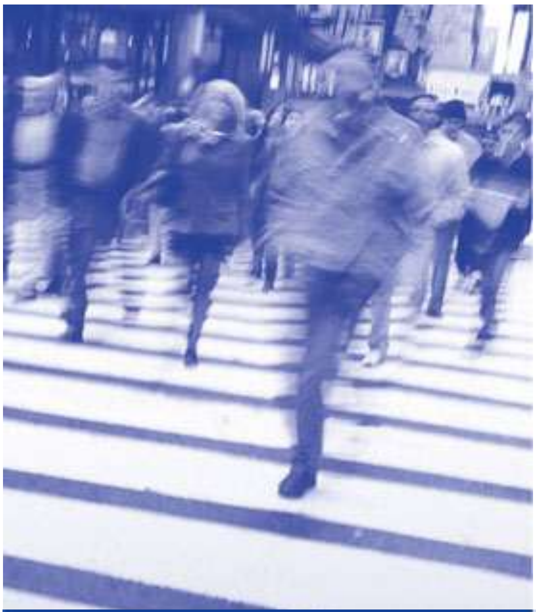


CIVITAS
Cleaner and better transport in cities

POINTER

Measure Evaluation Results

28 – Noise Reduction in Ústí nad Labem

67 – Efficient Goods Distribution in Ústí nad Labem

Deliverable F

Date: November 2012

THE CIVITAS INITIATIVE IS CO-FINANCED BY THE EUROPEAN UNION

Executive summary

This package of priority measures evaluated together consists of measures for traffic noise reduction and development of efficient freight logistics.

A study was undertaken to identify the level of noise pollution in the city, to assess impact of measures for noise reduction and to develop a noise map so that problem areas can be targeted as part of the Ústí nad Labem Sustainable Urban Transport Plan. Based on study results, tools suitable for reduction of noise from traffic on local roads were designed through traffic planning and management, construction and technical solutions. A plan for efficient distribution of goods in the city was designed. Results were implemented into the Sustainable Urban Transport Plan of the city.

Noise reduction was aimed at linking noise emissions with a road map to provide a noise map for the city as well as modelling some proposed solutions for reduction of traffic noise and to evaluate effectiveness of individual proposed scenarios. The following noise reducing model scenarios were evaluated, affecting freight logistics as well as predominant individual motor transport in the city:

- implementation of a city ring road bypassing the city centre,
- flat reduction of traffic speed in the city by 10%,
- elimination of freight vehicles with weight over 3,5t from the city centre.

Reduction of noise emissions in the urban environment through reduction of traffic intensity appears to be little effective, due to the fact that even small decrease in noise emissions requires significant reduction of transport intensity, which is difficult to achieve on the urban road network and which is feasible only through radical measures, such as construction of bypasses and consequent transfer of traffic away from sensitive zones. Although, even such measures may only be temporary – released capacity on the original road may trigger new saturation of transport.

The research showed that complete banning of freight vehicles is not feasible in Usti nad Labem. The city is not primarily a tourist destination and it relies on freight deliveries. Restricting freight transport is an option but may be counterproductive because it could result in an increase of trips by private vehicles. It is therefore necessary to seek a solution that will optimise the level of freight traffic, minimise trips, implement logistics arrangements, etc., which would at the same time maintain economic activities in the affected locality.

Suitable tools include:

- Reasonable access charges for entering the city centre;
- Incentive promotion of ecological vehicles (via omission of fees or subsidies, establishment of ecological zones);
- Limiting access of vehicles above particular weight in specific localities.

Seven specific scenarios for noise reduction in Ústí nad Labem were evaluated in comparison to the Zero variant (do-nothing scenario).

The basic Zero variant reflects the current state with no additional efforts towards noise reduction.

Proposed scenarios A, B, C and D are considering construction of bypasses between selected roads. Such measures proved to have only local effect manifested mainly in the relevant city quadrants decreasing the noise level by 2 – 5 dB. In other city parts, the changes are only small. The scenario

proposing decrease of traffic intensity has low impact and is not sufficient for significant noise reduction.

The scenario E is proposing implementation of the complex system of bypasses resulted in slight decrease in noise emissions on several areas.

Scenario F considering flat decrease of traffic speed in the entire city road network showed improvements on all the city roads, but decrease the noise level only by 1 dB on average. The speed reduction has a potential to reduce noise emissions if implemented in more than 10%.

Results of the scenario G proposing exclusion of freight vehicles are most visible. The decrease of noise emissions is achieved on almost all the roads in the city by more than 5 dB on average. Exclusion of freight vehicles is an effective measure, but it is necessary to determine on which roads it is appropriate to implement it and what effect this will have on the outside zones.

In order to efficiently reduce noise emissions in the city, it was recommended to apply other technical solutions, such as noise barriers, use of innovative materials preventing noise, tunnel solutions, etc. The measure should be supported by suitable demand management strategies for individual transport aimed at traffic calming and reducing number of vehicles by shortening the number of parking lots available in the city centre, introducing the paid entrance to the central zones, implementing calming elements etc.

A Introduction

A1 Objectives

The measure objectives are:

(A) High level / longer term:

- To reduce noise pollution caused by traffic in Ústí nad Labem
- To minimize negative impacts of noise (mainly from freight transport) on citizens living in highly exposed areas

(B) Strategic level:

- To reduce the number of areas where noise is above 65 dB near the busiest roads

(C) Measure level:

(1) To develop the emission noise map from noise generated by the current and predicted traffic in the city

(2) To identify problematic areas and roads with the highest level of noise emitted by the local traffic

(3) To propose measures reducing the noise emitted by cars for the most affected areas with regard to organisation and regulation of local traffic, targeted to year 2012

(4) To apply the traffic model and subsequently the noise model on the proposed solutions and include assessment of the proposals for effective distribution of goods in Ústí nad Labem

A2 Description

Ústí nad Labem has a target to reduce the proportion of residential areas located in areas exposed to noise levels above 65 dB as a result of busy roads. Studies were undertaken to gain a better understanding of noise impacts and measures reducing noise and to develop a noise map so that problem areas can be targeted as part of the Sustainable Urban Transport Plan of the city.

The measure was aimed at linking noise emissions with a road map to provide a noise map for the city, at modelling of proposed solutions for reduction of traffic noise and evaluating effectiveness of individual proposed scenarios.

The assessed scenarios were the following:

- Zero Scenario – The current state of the infrastructure is preserved, no changes towards the noise reduction are made. This scenario serves as a basis for comparison with other options.
- Scenario A – considering implementation of the southeast bypass between the 2nd class road number 261 (Litoměřická) and the 1st class road number 62 (Vodařská).
- Scenario B - considering implementation of the southwest bypass between the 2nd class road number 261 (Litoměřická) and Jateční Street.
- Scenario C - considering implementation of the northeast bypass between the 2nd class road number 528 (Petrovická) and the 1st class road number 62 (Vodařská).
- Scenario D - considering implementation of the northwest bypass between the streets and Jateční and Božtěšická.
- Scenario E – all the bypasses from previous scenarios are implemented.
- Scenario F – considering decrease of the traffic speed by 10%.
- Scenario G - excluding all the freight vehicles with the weight above 3,5 tonnes to determine the roads appropriate for such solution.

Tools for noise reduction and their suitability for implementation in Ústí nad Labem were reviewed, including possible implementation of greenery, noise walls, speed reduction, constructional changes on roads, suitable road surface or road profile, renewal of the vehicle fleet, avoiding crossroads, noise protection of buildings, traffic management, improvements of traffic flow or modifications of transport demand.

Possibilities to reduce noise through transport planning were examined involving modifications of road line and transverse profile, or intersections. Technical construction solutions for roads and buildings were looked at such as possibilities of road surface, noise protection and/ or architecture and design of buildings. Traffic management solutions were proposed regarding speed reduction, influencing traffic flow, restrictive measures, limiting transport demand and improvements in the vehicle fleet.

Based on the research into urban freight transport, a proposal for an optimal goods distribution system for the city was developed through analyses of the need for urban freight transport, its relations to the flow of goods and a survey of different distribution systems. The costs and benefits of distribution centres and freight villages were compared.

Solutions to reduce noise in the most affected areas in the city with high degree of freight transport were recommended and the action plan for improvements was compiled. Based on the findings, goods distribution scheme suitable for the city was developed and implemented into the SUTP of Ústí nad Labem.

B Measure implementation

B1 Innovative aspects

- **New organisational arrangements or relationship** – by means of a traffic model of the city, noise emissions were calculated and most polluted areas were treated, particularly residential areas, schools and hospitals. Specific organisational schemes for personal vehicles and for freight vehicles were proposed and assessed.
- **New physical infrastructure solutions** – a ring road bypassing the city centre was designed to lead unnecessary traffic and freight vehicles away from sensitive areas in the city centre. A complex of bypasses was proposed but had to be removed from the SUTP due to the pressure of a civil association "Stop the Tunnels", which protested against building new transport infrastructure in the city. Current political authorities in the city refuse this solution and it currently had to be removed from the SUTP in order to allow the document to be submitted for approval in the city.

B2 Research and Technology Development

The traffic planning software PHF-VISION from the company PHF Karlsruhe was used for development of the traffic model to calculate the traffic load for various scenarios.

The traffic model was based on following documents:

- National traffic census (2005)
- Directional survey on border crossings (2005)
- Timetable for construction work on highways and expressways in the Czech Republic
- Statistical lexicon of Municipalities in the Czech Republic (2005)
- Results of the traffic survey and noise measurements conducted by the processor (2009)
- Regulatory plan of Ústí nad Labem (2005)

The input data were: division of the area into individual zones, demographic and activity information for each zone, transport behaviour patterns of homogeneous groups of inhabitants, decision-making algorithms, offer of the transport network and offer of transport services.

The output data are matrixes of traffic volumes divided into three categories: personal vehicles, light trucks (less than 3.5 tonnes) and other freight vehicles (above 3.5 tonnes).

Based on the data, transport demand was calculated and transport demand matrixes were matched to the appropriate parameterised transport network. The matching was dependent on load capacity, iterative steps, defined network nodes and lines, length, category, capacity, initial speed, intersections, allowed movements and length of delay.

Differences in the burden of the road network for different scenarios and different time periods were identified. The final output was the annual average daily traffic intensity on the network (AADT).

The list of noise maps developed within the measure is the following:

1) Current state

- Level of noise emissions on the current road network in Ústí nad Labem (2009) – day-time (6 a.m. - 10 p.m.)
- Level of noise emissions on the current road network in Ústí nad Labem (2009) – night-time (10 p.m. - 6 a.m.)

2) Model scenarios

- Traffic noise emissions – Zero scenario for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Zero scenario for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario A for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario A for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario B for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario B for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario C for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario C for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario D for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario D for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario E for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario E for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario F for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario F for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Traffic noise emissions – Scenario G for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Traffic noise emissions – Scenario G for the year 2012 – night-time (10 p.m. - 6 a.m.)
- Difference in noise emissions between the Zero scenario and the scenario A for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario B for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario C for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario D for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario E for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario F for the year 2012 – day-time (6 a.m. - 10 p.m.)
- Difference in noise emissions between the Zero scenario and the scenario G for the year 2012 – day-time (6 a.m. - 10 p.m.)

The road network model was based on the model of private vehicles in the Czech Republic calculated to the level of 3rd class roads, including roads of European importance abroad. This model is continuously updated and used for the needs of local authorities.

The traffic model was used to simulate the current state of transport and the foreseen future state of the traffic load. The input data corresponded with the Regulatory plan of the city from the year 2005.

Noise emissions were calculated on a model using the software VISUM and the module Environment. Calculations were based on the German standard RLS-90 (Richtlinien für den Lärmschutz an Straßen).

The input data were:

1) The standard hourly traffic volume counted as a percentage of 24-hour model volume
2) Proportion of trucks
3) Type of road surface
4) Speed of traffic flow
5) Longitudinal gradient of the road

Problems related to noise emissions in the city were identified. Noise reducing model solutions were developed in 7 scenarios. These solutions involved proposals to construct specific bypasses, implement speed reduction by 10% and exclude freight transport from certain city parts. (For more details on model solutions, please see the section C1.2)

Furthermore, organisational and technical solutions for noise protection suitable for Ústí nad Labem were identified. This includes application of greenery, noise walls, speed reduction, constructional changes on roads, road surface, road profile, renewal of vehicle fleet, avoiding crossroads, noise protection of buildings, traffic management, improvements of traffic flow and modification of transport demand.

Based on the research into urban freight transport, a proposal for an optimal goods distribution system for the city was developed through analyses of the need for urban freight transport, its relations to the flow of goods and a survey of different distribution systems. The costs and benefits of distribution centres and freight villages were compared.

The new concept for goods distribution was analysed based on the existing distribution patterns (origin and destination, time scheme, volumes, periodicity etc.). Findings were processed by the traffic and noise model and evaluated, including economic parameters (vehicle/km), time consumption, traffic volumes and number of affected inhabitants.

Implementation of a goods distribution centre for centralised consolidation and deconsolidation of goods flows was recommended. It should be located on the outskirts by a major route with sufficient capacity (ideally by a highway, railway freight terminal, water container port or freight airport), in order to avoid burden to the urban infrastructure caused by transporting goods from manufacturers/distributors by large vehicles. Supply between the goods distribution centre and the city would be performed by smaller vehicles, which would serve more recipients on a single route, which would minimise number of trips realised in the city. However, such a solution is not currently feasible due to different ways of logistic management of individual businesses and lack of will to cooperate in the market competition.

Establishing goods distribution centres or freight villages revealed not to be effective (higher costs than benefits) and rather complicated for the city due to negligence of local competing companies in mutual distribution logistics.

The proposal instead involves restrictions for freight transport in the city, reasonable charges for entering the city centre and promotion of ecological vehicles (via omissions of fees or subsidies). The solution recommends establishing ecological zones in the city, along with speed reduction where speed limit exceeds 50km/hour in order to reduce noise burden in the city. Specific roads were proposed for excluding freight vehicles completely and suitable bypassing roads were proposed.

B3 Situation before CIVITAS

Ústí nad Labem is located at a railway junction on the important waterway Elbe, and in the near future, it will be fully connected to the major motorway D8 that links Prague with Dresden. As a result, there is a large volume of traffic noise, particularly freight related noise, which the city aims to reduce. The city is an important industrial centre of the region carrying a high degree of freight transport, which contributes to increasing noise levels. The increasing transport intensity contributes to an increasing noise burden for citizens living near main transport corridors.

Current goods distribution in the city is performed individually with no coordination. In the current state, integration of urban logistics in Ústí nad Labem is an issue with many influencing factors. Primarily, the city is a competitive environment. Due to large number of businesses (reception points for supplies) on a relatively small area in the city centre, transport performance of supply vehicles is significant. Each shop and each supplier have their own logistic organisation. In practice, every recipient in the city addresses supply separately, either by own logistics architecture or in combination with transport carried out by distributors. This situation results in a large number of trips performed in the city often by large vehicles serving more reception points. Small operators are supplied with smaller vehicles (light trucks, vans or passenger cars), serving mostly only one recipient and thus increasing number of performed trips. Furthermore, there are traffic flows leading through the centre of Ústí nad Labem, which do not have either source or destination in the territory, nor is utility value added to these goods.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: *(October 2008 – April 2009) – Development of emission noise map from traffic in the city*

The traffic planning software PHF-VISION ® from the company PHF Karlsruhe was used for the development of the traffic model to calculate the traffic load for various scenarios. The noise emissions are calculated on a model using the software VISUM ® and the module Environment. Calculations are based on the German standard RLS-90 (Richtlinien für den Lärmschutz an Straßen).

