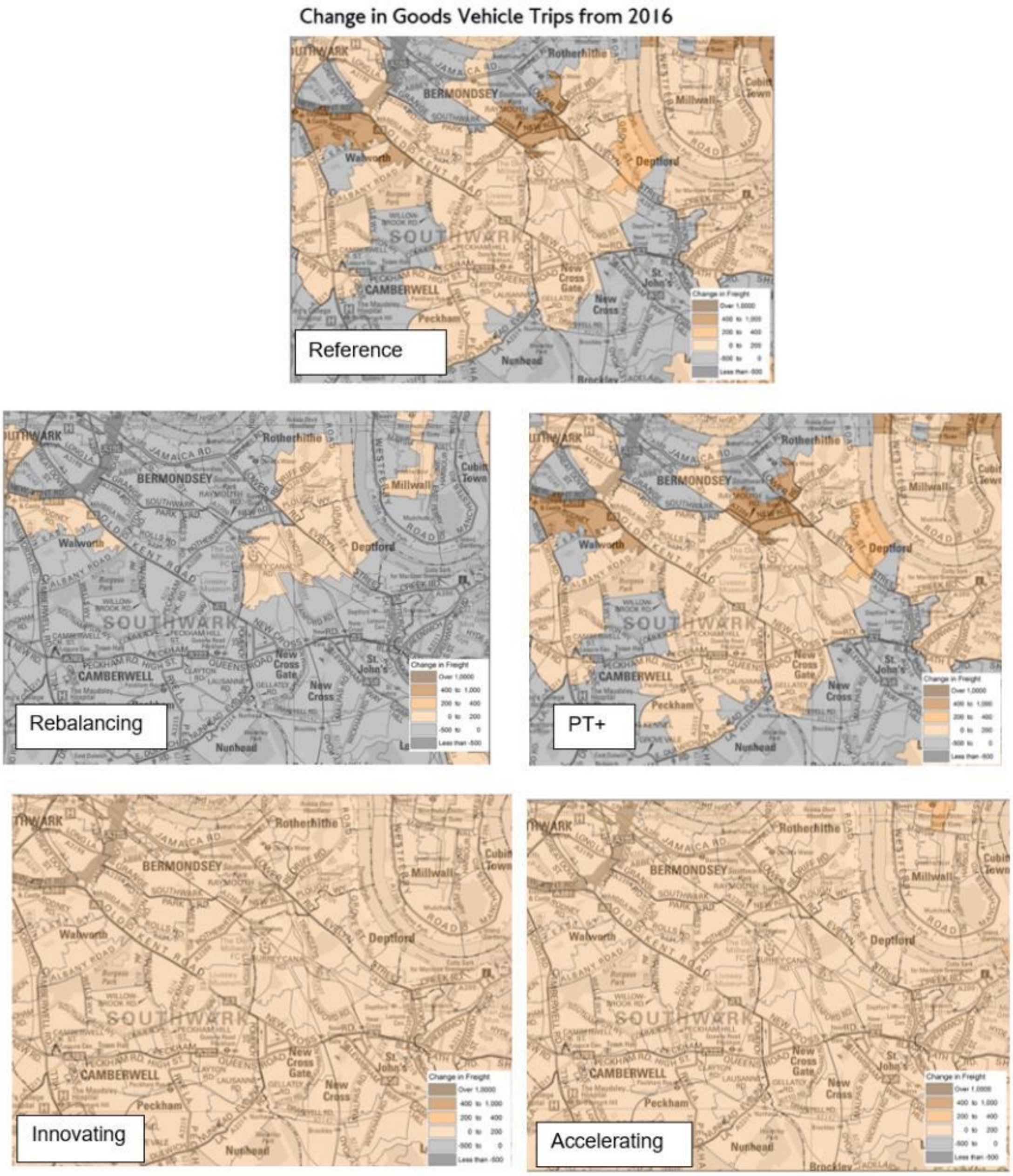


Figure 170. Change in Freight Trips from 2016 to 2041 for all scenarios

The London Assembly Future Transport Report (2017) looked into the potential use of Drones in London in the future, Whilst admittedly, the report revealed the likely scale of drone use in London is still largely unknown, they did report that any use is likely to be limited to the 'last mile' of the delivery chain but that the logistics will remain challenging. The best estimate given in the report is that drones will replace some deliveries currently made by road vehicles, but probably not to the extent of having a significant impact on traffic congestion levels.[28]

e) Modal Flows

It is also interesting to see the modelled flows for each mode in each of the scenarios in the table below which highlights key trends. Of note, the table shows rail flows are several orders of magnitude higher than any other mode signifying the strategic importance of this mode on the corridor as one of the major commuting links into London. The highest rail flows are in Accelerating London which has a high mode share for commuting. The figures are interesting for rail as it shows that scenarios create greater variability in rail flows than rail schemes themselves. Rebalancing London has lowest rail flows with less commuting due to a lower, and ageing, population and focus on localism.

For bus, the highest flows are also in Accelerating London which sees population and employment levels increase far greater than anticipated, providing congestion and crowding challenges on the transport network. The lowest flows are in PT+ which is to be expected following the BLUE and South London 'Metro-isation' in this scenario which would take pressure off buses.

Cycle Trips seem to follow the same pattern as rail with Accelerating London having the highest flows. This is due to this scenario having the highest levels of commuting with the highest growth in employment. More modest levels of growth are seen in the rebalancing scenario which means this sees the lowest flows.

Pedestrian trips may seem conservative in comparison to other modes; however, the data shows auxiliary flows only along the OKR which are trips walking to bus stops or rail stations only to give an indication of footway demand and kerbside activities in the 2041 scenarios. The highest trips can be seen in PT+ which would be expected with people accessing new rail stations as a result of BLUE along the corridor. Rebalancing and the reference case scenario have the joint lowest pedestrian flows with less commuting demand from an ageing population and localism as discussed above.

Unlike other modes, accelerating London has the lowest general traffic flows which can be interpreted as where people are travelling to. In this scenario, London is a super-charged and well-connected city which will attract a lot of commuting by PT which means fewer people going to work locally via private cars and creating traffic in the morning peak. The highest flows are in Innovating London which has high PHV and reasonably higher LGV flows too.

[28] https://www.london.gov.uk/sites/default/files/future_transport_report_-_final.pdf

Table 43. 2041 Old Kent Road Modal Flows in the AM peak for each scenario. Highest (red) and lowest (green) flows for each mode have been highlighted

OKR A2 - Albany Road to St James' Road	Reference Case	Innovating London	Rebalancing London	Accelerating London	PT+
Bus	3,500-6,000	3,000-6,000	2,000-5,000	3,000-6,500	1,200-4,000
Rail	124k	133K	108K	155K	132K
General Traffic	2,100-2,600	2,100-2,800	1,500-2,500	1,100-2,000	1,900-2,300
Cycle Trips	700-1,000	700-1,100	300-500	1,250-2,000	500-900
Pedestrian Trips	100-250	100-300	100-250	100-350	100 - 600

6.4 Future conditions on the Stress Section

6.4.1 Old Kent Road Opportunity Area

As previously referenced, Old Kent Road (OKR) has been identified as an opportunity area (OA) in the London Plan[29] which means it is one of limited places in London that has capacity to accommodate large scale development. The figure below outlines the parameters of the OA and OKR in the context of south London and the A2 feeder route.

[29] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/opportunity-areas/opportunity-areas

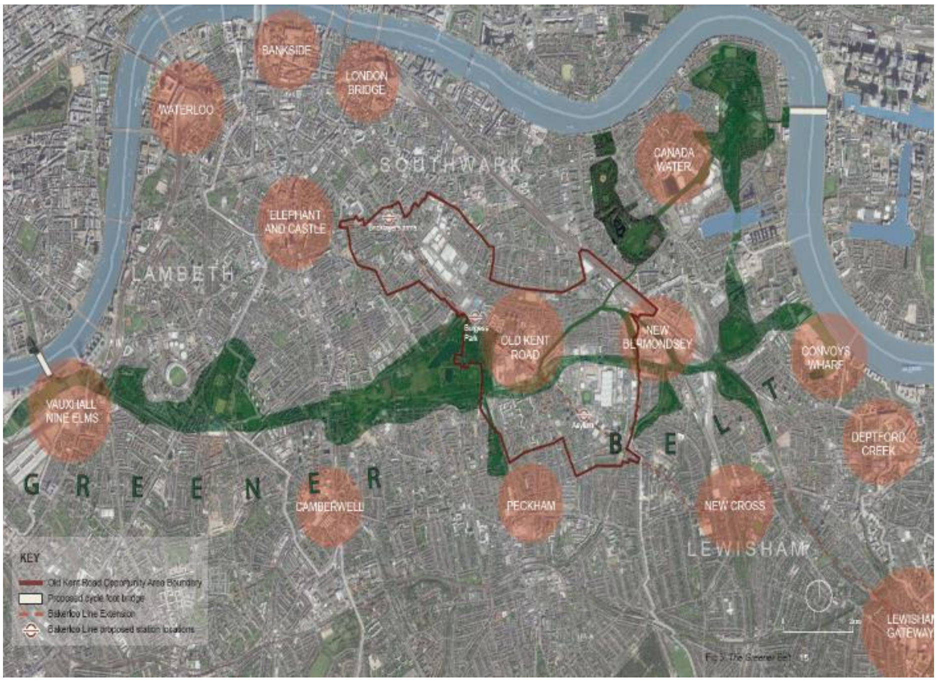


Figure 171. Old Kent Road Opportunity Area with A2 feeder route intersection. Source: OKR AAP[9]

The figure below outlines the proposed scale of the development, both housing and employment projections, that is planned to be accommodated within the OA and the spatial projections for this growth and land use by 2037. It should be noted these plans are provisional and currently being consulted on (January 2021 to April 2021), details of the consultation can be found at https://consultations.southwark.gov.uk/corporate-strategy/okraapdec20/.

There is a Mayoral commitment to deliver the BLUE, which could see two new underground stations serving the Old Kent Road and immediate vicinity, significantly increasing the public transport capacity in the area. However, funding is yet to be secured to deliver the scheme[30]. There is a level of uncertainty around the scale of growth OKR OA could accommodate with and without enhanced public transport capacity. The OKR Area Action Plan (AAP)[31] takes this uncertainty into account in the short, medium- and long-term growth in homes and jobs from 2017 to 2037 with and without the BLUE, as per the figure below.

However, up to 9,500 homes, commercial space and jobs are permitted to come forward as part of Phase 1 of the AAP in advance of BLUE. There is therefore a requirement to support this growth in the absence of delivery of significant public transport capacity, in the form of BLUE, through a Healthy Streets scheme which would also provide active travel measures after. TfL continue to look for third-party funding and work with potential development partners, which could help fund these public transport capacity improvements.

[30] https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/bakerloo-line-extension
[31] https://oldkentroad.org.uk/documents

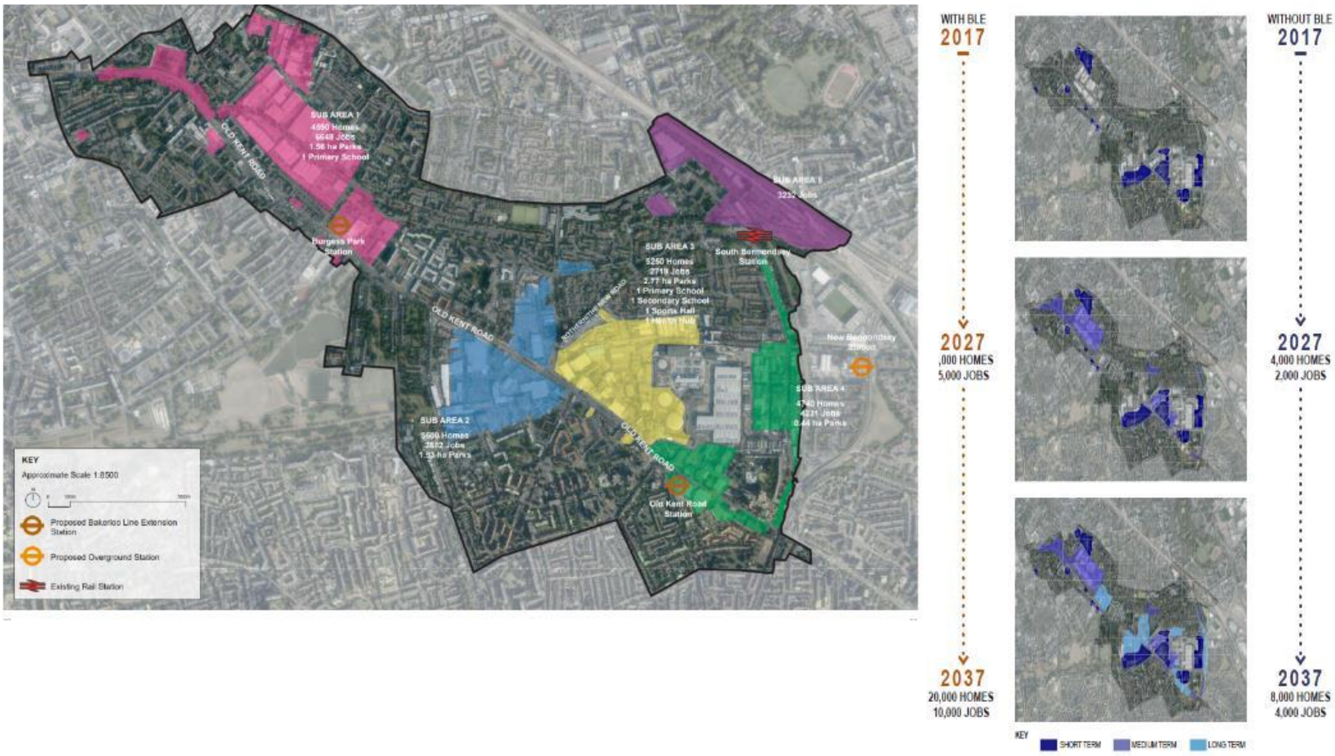


Figure 172. Spatial Projections for growth of housing and jobs on OKR and proposed locations for BLUE stations. Please Note: these plans are provisional and subject to consultation at https://consultations.southwark.gov.uk/corporate-strategy/okraapdec20/. Source: OKR AAP[9]

Building on the proposed OKR spatial plans for development presented above, the figure below illustrates the proposed changes to the existing land use. Of note is the relocation of the high street, expected to generate significant footfall and pedestrian activity, to the southern end of OKR where current land use it predominantly industrial.

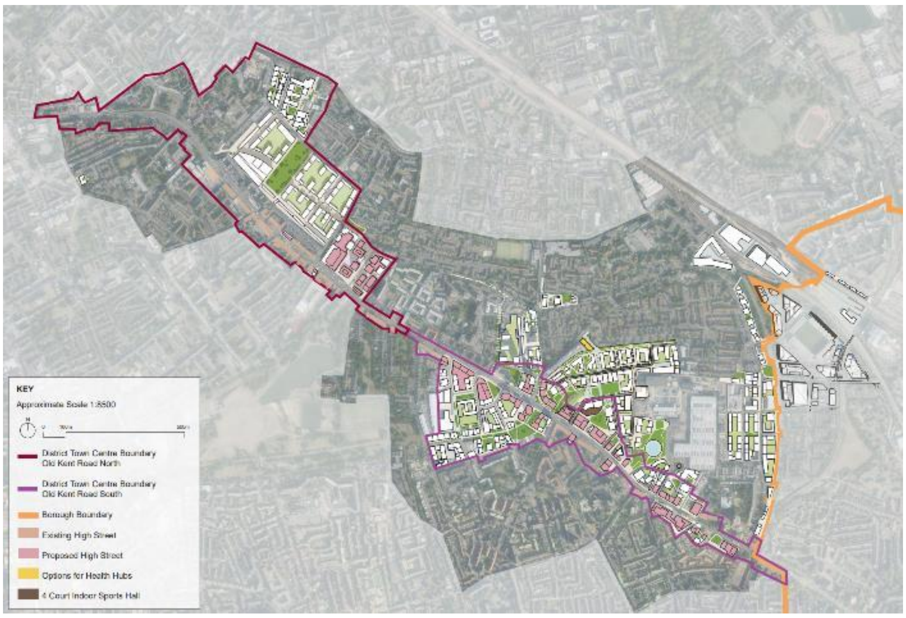


Figure 173. OKR Proposed Town Centres and High Street. Source: OKR AAP[9]

6.4.2 Expected Movement and Place-related Demands

Information in the table above has already been provided regarding pedestrian flows in the AM peak period for each of the scenarios modelled at an auxiliary level to give an indication of footway demand and kerbside activities with trips shown walking to bus stops or rail stations. Further information is provided in the figure below which details the range of expected movement demands by time of day interpreted from modelled origin and destination data for 2041.

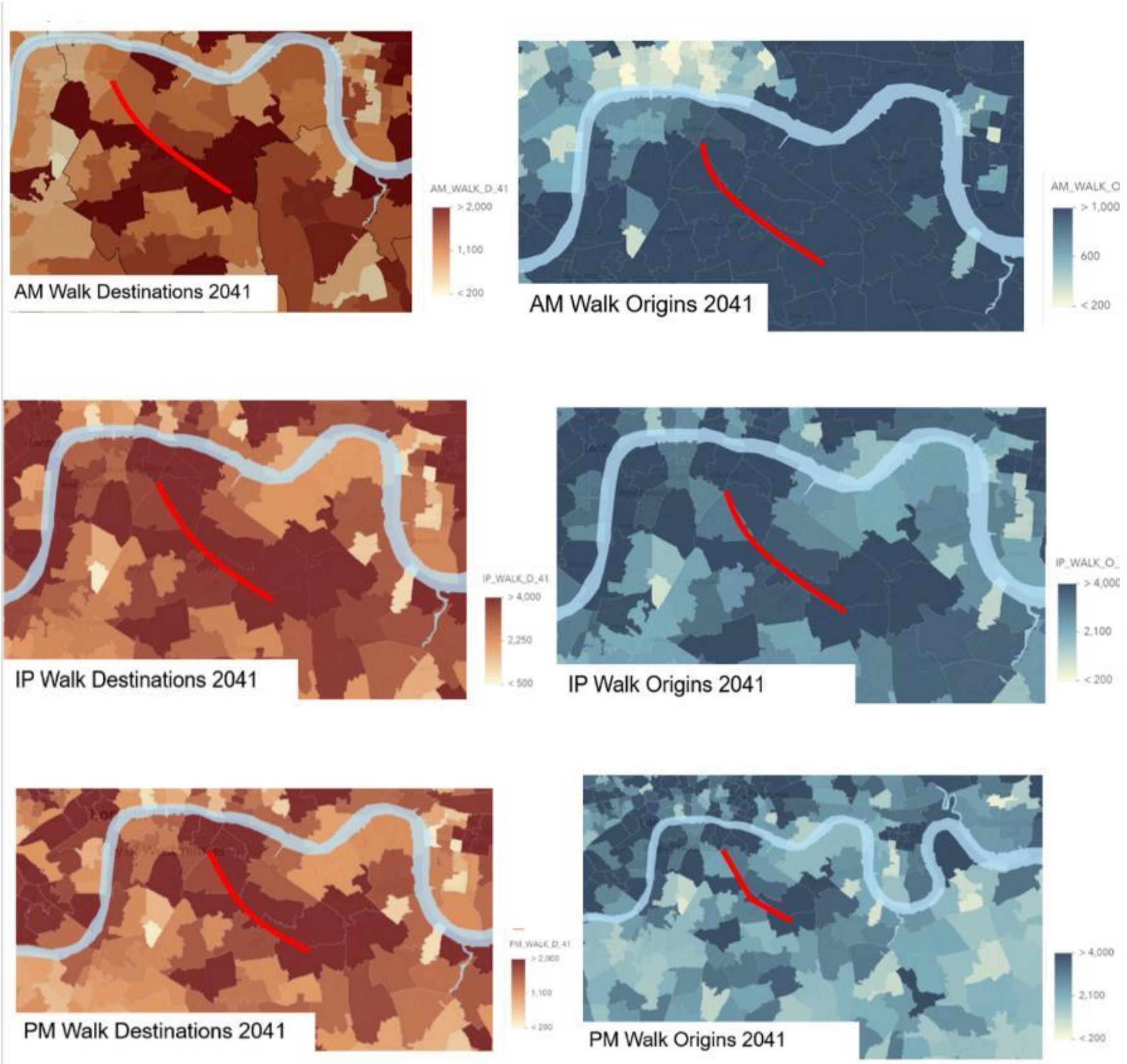


Figure 174. Modelled Origin and Destination outputs for Walking by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red.

This shows a concentration of over 2,000 walk trips ending at the southern end of OKR in the AM peak, highlighting the level of employment and jobs created on OKR attracting these trips. Similarly for origins, there is a high level, over 1,000 trips, originating in OKR and the wider impact area.

The Inter-Peak for destinations shows even higher concentrations than the AM peak with over 4,000 trips ending in most of the zones for OKR emphasising its location as a high street for essential services and leisure activities. Origins is similarly as high with up to 4,000 trips originating at the southern end of OKR and extending to Surrey Quays, with up to 2,000 originating trips along the entire length of the stress section.

Similar trends can also be seen replicated in the PM time period with up to 2,000 trips ending at the southern end of OKR and in various zones along the length of the Stress section, not dropping below 1,000 for the entire length. A similar trend is seen for trips originating in the PM peak as a result of the high population growth anticipated and high density living.

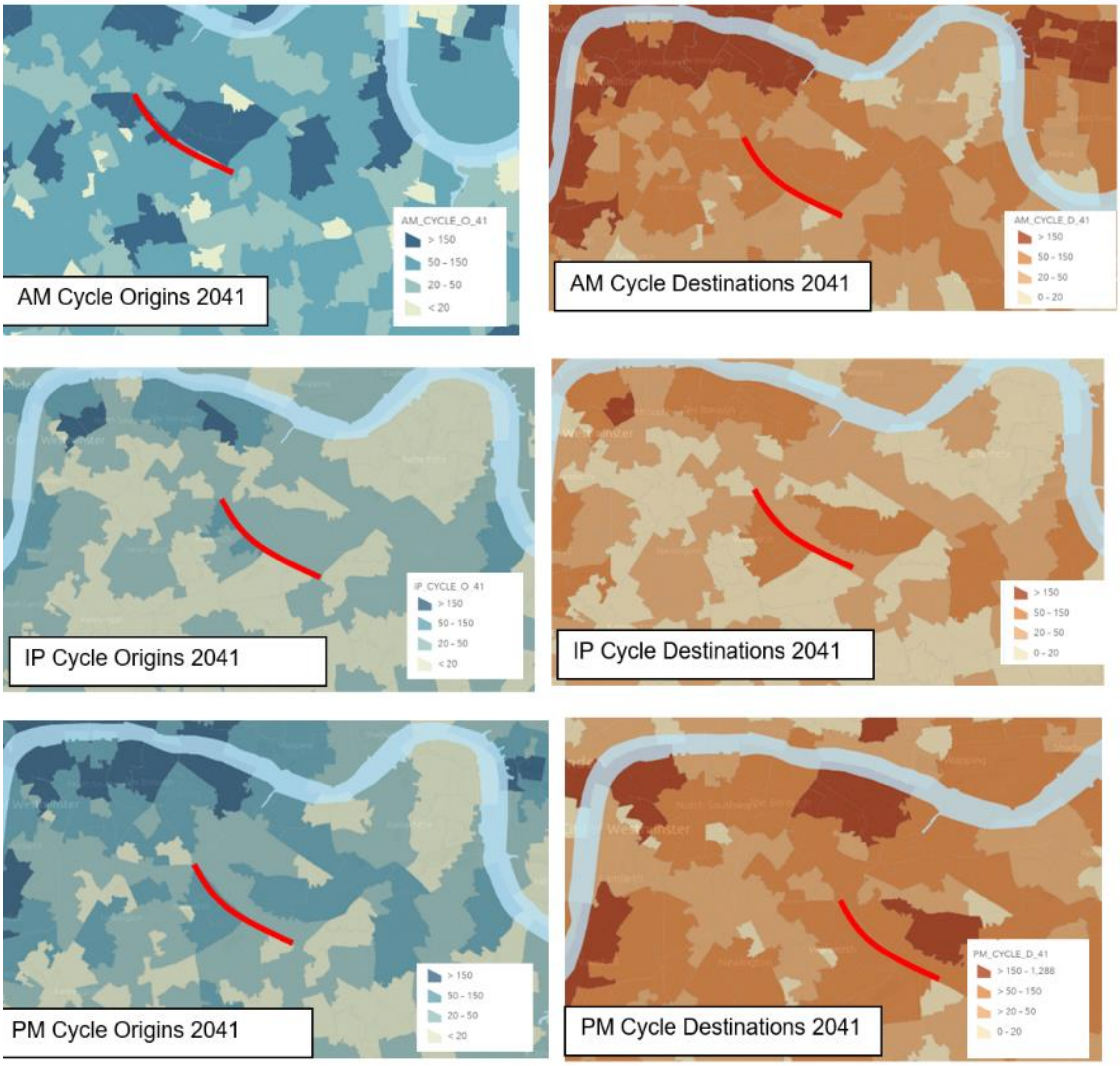


Figure 175. Modelled Origin and Destination outputs for cycling by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red.

There are two clear and unsurprising origin and destination outputs that show the greatest trips, these are AM origins and PM destinations. Both show similar patterns with the greatest cycle trips originating and ending at the south western edge of the OKR in particular. For the AM period, over 150 cycle trips are also generated at the northern edge of OKR. For AM destinations there are more modest trips ending in OKR but the wider impact area, particularly towards Waterloo shows a concentration of destination trips that, given the proximity of OKR, could be used as a through route for these trips.

The Inter-peak period sees much reduced cycle output, particularly as origin with most of the zones surrounding OKR seeing less than 50 trips. For destinations, the trend is similar except for the Western side of OKR which sees 50-150 trips.

The PM period for origins is also modest at majority 50 trip output, the destination output as described above however is more intense with up to 150 trips in most of the zones within the OKR vicinity and up to 1,200 trips in zones adjacent to the OKR. Providing safe and consistent cycle routes, wayfinding and cycle parking facilities will therefore be a key priority to consider in the design exercise.