Calculations were based on the standard hourly traffic volume counted as a percentage of 24-hour model volume, the proportion of trucks, type of road surface, speed of traffic flow and the longitudinal gradient of the road.

The primary output of the noise study was an emission noise map for the existent motor-vehicle traffic (the map for day-time and night-time period). (Please see the noise maps for individual model scenarios in the section C1.2).

Stage 2: *(May 2009 – September 2009) Identification of traffic noise related problems*

Based on the emission noise map, major problems related to traffic noise in the city were revealed. The noise maps were compared with demographic distribution of inhabitants in individual city zones. Roads with the highest noise burden were identified.

The motorway, as the strongest source of noise emissions on the road network, was assessed. It was presented that it does not have to have a negative impact on the citizens if it is situated in a proper distance from the residential areas and the noise is properly prevented.

Major problems present local roads leading directly through the residential areas or in their close distance, where traffic is realised partially by vehicles of residents themselves and its volume is difficult to reduce.

Potential was revealed in reducing the transit traffic and the freight traffic. Other technical and organisational solutions were proposed, such as speed reduction, implementation of one-way roads, improvements to a road surface etc.

Stage 3: *(October 2009 – April 2010) – Development of scenarios for traffic noise reduction and their assessment*

Based on identified noise burden and traffic noise related problems, noise reducing model solutions were developed in 7 scenarios. These solutions involved proposals to construct city bypasses, implement speed reduction by 10% and exclude freight transport from certain city parts.

Furthermore, organisational and technical solutions for noise protection suitable for the city were identified. This include application of greenery, noise walls, speed reduction, constructional changes on roads, road surface, road profile, renewal of vehicle fleet, avoiding crossroads, noise protection of buildings, traffic management, improvements of traffic flow and modification of transport demand.

Stage 4: *(May 2010 – April 2011) – Application of noise maps on freight transport in the city, development of goods distribution scheme*

Measures regulating freight transport and minimising negative impacts of freight related noise on city inhabitants were examined through transport planning, modifications of road line and transverse profile, technical construction solutions for roads and buildings, including possibilities of road surface, noise protection and/ or architecture and design of buildings. Traffic management solutions were proposed involving speed reduction, influencing traffic flow, restrictive measures, limiting transport demand and improvements in the vehicle fleet.

Based on the research into urban freight transport, a proposal for an optimal goods distribution system for the city was developed through analyses of the need for urban freight transport, its relations to the flow of goods and a survey of different distribution systems. The costs and benefits of distribution centres and freight villages were compared.

Stage 5: *(May 2011 – October 2011) – Development of action plans for noise reduction and freight distribution for the SUTP of Ústí nad Labem*

Solution for noise reduction and urban logistics dealing with traffic organisation and infrastructure changes, together with addressing the entire problem of city motor transport, were incorporated into the SUTP with the objectives to reduce traffic noise and limit number of trips performed in the central area, excluding all unnecessary trips without its source or destination in the area, which does not bring any benefit to the territory. For this traffic load, alternative route was proposed in terms of a city ring road bypassing the city centre and involving tunnel section and construction of two new bridges over the Elbe river. This most effective solution was not accepted by current city authorities and was removed from the SUTP of Ústí nad Labem. It currently remains only a theoretical solution.

Additional solutions regulating traffic in the city, lowering the noise burden and discouraging drivers from entering the area were proposed, such as implementation of a system of one-way roads, speed reduction, access restriction to public transport only, etc.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **Task 11.8.9, SUTP development** – The important tool for noise reduction and goods transport optimisation system were based on the proposal of new infrastructure, which were included in the SUTP.
- **Measure 26, Strategic Traffic Management** – Traffic management is one of the effective tools for noise reduction and efficient freight logistics in the city in terms of optimising traffic flow, decreasing the amount of pollution and establishing background for goods distribution.
- **Measure 27, City Centre Access Control** – Regulating entrance to the city centre helps to protect sensitive areas in the city from excessive noise from traffic.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1.1: Indicators

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	ECONOMY					
2a		**Costs**	Operation costs	Operation costs	Costs per pkm	Euros/pkm, quantitative, derived or measurement
2b		**Costs**	Capital Costs	Capital Costs	Total investment cost for the scenario	Euros per project
2c		**Costs**	Maintenance Costs	Maintenance Costs	Total maintenance cost for the CBA period	Euros per period, discounted
	ENVIRONMENT					
		Pollution/Nuisance	Noise	Noise impact	Population impacted by noise above level	Euros per noise level – number of affected inhabitants – modelled + survey
		Pollution/Nuisance	Noise	Noise level	Computed noise levels in various scenarios	quantitative, collected, derived
8		**Pollution/Nuisance**	Emissions	CO2 emissions	CO2 per modelled scenario	Kg (tons), quantitative
9		**Pollution/Nuisance**	Emissions	CO emissions	CO per modelled scenario	Kg (tons), quantitative
10		**Pollution/Nuisance**	Emissions	NOX emissions	NOX per modelled scenario	Kg (tons), quantitative
11		**Pollution/Nuisance**	Emissions	Particulate emissions	Particulate per modelled scenario	Kg (tons), quantitative
	TRANSPORT					
25		**TRANSPORT SYSTEM**	Freight Movements	Goods vehicles moving in demo areas	Daily number of goods vehicles moving in area	No, Quantitative, derived or measurement

Table C1. 1. 2: Method for evaluation of indicators

NO.	INDICATOR	TARGET VALUE	SOURCE OF DATA AND METHODS	FREQUENCY OF DATA COLLECTION
2a	Total operation costs	+ 5 %	Traffic model of basic ZERO scenario compared to scenarios of reduced noise – data collected before and after model implementation – operation costs of all users for evaluated period, discounted	2 x
2b	Capital costs		Evaluation of investment cost for new infrastructure, modifications and proposed regulations	1x
2c	Maintenance costs		Maintenance costs for new infrastructure or regulation tools during the project life	1x
	Noise impact	25 %	Percentage of people affected by traffic noise based on noise model and population distribution; simulation of before and after scenarios	2 x
	Noise level	- 5 %	Noise model – do-nothing scenario compared with pro-active scenario	2 x
8	CO2 emissions	- 5 %	Calculation by traffic model + environmental calculation modul PHF	2x
9	CO emissions	- 5 %	Calculation by traffic model + environmental calculation modul PHF	2x
10	NOX emissions	- 5 %	Calculation by traffic model + environmental calculation modul PHF	2x
11	Particulate emissions	- 5 %	Calculation by traffic model + environmental calculation modul PHF	2x
25	Goods vehicles moving in demo areas	- 15 %	Traffic model basic scenario compared to selected pro-active scenarios	2 x

Data for the traffic model were collected from the following sources:

- National traffic census (2005)
- Directional survey on border crossings (2005)
- Timetable for construction work on highways and expressways in the Czech Republic
- Statistical lexicon of Municipalities in the Czech Republic (2005)
- Results of the traffic survey conducted by the processor (2010) – on spot traffic counting on major roads in the city
- The Regulatory plan of Ústí nad Labem (2005)

Data were processed by the traffic planning software PHF-VISION (www.ptv.de) from the company PHF Karlsruhe. Transport demand was modelled by the software VISEM 8.10, transport demand matrixes were matched to the appropriate parameterised transport network by the software VISUM. The noise emissions are calculated by the module Environment of the software VISUM. Calculations are based on the German standard RLS-90 (Richtlinien für den Lärmschutz an Straßen).

C1.2 Establishing a Baseline

Seven specific scenarios for traffic noise reduction were defined, processed through the traffic model and evaluated in terms of their economic (capital, operating and maintenance) costs and benefits in order to find the most effective solutions reducing the noise impact in specific sensitive areas in the city. Proposed scenarios were compared to the do-nothing scenario. Traffic emissions and freight vehicles operating in the city were simulated on the traffic model of Ústí nad Labem.

Proposals for modifications of the transport network were simulated on a macroscopic model of the city to assess overall changes and impacts of specific measures on the entire city. The fundamental principles of the proposals were examined to reveal effectiveness of measures application, without regard to details of the road network (such as width ratio, speed bumps or other infrastructure components). (For more details about the solutions, please see the Archimedes deliverable R28.1 Study of Noise Reduction in Usti nad Labem).

Effectiveness of the following scenarios was evaluated:

Zero Scenario

The Zero Scenario (do-nothing) reflects the existing state, with the current state of transport infrastructure, no changes towards noise reduction and completed structures, which are currently in development (only minor part of the transport network). This scenario serves as a basis for comparison with other options.

(Please see the maps 1.1, 2.1, 2.2, 4.1, 5.1, and 5.2)

Figure C1.2.1 – The existing road network in Ústí nad Labem (year 2009), distinguishing roads by their type

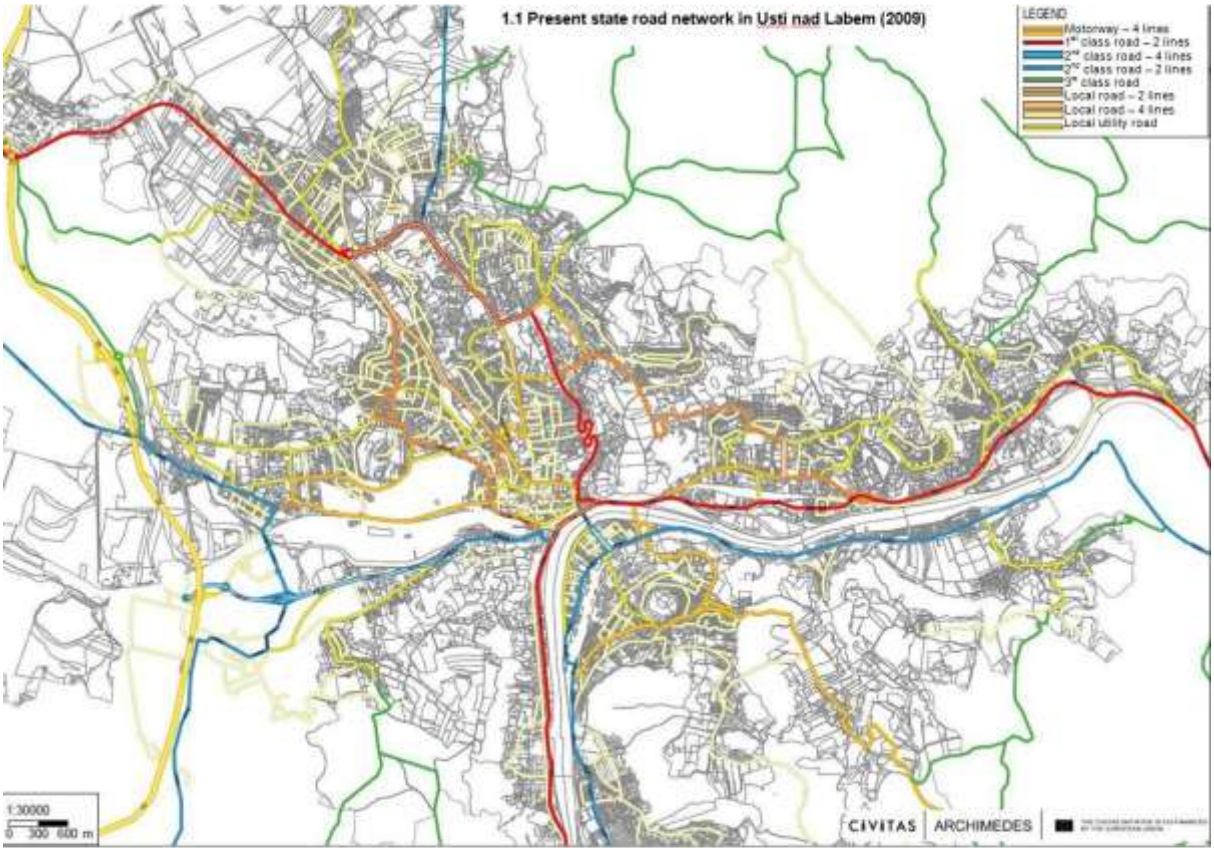


Figure C1.2.2 – Level of traffic noise emissions on the current road network in the city (in 2009) during the day-time period (6am – 10pm)

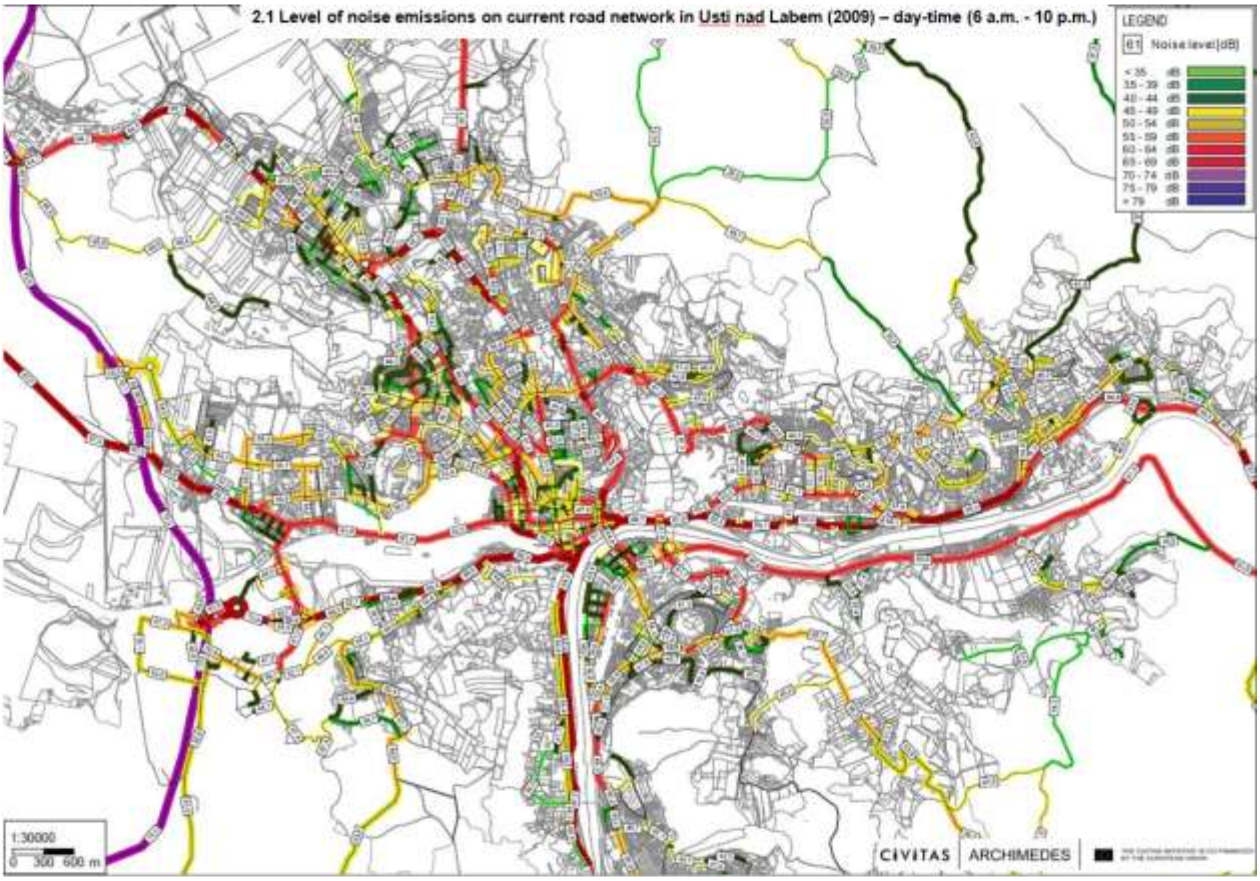


Figure C1.2.3 - Level of traffic noise emissions on the current road network in the city (in 2009) during the night-time period (10pm – 6am)

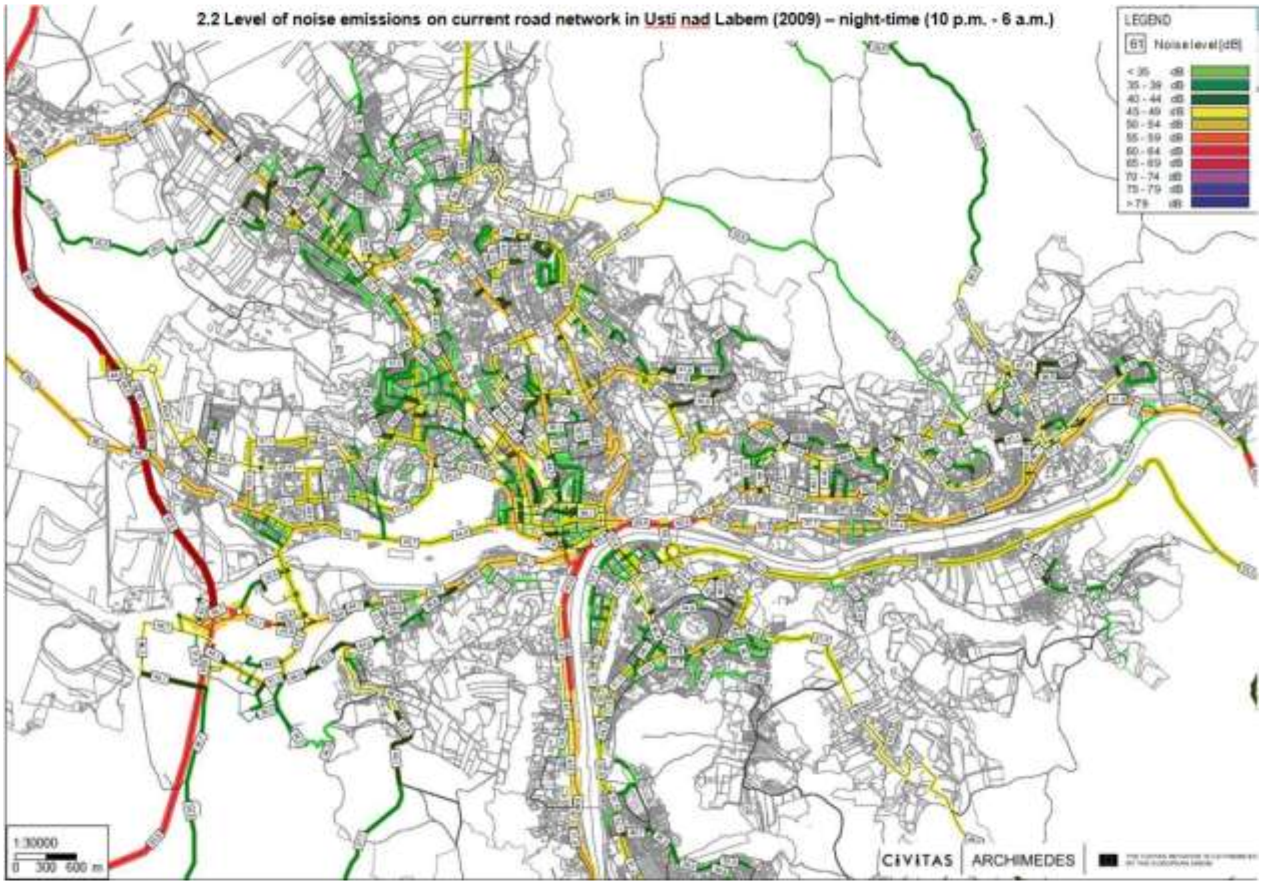


Figure C1.2.4 – The road network in the city considered for the Zero scenario (year 2012)

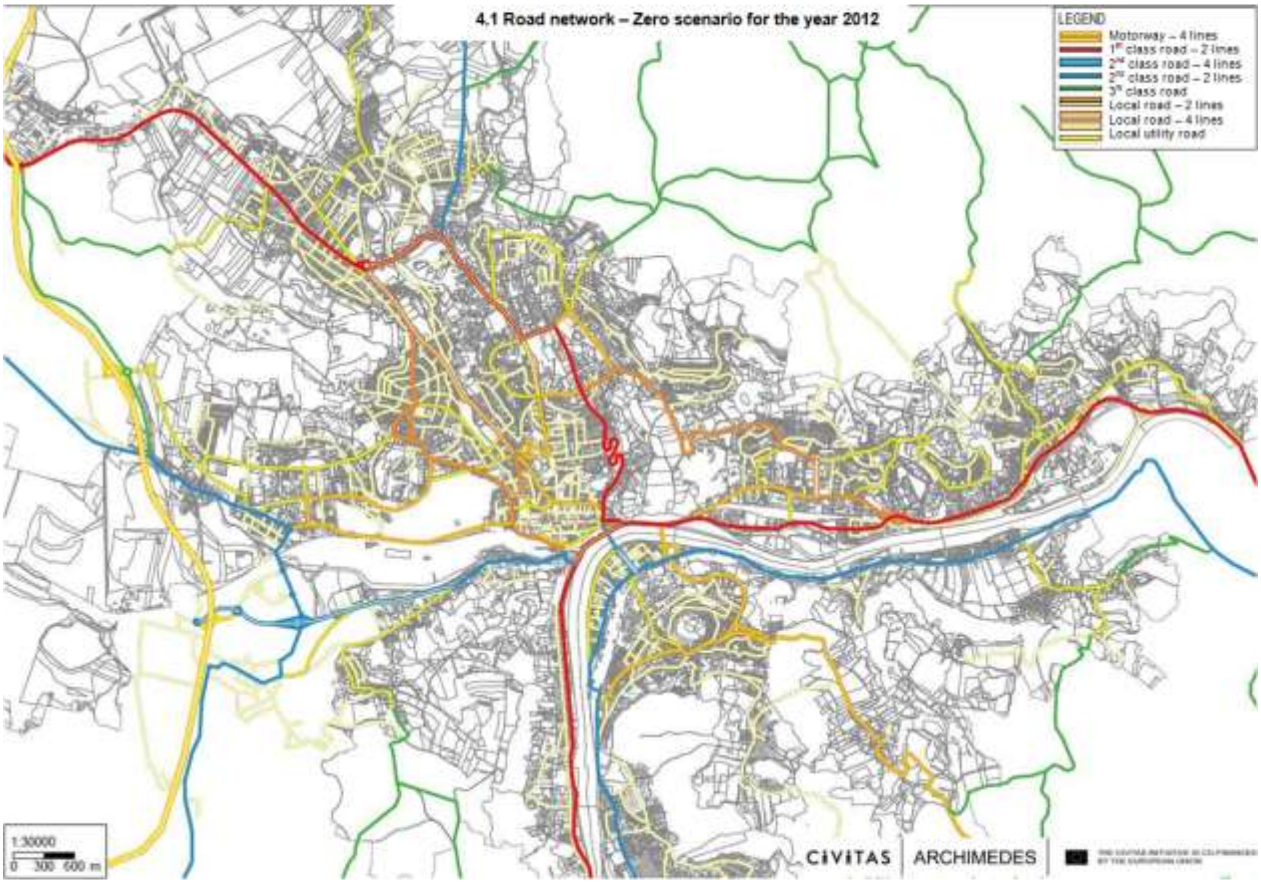


Figure C1.2.5 - Level of traffic noise emissions in the Zero scenario (year 2009) during the day-time period (6am – 10pm)

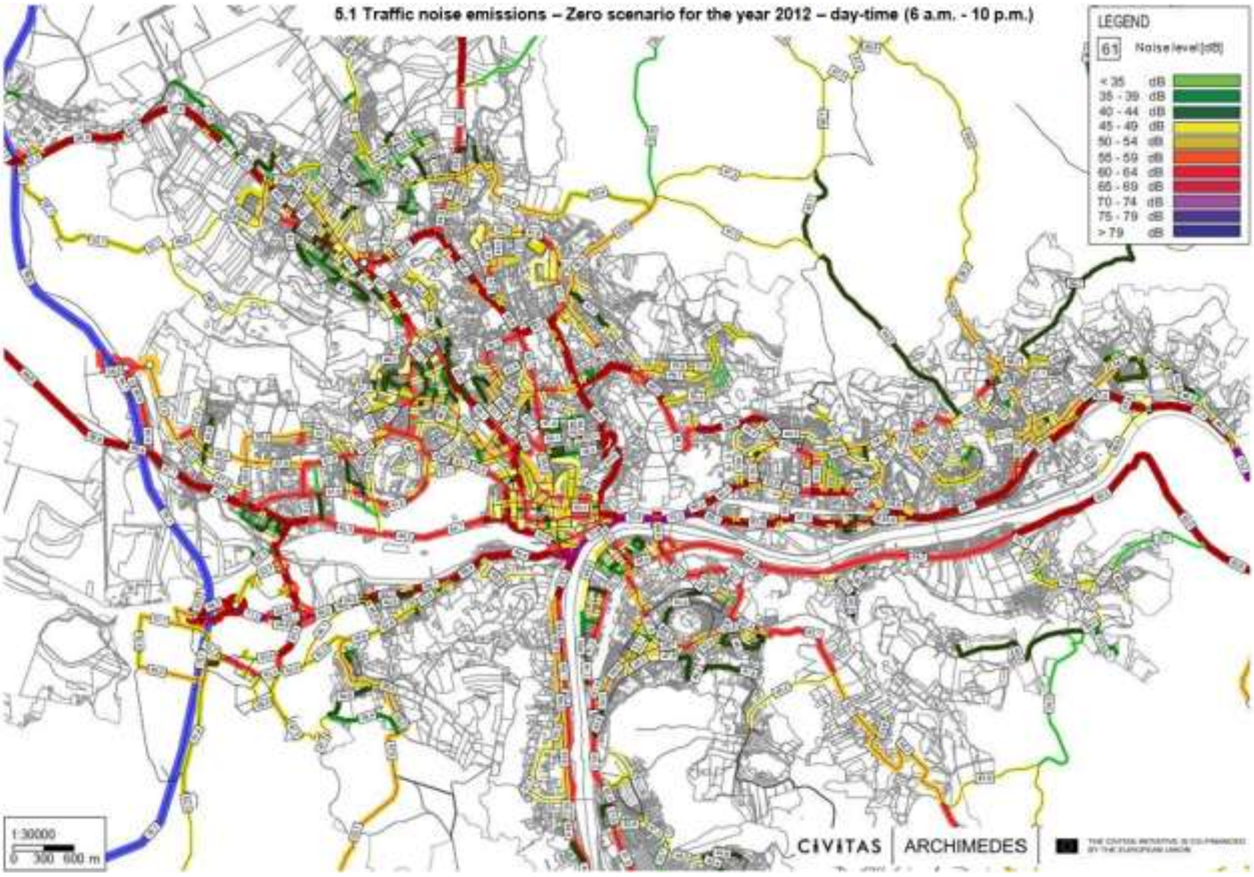
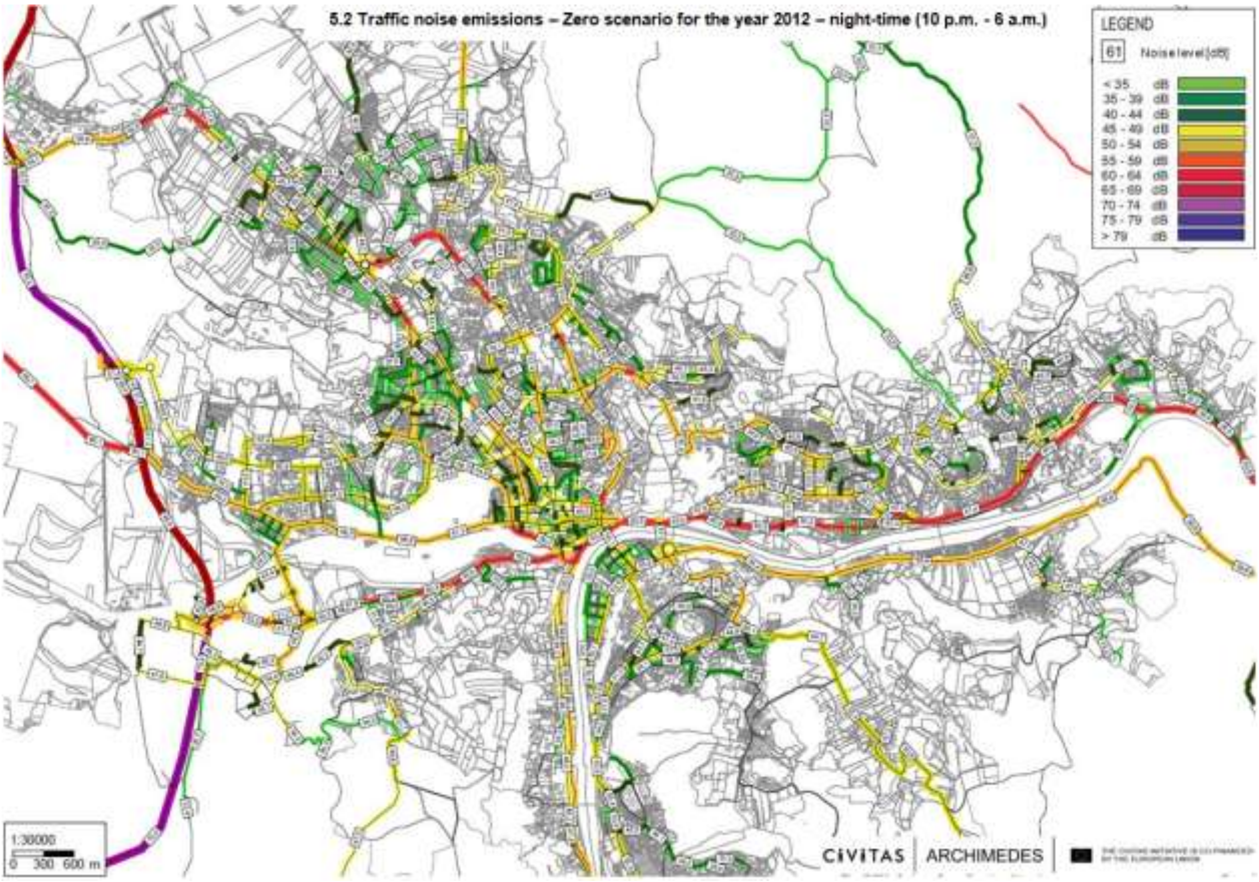