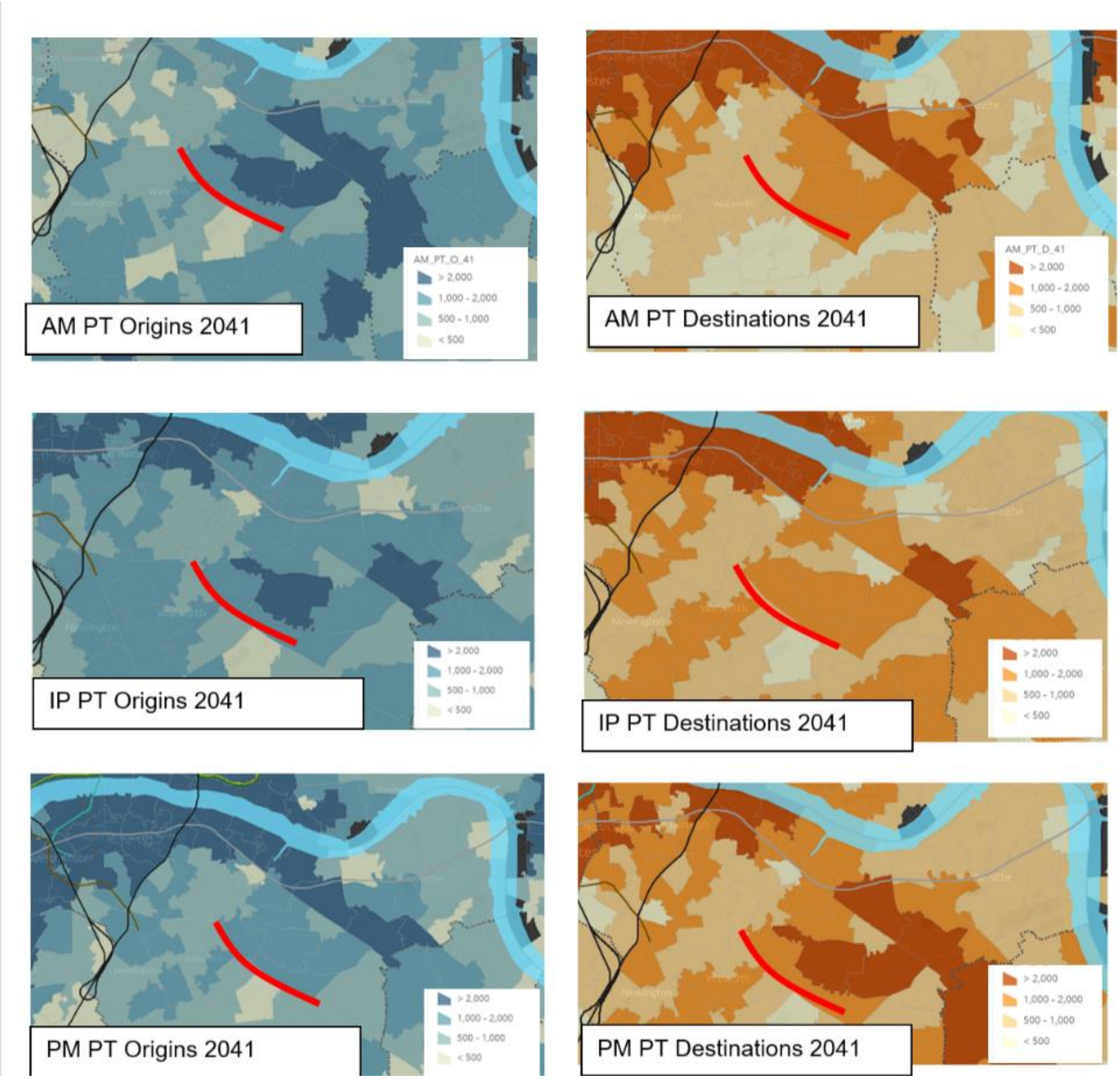


Figure 176. Modelled Origin and Destination outputs for Public Transport (RailPlan) by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red.

A clear trend that public transport is fundamental for OKR is evident across all three time periods and origin and destination outputs. Similar to the cycling outputs shown, commuting patterns are illustrated as origin outputs in the AM period and PM destinations with over 2,000 trips. Throughout other time periods and function, outputs remain high, between 1,000-2,000 trips in most of the MoTiON zones within the vicinity of OKR. Again, concentration of trip outputs can be seen in both origin and destination towards the eastern side of OKR.

6.5 Design brief for Future Conditions

6.5.1 Design Objectives

This section will outline the road uses and users considered as a priority for Old Kent Road stress section and the priorities for the design exercise.

The period to 2041 is the strategic focus of the Mayor's Transport Strategy (MTS) in achieving the 80% sustainable mode share. Therefore, the key policy priorities and road user priorities set out in this section are consistent with those outlined in the design brief for the current conditions of New Cross in London (Deliverable 5.1).

The overarching outcomes identified in the table below align to the MTS and also take into consideration the local borough vision set in the OKR Area Action Plan[32] and OKR Social Regeneration Charter[33].

The key priorities also consider the range of future conditions, as set out in the preceding chapters, of modal demand and supply factors that have implications for street design. The clear trend in all scenarios is the strategic importance of public transport on OKR, particularly in terms of efficient movement of people. However, this must also be balanced by the competing needs to accommodate significant population growth in terms of place-making and kerbside activities generated by a denser population. Walking, including interchanging between modes, will need careful consideration in the street design exercise; particularly, in the context of supply of new modes and the safety implications of these for pedestrians and other road users.

Table 44. Key Future Street Design Priorities

Key Priorities	
Provide safe and consistent cycle provision	Introduce road danger reduction measures
Improve bus journey time	Improve air quality

[32] https://oldkentroad.org.uk/wp-content/uploads/okr_area_action_plan.pdf
[33] https://oldkentroad.org.uk/wp-content/uploads/OKRSRC.pdf

Improve walking conditions	Improve access to public transport
Reduce severance for pedestrians	Improve interchange between modes
Reduce speed	Reduce private car trips and consolidate freight

In creating road space designs that deliver the above key priorities, road user requirements in terms of provision have been considered in the table below. More details, including the measures that will be used to evaluate success in achieving these outcomes can be found in the Appendices.

Table 45. Future Road User Priority and Provision

Road user	Pedestrians	Cyclists	Bus users	Rail passengers	Car driver /passenger	Motor-cyclists	Taxi & PHV passengers	HGV / LGV drivers
Provision	- Provide safe & Direct pedestrian crossings - Increase footway provision - Provide consistent pedestrian wayfinding - Reduce vehicle speeds - Improved urban realm	- Provide safe & consistent cycle provision - Reduce vehicle speeds - Provide secure cycle parking	- Accessible bus stop provision - Provide seating at bus stops and interchanges - Improve bus priority to reduce bus journey times	- Increase footway provision - Provide consistent wayfinding to improve interchange facilities	- Cleaner & Greener vehicles - Sustainable Mode shift	- Visibility improvements of infrastructure - Signing/ road marking improvements to reduce conflicts	- Accessible taxi ranks - Dedicated drop off/ pick up points at interchange locations	- Clear & Concise restrictions for Parking & Loading - Convenient locations for Parking & Loading - Consolidate & Re-time deliveries - Rear access - Out of area waiting facilities

6.5.2 Tasks to be carried out in the street design exercise using the MORE tools

Our action plan for March 2021 to September 2021 can be found below setting out how each of the tools developed in MORE (road space option design tools, street design toolkit, Linemap, VISSIM, road space appraisal tool) will be applied.

Table 46. Timelines for Design and Appraisal

Task Ref	Function	Tool	Mar		Apr		May		Jun		Jul		Aug		Sep	
4.1	Option generation tool	Policy intervention tool														
4.1	Option generation	Road designs tool														

4.2	Stakeholder engagement	LineMap														
4.2	Stakeholder engagement	Blocks & Acetates														
4.2	Stakeholder engagement	TraffWeb														
4.3	Micro Simulation	Build VISSIM Model														
4.3	Micro Simulation	VISSIM modelling (upgraded)														
4.4	Appraisal tool	Political and technical assessment														
4.4	Appraisal tool	Cost benefit analysis														
4.4	Appraisal tool	Multi-criteria analysis														

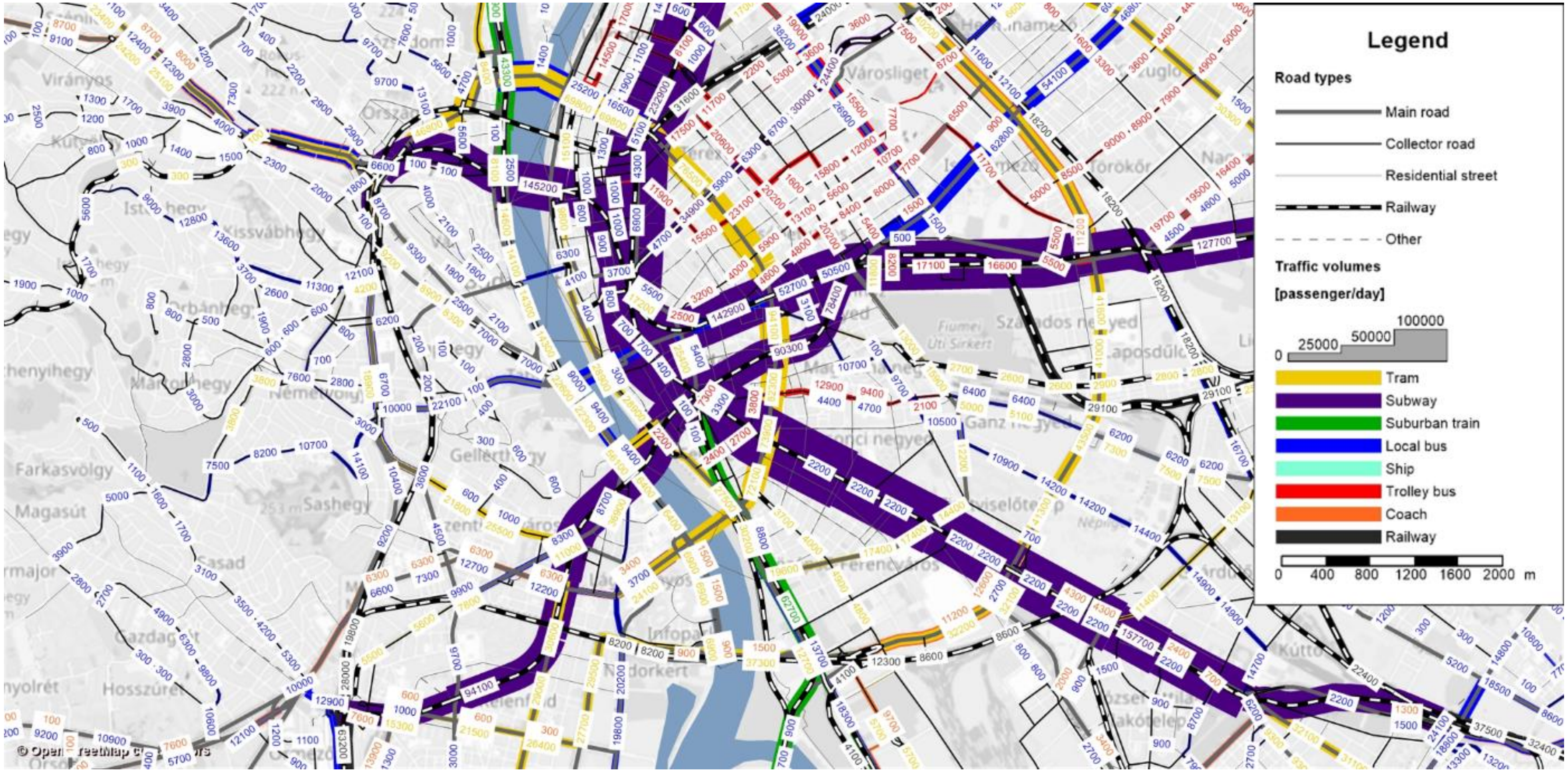
7 Appendices

7.1 BUDAPEST

Outputs of macroscopic traffic modelling at every scenario for private transport (in unit vehicle/day) and public transport (in passenger/day).

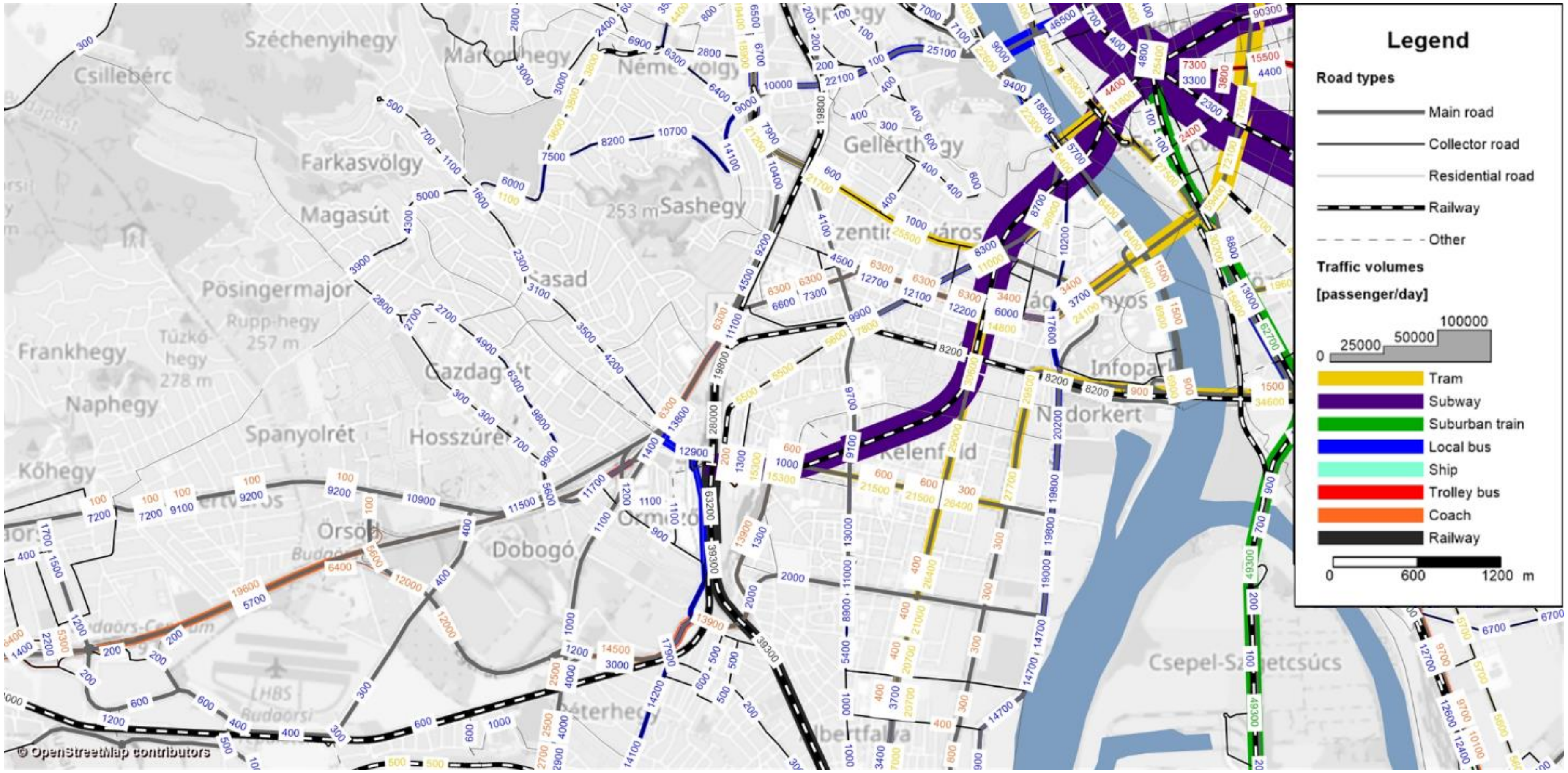
7.1.1 Output of SvBASE_2030 model

Budapest SvBASE_2030 [unit vehicle/day]



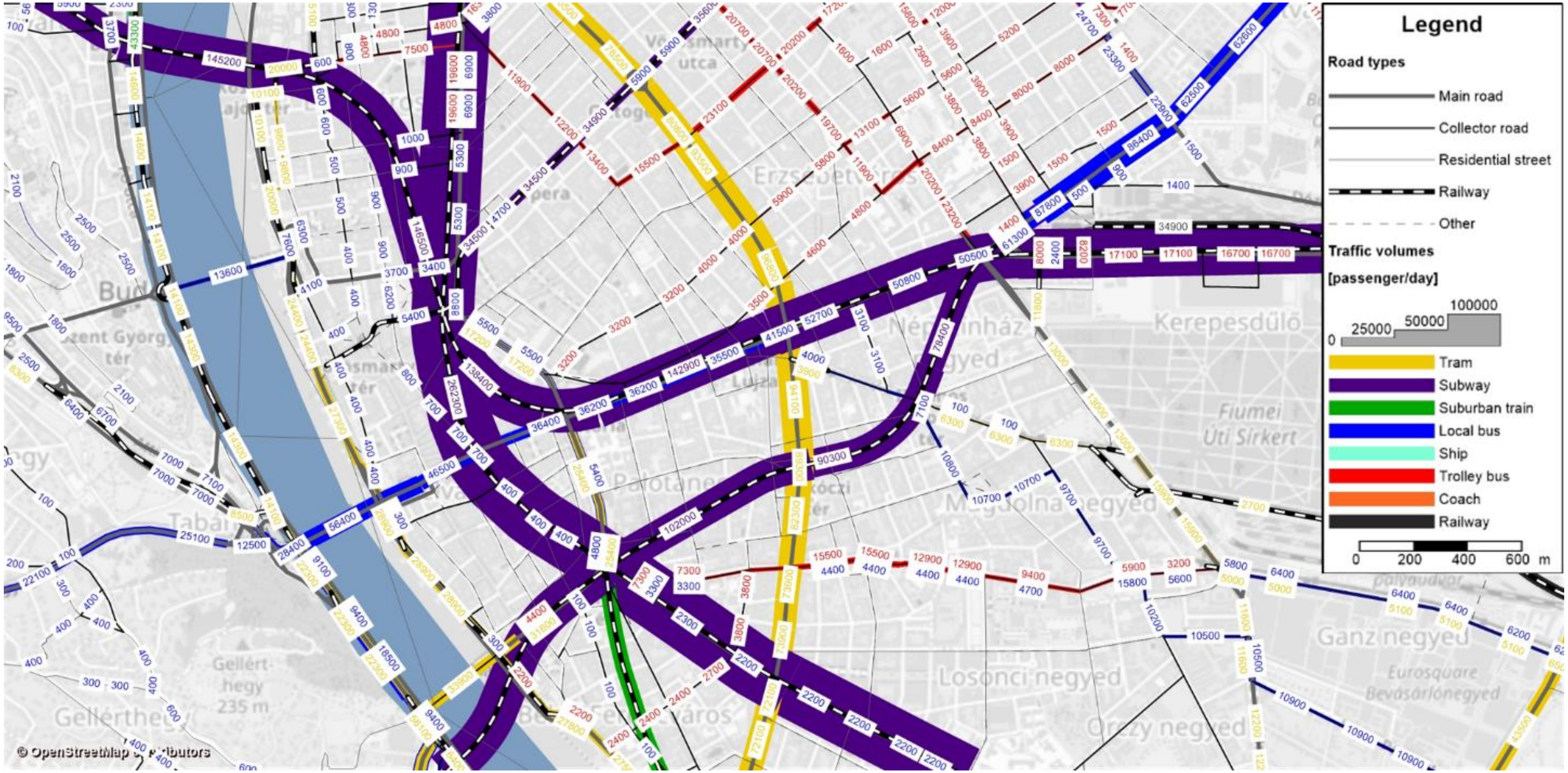
Budapest SvBASE_2030 [passenger/day]

M1/M7 - Budapest SvBASE_2030 [unit vehicle/day]



M1/M7 - Budapest SvBASE_2030 [passenger/day]

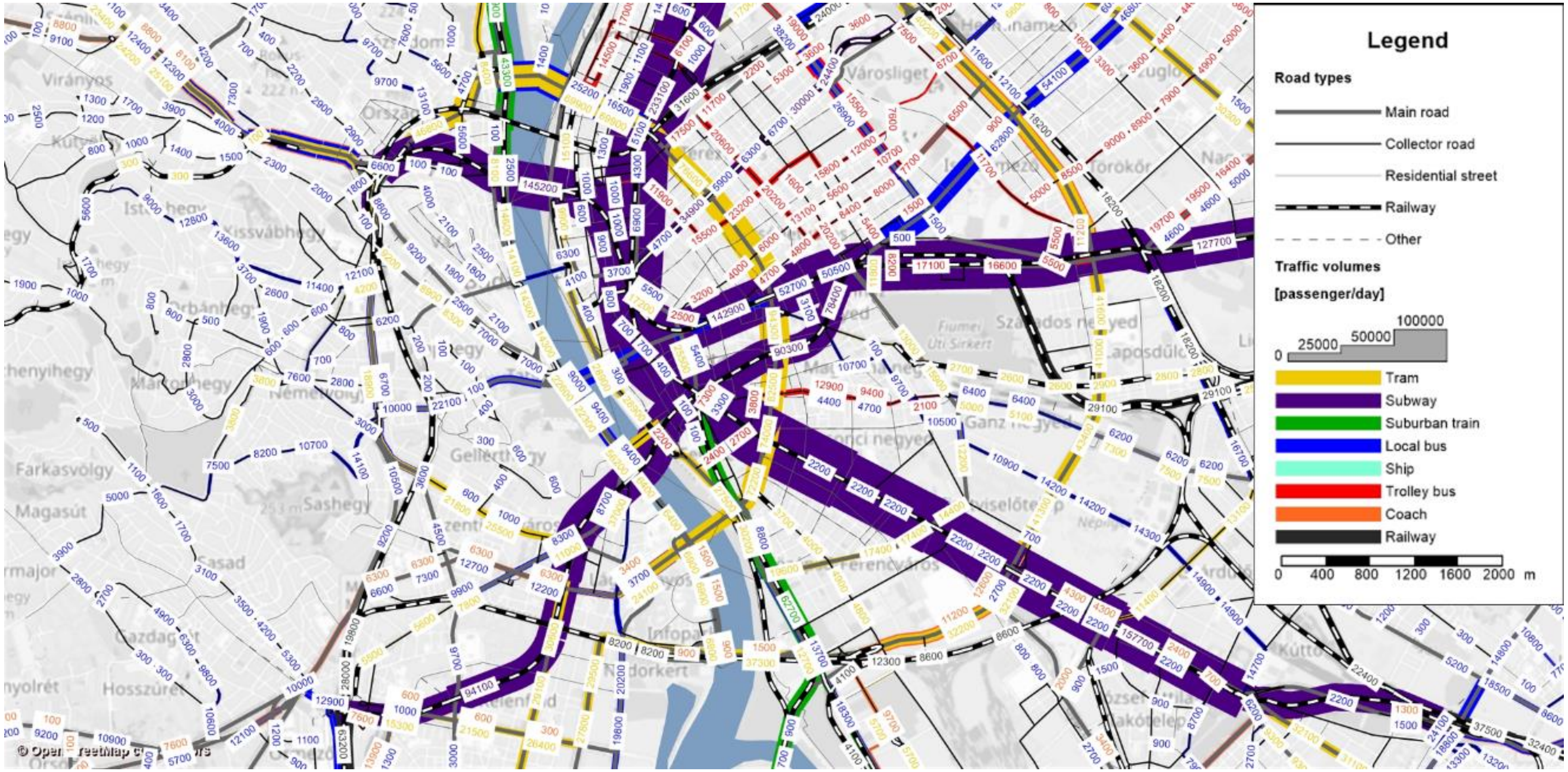
Stress Section (Rakóczi road – axis) SvBASE_2030 [unit vehicle/day]



Stress Section (Rakóczi road – axis) SvBASE_2030 [passenger/day]

7.1.2 Output of SvA_2030 model

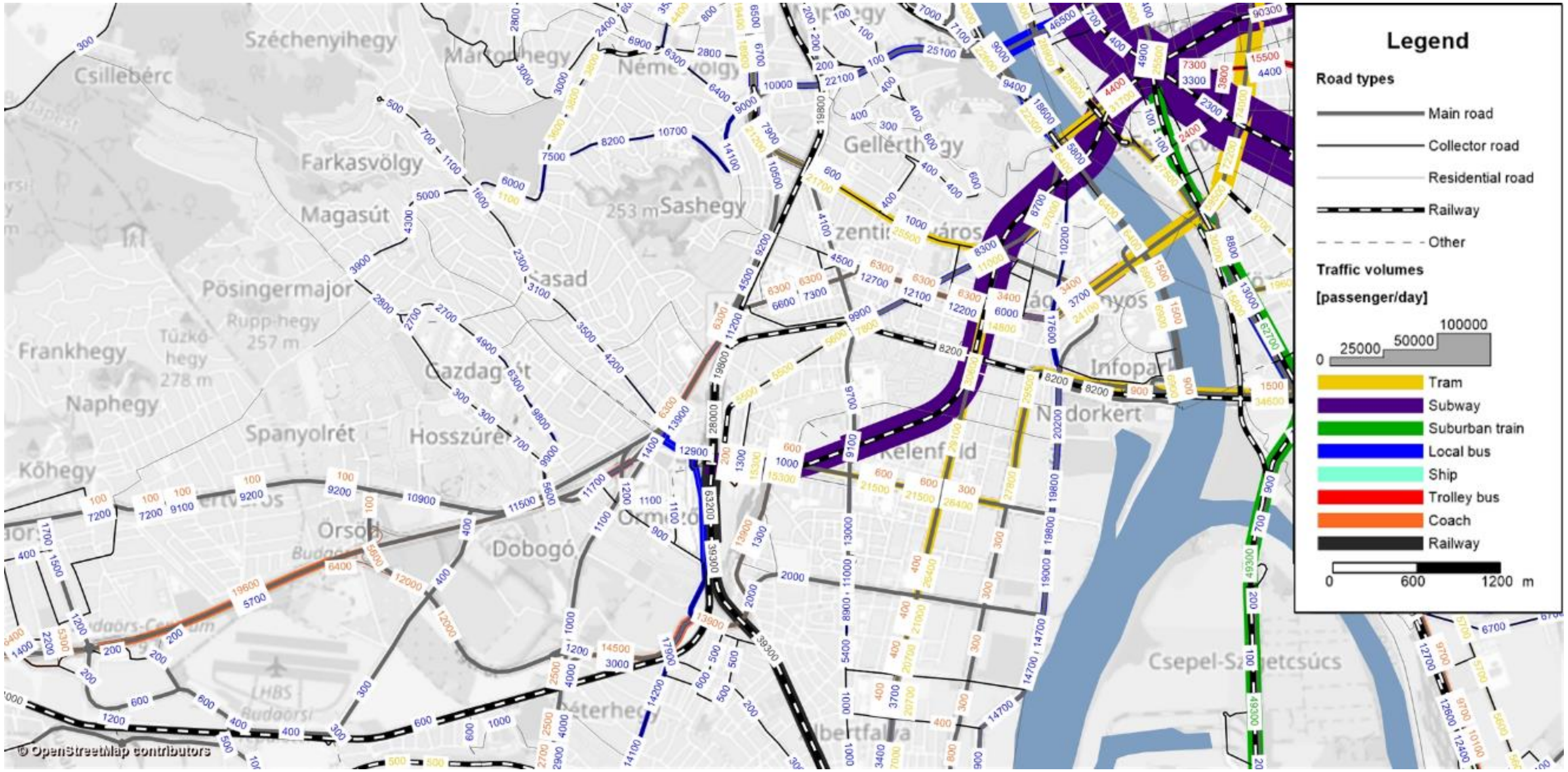
Budapest SvA_2030 [unit vehicle/day]