Figure C1.2.6 - Level of traffic noise emissions in the Zero scenario (year 2009) during the day-time period (6am – 10pm)



Scenario A

The scenario is proposing implementation of the southeast bypass between the 2nd class road number 261 (Litoměřická) and the 1st class road number 62 (Vodařská). (Please see the maps 4.2, 5.3, 5.4 and 6.1)

Figure C1.2.7 – The road network in the city considered for the Scenario A (year 2012)

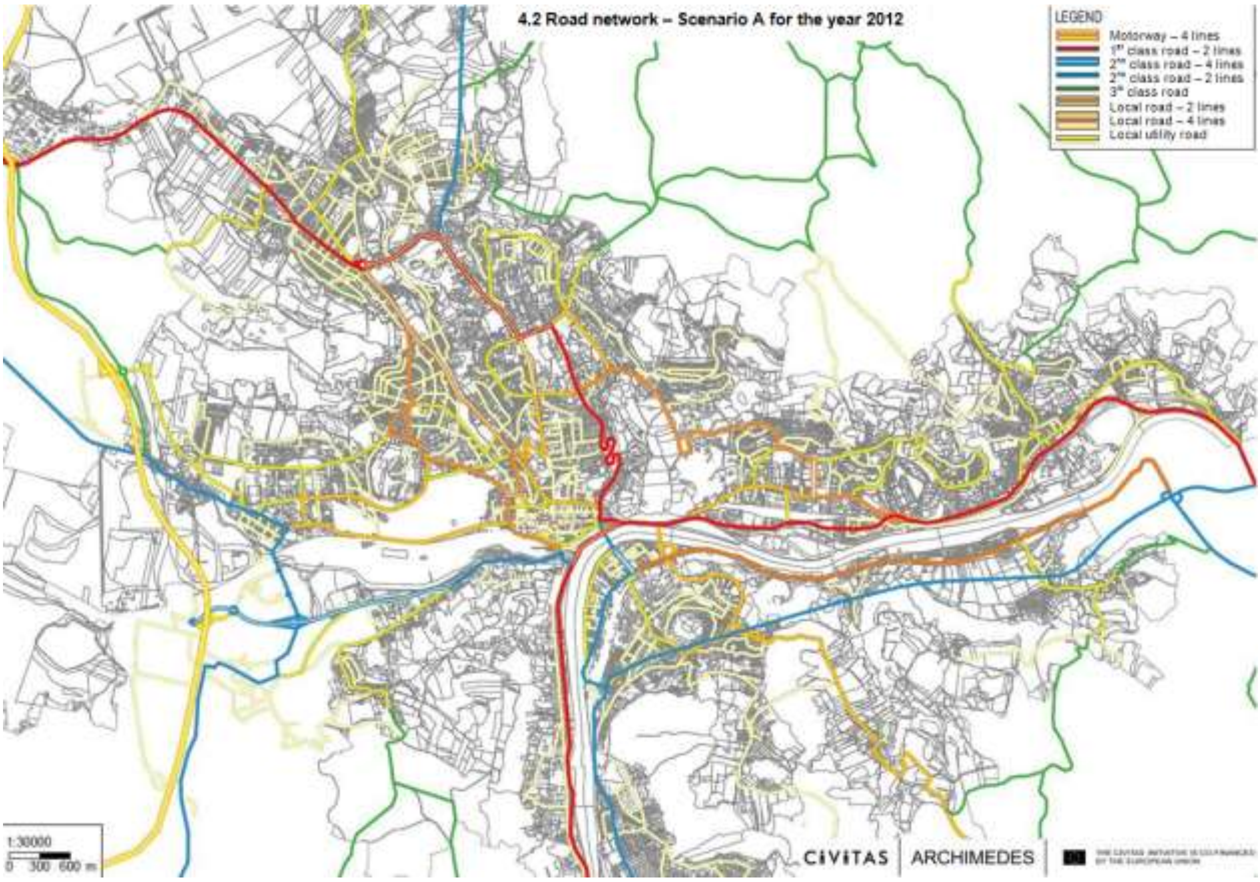


Figure C1.2.8 - Level of traffic noise emissions in the Scenario A in the city (in 2009) during the day-time period (6am – 10pm)

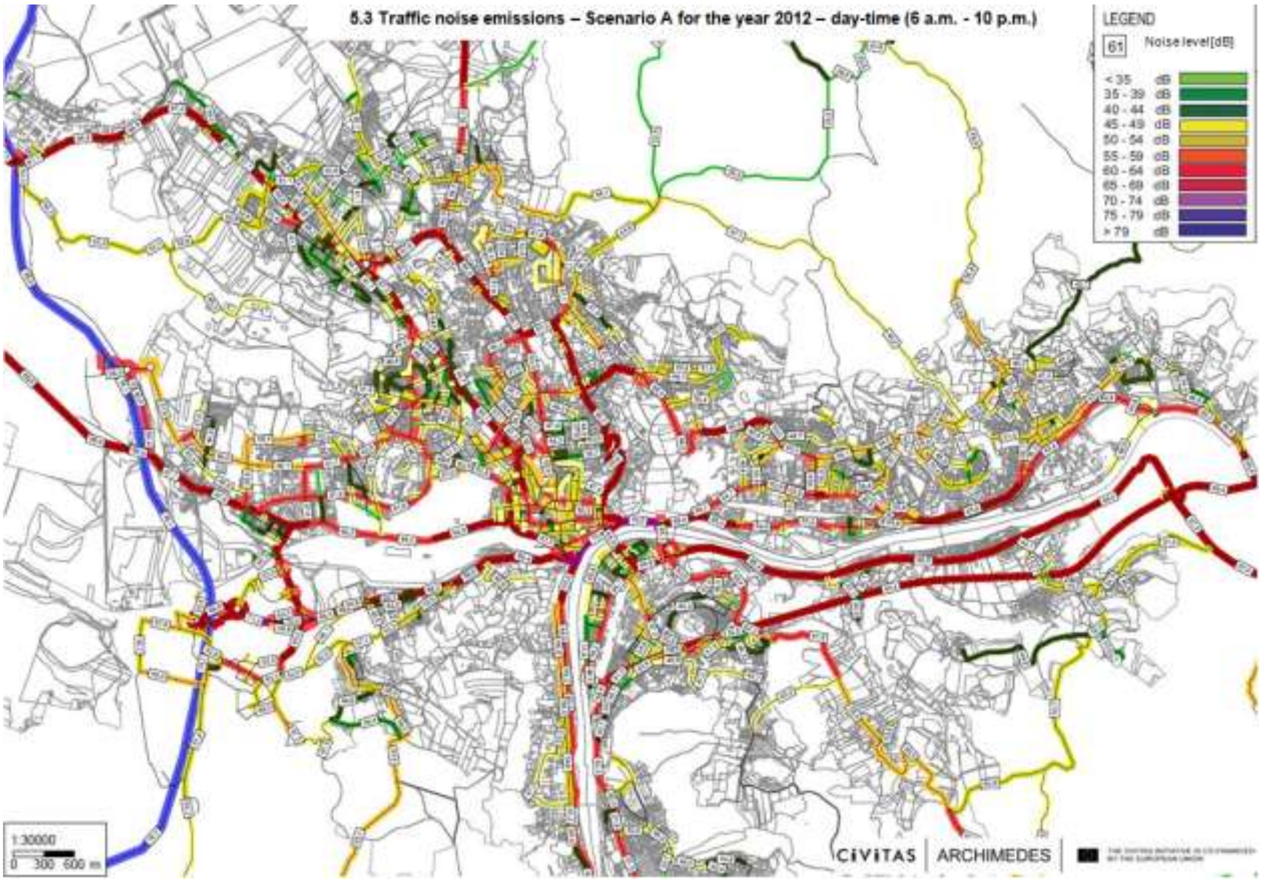


Figure C1.2.9 - Level of traffic noise emissions in the Scenario A in the city (in 2009) during the night-time period (10pm – 6am)

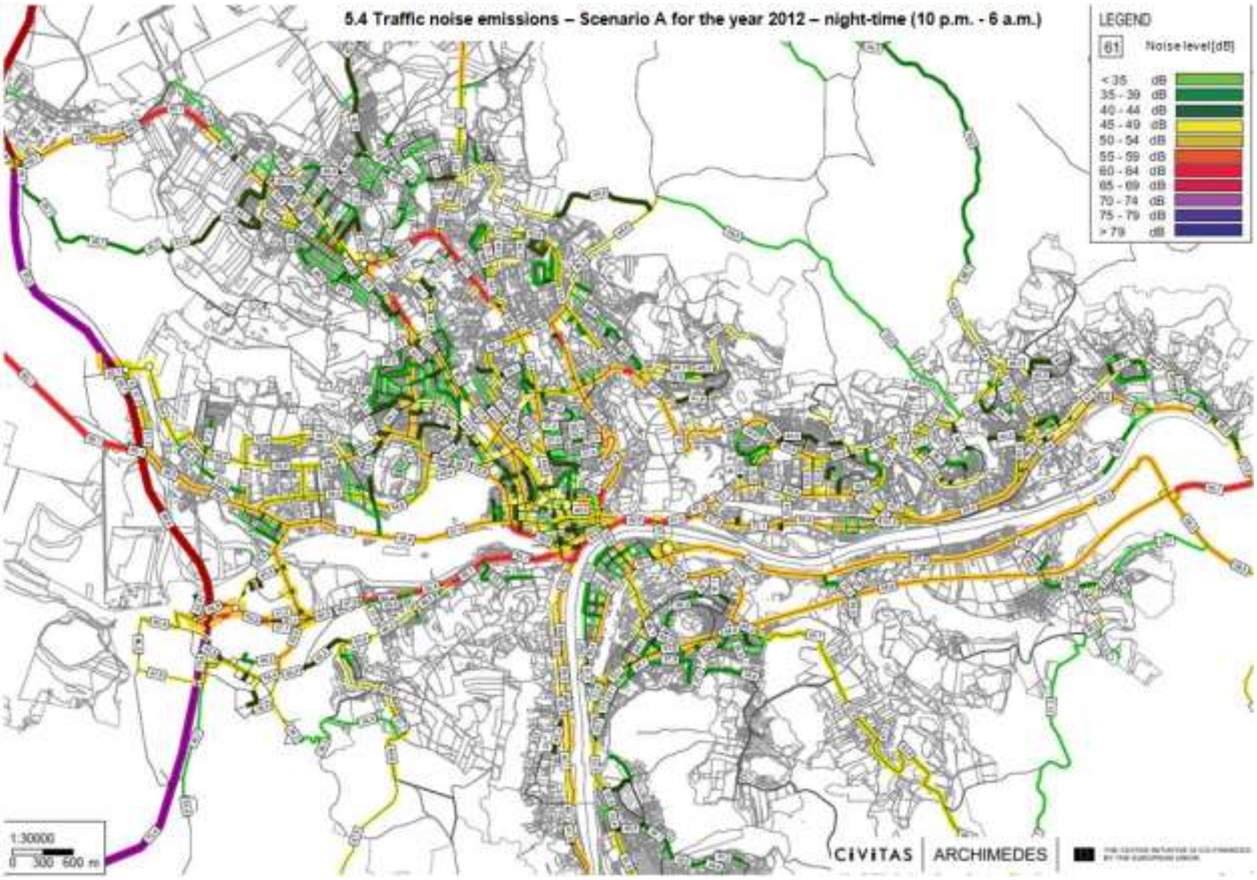
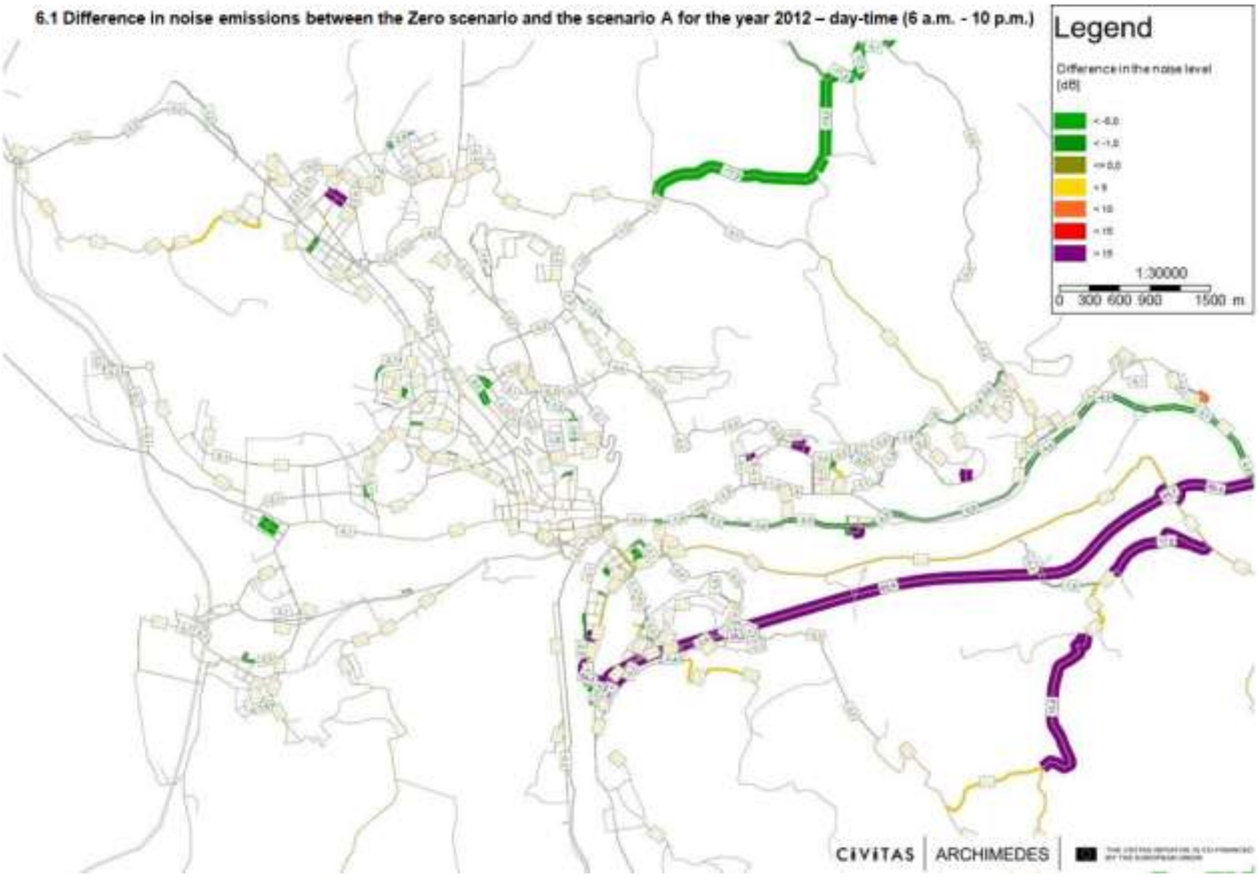


Figure C1.2.10 – Difference in traffic noise emissions between the Zero Scenario and the Scenario A (year 2012) during the day-time (6am – 10pm)



Scenario B

The scenario is proposing implementation of the southwest bypass between the 2nd class road number 261 (Litoměřická) and Jateční Street. (Please see the maps 4.3, 5.5, 5.6, and 6.2)

Figure C1.2.11 - The road network in the city considered for the Scenario B (year 2012)

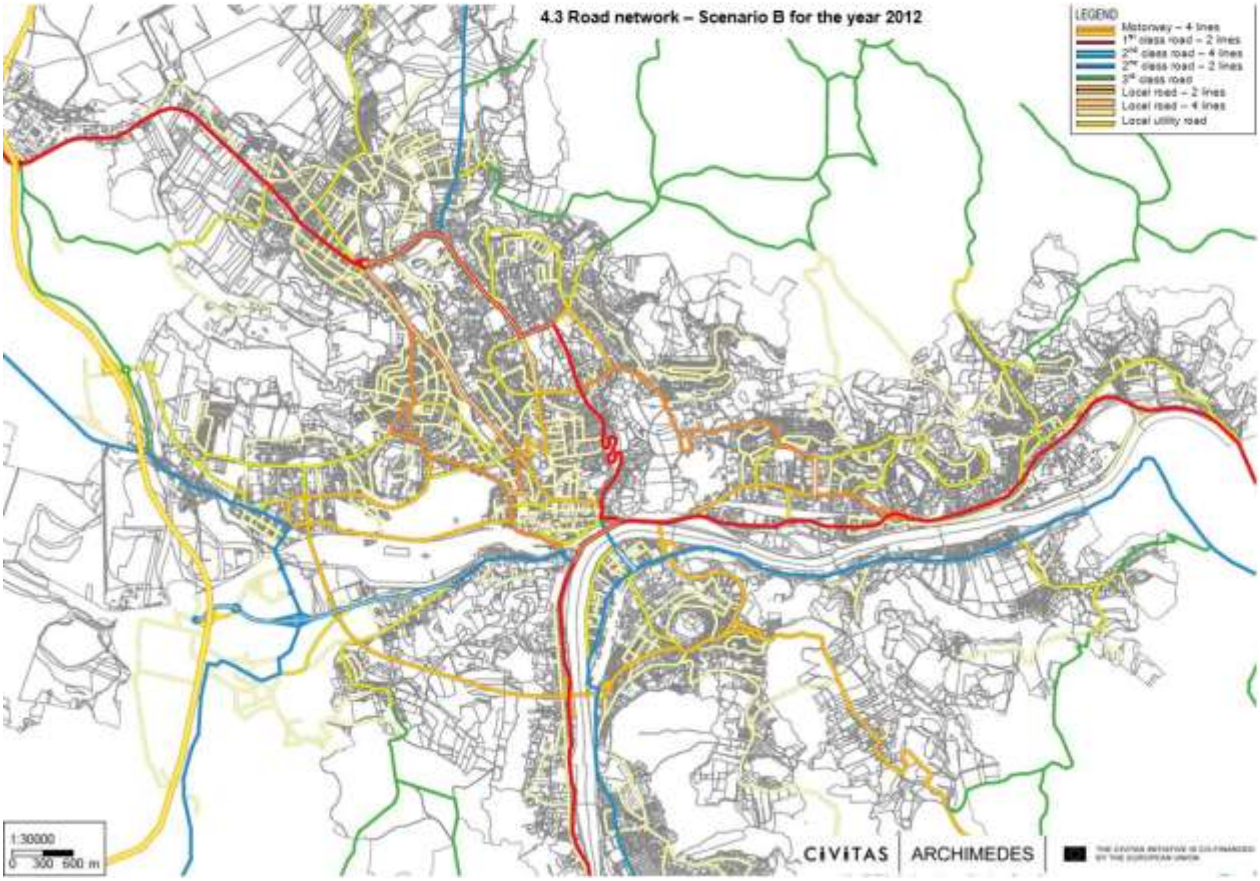


Figure C1.2.12 - Level of traffic noise emissions in the Scenario B in the city (in 2009) during the day-time period (6am – 10pm)

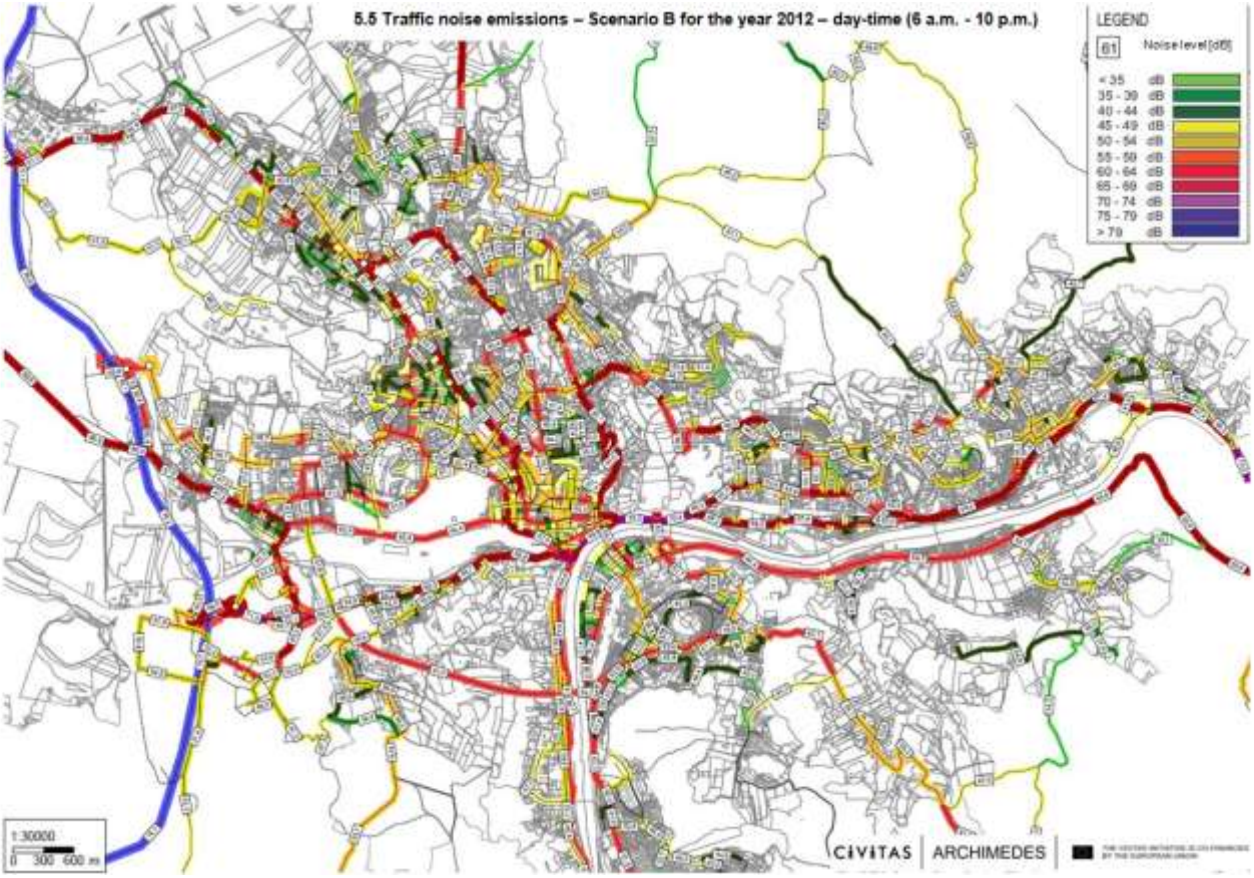


Figure C1.2.13 - Level of traffic noise emissions in the Scenario B in the city (in 2009) during the night-time period (10pm – 6am)

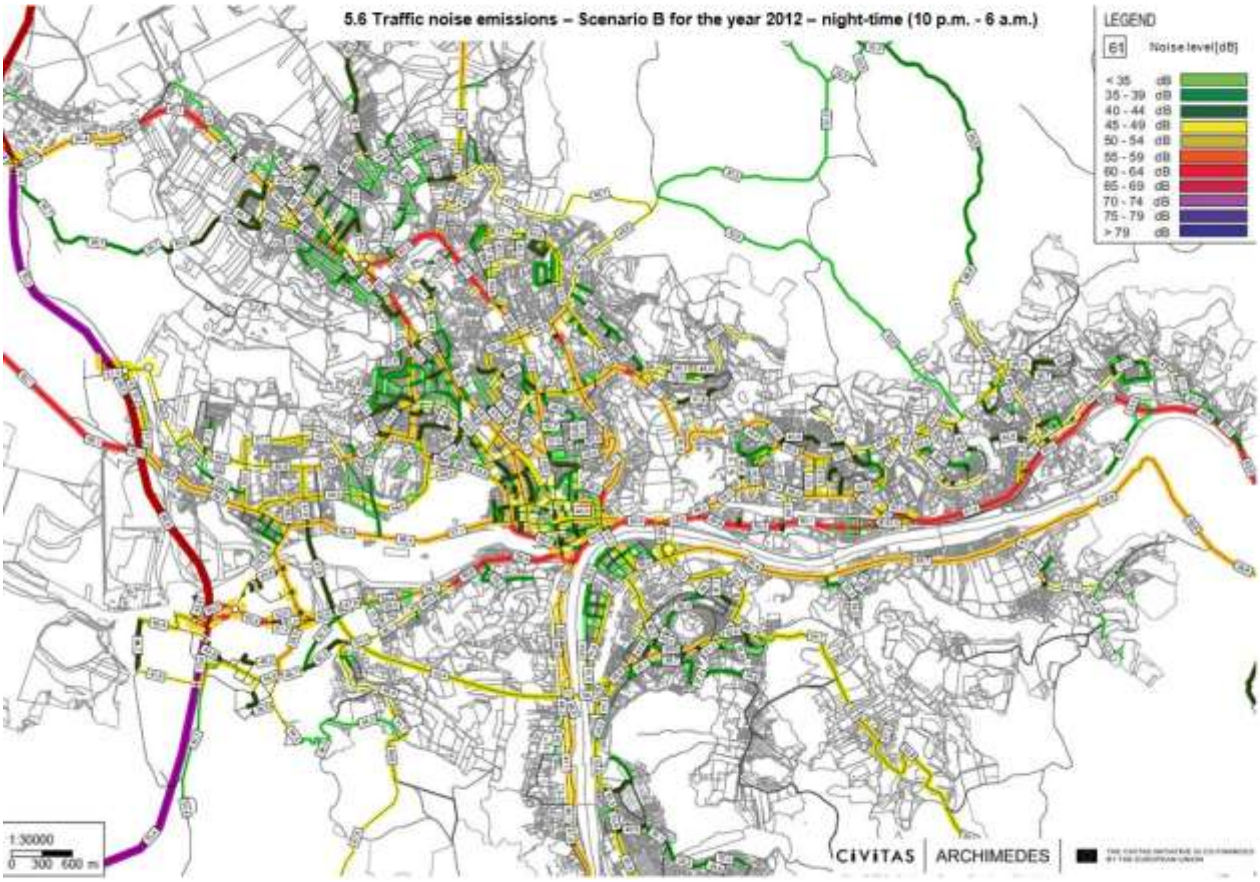
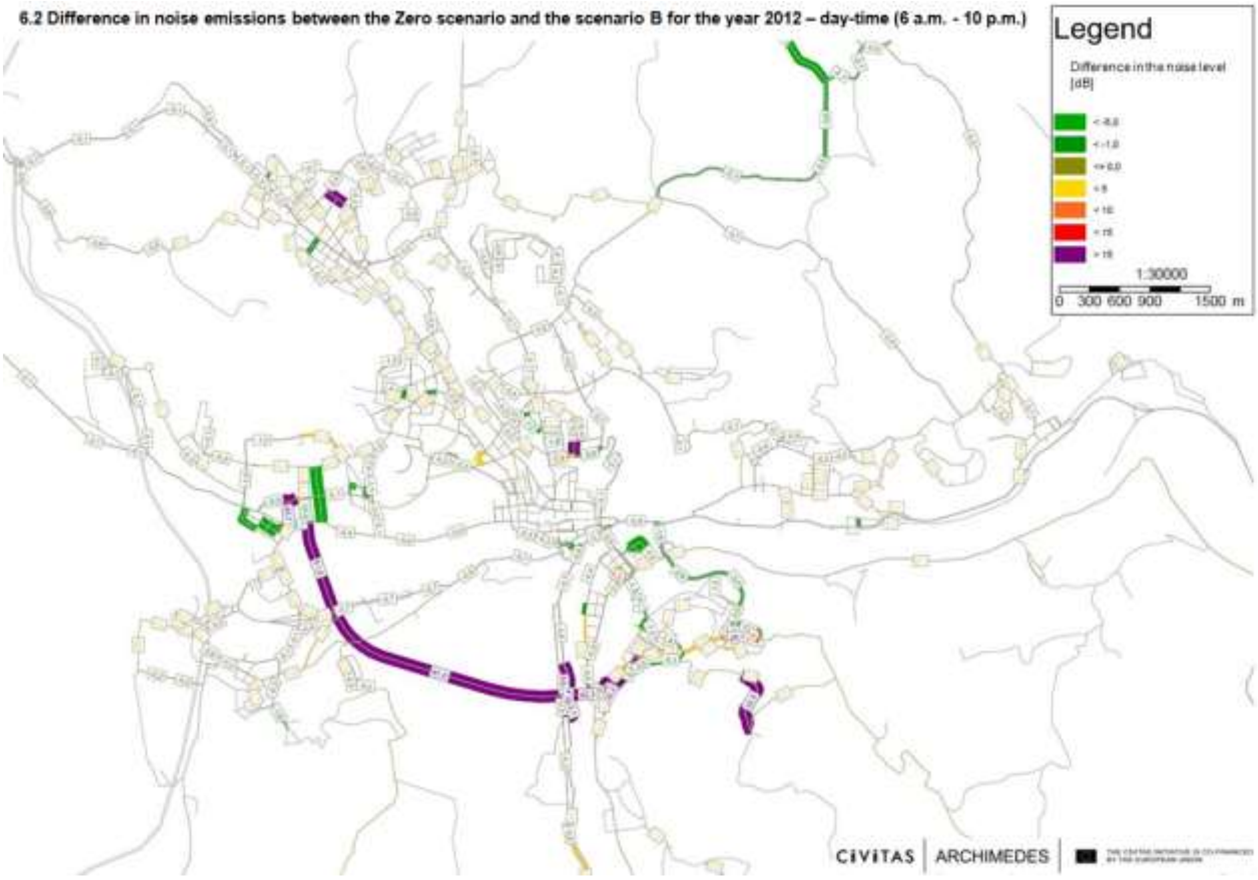