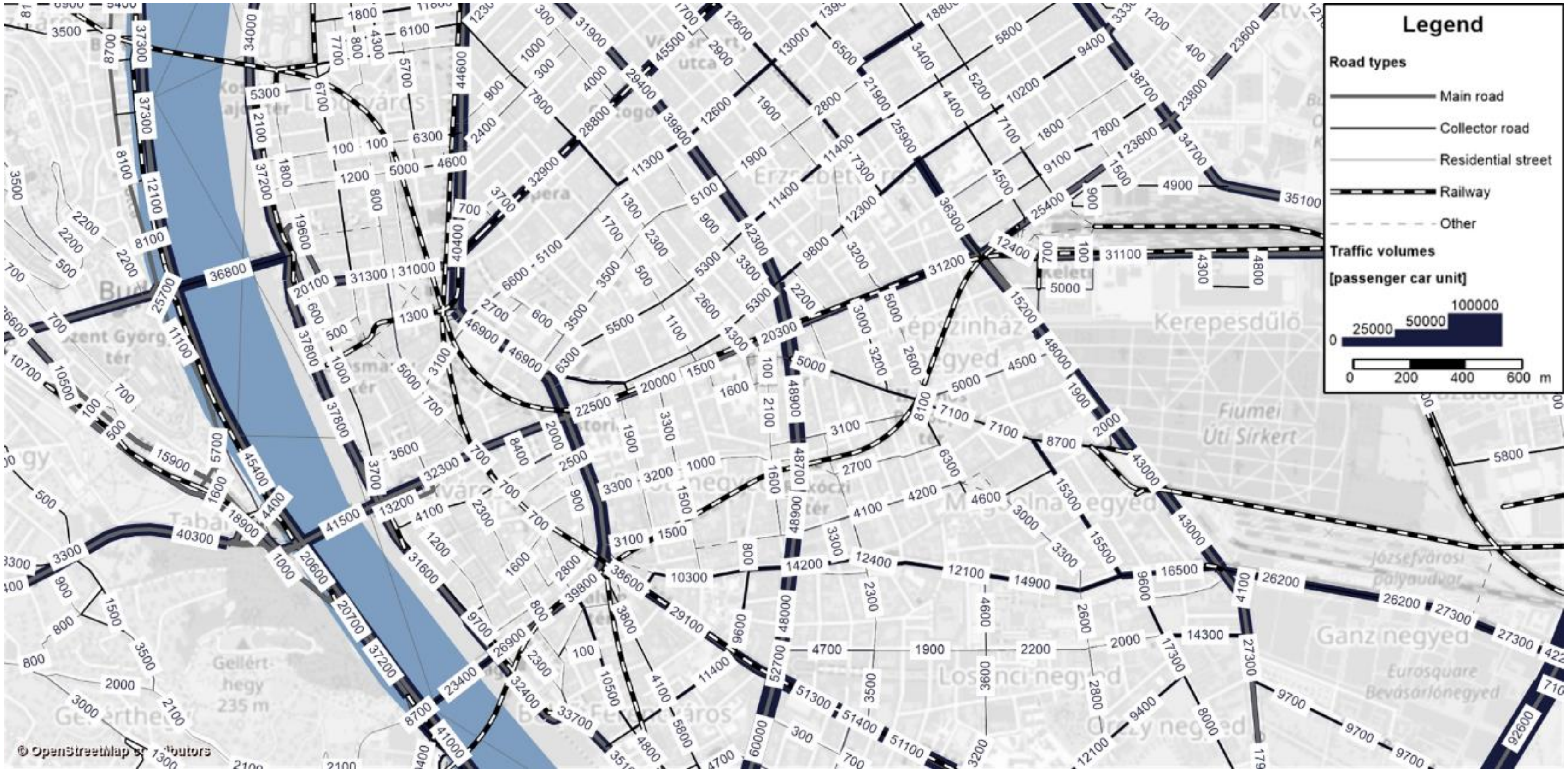
Budapest

SvA_2030 [passenger/day]

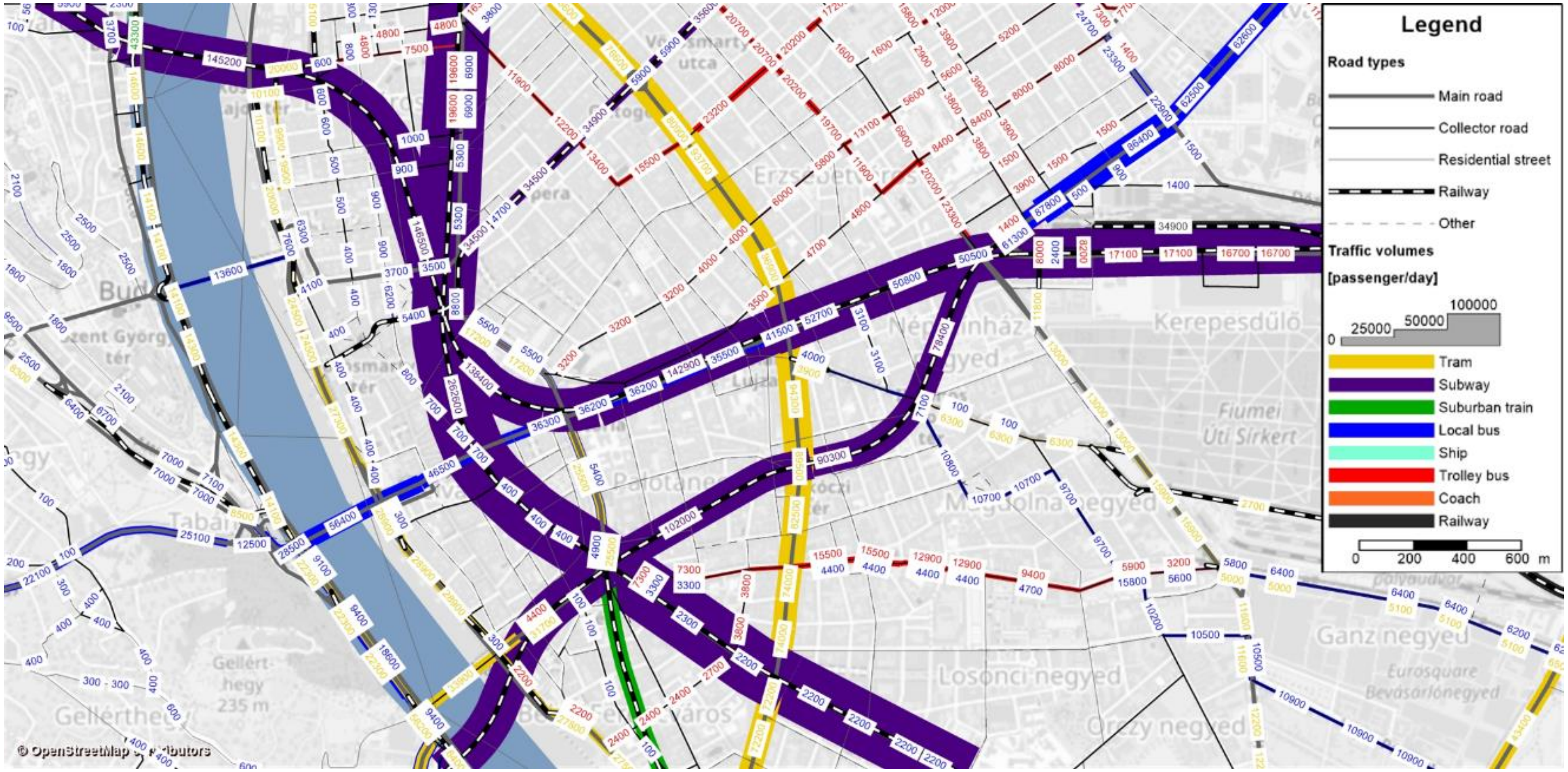
M1/M7 - Budapest SvA_2030 [unit vehicle/day]



M1/M7 - Budapest SvA_2030 [passenger/day]



Stress Section (Rakóczi road – axis) SvA_2030 [unit vehicle/day]



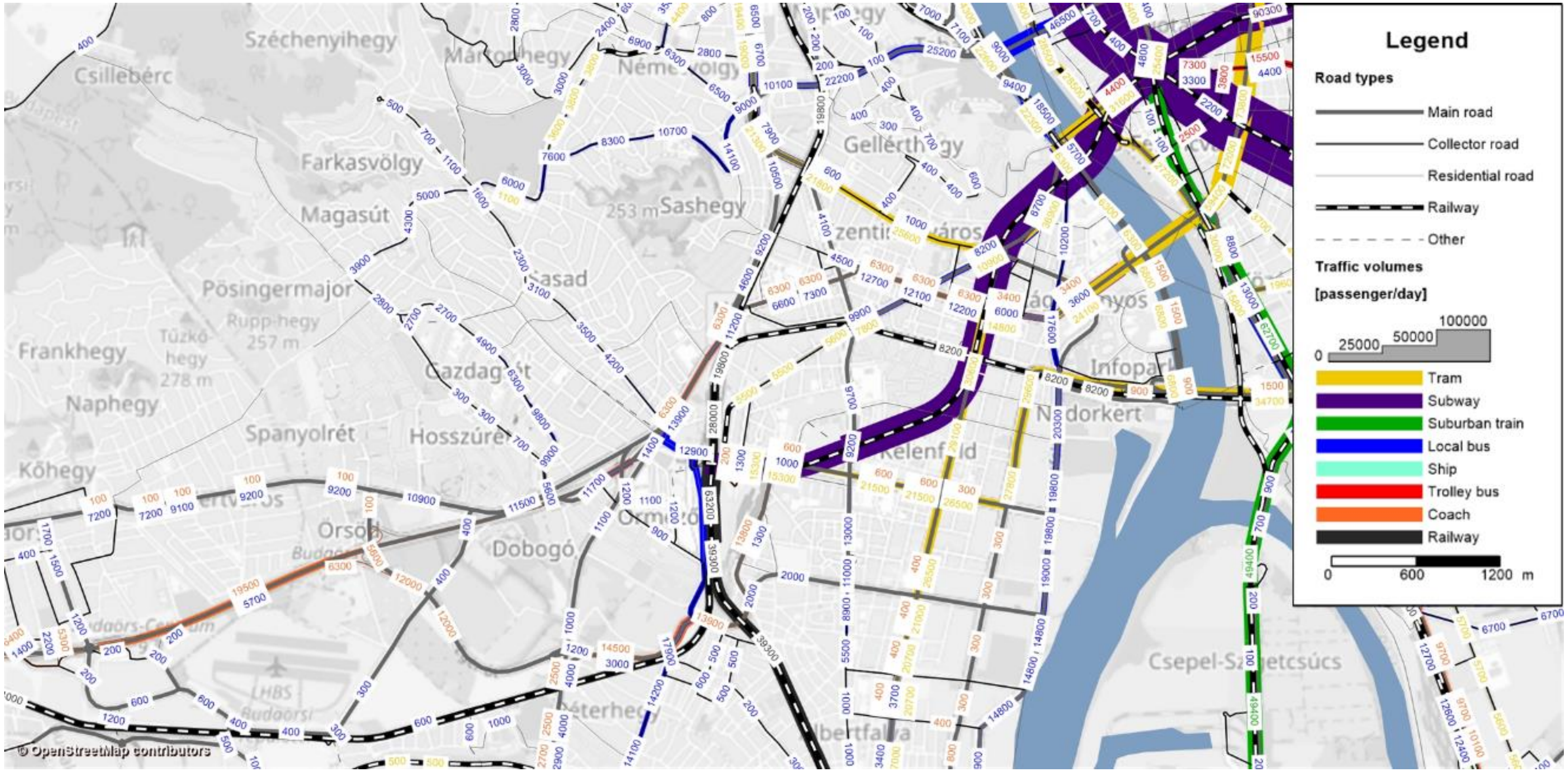
Stress Section (Rakóczi road – axis) SvA_2030 [passenger/day]

7.1.3 Output of SvB_2030 model

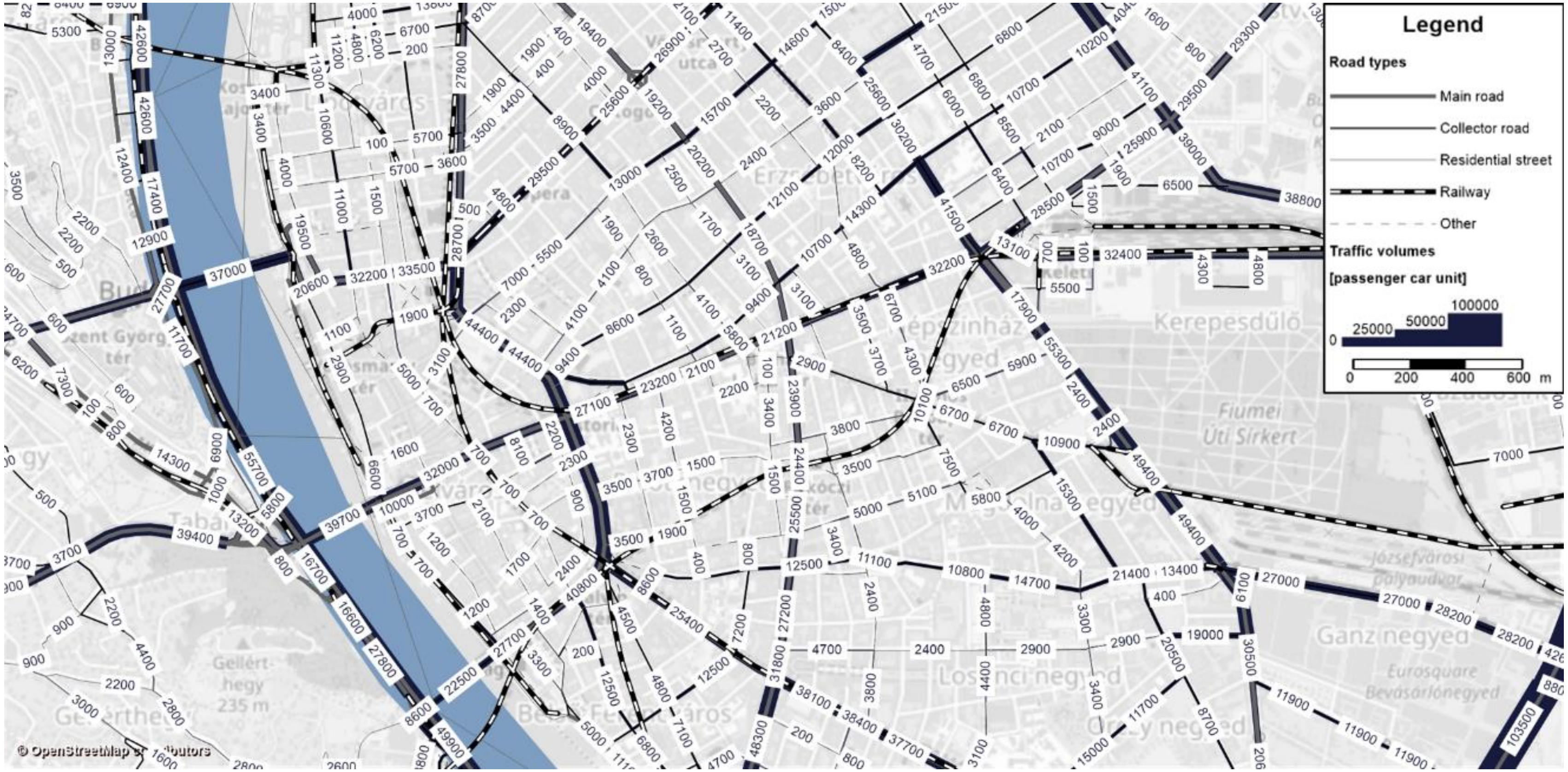
Budapest SvB_2030 [unit vehicle/day]

Budapest SvB_2030 [passenger/day]

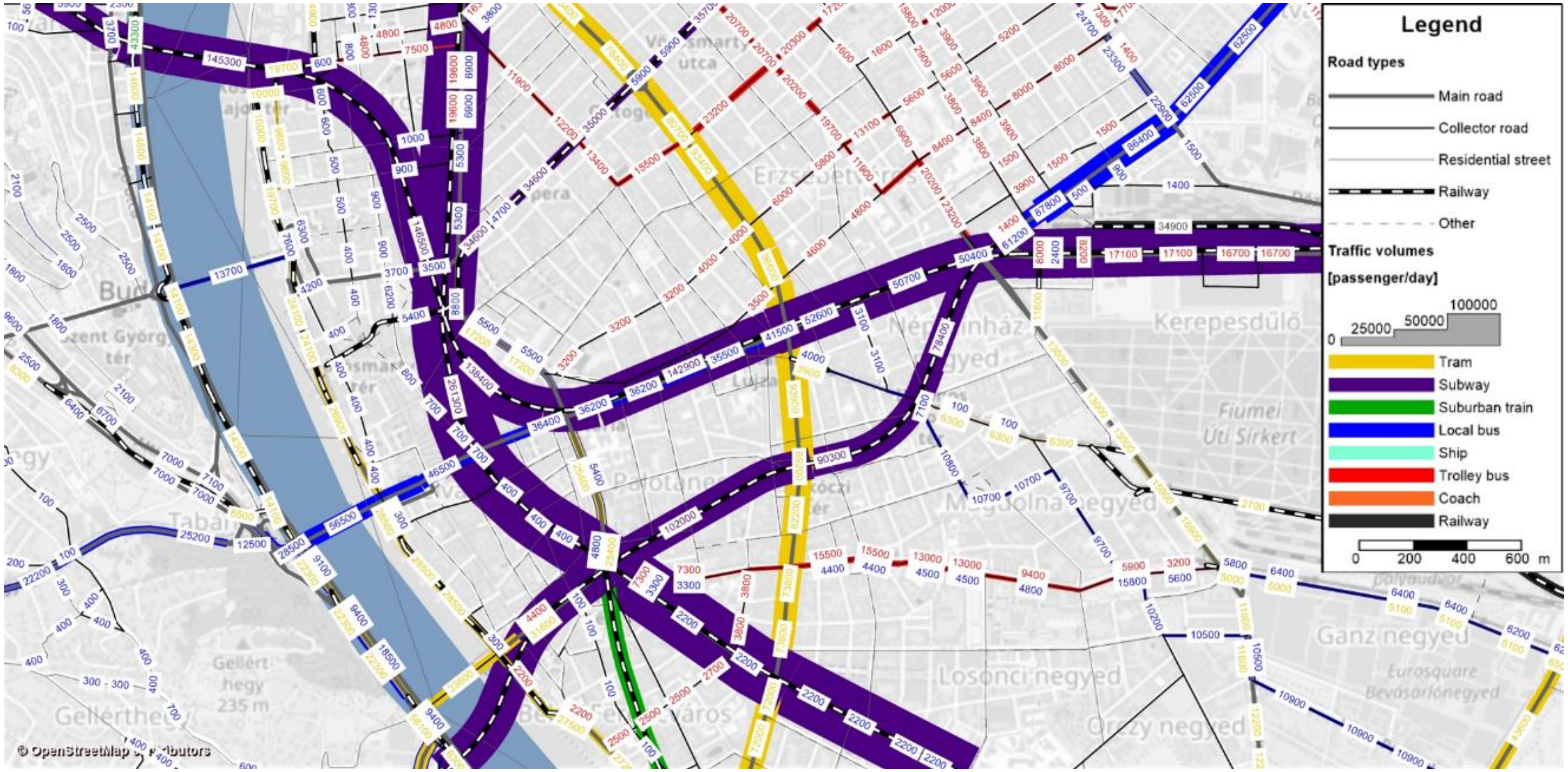
M1/M7 - Budapest SvB_2030 [unit vehicle/day]



M1/M7 - Budapest SvB_2030 [passenger/day]



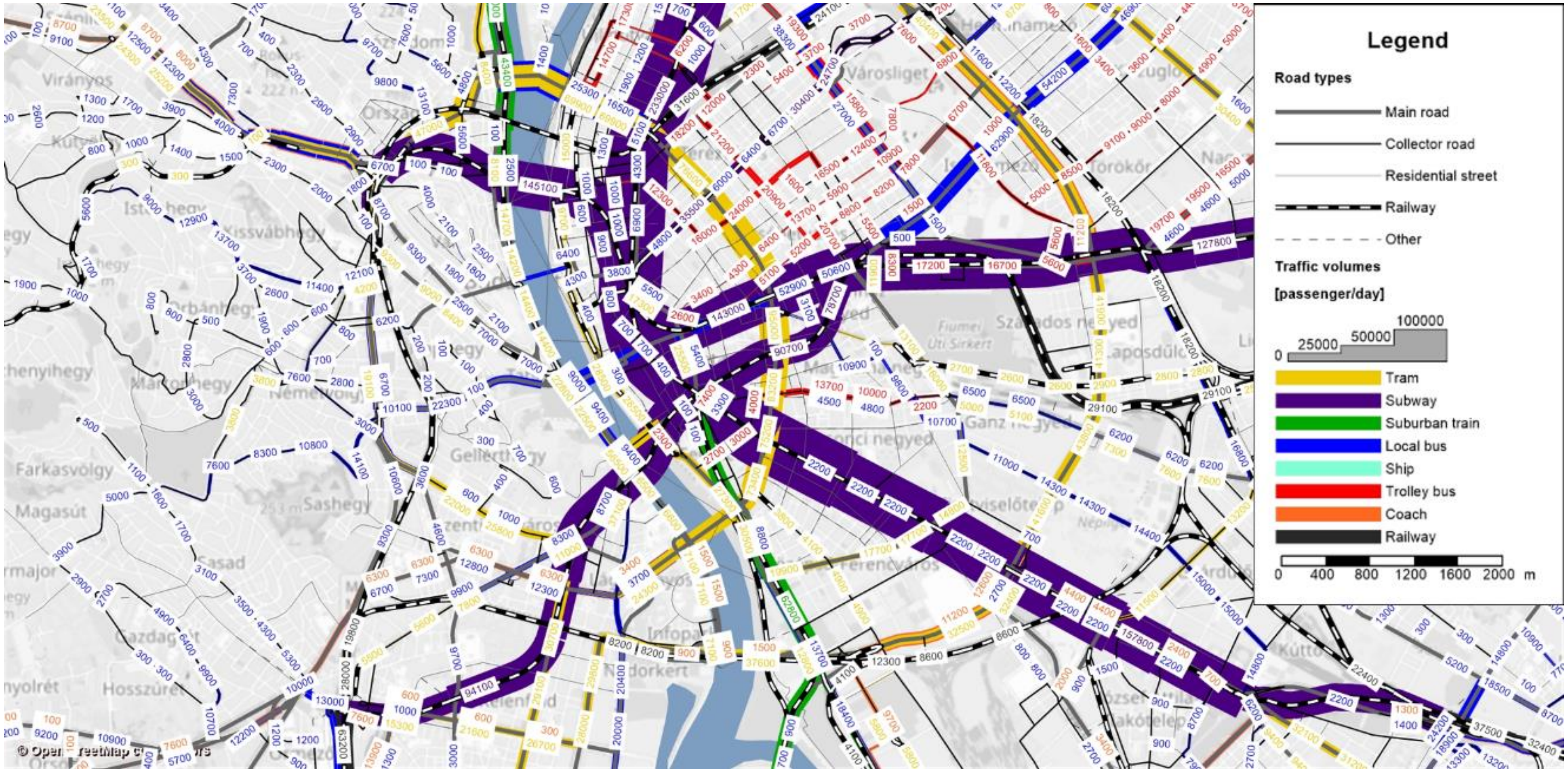
Stress Section (Rakóczi road – axis) SvB_2030 [unit vehicle/day]



Stress Section (Rakóczi road – axis) SvB_2030 [passenger/day]