Figure C1.2.14 - Difference in traffic noise emissions between the Zero Scenario and the Scenario B (year 2012) during the day-time (6am – 10pm)



Scenario C

The scenario is proposing implementation of the northeast bypass between the 2nd class road number 528 (Petrovická) and the 1st class road number 62 (Vodařská). (Please see the maps 4.4, 5.7, 5.8 and 6.3)

Figure C1.2.15 - The road network in the city considered for the Scenario C (year 2012)

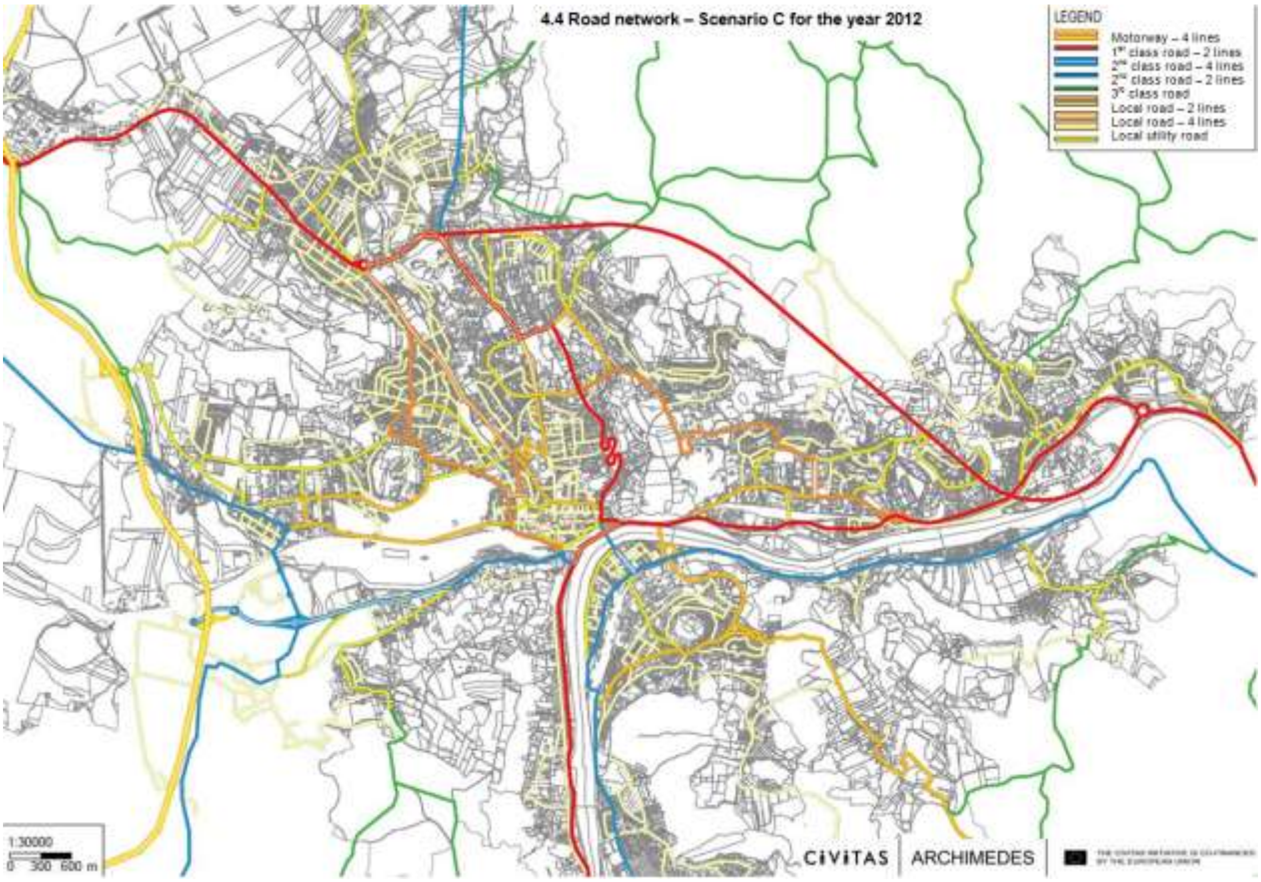


Figure C1.2.16 - Level of traffic noise emissions in the Scenario C in the city (in 2009) during the day-time period (6am – 10pm)

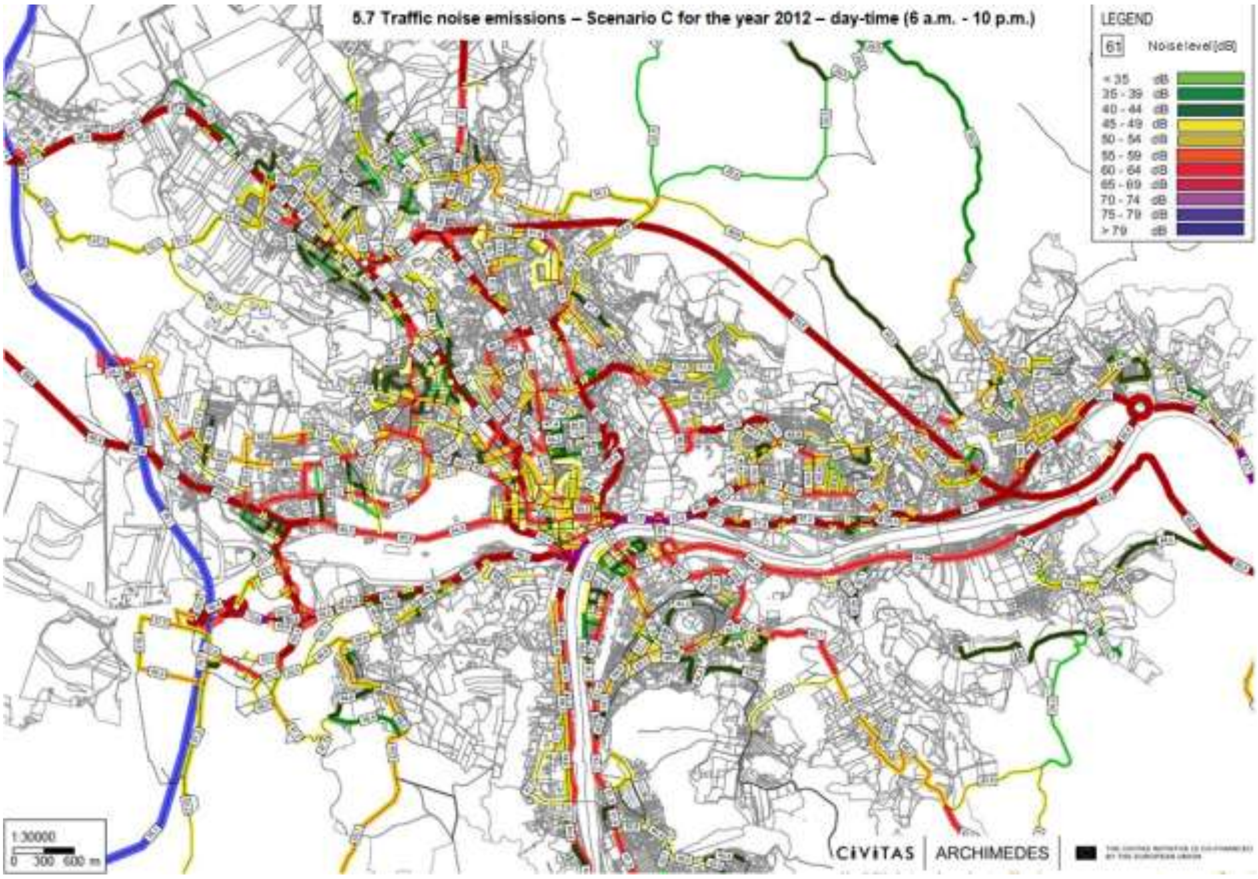


Figure C1.2.17 - Level of traffic noise emissions in the Scenario C in the city (in 2009) during the night-time period (10pm – 6am)

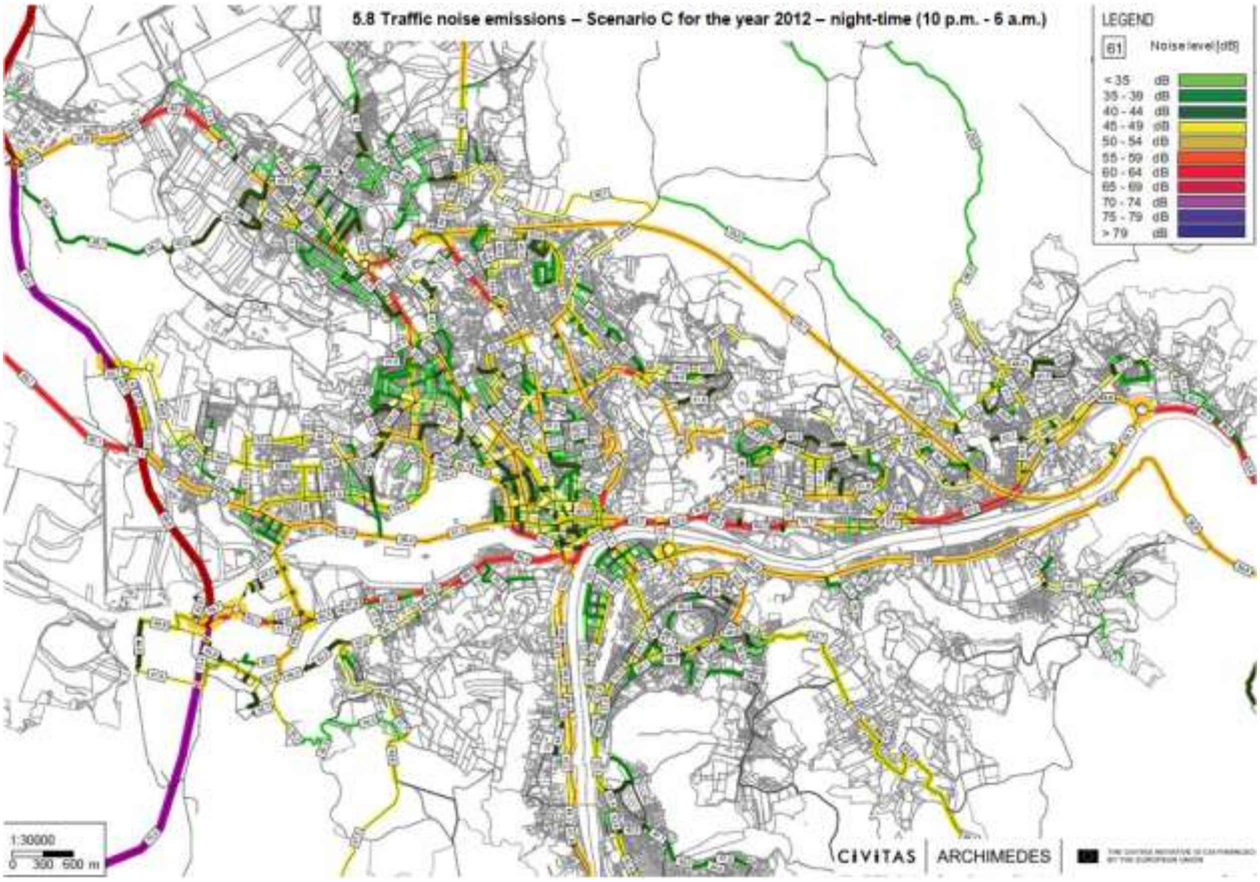
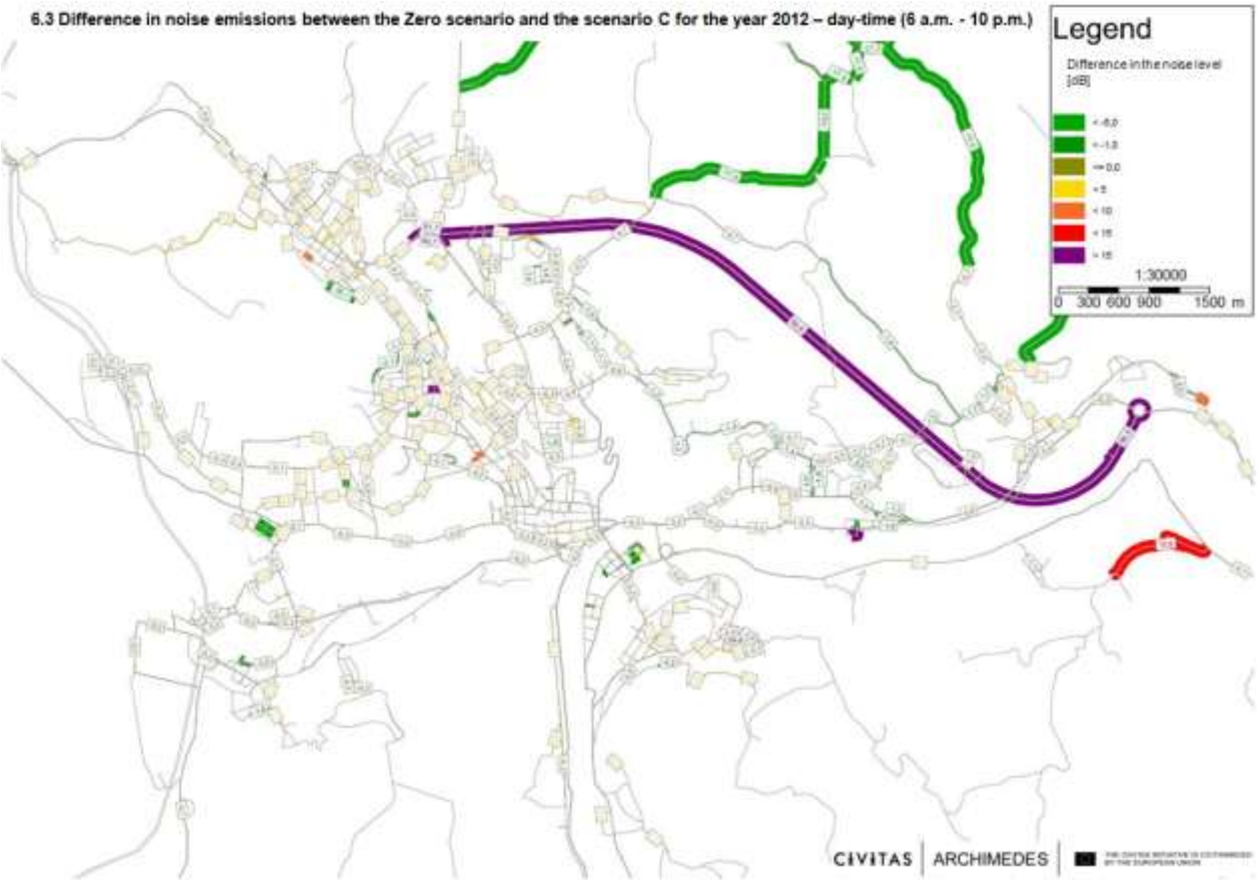


Figure C1.2.18 - Difference in traffic noise emissions between the Zero Scenario and the Scenario C (year 2012) during the day-time (6am – 10pm)



Scenario D

The scenario is considering implementation of the northwest bypass between the streets and Jateční and Božtěšická. (Please see the maps 4.5, 5.9, 5.10, 6.4)

Figure C1.2.19 - The road network in the city considered for the Scenario D (year 2012)

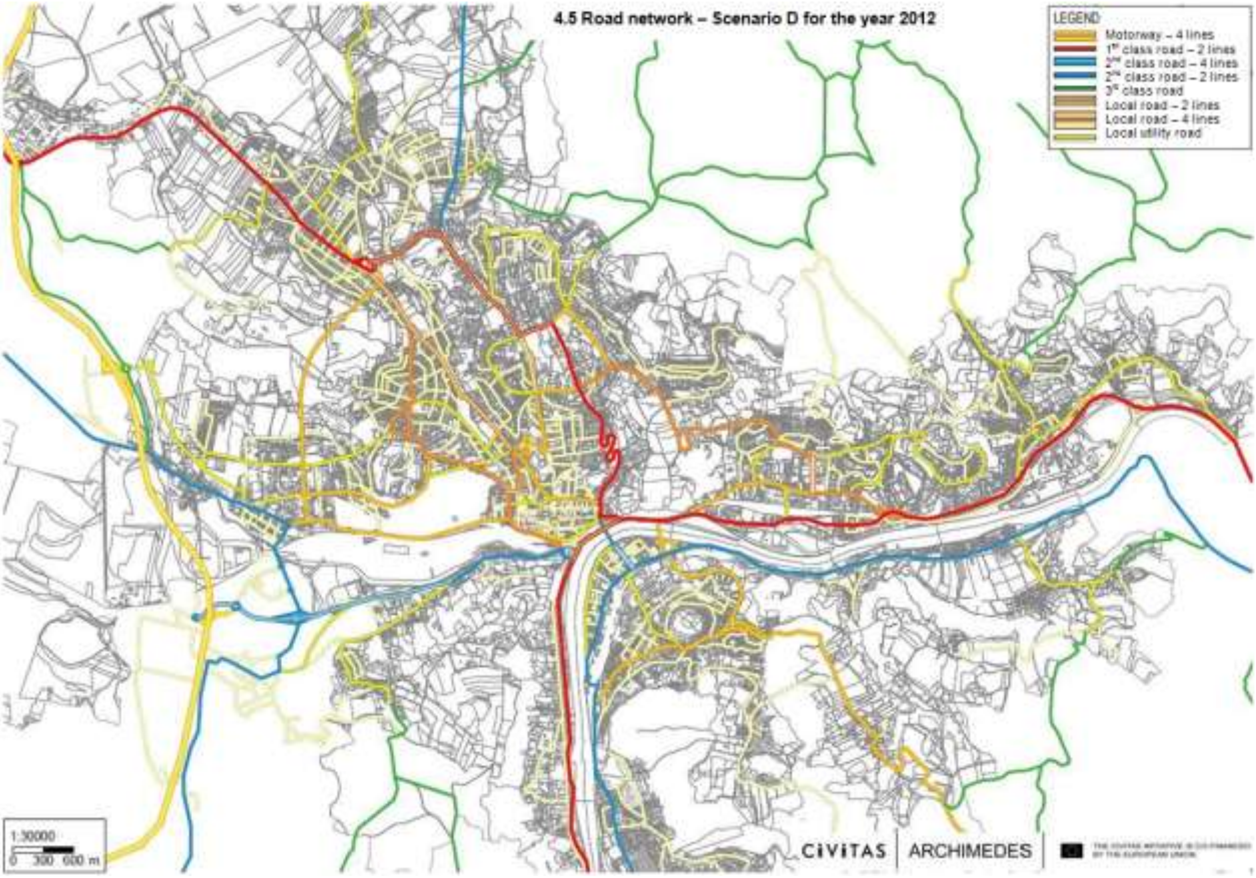


Figure C1.2.20 - Level of traffic noise emissions in the Scenario D in the city (in 2009) during the day-time period (6am – 10pm)

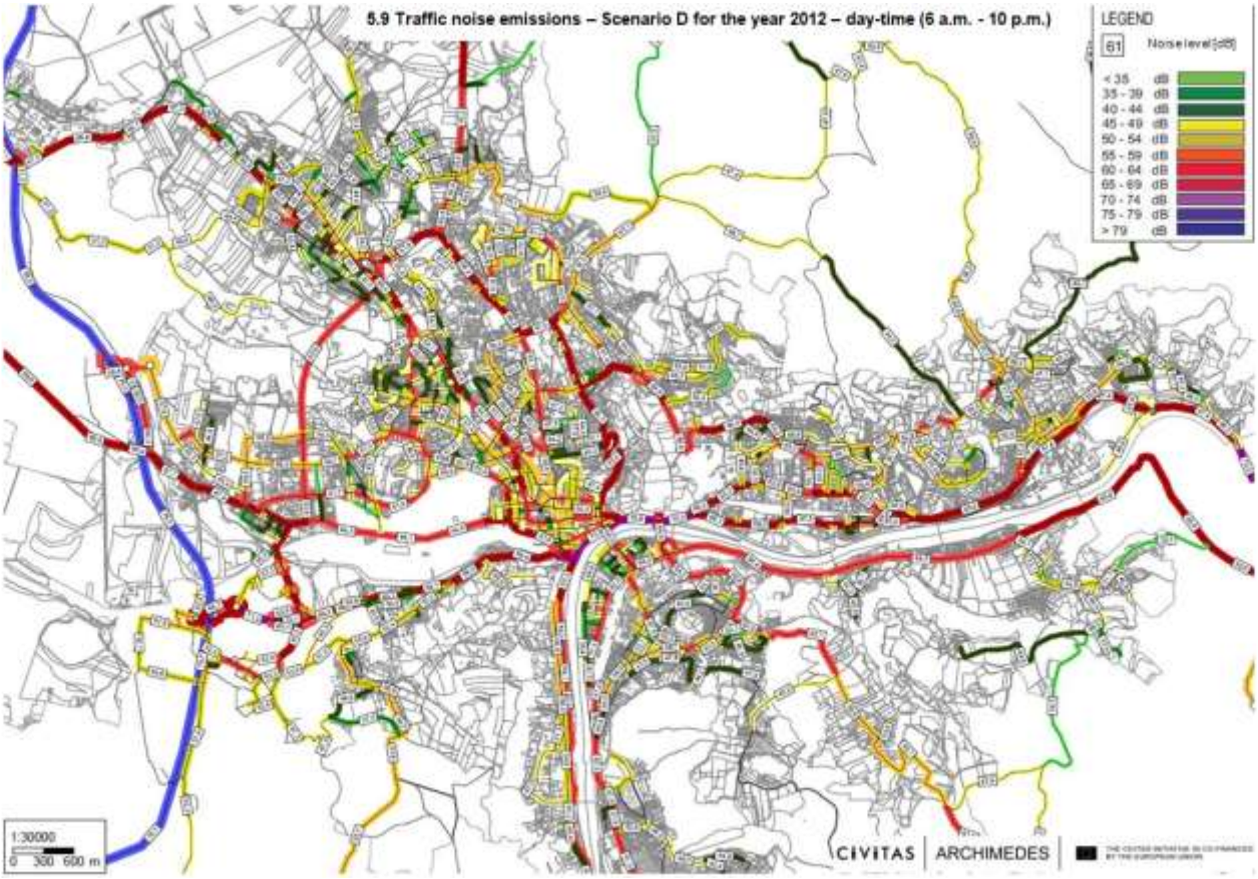


Figure C1.2.21 - Level of traffic noise emissions in the Scenario D in the city (in 2009) during the night-time period (10pm – 6am)

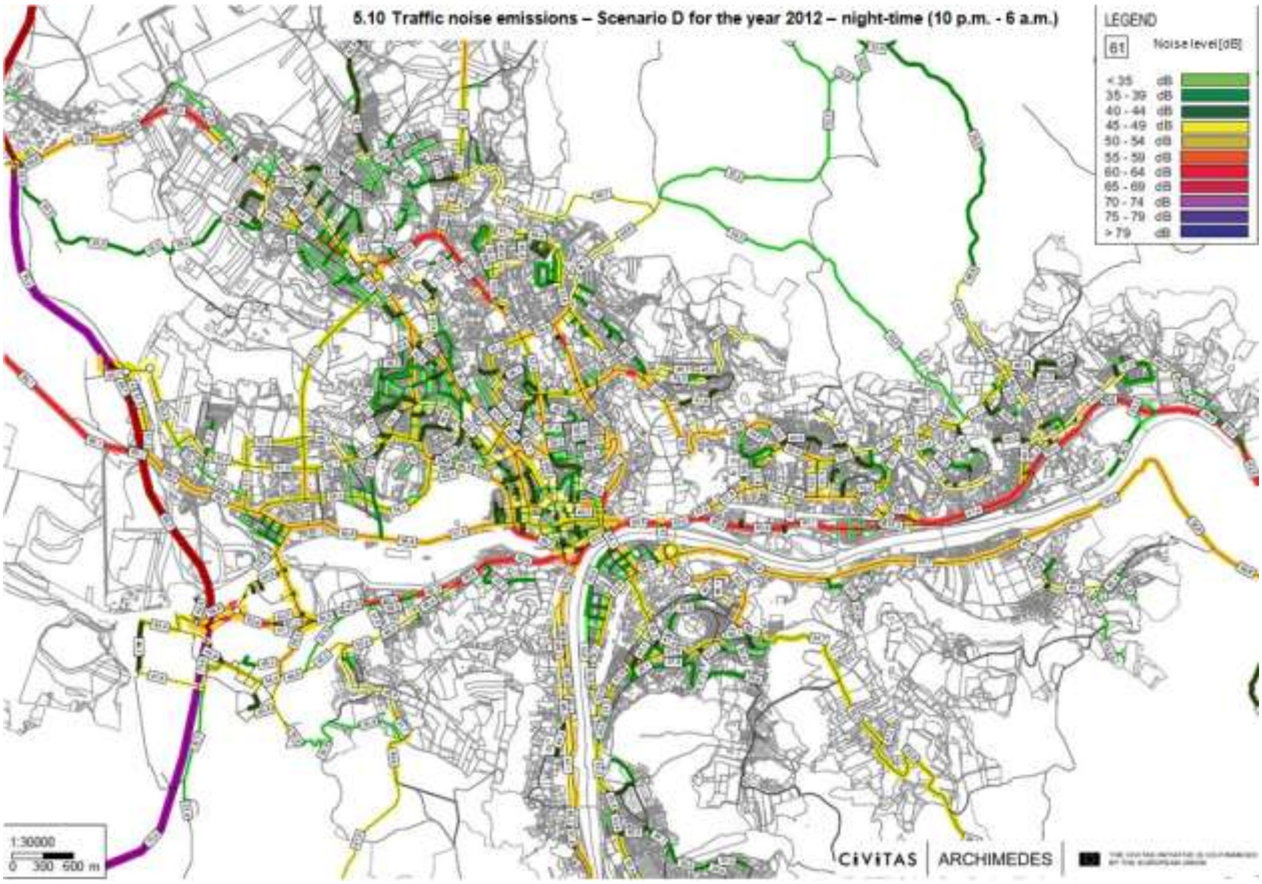
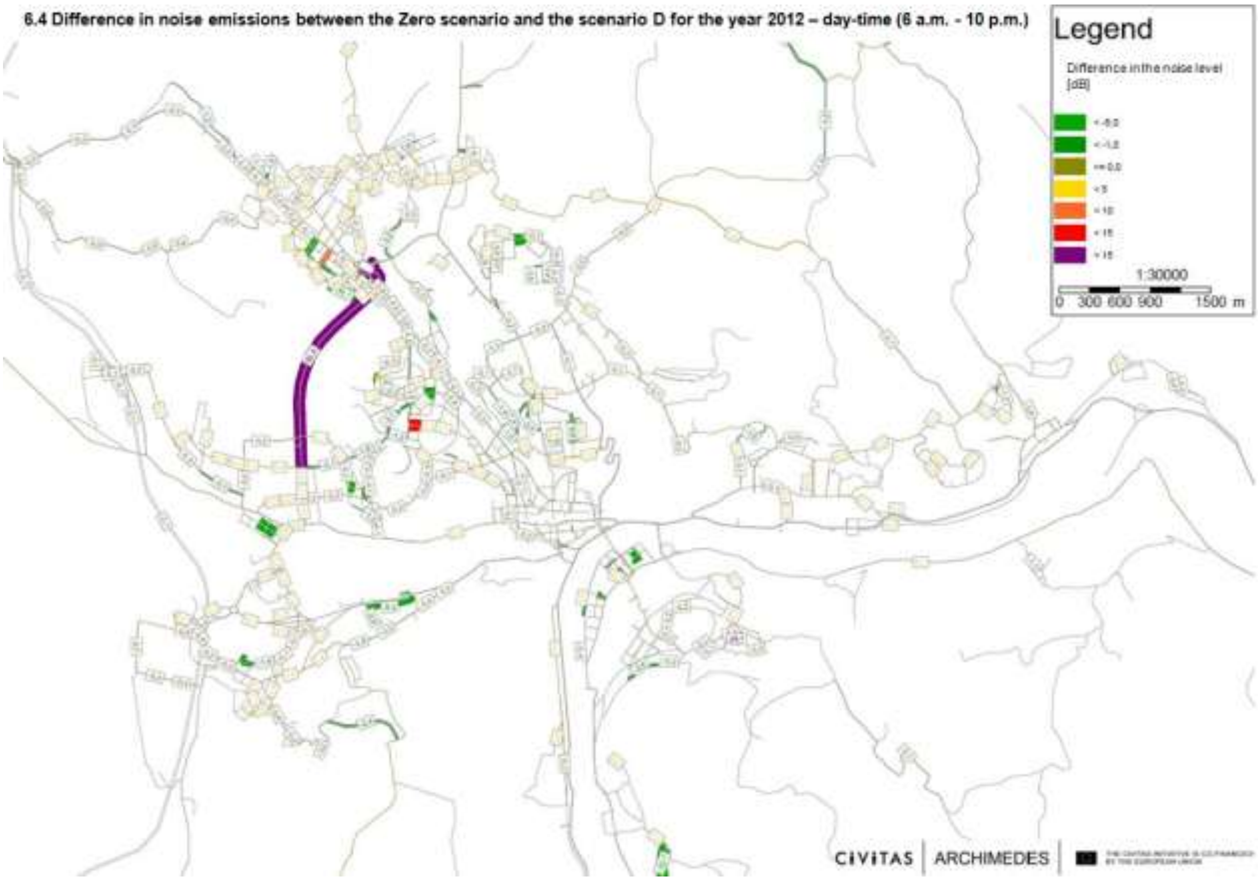


Figure C1.2.22 - Difference in traffic noise emissions between the Zero Scenario and the Scenario D (year 2012) during the day-time (6am – 10pm)



Scenario E

In this scenario, all the bypasses from previous scenarios (A, B, C and D) are implemented. (Please see the maps 4.6, 5.11, 5.12, and 6.5).

The scenario is based on the current state of transport infrastructure with completed structures, which are currently in development, and implemented proposed bypasses. It considers current state of traffic intensities with traffic growth foreseen by the Directorate of Roads and Highways.