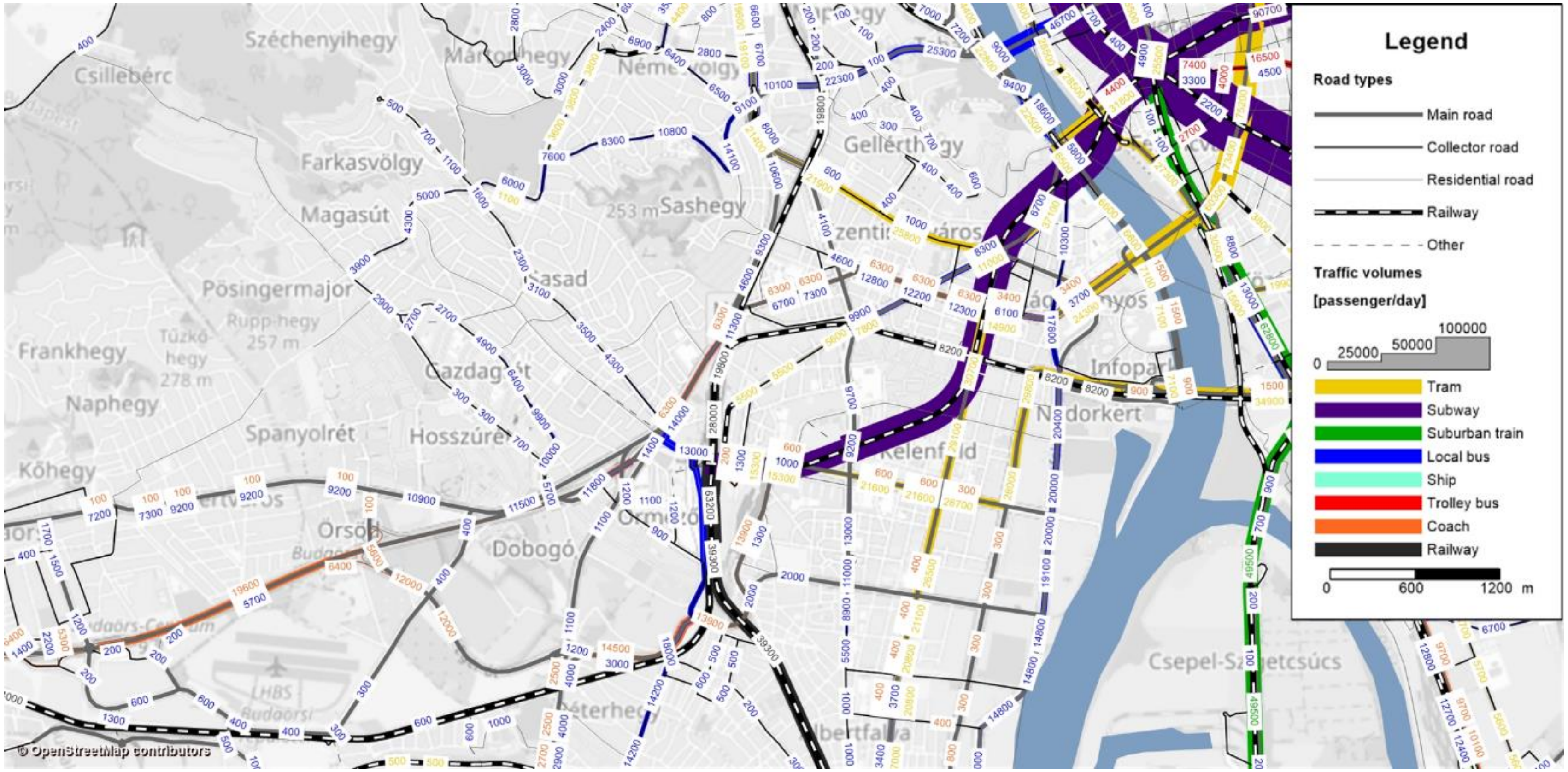
7.1.4 Output of SvC_2030 model

Budapest SvC_2030 [unit vehicle/day]

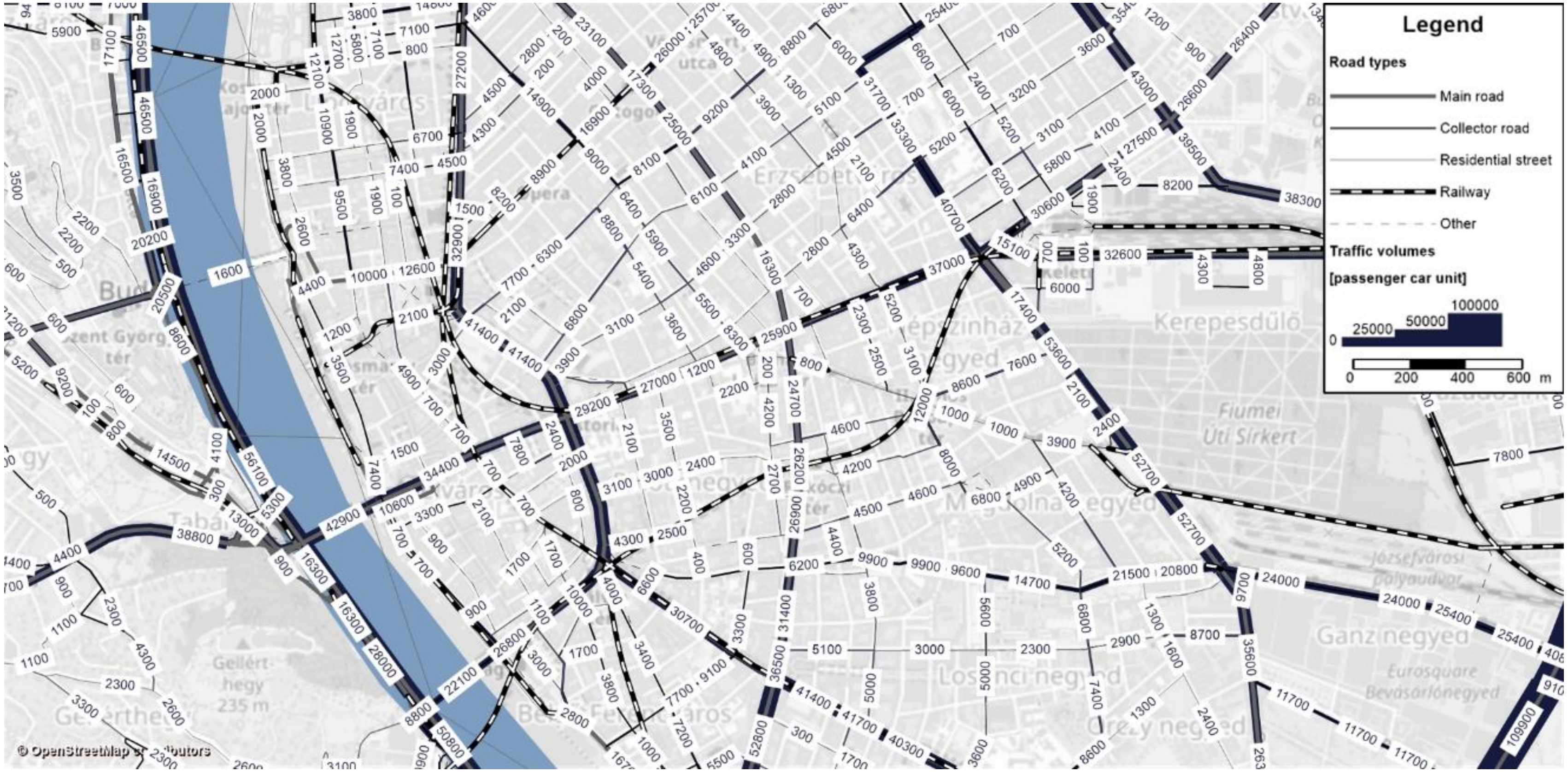


Budapest SvC_2030 [passenger/day]

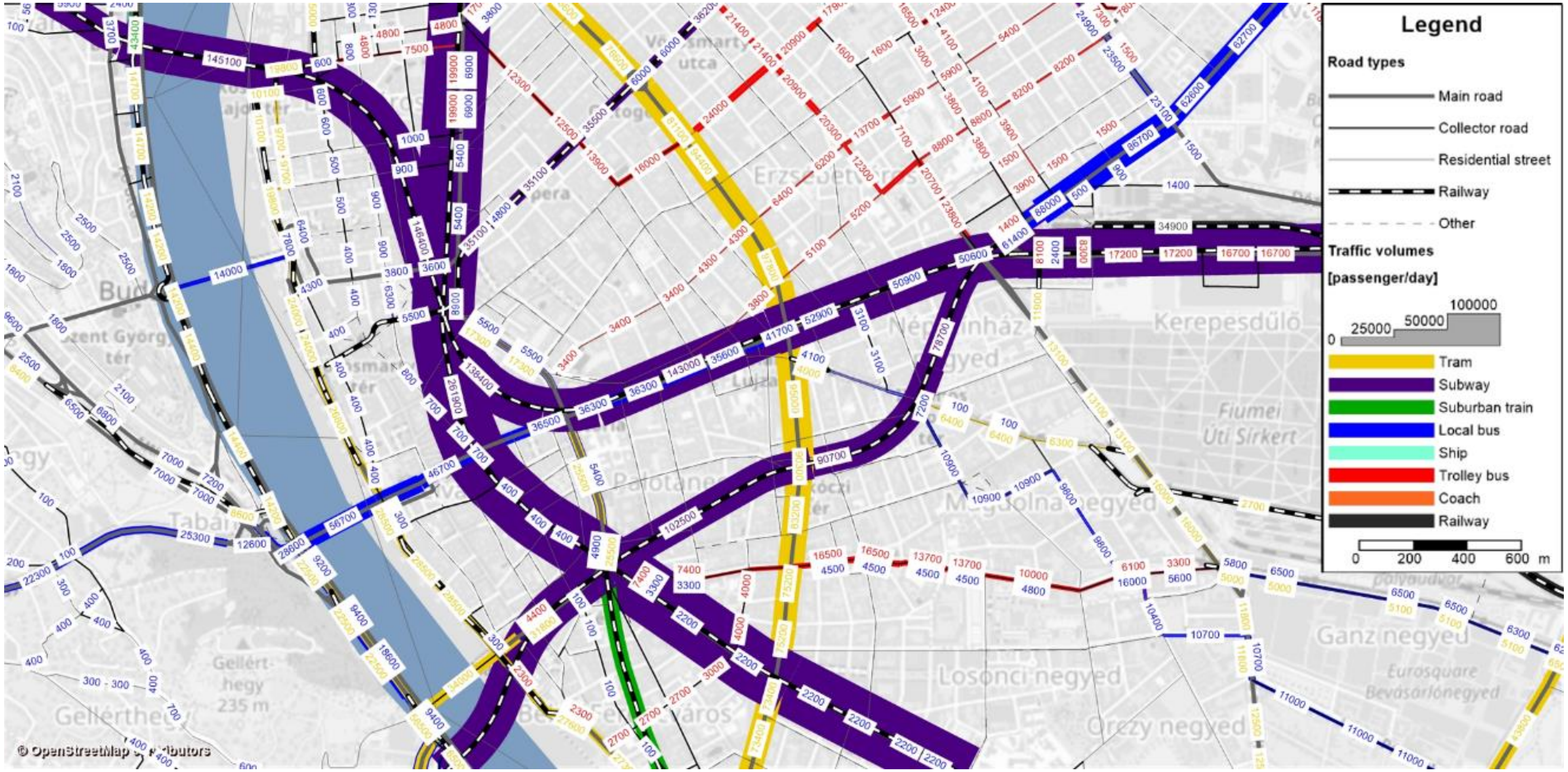
M1/M7 - Budapest SvC_2030 [unit vehicle/day]



M1/M7 - Budapest SvC_2030 [passenger/day]



Stress Section (Rakóczi road – axis) SvC_2030 [unit vehicle/day]



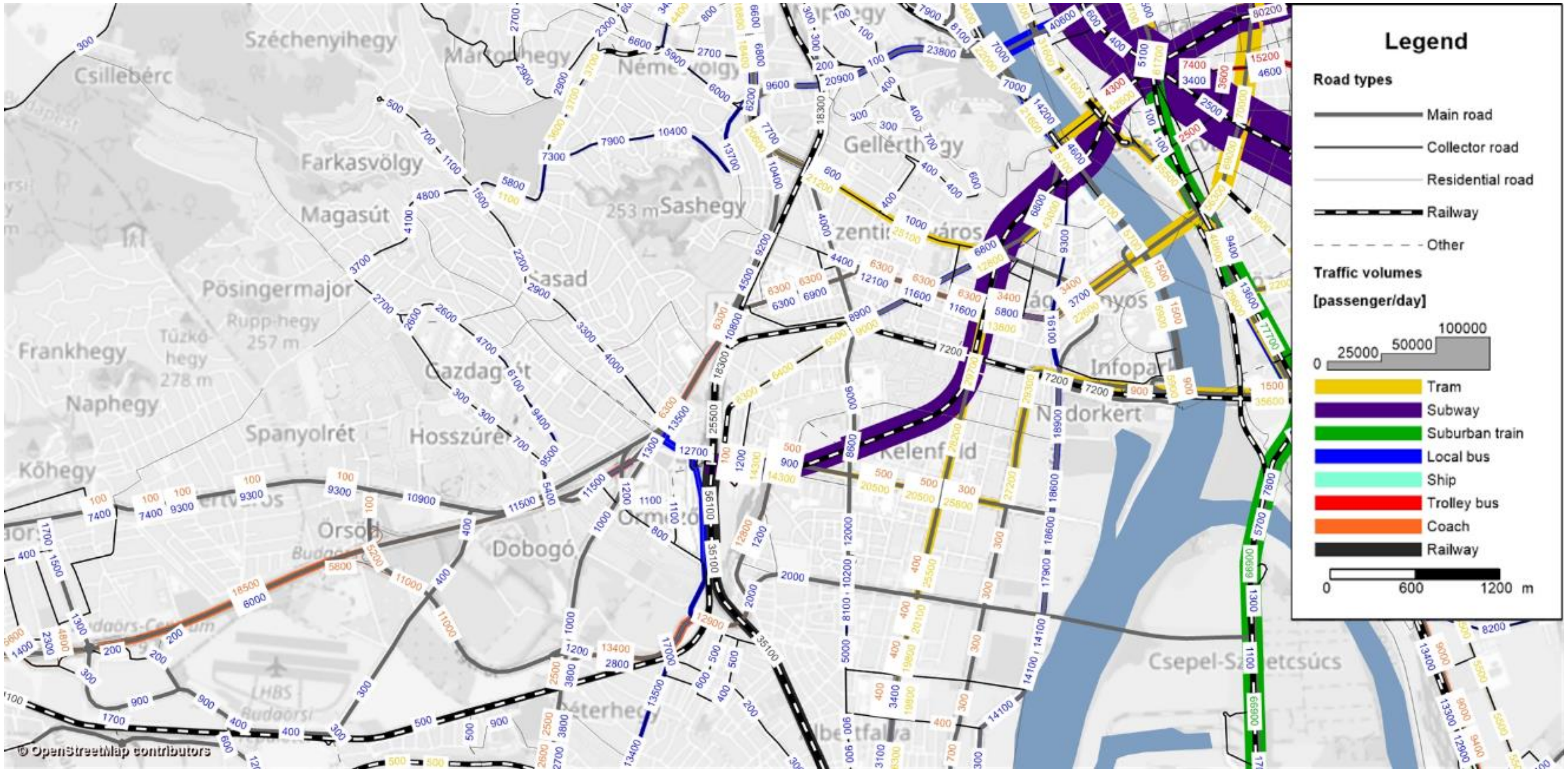
Stress Section (Rakóczi road – axis) SvC_2030 [passenger/day]

7.1.5 Output of SvBASE_2050 model

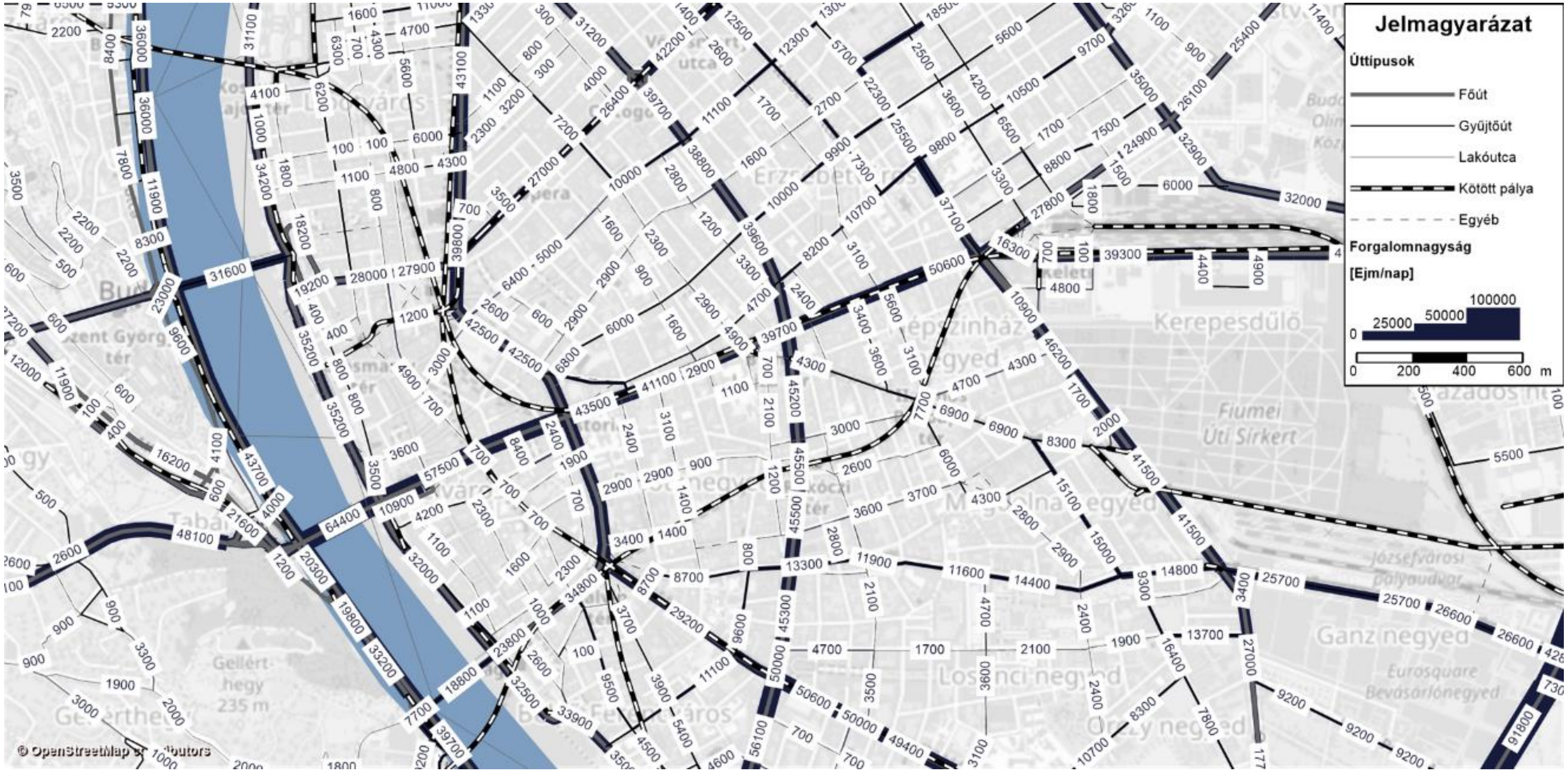
Budapest SvBASE_2050 [unit vehicle/day]

Budapest SvBASE_2050 [passenger/day]

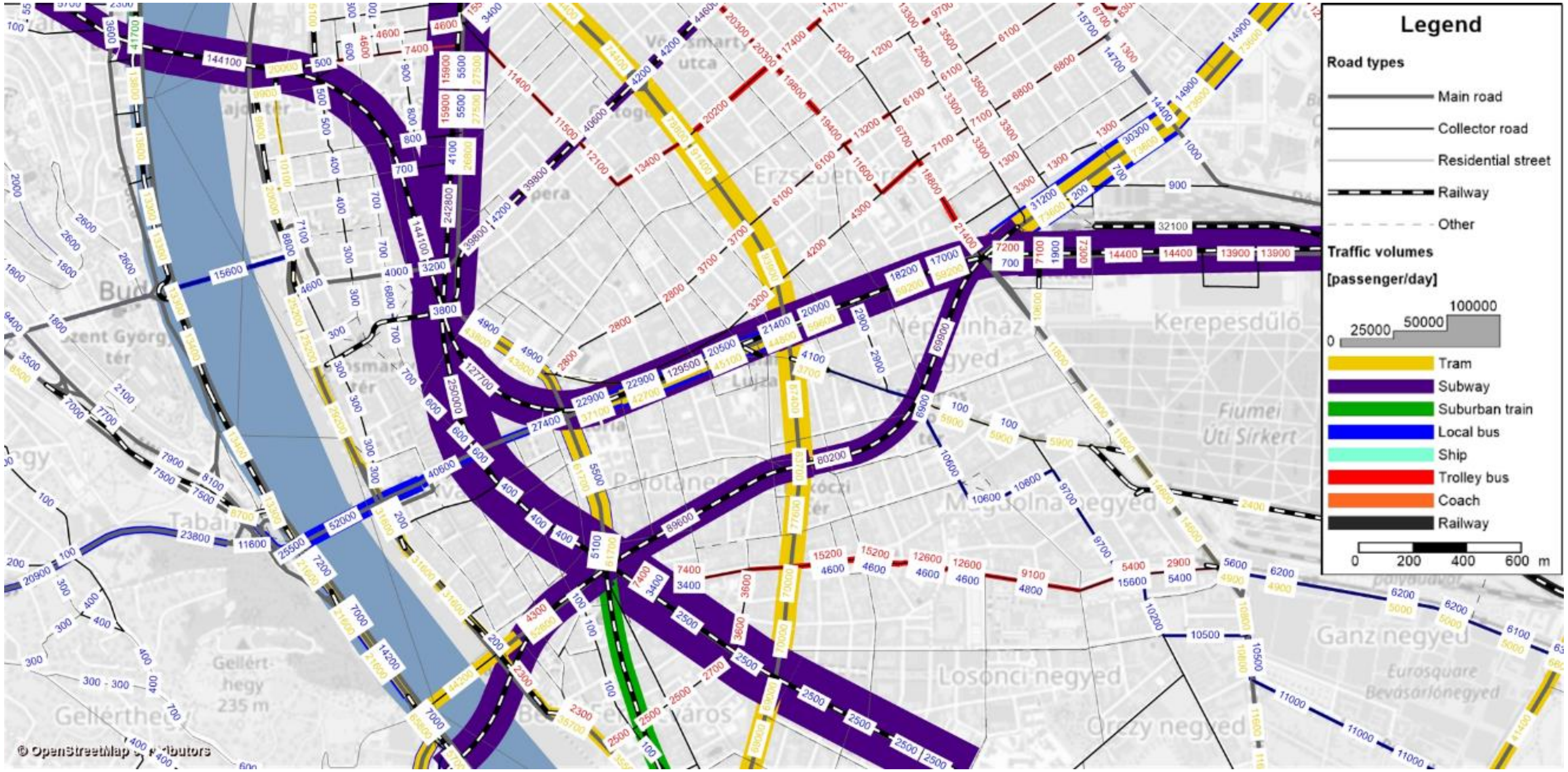
M1/M7 - Budapest SvBASE_2050 [unit vehicle/day]



M1/M7 - Budapest SvBASE_2050 [passenger/day]



Stress Section (Rakóczi road – axis) SvBASE_2050 [unit vehicle/day]



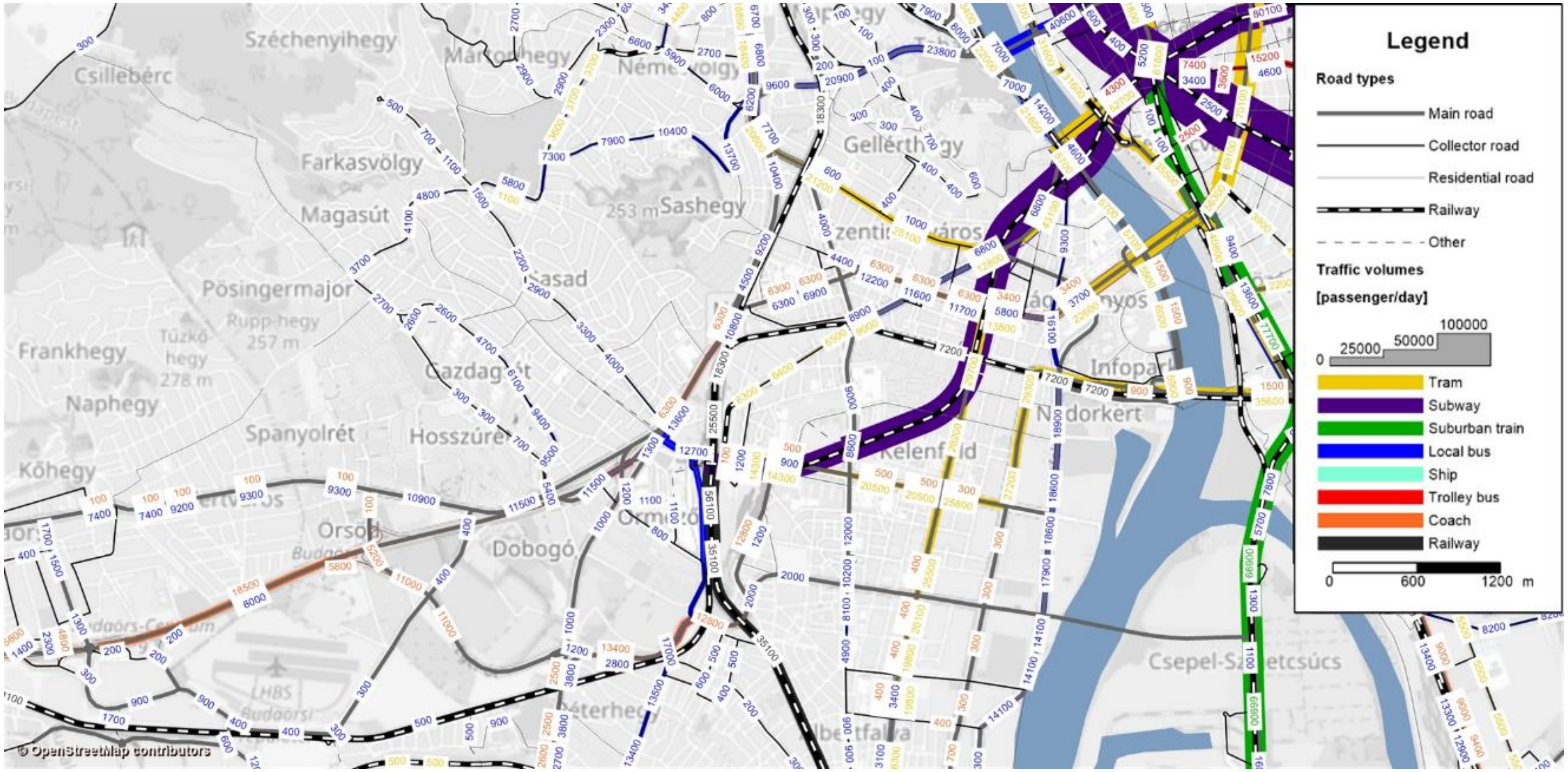
Stress Section (Rakóczi road – axis) SvBASE_2050 [passenger/day]

7.1.6 Output of SvA_2050 model

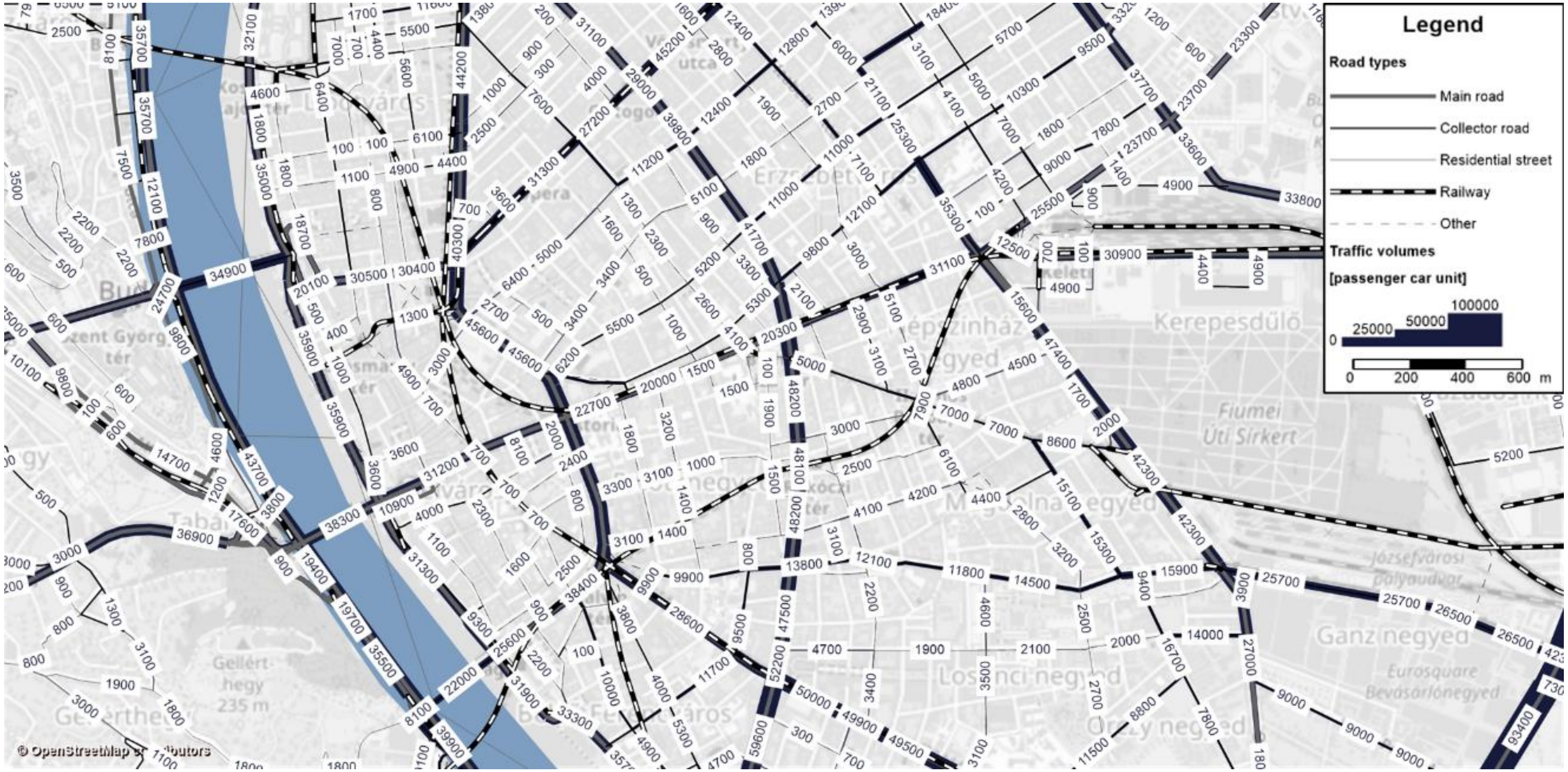
Budapest SvA_2050 [unit vehicle/day]

Budapest SvA_2050 [passenger/day]

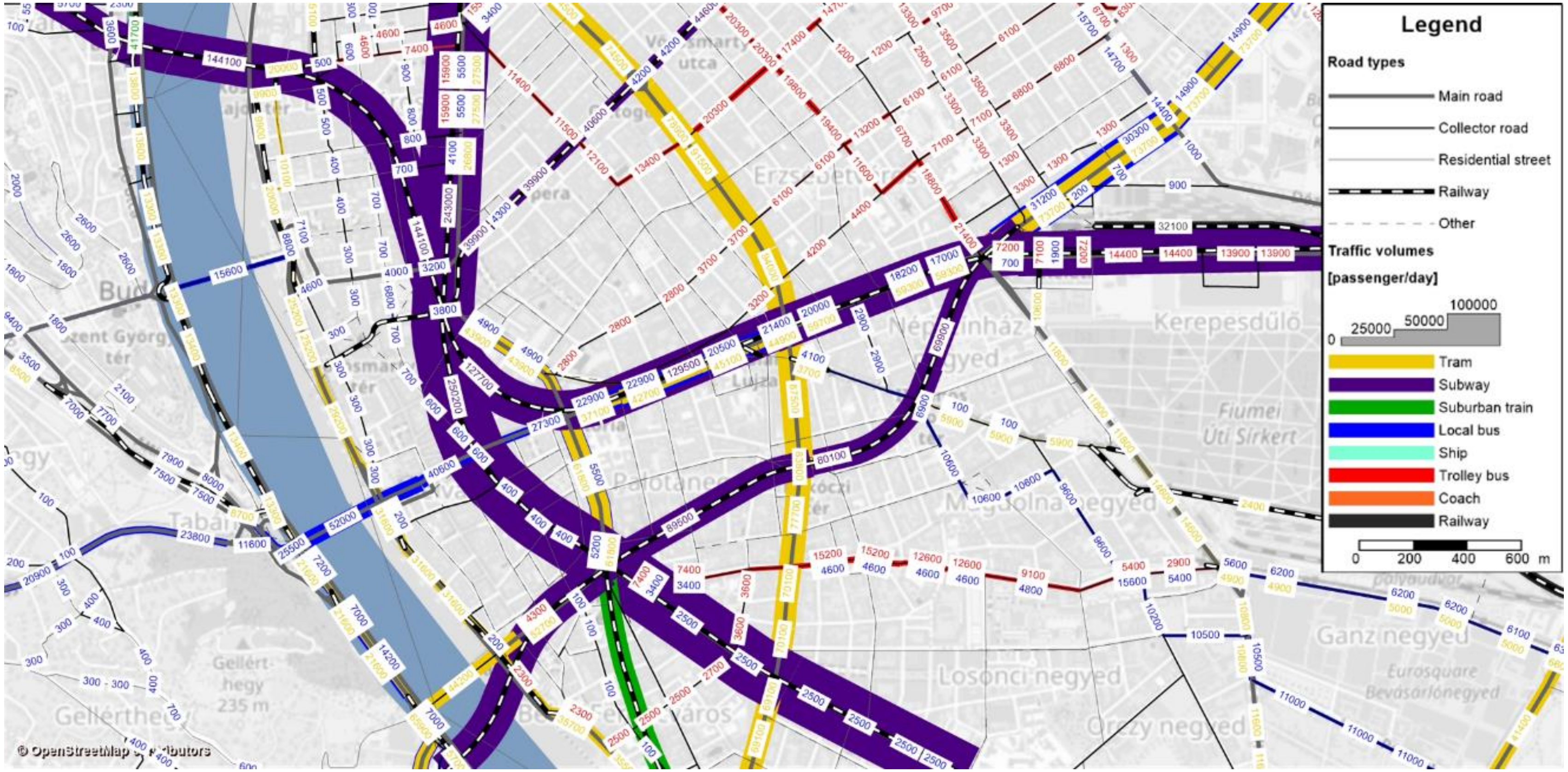
M1/M7 - Budapest SvA_2050 [unit vehicle/day]



M1/M7 - Budapest SvA_2050 [passenger/day]



Stress Section (Rakóczi road – axis) SvA_2050 [unit vehicle/day]



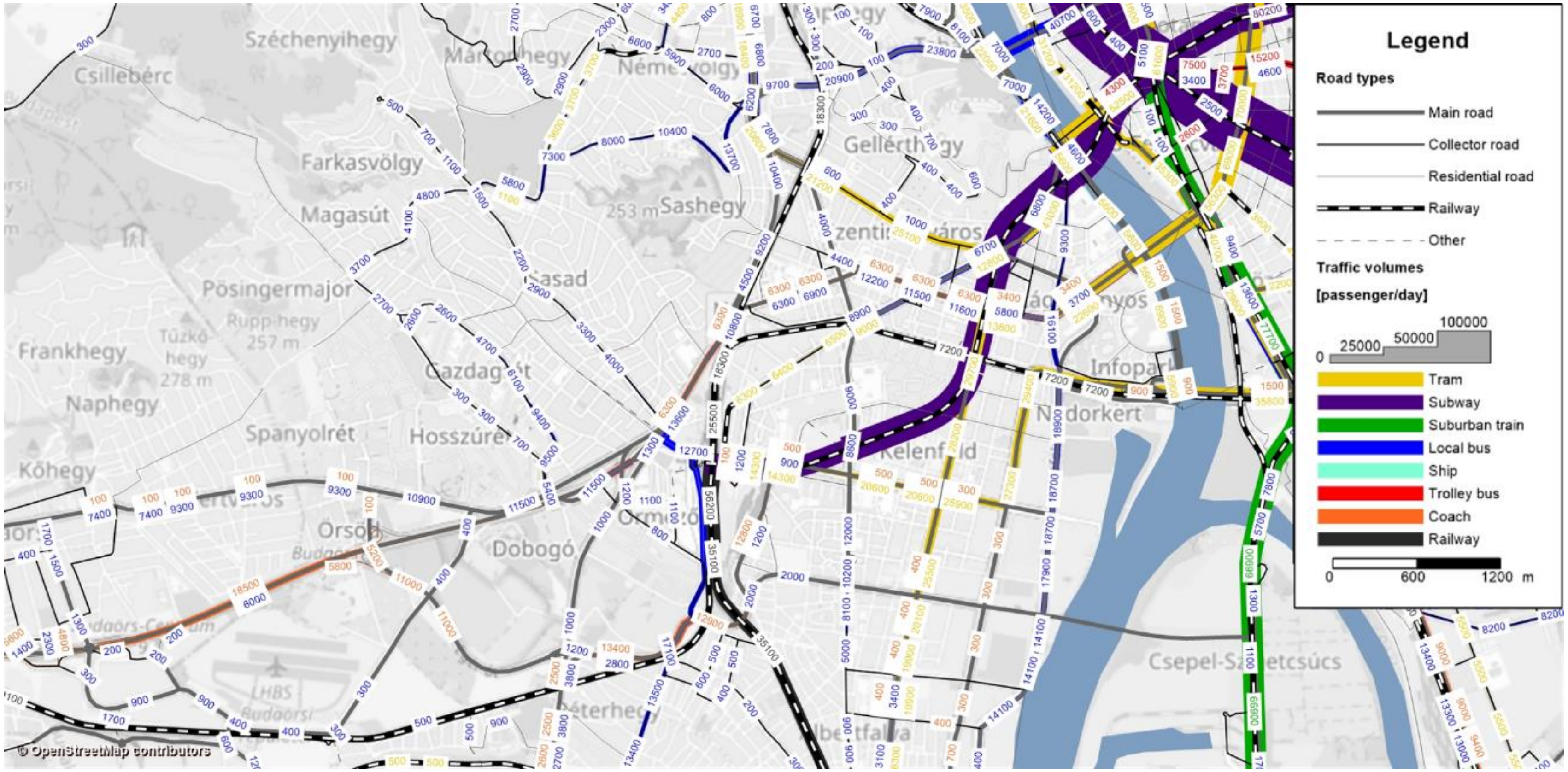
Stress Section (Rakóczi road – axis) SvA_2050 passenger/day]

7.1.7 Output of SvB_2050 model

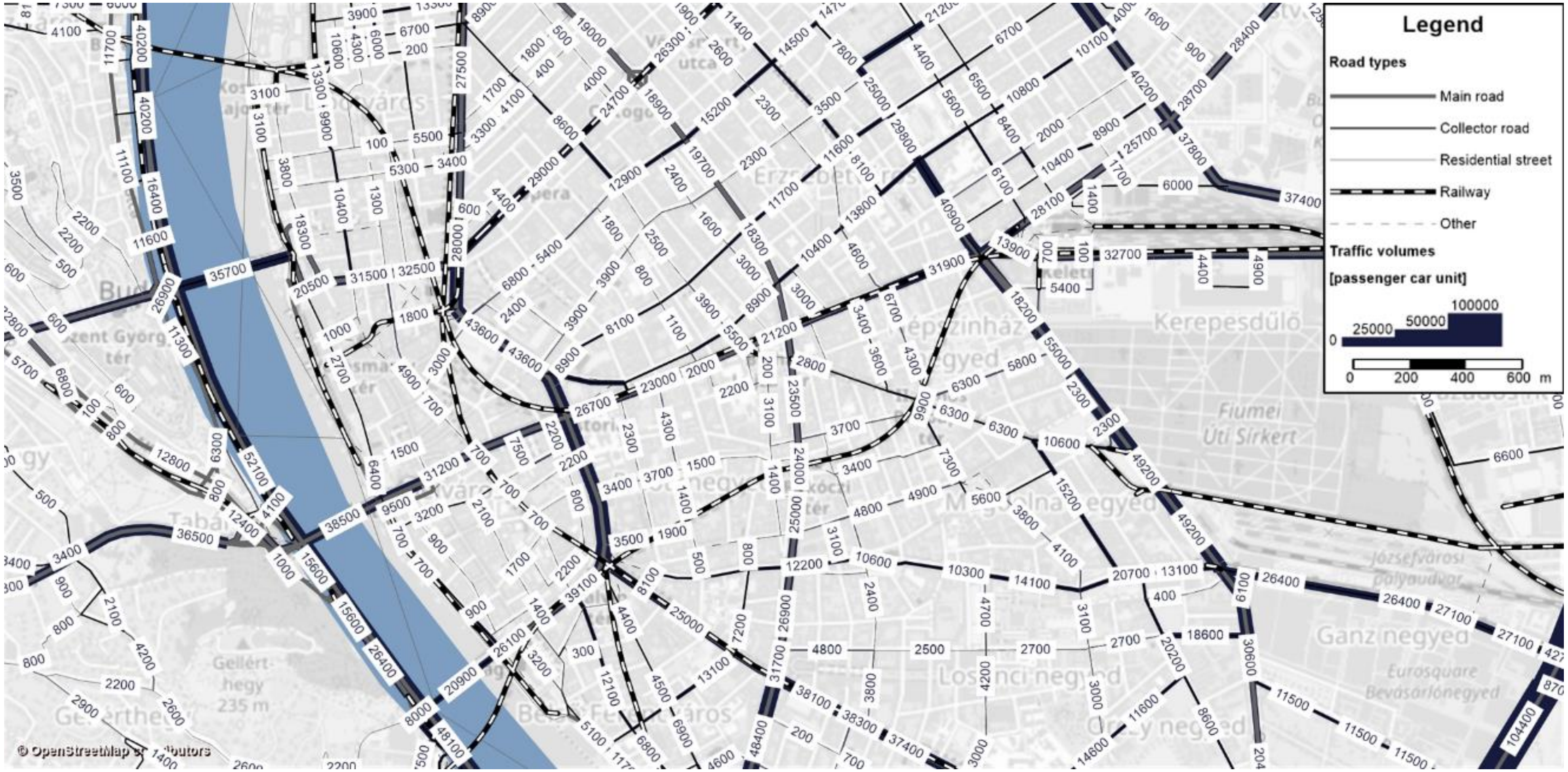
Budapest SvB_2050 [unit vehicle/day]

Budapest SvB_2050 [passenger/day]

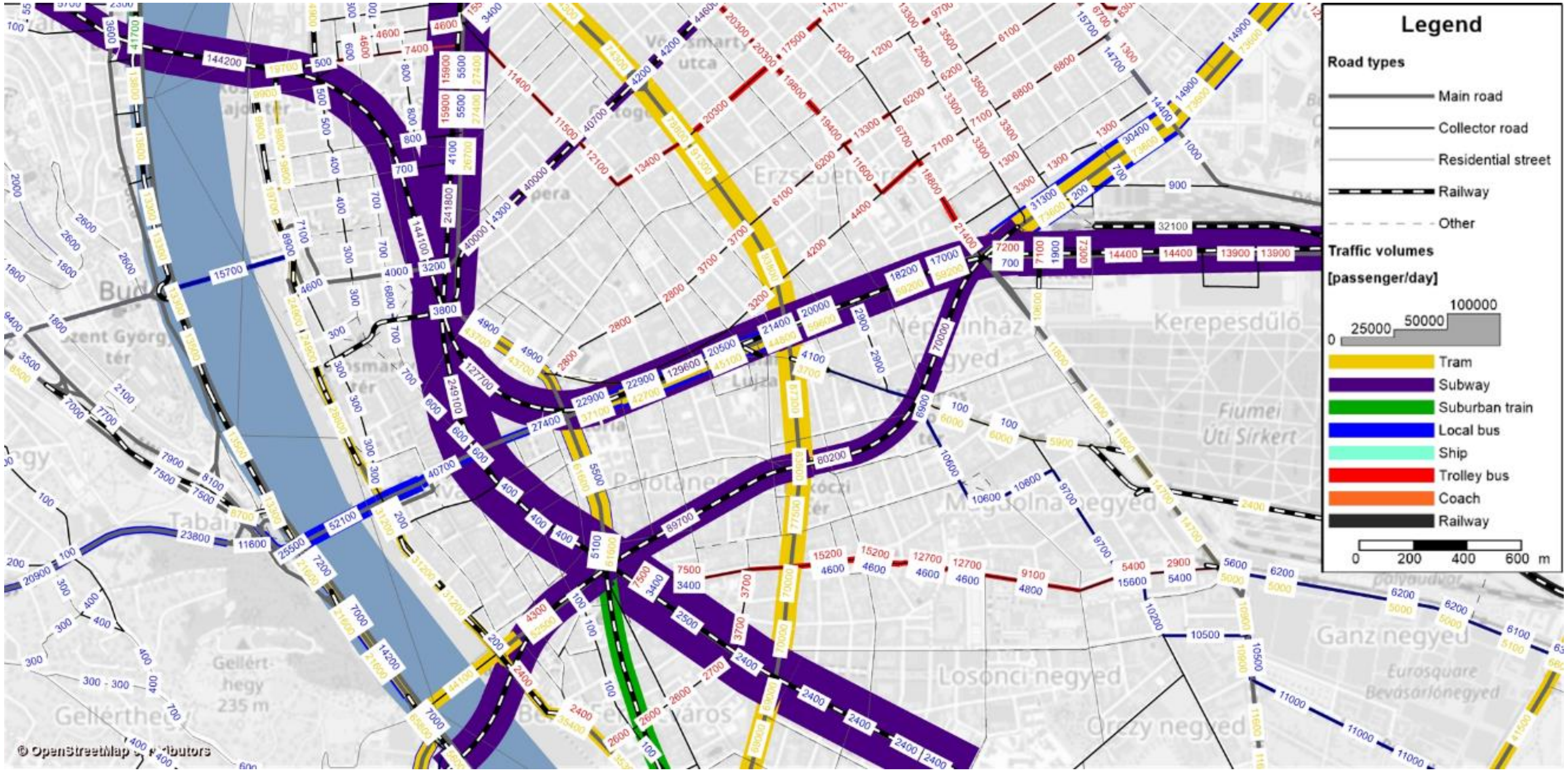
M1/M7 - Budapest SvB_2050 [unit vehicle/day]



M1/M7 - Budapest SvB_2050 [passenger/day]



Stress Section (Rakóczi road – axis) SvB_2050 [unit vehicle/day]



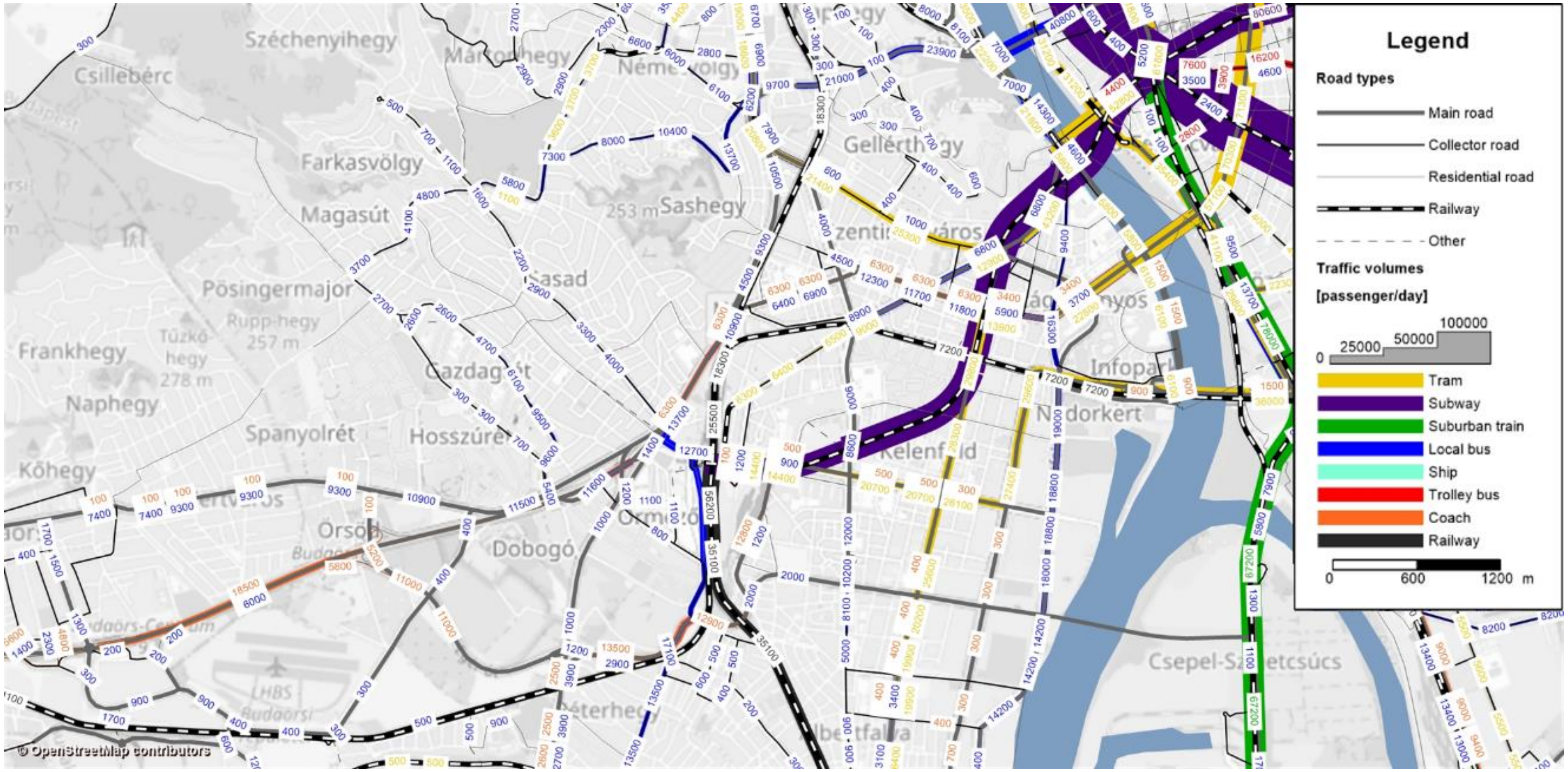
Stress Section (Rakóczi road – axis) SvB_2050 [passenger/day]

7.1.8 Output of SvC_2050 model

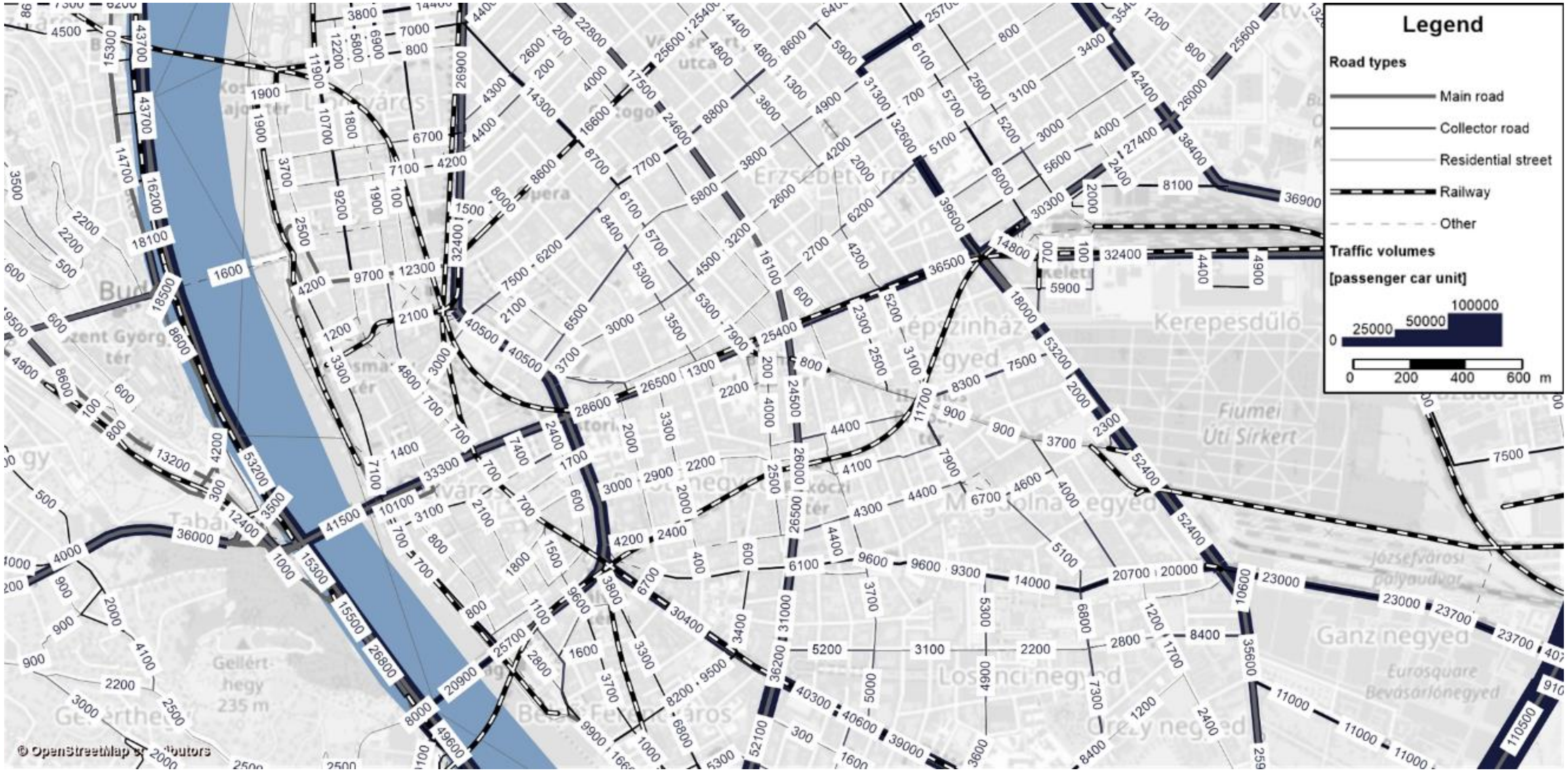
Budapest SvC_2050 [unit vehicle/day]

Budapest SvC_2050 [passenger/day]

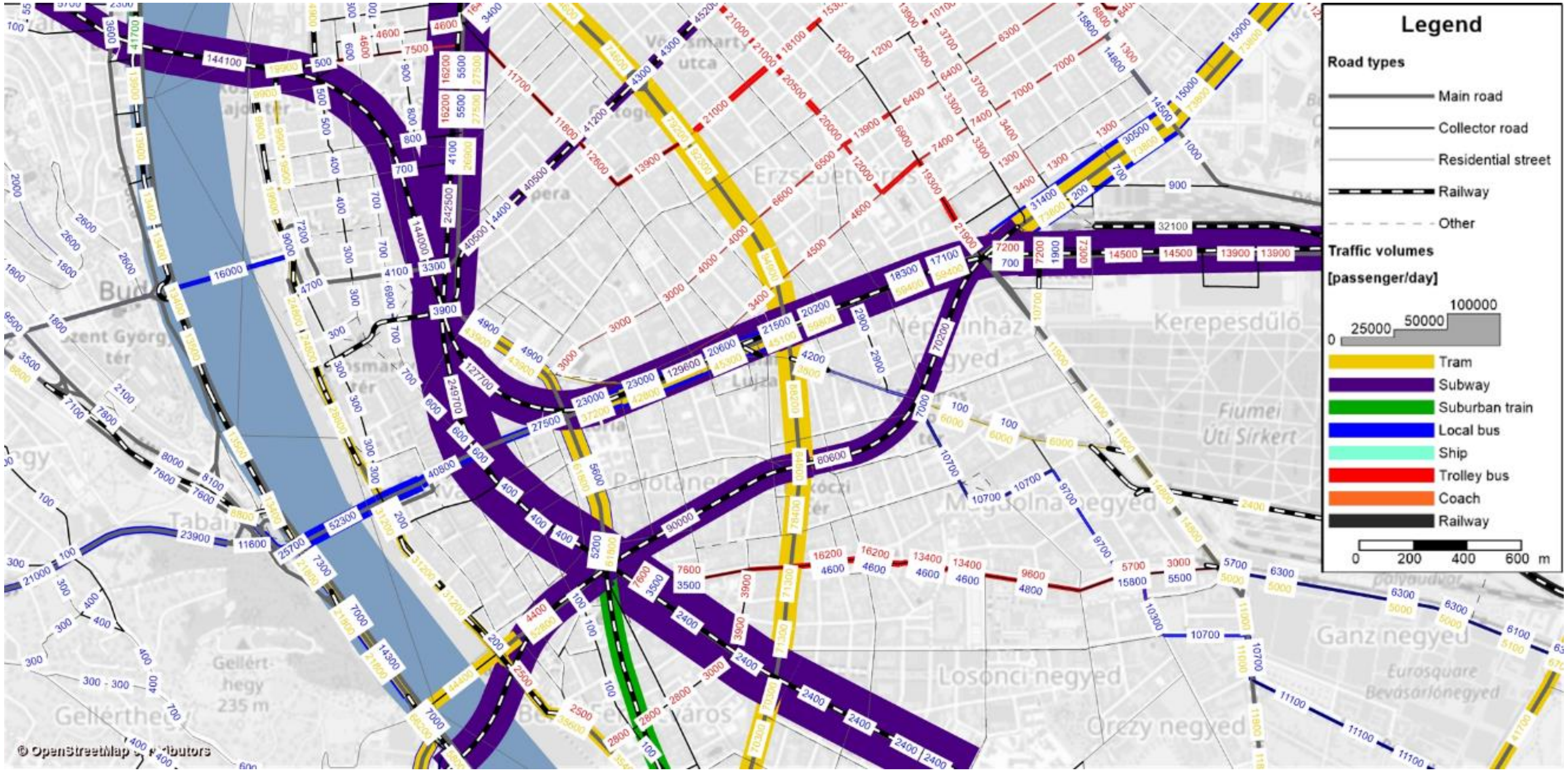
M1/M7 - Budapest SvC_2050 [unit vehicle/day]



M1/M7 - Budapest SvC_2050 [passenger/day]



Stress Section (Rakóczi road – axis) SvC_2050 [unit vehicle/day]



Stress Section (Rakóczi road – axis) SvC_2050 [passenger/day]

7.2 LISBON

7.2.1 Transport modes' CAGR

Scenario	Movements	Transport Mode	Mode	Day Period	Value_2020	Value 2040
Scenario 1	Crossing Traffic	Car	C	HPM	21,0	24,4
Scenario 1	Crossing Traffic	Light Duty Vehicle	LM	HPM	222,0	258,1
Scenario 1	Crossing Traffic	Heavy duty vehicles	Ca	HPM	1316,0	1529,9
Scenario 1	Crossing Traffic	Motorcycle	Mo	HPM	329,0	221,4
Scenario 1	Crossing Traffic	Bicycle	Bi	HPM	2139,0	638,9
Scenario 1	Crossing Traffic	Autonomous	Aut	HPM	0,0	0,3
Scenario 1	Local Traffic	Car	C	HPM	14,2	13,7
Scenario 1	Local Traffic	Light Duty Vehicle	LM	HPM	110,0	97,1
Scenario 1	Local Traffic	Heavy duty vehicles	Ca	HPM	277,0	298,6
Scenario 1	Local Traffic	Motorcycle	Mo	HPM	258,0	173,6
Scenario 1	Local Traffic	Bicycle	Bi	HPM	1240,0	147,6
Scenario 1	Local Traffic	Autonomous	Aut	HPM	0,0	0,4
Scenario 1	Pedestrian movements	Pedestrian	Ped	HPM	6,9	7,3
Scenario 1	Stores demand	Pedestrian	Stores	HPM	4,2	3,7
Scenario 1	PT Users	Public Transport users	PT	HPM	30,2	28,0
Scenario 1	Kerbside activities	Residents parking			17,5	23,1
Scenario 1	Kerbside activities	load/unload parking			1,6	1,3
Scenario 1	Kerbside activities	clients parking			1,3	1,6

Scenario	Movements	Transport Mode	Mode	Day Period	Value_2020	Value 2040
Scenario 2	Crossing Traffic	Car	C	HPM	21,0	24,4
Scenario 2	Crossing Traffic	Light Duty Vehicle	LM	HPM	222,0	258,1
Scenario 2	Crossing Traffic	Heavy duty vehicles	Ca	HPM	1316,0	1529,9
Scenario 2	Crossing Traffic	Motorcycle	Mo	HPM	329,0	221,4
Scenario 2	Crossing Traffic	Bicycle	Bi	HPM	2139,0	638,9
Scenario 2	Crossing Traffic	Autonomous	Aut	HPM	0,0	0,3
Scenario 2	Local Traffic	Car	C	HPM	14,2	18,7
Scenario 2	Local Traffic	Light Duty Vehicle	LM	HPM	110,0	118,6
Scenario 2	Local Traffic	Heavy duty vehicles	Ca	HPM	277,0	298,6
Scenario 2	Local Traffic	Motorcycle	Mo	HPM	258,0	173,6
Scenario 2	Local Traffic	Bicycle	Bi	HPM	1240,0	32,9
Scenario 2	Local Traffic	Autonomous	Aut	HPM	0,0	0,5
Scenario 2	Pedestrian movements	Pedestrian	Ped	HPM	6,9	7,9
Scenario 2	Stores demand	Pedestrian	Stores	HPM	4,2	3,5
Scenario 2	PT Users	Public Transport users	PT	HPM	30,2	29,1
Scenario 2	Kerbside activities	Residents parking			17,5	23,7
Scenario 2	Kerbside activities	load/unload parking			1,6	2,0
Scenario 2	Kerbside activities	clients parking			1,3	1,0

Scenario	Movements	Transport Mode	Mode	Day Period	Value_2020	Value 2040
Scenario 3	Crossing Traffic	Car	C	HPM	21,0	24,4
Scenario 3	Crossing Traffic	Light Duty Vehicle	LM	HPM	222,0	258,1
Scenario 3	Crossing Traffic	Heavy duty vehicles	Ca	HPM	1316,0	1529,9
Scenario 3	Crossing Traffic	Motorcycle	Mo	HPM	329,0	221,4
Scenario 3	Crossing Traffic	Bicycle	Bi	HPM	2139,0	638,9
Scenario 3	Crossing Traffic	Autonomous	Aut	HPM	0,0	0,3
Scenario 3	Local Traffic	Car	C	HPM	14,2	21,3
Scenario 3	Local Traffic	Light Duty Vehicle	LM	HPM	110,0	99,6
Scenario 3	Local Traffic	Heavy duty vehicles	Ca	HPM	277,0	306,2
Scenario 3	Local Traffic	Motorcycle	Mo	HPM	258,0	173,6
Scenario 3	Local Traffic	Bicycle	Bi	HPM	1240,0	27,1
Scenario 3	Local Traffic	Autonomous	Aut	HPM	0,0	0,3
Scenario 3	Pedestrian movements	Pedestrian	Ped	HPM	6,9	5,5
Scenario 3	Stores demand	Pedestrian	Stores	HPM	4,2	4,5
Scenario 3	PT Users	Public Transport users	PT	HPM	30,2	21,3
Scenario 3	Kerbside activities	Residents parking			17,5	21,9
Scenario 3	Kerbside activities	load/unload parking			1,6	1,4
Scenario 3	Kerbside activities	clients parking			1,3	1,5

Scenario	Movements	Transport Mode	Mode	Day Period	Value_2020	Value 2040
Scenario 4	Crossing Traffic	Car	C	HPM	21,0	27,1
Scenario 4	Crossing Traffic	Light Duty Vehicle	LM	HPM	222,0	350,0
Scenario 4	Crossing Traffic	Heavy duty vehicles	Ca	HPM	1316,0	2074,7
Scenario 4	Crossing Traffic	Motorcycle	Mo	HPM	329,0	221,4
Scenario 4	Crossing Traffic	Bicycle	Bi	HPM	2139,0	85,4
Scenario 4	Crossing Traffic	Autonomous	Aut	HPM	0,0	0,5
Scenario 4	Local Traffic	Car	C	HPM	14,2	18,3
Scenario 4	Local Traffic	Light Duty Vehicle	LM	HPM	110,0	173,4
Scenario 4	Local Traffic	Heavy duty vehicles	Ca	HPM	277,0	436,7
Scenario 4	Local Traffic	Motorcycle	Mo	HPM	258,0	173,6
Scenario 4	Local Traffic	Bicycle	Bi	HPM	1240,0	32,9
Scenario 4	Local Traffic	Autonomous	Aut	HPM	0,0	0,5
Scenario 4	Pedestrian movements	Pedestrian	Ped	HPM	6,9	7,8
Scenario 4	Stores demand	Pedestrian	Stores	HPM	4,2	3,5
Scenario 4	PT Users	Public Transport users	PT	HPM	30,2	21,4
Scenario 4	Kerbside activities	Residents parking			17,5	22,5
Scenario 4	Kerbside activities	load/unload parking			1,6	2,5
Scenario 4	Kerbside activities	clients parking			1,3	1,1

7.2.2 OD Matrices – morning peak period, 2040

Car
Light Duty Vehicles
Heavy Duty Vehicles
Motorcycle
Bicycle
Public Transport (BUS)
Autonomous Vehicles
Pedestrians

Car – morning peak period, 2040

HPM_C_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	990,7	0,0	226,2	742,5	4,2	0,0	4,0	0,8	7,3	1,9	2,1	0,0	0,1	0,9	0,6	0,1
2	167,8	5,3	0,0	41,5	0,3	0,0	18,3	4,1	38,1	7,6	16,5	0,0	5,4	19,9	9,2	1,6
3	685,6	669,1	0,0	0,0	2,7	0,0	2,9	0,6	3,9	1,0	2,4	0,0	0,7	0,5	0,5	1,3
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	15,1	2,2	7,4	5,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	113,2	4,3	14,3	10,8	1,0	0,0	0,0	1,7	19,0	3,7	7,0	4,0	1,4	15,9	25,3	4,9
7	155,9	8,1	27,4	20,5	1,8	0,0	41,8	0,0	9,6	2,5	4,9	3,0	1,4	12,4	18,7	3,7
8	191,9	17,3	58,6	43,6	3,2	0,0	0,1	63,7	0,0	0,4	0,6	0,4	0,1	1,4	2,2	0,4
9	44,5	3,4	11,9	8,7	0,7	0,0	0,0	1,2	0,0	0,0	4,0	2,9	0,5	2,9	4,7	3,5
10	198,2	2,3	7,7	5,8	0,4	0,0	0,0	0,7	0,0	13,3	0,0	12,8	7,3	52,3	80,3	15,2
11	508,8	1,3	39,9	9,3	1,7	0,0	0,0	2,6	0,1	10,3	11,5	0,0	5,3	171,7	172,4	82,8
12	56,1	4,2	14,1	10,4	0,8	0,0	0,0	1,3	0,0	1,1	6,5	3,7	0,0	3,7	5,8	4,5
13	396,5	0,7	37,0	1,8	4,7	0,0	0,1	8,0	0,1	7,9	35,4	41,0	4,3	0,0	144,4	111,0
14	362,1	0,7	37,6	20,1	5,6	0,0	0,1	7,9	0,2	8,0	35,4	218,0	3,6	24,9	0,0	0,0
15	234,1	2,3	25,2	5,6	1,4	0,0	0,0	2,2	0,1	2,1	9,2	181,8	0,8	3,4	0,0	0,0
Scenario 1	4120,4	721,2	507,2	925,8	28,7	0,0	67,4	94,7	78,3	59,8	135,6	467,6	30,9	310,0	464,1	229,1

HPM_C_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	997,9	0,0	232,1	748,5	3,6	0,0	3,4	0,7	4,8	1,8	1,5	0,0	0,1	0,9	0,6	0,1
2	141,3	4,9	0,0	38,7	0,3	0,0	15,1	3,4	27,3	6,7	12,1	0,0	3,5	19,0	8,7	1,5
3	682,4	669,3	0,0	0,0	2,3	0,0	2,4	0,5	2,6	1,0	1,7	0,0	0,4	0,6	0,5	1,3
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	5,8	0,7	3,1	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	95,0	3,9	13,4	9,8	0,7	0,0	0,0	1,2	10,8	3,1	4,2	3,7	0,7	15,1	23,7	4,5
7	130,0	7,3	25,6	18,6	1,3	0,0	30,7	0,0	5,4	2,1	3,0	2,8	0,7	11,7	17,5	3,4
8	161,1	15,4	54,0	38,9	2,2	0,0	0,0	45,9	0,0	0,3	0,4	0,3	0,1	1,3	2,0	0,4
9	39,9	3,1	11,3	8,1	0,5	0,0	0,0	0,9	0,0	0,0	2,4	2,7	0,3	2,8	4,5	3,3
10	162,3	1,9	6,5	4,7	0,2	0,0	0,0	0,4	0,0	9,8	0,0	10,6	2,8	43,8	69,1	12,4
11	517,5	1,4	41,3	9,4	1,5	0,0	0,0	2,2	0,0	9,8	8,0	0,0	3,0	181,3	175,3	84,3
12	42,5	3,3	11,6	8,1	0,4	0,0	0,0	0,8	0,0	0,8	3,2	3,0	0,0	3,0	4,8	3,5
13	386,8	0,7	38,0	1,8	4,1	0,0	0,1	6,7	0,1	7,4	24,6	42,4	2,4	0,0	146,2	112,3
14	337,2	0,6	36,2	19,0	4,8	0,0	0,1	6,7	0,1	7,2	26,5	209,4	2,4	24,1	0,0	0,0
15	235,9	2,3	25,7	5,7	1,2	0,0	0,0	1,8	0,0	2,0	6,4	186,7	0,4	3,6	0,0	0,0
Scenario 2	**3935,6**	**714,8**	**499,0**	**913,3**	**23,1**	**0,0**	**51,8**	**71,2**	**51,2**	**51,8**	**94,0**	**461,6**	**16,6**	**307,2**	**453,0**	**227,1**

HPM_C_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	983,8	0,0	228,0	743,6	2,4	0,0	2,8	0,5	2,4	1,6	1,0	0,0	0,0	0,9	0,6	0,1
2	118,0	4,6	0,0	36,5	0,2	0,0	12,5	2,8	17,4	5,8	8,8	0,0	2,1	17,6	8,3	1,4
3	672,9	663,4	0,0	0,0	1,5	0,0	2,0	0,4	1,2	0,8	1,1	0,0	0,1	0,6	0,5	1,3
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	75,7	3,6	12,1	8,9	0,3	0,0	0,0	0,9	2,9	2,4	2,0	3,3	0,1	13,2	21,9	4,1
7	104,3	6,7	23,0	16,7	0,5	0,0	21,0	0,0	1,4	1,6	1,4	2,5	0,1	10,2	16,2	3,0
8	128,4	13,4	46,9	33,8	0,6	0,0	0,0	29,8	0,0	0,2	0,1	0,3	0,0	1,1	1,8	0,3
9	32,4	2,7	9,8	6,9	0,1	0,0	0,0	0,6	0,0	0,0	0,9	2,3	0,0	2,3	4,0	2,8
10	128,4	1,5	5,3	3,8	0,0	0,0	0,0	0,2	0,0	6,3	0,0	8,3	0,0	33,8	59,1	9,9
11	496,2	1,3	40,0	9,2	0,9	0,0	0,0	1,8	0,0	8,5	5,1	0,0	1,1	173,4	172,1	82,5
12	30,7	2,6	9,1	6,3	0,0	0,0	0,0	0,4	0,0	0,5	0,6	2,3	0,0	2,2	4,1	2,7
13	361,4	0,7	36,6	1,8	2,5	0,0	0,1	5,4	0,0	6,4	15,2	40,6	0,9	0,0	142,5	108,9
14	322,2	0,6	35,5	18,8	3,9	0,0	0,1	5,9	0,1	6,6	20,8	204,9	1,6	23,4	0,0	0,0
15	226,9	2,3	25,2	5,6	0,8	0,0	0,0	1,5	0,0	1,7	4,2	182,1	0,2	3,5	0,0	0,0
Scenario 3	**3681,4**	**703,4**	**471,5**	**891,9**	**13,6**	**0,0**	**38,4**	**50,1**	**25,6**	**42,7**	**61,1**	**446,5**	**6,2**	**282,3**	**431,0**	**217,1**

HPM_C_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**764,1**	0,0	173,0	579,2	2,3	0,0	2,5	0,5	3,1	1,3	1,0	0,0	0,0	0,7	0,4	0,1
2	**86,3**	3,2	0,0	25,3	0,2	0,0	9,2	2,1	14,7	4,2	7,0	0,0	1,8	12,0	5,7	1,0
3	**524,2**	515,2	0,0	0,0	1,4	0,0	1,7	0,3	1,6	0,7	1,1	0,0	0,2	0,4	0,4	1,0
4	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	**1,1**	0,1	0,7	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**67,0**	3,0	9,7	7,4	0,4	0,0	0,0	0,9	6,2	2,2	2,7	2,7	0,4	10,7	17,3	3,4
7	**92,5**	5,6	18,4	13,9	0,7	0,0	21,3	0,0	3,1	1,5	1,9	2,1	0,4	8,3	12,8	2,5
8	**114,5**	11,5	38,4	28,8	1,1	0,0	0,0	31,4	0,0	0,2	0,2	0,2	0,0	0,9	1,5	0,3
9	**27,8**	2,3	7,9	5,8	0,3	0,0	0,0	0,6	0,0	0,0	1,4	1,9	0,1	1,9	3,2	2,4
10	**113,0**	1,4	4,5	3,4	0,1	0,0	0,0	0,3	0,0	6,6	0,0	7,4	1,3	29,8	49,2	8,9
11	**378,5**	1,0	30,1	7,1	0,9	0,0	0,0	1,6	0,0	7,0	5,3	0,0	1,8	130,7	129,3	63,5
12	**29,4**	2,4	8,0	5,9	0,2	0,0	0,0	0,5	0,0	0,5	1,8	2,1	0,0	2,0	3,4	2,5
13	**277,8**	0,5	27,1	1,3	2,3	0,0	0,1	4,6	0,0	5,2	15,7	30,7	1,4	0,0	106,0	82,8
14	**242,1**	0,5	26,0	14,0	3,1	0,0	0,1	4,7	0,1	5,1	17,9	151,9	1,6	17,2	0,0	0,0
15	**175,7**	1,8	19,0	4,3	0,8	0,0	0,0	1,3	0,0	1,4	4,3	139,9	0,3	2,6	0,0	0,0
Scenario 4	**2894,2**	**548,4**	**362,9**	**696,6**	**13,7**	**0,0**	**35,0**	**48,8**	**28,9**	**36,1**	**60,6**	**338,9**	**9,4**	**217,3**	**329,3**	**168,3**

Light duty vehicle – morning peak period, 2040

HPM_LM_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100,1	0,0	22,2	77,6	0,0	0,0	0,1	0,0	0,2	0,0	0,1	0,0	0,0	0,0	0,0	0,0
2	30,4	4,5	0,0	2,0	0,0	0,0	1,8	0,9	8,5	1,4	6,1	0,0	0,4	3,0	1,2	0,7
3	29,8	20,2	0,0	0,0	2,4	0,0	0,3	0,4	2,5	0,4	2,1	0,0	0,2	0,2	0,1	0,9
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	0,7	0,1	0,4	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	7,4	0,6	1,4	1,6	0,0	0,0	0,0	0,0	0,7	0,0	0,3	0,0	0,1	1,0	1,5	0,0
7	12,7	0,5	1,1	0,7	0,0	0,0	3,0	0,0	0,4	0,0	0,2	1,2	0,1	2,2	2,0	1,3
8	12,4	0,2	1,1	0,4	0,0	0,0	0,0	10,6	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
9	0,5	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,2	0,0
10	42,9	1,1	1,5	1,8	0,1	0,0	0,0	0,2	0,0	2,7	0,0	5,7	0,5	12,8	10,7	5,8
11	76,6	0,6	6,4	2,3	0,0	0,0	0,0	1,3	0,0	0,0	5,0	0,0	0,2	28,8	18,3	13,6
12	3,8	0,3	0,8	0,6	0,0	0,0	0,0	0,1	0,0	0,0	0,4	0,1	0,0	0,8	0,7	0,1
13	45,9	0,2	2,2	0,2	0,0	0,0	0,0	1,1	0,0	3,0	4,7	3,3	1,7	0,0	20,5	9,1
14	37,3	0,0	2,8	1,8	0,1	0,0	0,0	0,9	0,0	2,4	4,0	19,9	0,3	5,1	0,0	0,0
15	42,9	1,6	5,9	2,6	0,4	0,0	0,0	0,9	0,0	3,9	6,5	17,2	0,0	3,8	0,0	0,0
Scenario 1	443,5	29,9	45,9	91,7	3,0	0,0	5,2	16,7	12,3	13,8	29,4	47,5	3,6	57,7	55,2	31,5

HPM_LM_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	101,4	0,0	23,0	78,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	27,6	4,4	0,0	1,6	0,0	0,0	1,4	0,9	7,5	1,3	5,6	0,0	0,2	2,9	1,1	0,6
3	29,6	20,3	0,0	0,0	2,4	0,0	0,3	0,4	2,3	0,4	2,0	0,0	0,2	0,2	0,1	0,9
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	5,9	0,6	1,4	1,5	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	1,0	1,4	0,0
7	10,6	0,5	1,0	0,6	0,0	0,0	2,0	0,0	0,0	0,0	0,0	1,2	0,0	2,1	1,9	1,2
8	10,0	0,0	0,8	0,0	0,0	0,0	0,0	9,1	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
9	0,3	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0
10	39,6	1,0	1,4	1,7	0,1	0,0	0,0	0,2	0,0	2,4	0,0	5,5	0,0	12,1	9,6	5,5
11	78,1	0,6	6,5	2,3	0,0	0,0	0,0	1,3	0,0	0,0	4,7	0,0	0,0	30,1	18,7	13,9
12	2,5	0,2	0,5	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	0,6	0,0
13	45,3	0,2	2,3	0,2	0,0	0,0	0,0	1,0	0,0	3,0	3,6	3,5	1,5	0,0	20,7	9,3
14	34,4	0,0	2,6	1,6	0,0	0,0	0,0	0,8	0,0	2,3	3,1	18,8	0,2	5,0	0,0	0,0
15	43,3	1,6	6,0	2,6	0,4	0,0	0,0	0,9	0,0	3,8	6,3	17,9	0,0	3,8	0,0	0,0
Scenario 2	428,6	29,3	45,8	90,9	3,0	0,0	3,8	14,6	9,9	13,3	25,3	46,9	2,2	57,9	54,4	31,4

HPM_LM_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100,6	0,0	22,4	77,7	0,0	0,0	0,1	0,0	0,3	0,0	0,1	0,0	0,0	0,0	0,0	0,0
2	28,0	4,4	0,0	1,3	0,0	0,0	1,5	0,9	8,0	1,3	5,9	0,0	0,3	2,7	1,0	0,6
3	29,1	19,5	0,0	0,0	2,4	0,0	0,3	0,4	2,5	0,4	2,1	0,0	0,2	0,2	0,1	0,9
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	1,0	0,1	0,5	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	7,8	0,6	1,5	1,6	0,0	0,0	0,0	0,0	0,9	0,1	0,3	0,0	0,1	1,1	1,6	0,0
7	13,2	0,5	1,2	0,8	0,0	0,0	3,2	0,0	0,5	0,0	0,2	1,3	0,1	2,2	2,0	1,3
8	13,1	0,2	1,3	0,5	0,0	0,0	0,0	10,9	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
9	0,7	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,2	0,0
10	43,4	1,1	1,6	1,8	0,1	0,0	0,0	0,2	0,0	2,8	0,0	5,7	0,5	13,0	10,8	5,8
11	76,8	0,6	6,4	2,3	0,0	0,0	0,0	1,4	0,0	0,0	5,0	0,0	0,2	29,0	18,3	13,6
12	3,9	0,3	0,8	0,6	0,0	0,0	0,0	0,1	0,0	0,0	0,4	0,1	0,0	0,8	0,7	0,1
13	45,2	0,2	2,1	0,2	0,0	0,0	0,0	1,1	0,0	3,0	4,6	3,3	1,7	0,0	20,2	8,8
14	34,5	0,0	2,5	1,6	0,1	0,0	0,0	0,9	0,0	2,3	3,8	18,2	0,3	4,9	0,0	0,0
15	43,0	1,6	5,9	2,6	0,4	0,0	0,0	0,9	0,0	3,9	6,5	17,3	0,0	3,8	0,0	0,0
Scenario 3	440,3	29,1	46,4	91,3	3,0	0,0	5,1	16,9	12,1	13,9	29,1	45,8	3,5	57,7	55,0	31,2

HPM_LM_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	95,4	0,0	19,8	75,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	14,9	4,2	0,0	0,0	0,0	0,0	0,0	0,5	2,4	0,8	3,8	0,0	0,0	1,8	0,7	0,6
3	24,6	16,9	0,0	0,0	2,1	0,0	0,1	0,4	1,8	0,4	1,7	0,0	0,1	0,2	0,1	0,9
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	2,6	0,4	0,7	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,3	0,0
7	4,8	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,1	0,0	1,5	1,1	1,1
8	1,8	0,0	0,0	0,0	0,0	0,0	0,0	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
10	24,4	0,9	0,8	1,3	0,0	0,0	0,0	0,1	0,0	0,9	0,0	4,5	0,0	7,4	4,2	4,3
11	68,4	0,6	5,8	2,2	0,0	0,0	0,0	1,1	0,0	0,0	3,3	0,0	0,0	26,6	15,6	13,0
12	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,2	0,0
13	33,3	0,1	1,4	0,2	0,0	0,0	0,0	0,4	0,0	2,5	0,0	2,7	0,8	0,0	17,6	7,6
14	23,7	0,0	1,7	1,2	0,0	0,0	0,0	0,3	0,0	2,0	0,0	14,1	0,0	4,3	0,0	0,0
15	39,3	1,6	5,6	2,5	0,3	0,0	0,0	0,7	0,0	3,7	5,2	15,9	0,0	3,8	0,0	0,0
Scenario 4	333,7	24,9	35,7	84,1	2,3	0,0	0,1	5,4	4,2	10,3	14,0	38,3	0,9	46,2	39,8	27,5

Heavy duty vehicles – morning peak period, 2040

HPM_Ca_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**17,3**	0,0	6,0	2,4	5,2	0,8	0,4	0,1	0,0	0,0	0,4	0,3	0,0	1,0	0,3	0,3
2	**4,6**	0,8	0,0	1,0	0,7	0,7	0,3	0,1	0,0	0,1	0,1	0,1	0,0	0,3	0,2	0,1
3	**9,6**	5,6	0,5	0,0	1,1	1,1	0,4	0,1	0,0	0,0	0,1	0,2	0,0	0,3	0,1	0,1
4	**2,5**	0,7	0,0	0,0	0,0	0,5	0,7	0,2	0,0	0,0	0,1	0,2	0,0	0,0	0,0	0,0
5	**3,5**	0,1	0,1	0,3	2,2	0,0	0,1	0,0	0,0	0,0	0,1	0,1	0,0	0,3	0,1	0,1
6	**2,3**	0,4	0,6	0,7	0,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0
7	**0,6**	0,0	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1
8	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	**0,3**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0
10	**18,1**	0,1	0,0	0,0	0,0	0,1	0,0	0,2	0,0	0,6	0,0	4,5	0,7	6,3	2,9	2,6
11	**10,1**	0,2	0,3	0,3	0,0	0,1	0,1	0,3	0,0	0,1	1,2	0,0	0,1	3,9	2,2	1,2
12	**0,3**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0
13	**7,3**	0,5	0,3	0,3	0,0	0,3	0,1	0,6	0,0	0,3	0,8	1,6	0,2	0,0	1,6	0,9
14	**7,5**	0,2	0,5	0,3	0,0	0,1	0,1	0,4	0,0	0,2	0,7	2,4	0,2	1,8	0,0	0,6
15	**8,1**	0,4	0,2	0,2	0,0	0,2	0,1	0,6	0,0	0,4	1,0	1,2	0,2	2,5	1,0	0,0
Scenario 1	**92,1**	**9,1**	**8,7**	**5,6**	**9,5**	**4,0**	**2,4**	**2,4**	**0,0**	**1,8**	**4,7**	**10,6**	**1,5**	**17,0**	**8,7**	**6,1**

HPM_Ca_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**17,8**	0,0	6,2	2,5	5,3	0,8	0,5	0,1	0,0	0,0	0,4	0,3	0,0	1,0	0,3	0,3
2	**5,0**	0,8	0,0	1,0	0,7	0,7	0,4	0,1	0,3	0,1	0,2	0,1	0,1	0,3	0,2	0,1
3	**9,7**	5,6	0,5	0,0	1,1	1,1	0,4	0,1	0,0	0,0	0,1	0,2	0,0	0,3	0,1	0,1
4	**2,7**	0,7	0,0	0,1	0,0	0,5	0,7	0,2	0,0	0,0	0,1	0,2	0,0	0,1	0,0	0,1
5	**4,1**	0,2	0,4	0,5	2,2	0,0	0,1	0,0	0,0	0,0	0,1	0,1	0,0	0,3	0,1	0,1
6	**2,8**	0,4	0,6	0,7	0,3	0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,2	0,2	0,1
7	**1,2**	0,1	0,3	0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,2	0,1	0,1
8	**0,2**	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	**0,7**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,2	0,1	0,1
10	**19,9**	0,1	0,1	0,1	0,0	0,1	0,0	0,2	0,0	0,8	0,0	4,6	0,9	6,8	3,4	2,7
11	**10,8**	0,2	0,3	0,3	0,1	0,1	0,1	0,3	0,0	0,2	1,4	0,0	0,2	4,1	2,3	1,2
12	**0,7**	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,2	0,1	0,1
13	**8,0**	0,5	0,3	0,3	0,0	0,3	0,1	0,7	0,0	0,4	1,2	1,6	0,3	0,0	1,6	0,9
14	**7,6**	0,2	0,4	0,3	0,0	0,1	0,1	0,4	0,0	0,2	1,0	2,2	0,2	1,8	0,0	0,6
15	**8,4**	0,4	0,3	0,2	0,0	0,2	0,1	0,6	0,0	0,4	1,1	1,3	0,2	2,5	1,0	0,0
Scenario 2	**99,6**	**9,3**	**9,6**	**6,3**	**9,8**	**4,0**	**2,5**	**2,6**	**0,3**	**2,2**	**6,2**	**10,8**	**1,9**	**18,0**	**9,6**	**6,4**

HPM_Ca_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	17,4	0,0	6,1	2,4	5,2	0,8	0,4	0,1	0,0	0,0	0,4	0,3	0,0	1,0	0,3	0,3
2	4,3	0,8	0,0	0,9	0,7	0,7	0,3	0,1	0,0	0,0	0,1	0,1	0,0	0,3	0,2	0,1
3	9,5	5,5	0,5	0,0	1,1	1,1	0,4	0,1	0,0	0,0	0,1	0,2	0,0	0,3	0,1	0,1
4	2,5	0,7	0,0	0,0	0,0	0,5	0,7	0,2	0,0	0,0	0,1	0,2	0,0	0,0	0,0	0,0
5	3,6	0,1	0,2	0,3	2,2	0,0	0,1	0,0	0,0	0,0	0,1	0,1	0,0	0,3	0,1	0,1
6	2,4	0,4	0,6	0,7	0,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0
7	0,6	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1
8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,2	0,1	0,0
10	18,3	0,1	0,0	0,0	0,0	0,1	0,0	0,2	0,0	0,7	0,0	4,5	0,7	6,4	3,0	2,6
11	10,2	0,2	0,3	0,3	0,1	0,1	0,1	0,3	0,0	0,1	1,2	0,0	0,1	3,9	2,2	1,2
12	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0
13	7,2	0,5	0,3	0,3	0,0	0,3	0,1	0,6	0,0	0,3	0,8	1,6	0,2	0,0	1,5	0,8
14	7,1	0,2	0,4	0,3	0,0	0,1	0,1	0,4	0,0	0,2	0,7	2,1	0,2	1,8	0,0	0,6
15	8,1	0,4	0,2	0,2	0,0	0,2	0,1	0,6	0,0	0,4	1,0	1,2	0,2	2,5	1,0	0,0
Scenario 3	91,9	9,0	8,7	5,6	9,6	4,0	2,3	2,4	0,0	1,9	4,7	10,3	1,5	17,1	8,8	6,1

HPM_Ca_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	16,3	0,0	5,6	2,1	5,1	0,8	0,4	0,1	0,0	0,0	0,3	0,3	0,0	1,0	0,3	0,3
2	3,3	0,7	0,0	0,7	0,7	0,7	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,1	0,1
3	8,8	5,1	0,5	0,0	1,0	1,1	0,3	0,1	0,0	0,0	0,0	0,2	0,0	0,3	0,1	0,1
4	2,4	0,6	0,0	0,0	0,0	0,5	0,7	0,2	0,0	0,0	0,1	0,2	0,0	0,0	0,0	0,0
5	3,0	0,0	0,0	0,0	2,1	0,0	0,1	0,0	0,0	0,0	0,1	0,1	0,0	0,3	0,1	0,1
6	1,7	0,4	0,4	0,6	0,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0
10	13,9	0,1	0,0	0,0	0,0	0,1	0,0	0,2	0,0	0,2	0,0	4,2	0,2	5,1	1,5	2,3
11	8,4	0,2	0,2	0,3	0,0	0,1	0,1	0,2	0,0	0,0	0,8	0,0	0,0	3,5	1,8	1,1
12	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0
13	5,1	0,5	0,1	0,3	0,0	0,3	0,1	0,4	0,0	0,2	0,0	1,5	0,0	0,0	1,1	0,6
14	5,0	0,2	0,3	0,2	0,0	0,1	0,1	0,3	0,0	0,1	0,0	1,5	0,1	1,7	0,0	0,6
15	7,4	0,4	0,2	0,2	0,0	0,2	0,1	0,5	0,0	0,3	0,7	1,0	0,1	2,5	1,0	0,0
Scenario 4	75,5	8,2	7,3	4,3	9,2	4,0	1,9	1,9	0,0	1,0	2,2	8,9	0,5	14,8	6,0	5,2

Motorcycle – morning peak period, 2040

HPM_Mo_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	44,9	0,0	9,9	22,1	2,1	0,6	1,9	0,3	3,5	0,1	1,4	0,6	0,2	1,2	0,6	0,6
2	17,7	0,4	0,0	3,7	0,2	0,3	2,3	0,4	5,5	0,3	1,4	0,3	0,5	1,3	0,7	0,3
3	23,7	18,3	0,9	0,0	0,3	0,4	0,9	0,1	1,7	0,0	0,3	0,2	0,1	0,3	0,1	0,2
4	1,8	0,2	0,3	0,3	0,0	0,0	0,1	0,1	0,5	0,0	0,0	0,1	0,0	0,1	0,1	0,1
5	2,4	0,3	1,2	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	9,8	0,4	2,5	2,0	0,1	0,0	0,0	0,1	1,7	0,1	0,6	0,1	0,1	0,5	1,5	0,1
7	11,8	0,5	2,7	1,7	0,2	0,0	2,2	0,0	1,4	0,1	0,7	0,2	0,2	0,6	1,2	0,2
8	31,1	1,5	10,2	7,7	0,4	0,0	0,0	4,5	0,0	0,0	2,5	0,5	0,2	1,7	1,0	0,8
9	2,4	0,1	0,6	0,3	0,0	0,0	0,0	0,1	0,0	0,0	0,5	0,1	0,1	0,2	0,3	0,1
10	22,9	0,3	0,8	0,6	0,0	0,0	0,1	0,4	0,2	0,9	0,0	2,8	1,4	5,8	7,0	2,5
11	38,6	0,4	2,4	1,3	0,1	0,0	0,1	0,5	0,2	0,3	2,9	0,0	1,6	10,5	11,3	7,0
12	6,4	0,3	1,3	0,8	0,1	0,0	0,0	0,3	0,0	0,1	1,2	0,5	0,0	0,7	0,6	0,5
13	28,4	0,8	3,2	2,2	0,1	0,1	0,3	1,3	0,6	0,2	5,6	2,6	1,2	0,0	7,6	2,6
14	20,2	0,2	2,3	1,2	0,3	0,0	0,1	0,7	0,2	0,4	3,2	8,5	0,5	2,2	0,0	0,5
15	37,3	1,2	4,6	3,6	0,1	0,2	0,4	1,7	0,7	0,2	7,0	4,3	1,3	8,4	3,6	0,0
Scenario 1	299,5	24,9	43,0	48,2	4,0	1,7	8,3	10,4	16,0	2,8	27,3	20,9	7,3	33,6	35,6	15,6

HPM_Mo_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	48,0	0,0	11,0	23,7	2,3	0,6	1,9	0,3	3,7	0,1	1,4	0,6	0,2	1,2	0,6	0,6
2	28,9	0,7	0,0	6,2	0,2	0,3	3,5	0,7	8,4	0,9	2,6	0,3	0,9	2,6	1,2	0,4
3	28,3	22,4	0,9	0,0	0,4	0,4	0,9	0,1	1,8	0,0	0,4	0,2	0,1	0,3	0,1	0,2
4	2,8	0,3	0,7	0,5	0,0	0,0	0,1	0,1	0,5	0,0	0,0	0,1	0,0	0,2	0,2	0,1
5	3,4	0,4	1,6	1,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	11,7	0,4	2,6	2,0	0,2	0,0	0,0	0,1	2,4	0,2	0,8	0,2	0,2	0,8	1,7	0,2
7	14,2	0,5	3,0	1,9	0,3	0,0	3,0	0,0	1,7	0,1	0,8	0,2	0,2	0,8	1,3	0,2
8	34,2	1,7	11,0	8,2	0,6	0,0	0,0	5,9	0,0	0,0	2,5	0,5	0,2	1,7	1,0	0,8
9	3,3	0,1	0,8	0,4	0,1	0,0	0,0	0,1	0,0	0,0	0,6	0,2	0,1	0,2	0,4	0,2
10	26,1	0,3	0,9	0,7	0,0	0,0	0,1	0,4	0,2	1,2	0,0	3,1	1,6	6,8	7,9	2,7
11	44,8	0,4	2,9	1,4	0,1	0,0	0,1	0,5	0,2	0,6	3,2	0,0	1,8	13,2	12,7	7,8
12	7,4	0,3	1,5	1,0	0,1	0,0	0,0	0,3	0,0	0,1	1,4	0,6	0,0	0,8	0,7	0,6
13	36,2	0,9	3,9	2,2	0,4	0,1	0,3	1,6	0,6	0,5	6,9	3,4	1,3	0,0	9,6	4,6
14	30,5	0,2	3,2	1,7	0,5	0,0	0,1	1,0	0,2	0,7	4,5	14,4	0,6	2,9	0,0	0,5
15	39,8	1,2	4,8	3,7	0,2	0,2	0,4	1,7	0,7	0,3	7,2	6,1	1,3	8,4	3,6	0,0
Scenario 2	359,7	30,0	48,9	54,6	5,4	1,7	10,5	12,8	20,5	4,6	32,3	30,0	8,6	40,0	40,9	18,9

HPM_Mo_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**46,3**	0,0	10,3	22,9	2,2	0,6	1,9	0,3	3,5	0,1	1,4	0,6	0,2	1,2	0,6	0,6
2	**26,6**	0,7	0,0	5,8	0,2	0,3	3,3	0,6	7,6	0,8	2,3	0,3	0,8	2,4	1,1	0,4
3	**27,1**	21,5	0,9	0,0	0,3	0,4	0,9	0,1	1,7	0,0	0,3	0,2	0,1	0,3	0,1	0,2
4	**2,1**	0,3	0,4	0,3	0,0	0,0	0,1	0,1	0,5	0,0	0,0	0,1	0,0	0,1	0,1	0,1
5	**2,7**	0,3	1,3	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**10,3**	0,4	2,5	2,0	0,2	0,0	0,0	0,1	1,9	0,1	0,6	0,1	0,2	0,6	1,5	0,1
7	**12,4**	0,5	2,8	1,8	0,2	0,0	2,4	0,0	1,5	0,1	0,7	0,2	0,2	0,7	1,2	0,2
8	**31,9**	1,5	10,5	7,8	0,4	0,0	0,0	4,9	0,0	0,0	2,5	0,5	0,2	1,7	1,0	0,8
9	**2,7**	0,1	0,7	0,3	0,0	0,0	0,0	0,1	0,0	0,0	0,5	0,1	0,1	0,2	0,4	0,2
10	**23,7**	0,3	0,8	0,6	0,0	0,0	0,1	0,4	0,2	1,0	0,0	2,9	1,4	6,1	7,2	2,6
11	**42,1**	0,4	2,7	1,3	0,1	0,0	0,1	0,5	0,2	0,4	3,1	0,0	1,7	11,9	12,2	7,5
12	**6,7**	0,3	1,3	0,8	0,1	0,0	0,0	0,3	0,0	0,1	1,2	0,5	0,0	0,7	0,6	0,6
13	**33,5**	0,9	3,7	2,2	0,2	0,1	0,3	1,5	0,6	0,4	6,2	3,2	1,2	0,0	9,0	4,0
14	**28,9**	0,2	3,1	1,6	0,5	0,0	0,1	0,9	0,2	0,6	4,1	13,7	0,6	2,8	0,0	0,5
15	**38,7**	1,2	4,7	3,7	0,2	0,2	0,4	1,7	0,7	0,2	7,1	5,4	1,3	8,4	3,6	0,0
Scenario 3	**335,8**	**28,6**	**45,8**	**52,1**	**4,6**	**1,7**	**9,6**	**11,4**	**18,6**	**3,8**	**30,1**	**27,9**	**7,9**	**37,2**	**38,7**	**17,7**

HPM_Mo_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**46,0**	0,0	10,2	22,7	2,2	0,6	1,9	0,3	3,5	0,1	1,4	0,6	0,2	1,2	0,6	0,6
2	**26,2**	0,7	0,0	5,8	0,2	0,3	3,2	0,6	7,5	0,7	2,2	0,3	0,8	2,3	1,1	0,4
3	**26,9**	21,3	0,9	0,0	0,3	0,4	0,9	0,1	1,7	0,0	0,3	0,2	0,1	0,3	0,1	0,2
4	**2,0**	0,3	0,4	0,3	0,0	0,0	0,1	0,1	0,5	0,0	0,0	0,1	0,0	0,1	0,1	0,1
5	**2,6**	0,3	1,2	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**10,2**	0,4	2,5	2,0	0,2	0,0	0,0	0,1	1,8	0,1	0,6	0,1	0,2	0,6	1,5	0,1
7	**12,1**	0,5	2,8	1,7	0,2	0,0	2,3	0,0	1,4	0,1	0,7	0,2	0,2	0,7	1,2	0,2
8	**31,7**	1,5	10,4	7,8	0,4	0,0	0,0	4,7	0,0	0,0	2,5	0,5	0,2	1,7	1,0	0,8
9	**2,6**	0,1	0,7	0,3	0,0	0,0	0,0	0,1	0,0	0,0	0,5	0,1	0,1	0,2	0,4	0,2
10	**23,3**	0,3	0,8	0,6	0,0	0,0	0,1	0,4	0,2	0,9	0,0	2,9	1,4	6,0	7,1	2,5
11	**41,8**	0,4	2,7	1,3	0,1	0,0	0,1	0,5	0,2	0,4	3,0	0,0	1,7	11,8	12,1	7,5
12	**6,6**	0,3	1,3	0,8	0,1	0,0	0,0	0,3	0,0	0,1	1,2	0,5	0,0	0,7	0,6	0,6
13	**33,1**	0,9	3,7	2,2	0,2	0,1	0,3	1,4	0,6	0,4	6,1	3,1	1,2	0,0	8,9	4,0
14	**28,7**	0,2	3,1	1,6	0,4	0,0	0,1	0,9	0,2	0,6	4,0	13,6	0,6	2,8	0,0	0,5
15	**38,6**	1,2	4,7	3,7	0,2	0,2	0,4	1,7	0,7	0,2	7,0	5,3	1,3	8,4	3,6	0,0
Scenario 4	**332,2**	**28,4**	**45,3**	**51,7**	**4,5**	**1,7**	**9,4**	**11,2**	**18,4**	**3,7**	**29,7**	**27,6**	**7,8**	**36,8**	**38,3**	**17,6**

Bicycle – morning peak period, 2040

HPM_Bi_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**11,6**	0,0	4,2	3,4	0,7	0,0	0,5	0,1	1,8	0,1	0,4	0,1	0,1	0,1	0,2	0,1
2	**12,9**	0,4	0,0	0,7	0,0	0,0	1,4	0,3	6,0	0,3	2,1	0,1	1,0	0,2	0,2	0,0
3	**6,7**	2,5	0,9	0,0	0,4	0,0	0,4	0,1	0,9	0,1	0,5	0,2	0,2	0,0	0,3	0,1
4	**4,2**	0,3	1,5	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,6	0,6	0,2
5	**7,2**	1,0	3,4	2,6	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**15,2**	0,4	1,2	1,0	0,3	0,0	0,0	0,3	5,8	0,5	1,8	0,3	0,5	1,3	1,6	0,4
7	**19,7**	0,5	2,0	1,4	0,5	0,0	7,4	0,0	3,0	0,3	1,3	0,2	0,5	1,0	1,3	0,3
8	**24,3**	1,4	5,2	3,7	1,0	0,0	0,0	12,2	0,0	0,1	0,2	0,0	0,0	0,1	0,2	0,0
9	**5,0**	0,3	1,0	0,7	0,2	0,0	0,0	0,2	0,0	0,0	1,1	0,2	0,2	0,3	0,4	0,3
10	**28,6**	0,4	1,1	1,0	0,2	0,0	0,0	0,2	0,0	2,5	0,0	2,0	2,9	7,4	9,0	2,0
11	**15,9**	0,2	1,2	1,0	0,3	0,0	0,0	0,3	0,0	0,7	2,5	0,0	2,3	2,7	2,9	1,9
12	**11,0**	0,6	2,0	1,6	0,3	0,0	0,0	0,3	0,0	0,2	2,1	0,8	0,0	0,7	1,6	0,7
13	**15,3**	0,0	0,5	0,1	0,8	0,0	0,0	0,9	0,0	0,5	6,9	0,5	1,3	0,0	3,3	0,4
14	**12,4**	0,2	1,1	0,7	0,5	0,0	0,0	0,6	0,0	0,4	4,5	1,7	0,7	1,3	0,0	0,7
15	**7,0**	0,1	0,4	0,4	0,2	0,0	0,1	0,2	0,0	0,1	1,9	1,6	0,3	0,2	1,4	0,0
Scenario 1	**197,0**	**8,4**	**25,8**	**19,3**	**5,4**	**0,0**	**10,0**	**15,7**	**17,6**	**5,8**	**25,4**	**8,1**	**9,9**	**15,8**	**22,9**	**6,8**

HPM_Bi_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**29,1**	0,00	4,57	4,08	4,12	0,00	2,53	0,47	9,74	0,71	2,25	0,14	0,20	0,07	0,16	0,06
2	**67,7**	0,62	0,00	2,35	0,20	0,00	8,04	1,75	33,88	2,09	11,69	0,09	5,27	1,06	0,54	0,08
3	**20,7**	5,00	0,93	0,00	2,72	0,00	1,87	0,34	5,23	0,38	2,55	0,23	1,04	0,05	0,28	0,06
4	**26,0**	1,92	9,30	5,58	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,11	0,00	3,51	3,48	1,11
5	**40,0**	5,87	18,36	14,64	0,84	0,00	0,04	0,01	0,00	0,01	0,04	0,02	0,02	0,07	0,09	0,02
6	**77,3**	1,57	5,00	4,04	1,52	0,00	0,00	1,57	32,28	2,75	9,62	1,45	2,45	6,10	7,14	1,77
7	**104,2**	2,93	9,49	7,47	2,90	0,00	40,89	0,00	16,44	1,88	6,87	1,14	2,49	4,88	5,48	1,36
8	**129,8**	7,86	25,45	20,12	5,66	0,00	0,07	67,33	0,00	0,31	0,91	0,17	0,25	0,68	0,81	0,19
9	**27,2**	1,58	5,26	4,10	1,39	0,00	0,01	1,30	0,00	0,00	6,22	1,39	1,08	1,48	1,75	1,66
10	**141,9**	1,62	4,95	4,16	0,90	0,00	0,01	0,85	0,03	14,13	0,00	9,22	15,20	37,76	42,65	10,40
11	**40,9**	0,19	1,40	1,09	1,70	0,00	0,02	1,60	0,07	3,94	12,42	0,00	8,68	3,88	3,65	2,30
12	**51,0**	3,14	9,91	7,94	1,82	0,00	0,05	1,71	0,00	1,22	11,36	3,16	0,00	3,05	4,26	3,39
13	**65,6**	0,05	0,88	0,13	4,88	0,00	0,10	4,98	0,17	3,05	37,80	1,01	6,50	0,00	4,49	1,52
14	**47,6**	0,21	1,71	1,09	3,03	0,00	0,04	3,21	0,16	2,04	24,43	5,70	3,52	1,77	0,00	0,66
15	**19,8**	0,14	0,53	0,45	1,41	0,00	0,10	1,32	0,07	0,79	9,74	2,47	1,26	0,19	1,35	0,00
Scenario 2	**888,8**	**32,7**	**97,7**	**77,2**	**33,1**	**0,0**	**53,8**	**86,5**	**98,1**	**33,3**	**135,9**	**27,3**	**48,0**	**64,6**	**76,1**	**24,6**

HPM_Bi_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	30,8	0,0	4,3	3,8	4,4	0,0	2,8	0,5	10,9	0,8	2,5	0,1	0,2	0,1	0,2	0,1
2	74,3	0,6	0,0	2,2	0,2	0,0	8,9	1,9	37,5	2,2	13,1	0,1	5,9	1,0	0,5	0,1
3	21,9	4,7	0,9	0,0	2,9	0,0	2,1	0,4	5,8	0,4	2,9	0,2	1,2	0,1	0,3	0,1
4	27,7	2,0	9,9	5,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	3,7	3,7	1,2
5	44,8	6,6	20,5	16,4	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0
6	86,4	1,8	5,6	4,5	1,6	0,0	0,0	1,8	36,1	3,0	10,9	1,6	2,8	6,8	8,0	2,0
7	117,0	3,3	10,6	8,4	3,2	0,0	46,1	0,0	18,4	2,1	7,8	1,3	2,8	5,5	6,1	1,5
8	144,9	8,8	28,2	22,4	6,2	0,0	0,1	75,6	0,0	0,3	1,0	0,2	0,3	0,8	0,9	0,2
9	29,8	1,7	5,7	4,5	1,5	0,0	0,0	1,5	0,0	0,0	7,0	1,5	1,2	1,6	1,9	1,8
10	160,1	1,8	5,6	4,7	1,0	0,0	0,0	1,0	0,0	15,8	0,0	10,4	17,2	42,7	48,2	11,8
11	43,5	0,2	1,3	1,1	1,8	0,0	0,0	1,8	0,1	4,3	14,0	0,0	9,7	3,5	3,5	2,2
12	57,5	3,6	11,2	9,0	2,0	0,0	0,1	1,9	0,0	1,4	12,9	3,5	0,0	3,4	4,7	3,8
13	72,0	0,1	0,8	0,1	5,2	0,0	0,1	5,6	0,2	3,3	42,8	0,9	7,4	0,0	4,3	1,3
14	51,6	0,2	1,7	1,1	3,2	0,0	0,0	3,6	0,2	2,2	27,6	5,5	4,0	1,7	0,0	0,7
15	21,3	0,1	0,5	0,4	1,5	0,0	0,1	1,5	0,1	0,9	11,0	2,2	1,4	0,2	1,4	0,0
Scenario 3	983,7	35,4	106,9	84,6	35,5	0,0	60,4	97,1	109,2	36,7	153,6	28,8	54,2	71,0	83,7	26,7

HPM_Bi_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	72,3	0,0	30,1	23,6	3,5	0,0	2,3	0,4	8,8	0,6	2,1	0,1	0,2	0,2	0,2	0,1
2	118,8	2,3	0,0	16,4	0,3	0,0	13,3	2,9	43,3	4,4	16,0	0,1	6,5	8,9	3,8	0,6
3	43,2	28,3	0,9	0,0	2,5	0,0	1,8	0,3	4,8	0,4	2,4	0,2	1,0	0,1	0,4	0,1
4	22,6	1,6	8,1	4,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	3,0	3,1	1,0
5	36,9	5,3	17,4	13,3	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0
6	76,8	1,5	6,1	3,9	1,3	0,0	0,0	1,4	29,2	2,4	8,8	1,5	2,2	7,0	9,5	1,7
7	101,6	2,7	11,6	7,2	2,5	0,0	37,1	0,0	14,9	1,7	6,3	1,2	2,3	5,6	7,2	1,3
8	125,4	7,2	29,5	19,2	5,0	0,0	0,1	61,0	0,0	0,3	0,8	0,2	0,2	0,7	1,0	0,2
9	26,7	1,4	6,0	3,8	1,2	0,0	0,0	1,2	0,0	0,0	5,6	1,3	1,0	1,6	2,1	1,6
10	145,9	1,5	5,4	3,9	0,8	0,0	0,0	0,8	0,0	12,7	0,0	9,0	13,9	39,3	48,6	9,9
11	98,6	0,2	7,0	1,6	1,5	0,0	0,0	1,5	0,1	3,8	11,8	0,0	8,2	26,4	28,9	7,5
12	49,9	2,9	10,6	7,5	1,6	0,0	0,1	1,6	0,0	1,1	10,4	3,1	0,0	3,1	4,7	3,2
13	114,4	0,1	7,5	0,3	4,8	0,0	0,1	5,1	0,2	3,3	37,2	6,0	6,3	0,0	30,3	13,2
14	110,0	0,3	9,8	4,4	3,7	0,0	0,0	4,1	0,2	3,1	27,6	45,2	3,8	7,1	0,0	0,7
15	35,8	0,2	3,9	0,7	1,3	0,0	0,1	1,3	0,1	0,7	9,2	15,2	1,2	0,6	1,4	0,0
Scenario 4	1179,0	55,7	153,9	110,7	30,8	0,0	54,9	81,7	101,6	34,5	138,1	84,0	46,9	103,8	141,3	41,2

Public Transport (Bus) – morning peak period, 2040

HPM_PT_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	25,0	0,0	0,0	0,0	0,1	2,3	2,3	3,4	5,2	1,0	8,0	0,0	2,7	0,0	0,0	0,0
2	97,1	0,0	0,0	0,0	6,0	8,9	8,5	12,4	19,4	4,4	28,1	0,0	9,3	0,0	0,0	0,0
3	10,1	0,0	0,0	0,0	0,2	0,9	0,9	1,4	2,1	0,4	3,2	0,0	1,1	0,0	0,0	0,0
4	43,6	8,5	13,8	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,1	12,7	3,4
5	62,3	13,8	19,7	4,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,4	15,0	5,5
6	59,4	13,3	18,7	4,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,3	14,1	5,3
7	86,6	19,4	27,3	6,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,8	20,5	7,8
8	134,9	30,1	42,5	10,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,5	32,1	12,1
9	30,6	6,7	9,7	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,7	7,6	2,7
10	195,5	43,9	61,6	15,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	11,0	45,9	17,6
11	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
12	64,7	14,6	20,4	5,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,6	15,1	5,8
13	27,4	0,0	0,0	0,0	0,0	2,5	2,6	3,8	5,7	1,1	8,8	0,0	3,0	0,0	0,0	0,0
14	158,6	0,0	0,0	0,0	11,8	14,6	13,8	20,0	31,3	7,3	45,0	0,0	14,8	0,0	0,0	0,0
15	44,4	0,0	0,0	0,0	0,2	4,1	4,2	6,1	9,2	1,7	14,2	0,0	4,8	0,0	0,0	0,0
Scenario 1	1040,3	150,2	213,8	52,8	18,2	33,3	32,3	47,1	73,0	15,8	107,2	0,0	35,7	37,5	163,2	60,3

HPM_PT_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	35,6	0,0	0,0	0,0	2,9	3,2	3,1	4,5	7,1	1,6	10,0	0,0	3,3	0,0	0,0	0,0
2	113,8	0,0	0,0	0,0	9,2	10,4	9,8	14,3	22,4	5,3	32,0	0,0	10,5	0,0	0,0	0,0
3	19,4	0,0	0,0	0,0	1,6	1,8	1,7	2,4	3,8	0,9	5,5	0,0	1,8	0,0	0,0	0,0
4	61,0	13,6	19,2	5,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,3	13,1	5,5
5	69,3	15,4	21,8	5,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,9	15,0	6,3
6	65,3	14,6	20,5	5,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,6	14,1	5,9
7	94,9	21,1	29,8	8,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,7	20,5	8,6
8	149,4	33,3	46,9	12,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	10,6	32,1	13,6
9	35,1	7,8	11,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,5	7,6	3,2
10	212,7	47,4	66,8	18,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	15,1	45,8	19,3
11	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
12	70,2	15,7	22,0	6,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0	15,1	6,4
13	49,8	0,0	0,0	0,0	4,0	4,5	4,3	6,2	9,9	2,3	14,0	0,0	4,6	0,0	0,0	0,0
14	161,5	0,0	0,0	0,0	13,0	14,8	13,9	20,2	31,8	7,5	45,3	0,0	14,9	0,0	0,0	0,0
15	62,5	0,0	0,0	0,0	5,0	5,6	5,4	7,8	12,4	2,8	17,6	0,0	5,9	0,0	0,0	0,0
Scenario 2	1200,2	168,9	238,0	64,8	35,6	40,2	38,1	55,4	87,4	20,3	124,4	0,0	41,1	53,7	163,3	68,8

HPM_PT_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**62,6**	0,0	0,0	0,0	4,9	5,6	5,4	7,9	12,3	2,7	17,9	0,0	6,0	0,0	0,0	0,0
2	**192,6**	0,0	0,0	0,0	15,4	17,6	16,6	24,2	37,8	8,8	54,3	0,0	17,9	0,0	0,0	0,0
3	**46,2**	0,0	0,0	0,0	3,7	4,2	4,0	5,8	9,1	2,1	13,1	0,0	4,3	0,0	0,0	0,0
4	**84,7**	17,1	26,7	7,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,1	18,7	7,3
5	**97,1**	19,6	30,6	9,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,1	21,5	8,3
6	**91,7**	18,6	28,9	8,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,7	20,1	7,9
7	**133,5**	27,1	42,1	12,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	11,1	29,2	11,5
8	**208,7**	42,3	65,8	19,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	17,4	45,8	18,0
9	**48,4**	9,7	15,3	4,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,0	10,9	4,1
10	**300,2**	61,2	94,6	27,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	25,1	65,4	26,0
11	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
12	**99,1**	20,2	31,2	9,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,3	21,5	8,6
13	**99,7**	0,0	0,0	0,0	7,8	9,0	8,6	12,5	19,5	4,4	28,4	0,0	9,4	0,0	0,0	0,0
14	**238,1**	0,0	0,0	0,0	19,1	21,9	20,5	29,9	46,8	11,0	66,9	0,0	22,1	0,0	0,0	0,0
15	**109,0**	0,0	0,0	0,0	8,5	9,8	9,4	13,7	21,3	4,7	31,2	0,0	10,4	0,0	0,0	0,0
Scenario 3	**1811,7**	**215,8**	**335,3**	**98,4**	**59,3**	**68,0**	**64,6**	**94,0**	**146,8**	**33,7**	**211,9**	**0,0**	**70,0**	**88,8**	**233,2**	**91,9**

6

HPM_PT_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**60,7**	0,0	0,0	0,0	4,7	5,4	5,3	7,6	12,0	2,6	17,3	0,0	5,8	0,0	0,0	0,0
2	**188,8**	0,0	0,0	0,0	15,1	17,2	16,3	23,7	37,2	8,6	53,2	0,0	17,6	0,0	0,0	0,0
3	**44,1**	0,0	0,0	0,0	3,5	4,0	3,8	5,5	8,7	2,0	12,5	0,0	4,1	0,0	0,0	0,0
4	**83,5**	16,8	26,3	7,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,9	18,6	7,2
5	**95,3**	19,2	30,0	8,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,9	21,3	8,2
6	**90,4**	18,3	28,5	8,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,5	20,0	7,8
7	**131,3**	26,6	41,4	12,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	10,9	29,0	11,3
8	**206,3**	41,9	65,0	18,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	17,1	45,6	17,8
9	**47,5**	9,5	15,0	4,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,9	10,8	4,0
10	**295,4**	60,2	93,1	27,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	24,5	65,0	25,6
11	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
12	**97,8**	20,0	30,8	9,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,1	21,4	8,5
13	**96,7**	0,0	0,0	0,0	7,6	8,7	8,4	12,1	19,1	4,2	27,5	0,0	9,2	0,0	0,0	0,0
14	**236,2**	0,0	0,0	0,0	18,9	21,7	20,4	29,6	46,5	10,9	66,4	0,0	21,9	0,0	0,0	0,0
15	**106,0**	0,0	0,0	0,0	8,3	9,4	9,2	13,3	21,0	4,5	30,3	0,0	10,1	0,0	0,0	0,0
Scenario 4	**1779,9**	**212,4**	**330,1**	**95,8**	**58,1**	**66,2**	**63,2**	**91,8**	**144,4**	**32,8**	**207,1**	**0,0**	**68,7**	**86,9**	**231,7**	**90,5**

Autonomous Vehicles – morning peak period, 2040

HPM_Aut_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	425,6	0,0	96,9	318,2	2,8	0,0	1,7	0,3	3,1	0,8	0,9	0,0	0,0	0,4	0,2	0,1
2	71,9	2,3	0,0	17,8	0,2	0,0	7,9	1,8	16,3	3,2	7,1	0,0	2,3	8,5	3,9	0,7
3	294,5	286,8	0,0	0,0	1,8	0,0	1,2	0,2	1,7	0,4	1,0	0,0	0,3	0,2	0,2	0,6
4	1,3	0,1	0,5	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,2	0,1
5	6,5	0,9	3,2	2,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	48,8	1,8	6,1	4,6	0,7	0,0	0,0	0,7	8,1	1,6	3,0	1,7	0,6	6,8	10,8	2,1
7	67,3	3,5	11,7	8,8	1,2	0,0	17,9	0,0	4,1	1,1	2,1	1,3	0,6	5,3	8,0	1,6
8	83,0	7,4	25,1	18,7	2,2	0,0	0,0	27,3	0,0	0,2	0,3	0,2	0,1	0,6	1,0	0,2
9	19,3	1,5	5,1	3,7	0,5	0,0	0,0	0,5	0,0	0,0	1,7	1,2	0,2	1,2	2,0	1,5
10	85,0	1,0	3,3	2,5	0,3	0,0	0,0	0,3	0,0	5,7	0,0	5,5	3,1	22,4	34,4	6,5
11	196,4	0,0	0,0	0,4	0,2	0,1	0,0	1,1	0,0	4,4	4,9	0,0	2,3	73,6	73,9	35,5
12	24,2	1,8	6,0	4,4	0,6	0,0	0,0	0,6	0,0	0,5	2,8	1,6	0,0	1,6	2,5	1,9
13	171,1	0,3	15,8	0,8	3,2	0,0	0,0	3,4	0,1	3,4	15,2	17,6	1,9	0,0	61,9	47,6
14	155,9	0,3	16,1	8,6	3,1	0,0	0,0	3,4	0,1	3,4	15,2	93,4	1,6	10,7	0,0	0,0
15	100,7	1,0	10,8	2,4	1,0	0,0	0,0	0,9	0,0	0,9	4,0	77,9	0,3	1,5	0,0	0,0
Scenario 1	**1751,7**	**308,6**	**200,8**	**393,4**	**18,0**	**0,1**	**28,9**	**40,6**	**33,5**	**25,6**	**58,1**	**200,4**	**13,2**	**133,0**	**199,1**	**98,2**

HPM_Aut_2040	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	428,4	0,0	99,5	320,8	2,3	0,0	1,4	0,3	2,1	0,8	0,6	0,0	0,0	0,4	0,2	0,1
2	60,6	2,1	0,0	16,6	0,2	0,0	6,5	1,5	11,7	2,9	5,2	0,0	1,5	8,2	3,7	0,7
3	293,0	286,8	0,0	0,0	1,5	0,0	1,0	0,2	1,1	0,4	0,7	0,0	0,2	0,2	0,2	0,6
4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	2,5	0,3	1,3	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	40,9	1,7	5,8	4,2	0,5	0,0	0,0	0,5	4,6	1,3	1,8	1,6	0,3	6,5	10,2	1,9
7	56,1	3,1	11,0	8,0	0,9	0,0	13,1	0,0	2,3	0,9	1,3	1,2	0,3	5,0	7,5	1,5
8	69,6	6,6	23,1	16,7	1,5	0,0	0,0	19,7	0,0	0,1	0,2	0,1	0,0	0,5	0,9	0,2
9	17,3	1,3	4,9	3,5	0,4	0,0	0,0	0,4	0,0	0,0	1,0	1,2	0,1	1,2	1,9	1,4
10	69,6	0,8	2,8	2,0	0,2	0,0	0,0	0,2	0,0	4,2	0,0	4,5	1,2	18,8	29,6	5,3
11	199,6	0,0	0,0	0,4	0,2	0,1	0,0	0,9	0,0	4,2	3,4	0,0	1,3	77,7	75,1	36,1
12	18,4	1,4	5,0	3,5	0,3	0,0	0,0	0,3	0,0	0,3	1,4	1,3	0,0	1,3	2,1	1,5
13	166,6	0,3	16,3	0,8	2,6	0,0	0,0	2,9	0,0	3,2	10,5	18,2	1,0	0,0	62,6	48,1
14	145,1	0,3	15,5	8,2	2,6	0,0	0,0	2,9	0,1	3,1	11,4	89,8	1,0	10,3	0,0	0,0
15	101,3	1,0	11,0	2,4	0,8	0,0	0,0	0,8	0,0	0,8	2,8	80,0	0,2	1,5	0,0	0,0
Scenario 2	**1668,9**	**305,8**	**196,2**	**387,8**	**14,0**	**0,1**	**22,2**	**30,5**	**21,9**	**22,2**	**40,3**	**197,8**	**7,1**	**131,7**	**194,1**	**97,3**

HPM_Aut_2040	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	**422,3**	0,0	97,7	318,7	1,7	0,0	1,2	0,2	1,0	0,7	0,4	0,0	0,0	0,4	0,2	0,1
2	**50,6**	2,0	0,0	15,6	0,1	0,0	5,3	1,2	7,5	2,5	3,8	0,0	0,9	7,5	3,5	0,6
3	**288,8**	284,3	0,0	0,0	1,1	0,0	0,8	0,2	0,5	0,4	0,5	0,0	0,1	0,2	0,2	0,6
4	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**32,6**	1,5	5,2	3,8	0,3	0,0	0,0	0,4	1,3	1,0	0,9	1,4	0,0	5,7	9,4	1,7
7	**45,0**	2,9	9,9	7,2	0,5	0,0	9,0	0,0	0,6	0,7	0,6	1,1	0,0	4,4	6,9	1,3
8	**55,5**	5,7	20,1	14,5	0,8	0,0	0,0	12,8	0,0	0,1	0,1	0,1	0,0	0,5	0,8	0,1
9	**14,0**	1,2	4,2	3,0	0,2	0,0	0,0	0,2	0,0	0,0	0,4	1,0	0,0	1,0	1,7	1,2
10	**55,1**	0,6	2,3	1,6	0,1	0,0	0,0	0,1	0,0	2,7	0,0	3,6	0,0	14,5	25,3	4,3
11	**191,3**	0,0	0,0	0,4	0,2	0,1	0,0	0,8	0,0	3,7	2,2	0,0	0,5	74,3	73,8	35,4
12	**13,3**	1,1	3,9	2,7	0,1	0,0	0,0	0,2	0,0	0,2	0,3	1,0	0,0	1,0	1,7	1,2
13	**155,7**	0,3	15,7	0,8	1,8	0,0	0,0	2,3	0,0	2,7	6,5	17,4	0,4	0,0	61,1	46,7
14	**138,5**	0,3	15,2	8,1	2,1	0,0	0,0	2,5	0,0	2,8	8,9	87,8	0,7	10,0	0,0	0,0
15	**97,5**	1,0	10,8	2,4	0,6	0,0	0,0	0,6	0,0	0,7	1,8	78,0	0,1	1,5	0,0	0,0
Scenario 3	**1560,2**	**300,9**	**184,9**	**378,7**	**9,6**	**0,1**	**16,5**	**21,5**	**11,0**	**18,3**	**26,2**	**191,4**	**2,7**	**121,0**	**184,7**	**93,0**

HPM_Aut_2040	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	**626,4**	0,0	141,6	473,9	3,1	0,0	2,0	0,4	2,5	1,1	0,8	0,0	0,0	0,6	0,3	0,1
2	**70,7**	2,6	0,0	20,7	0,2	0,0	7,6	1,7	12,0	3,4	5,7	0,0	1,5	9,8	4,7	0,8
3	**429,6**	421,6	0,0	0,0	2,0	0,0	1,4	0,3	1,3	0,6	0,9	0,0	0,2	0,3	0,3	0,8
4	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
5	**0,9**	0,1	0,6	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	**55,1**	2,4	7,9	6,0	0,6	0,0	0,0	0,7	5,1	1,8	2,2	2,2	0,3	8,8	14,2	2,7
7	**76,2**	4,5	15,1	11,4	1,1	0,0	17,5	0,0	2,5	1,2	1,6	1,7	0,3	6,8	10,5	2,1
8	**94,6**	9,4	31,4	23,5	1,8	0,0	0,0	25,7	0,0	0,2	0,2	0,2	0,0	0,7	1,2	0,2
9	**23,0**	1,9	6,5	4,8	0,4	0,0	0,0	0,5	0,0	0,0	1,2	1,6	0,1	1,6	2,6	1,9
10	**92,6**	1,1	3,7	2,8	0,2	0,0	0,0	0,2	0,0	5,4	0,0	6,1	1,1	24,4	40,2	7,3
11	**278,7**	0,0	0,0	0,6	0,3	0,1	0,0	1,3	0,0	5,8	4,4	0,0	1,5	107,0	105,8	52,0
12	**24,3**	1,9	6,6	4,8	0,4	0,0	0,0	0,4	0,0	0,4	1,5	1,7	0,0	1,7	2,8	2,1
13	**228,7**	0,4	22,2	1,1	3,3	0,0	0,0	3,8	0,0	4,2	12,9	25,1	1,1	0,0	86,7	67,7
14	**198,9**	0,4	21,3	11,5	3,4	0,0	0,0	3,8	0,1	4,2	14,7	124,2	1,3	14,0	0,0	0,0
15	**144,2**	1,5	15,5	3,5	1,0	0,0	0,0	1,1	0,0	1,2	3,6	114,4	0,2	2,1	0,0	0,0
Scenario 4	**2343,8**	**447,9**	**272,3**	**564,7**	**17,7**	**0,1**	**28,6**	**40,0**	**23,6**	**29,5**	**49,6**	**277,3**	**7,7**	**177,8**	**269,4**	**137,7**

7.3 LONDON

Key Performance Indicators used to assess success in achieving Key Priorities identified and road user provision in the design exercise

Pedestrians	Key Performance Indicator
Provide safe & direct pedestrian crossings	Extent to which each crossing facility is suitable for pedestrians with reduced mobility. Pedestrian Comfort Metric, detection and optimisation technology for active mode users at traffic lights
Increase footway provision	Extra space beyond standard footway width: location, width (m), space (m2)
Reduce vehicle speeds	Speed limit at street section, further legal aspects of traffic regulation
Improved Urban Realm	Qualitative assessment of facade designs, location and type of trees, location, space (m2), width/ length of facilities for playing or exercise or stationary activities beyond standard footway width
Cyclists	
Provide safe & consistent cycling provision	Safety Audit Assessment
Reduce vehicle speeds	Speed limit at street section, further legal aspects of traffic regulation
Provide secure cycle parking	Location of bile parking stands; stands for scooters etc
Bus Passengers	
Accessible bus stop provision	Extent to which PT stop is accessible to persons with reduced mobility
Provide seating at bus stops & Interchanges	Location, width/ length (m) of benches, formal, informal seating facilities
Improve bus priority to reduce bus journey times	Number & width of lanes, allowed user groups on each lane, travel times change
Rail Passengers	
Increase footway provision	Extra space beyond standard footway width: location, width (m), space (m2)
Provide consistent wayfinding to improve interchange facilities	Location, width/ length (m) bus stops/ shelters. Characteristics of bus stop facilities
Car Driver/ Passenger	
Cleaner & greener vehicles	Modelled Air Pollution Concentration

Sustainable mode shift	Vehicle volumes change, cycle volume change, pedestrian volume change
Motorcyclists	
Visibility improvements of infrastructure	Safety Audit Assessment
Signing/ road marking improvements to reduce conflicts	Safety Audit Assessment
Taxi & PHV passengers	
Accessible taxi ranks	Extent to which rank is accessible to persons with reduced mobility
Dedicated drop off/ pick up points at Interchange locations	Location, width/ length of pick-up points
HGV/ LGV Drivers	
Clear & concise restrictions for parking & loading	Documentation of all parking facilities and restrictions. Details of any charges.
Convenient locations for parking & loading	Location, width/ length of pick-up points, number & duration of parking & loading events
Consolidate & re-time deliveries	Number & duration of parking/ loading events by location, time, type of vehicles
Rear access	Number & duration of parking/ loading events by location, time, type of vehicles
Out of area waiting facilities	Number & duration of parking/ loading events by location, time, type of vehicles