This scenario was used for evaluation of measure effects.

Figure C1.2.23 - The road network in the city considered for the Scenario E (year 2012)

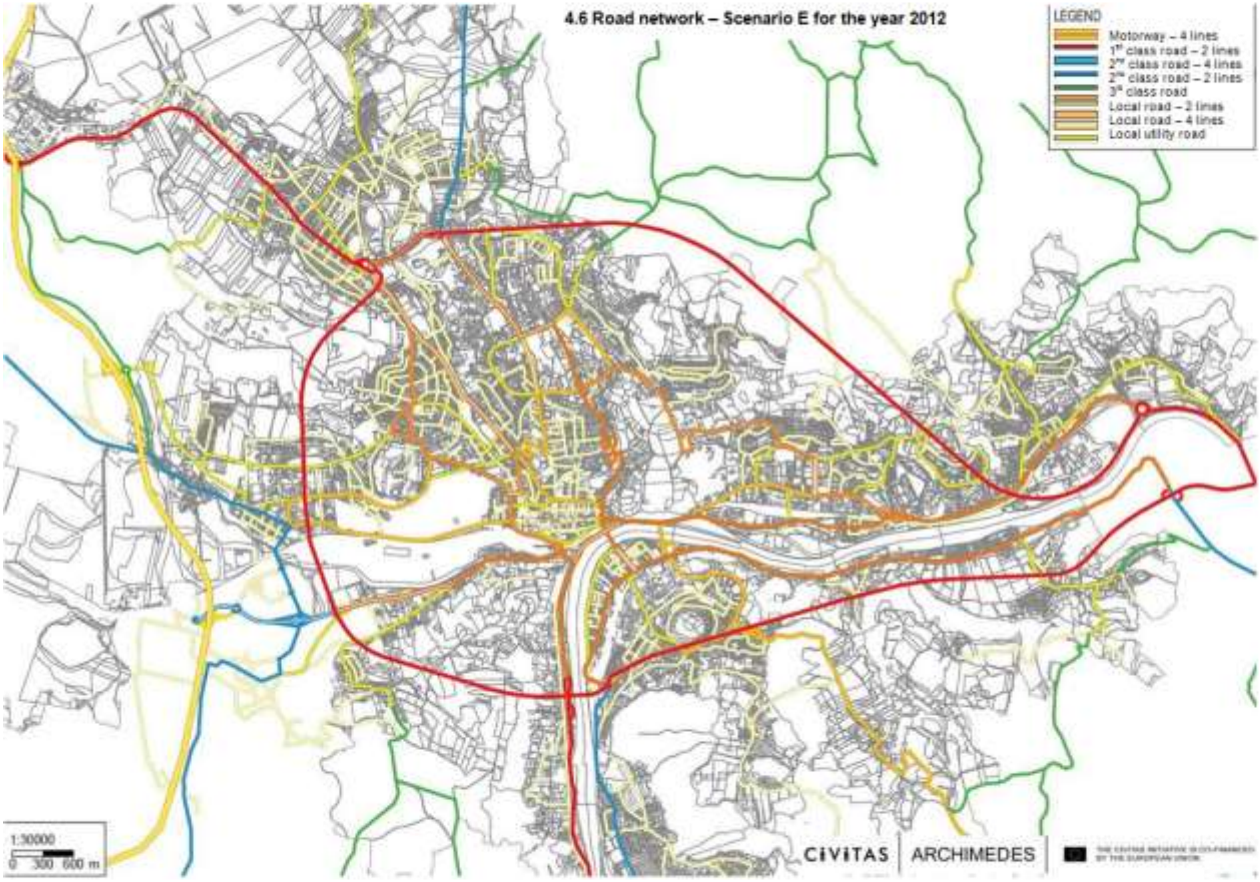


Figure C1.2.24 - Level of traffic noise emissions in the Scenario E in the city (in 2009) during the day-time period (6am – 10pm)

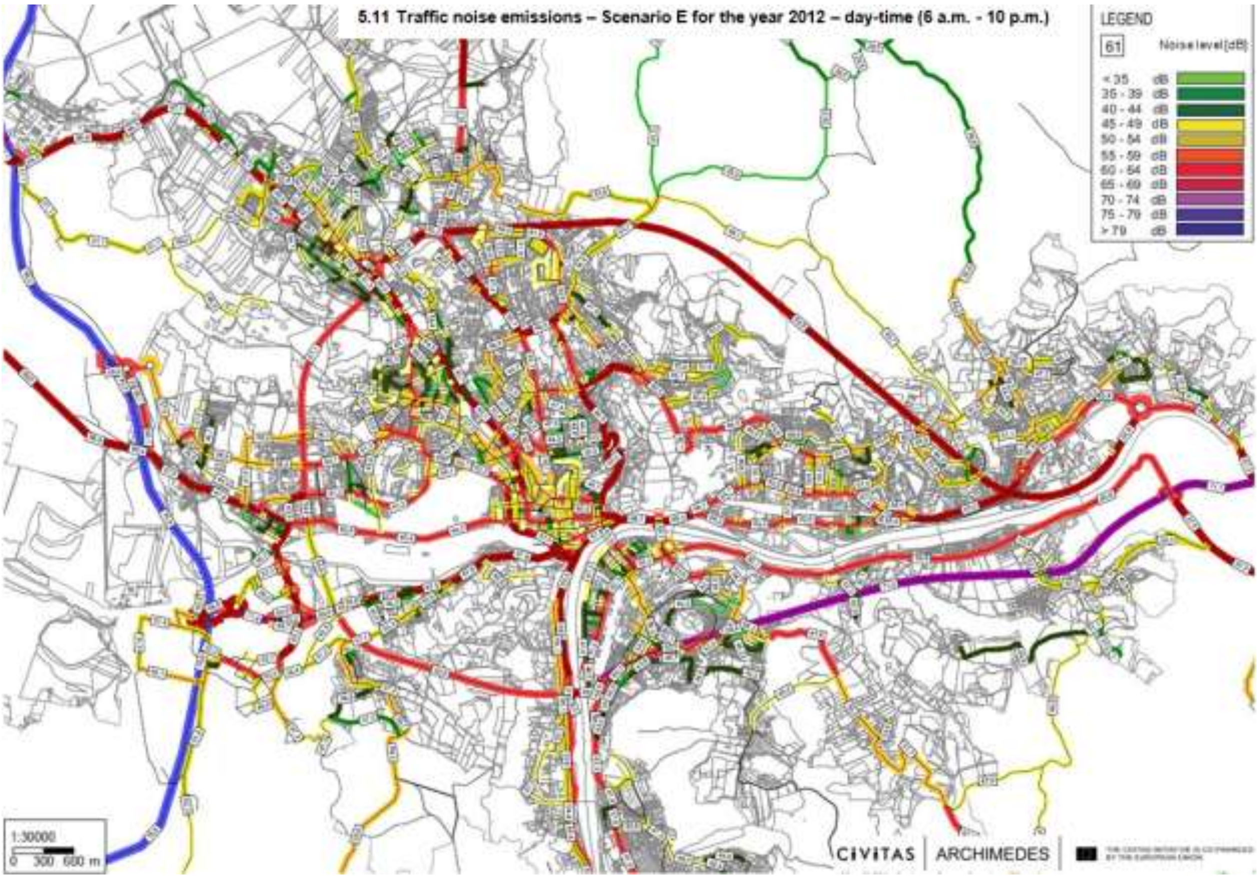


Figure C1.2.25 - Level of traffic noise emissions in the Scenario E in the city (in 2009) during the night-time period (10pm – 6am)

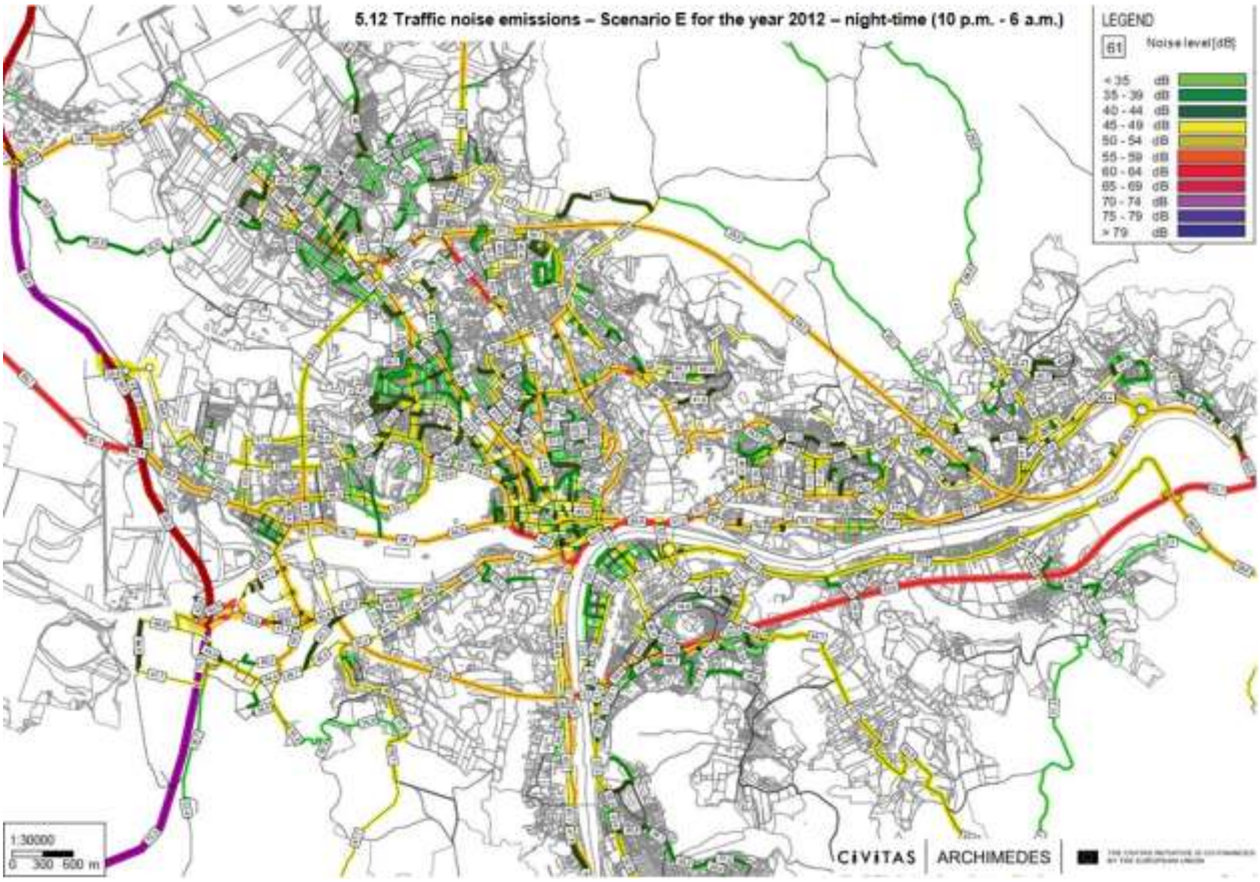
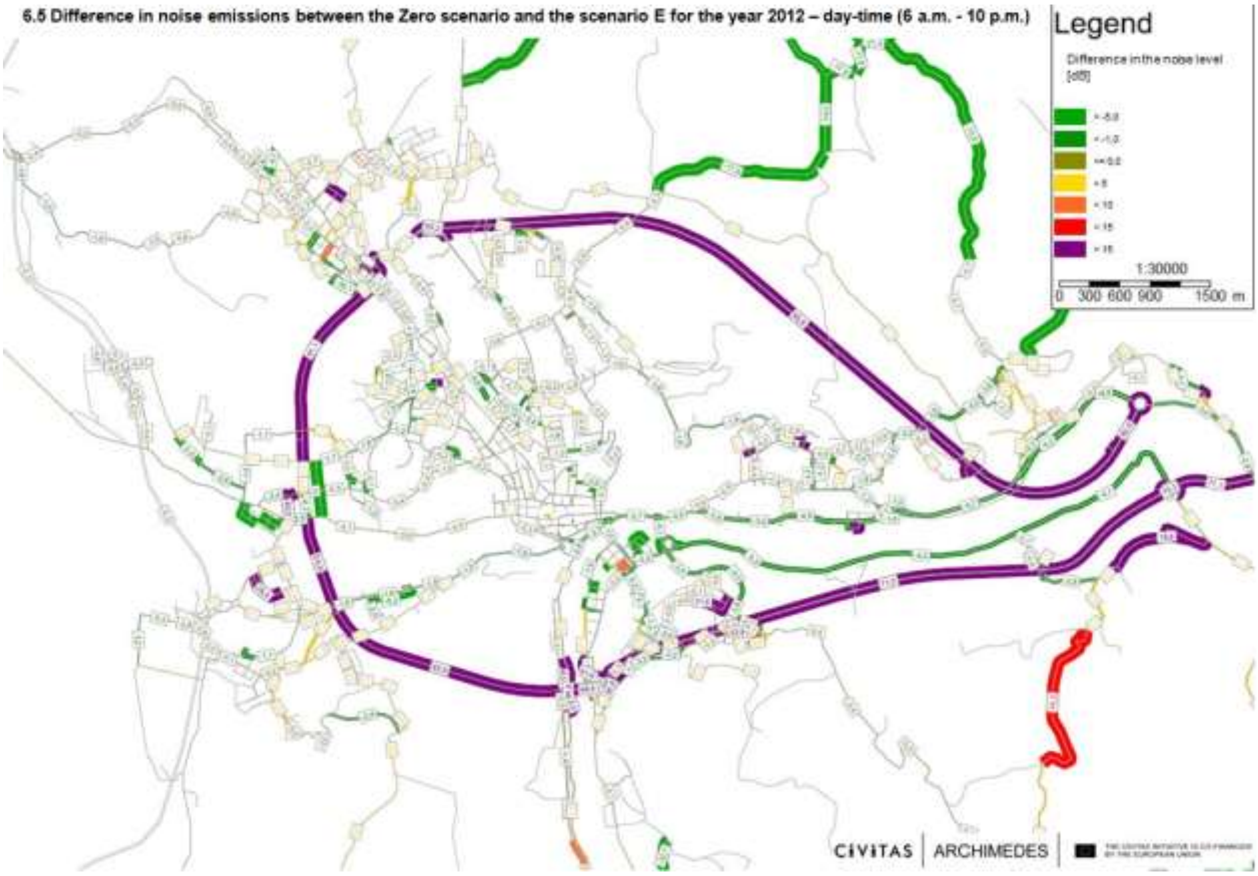


Figure C1.2.26 - Difference in traffic noise emissions between the Zero Scenario and the Scenario E (year 2012) during the day-time (6am – 10pm)



Scenario F

The scenario is considering flat decrease of the traffic speed by 10% on the entire city network (Please see the maps 5.13, 5.14, 6.6).

The scenario is based on the current state of transport infrastructure with completed structures, which are currently in development. It considers current state of traffic intensities with traffic growth foreseen by the Directorate of Roads and Highways.

It presents effectiveness of implementing speed reduction on individual streets in the city and evaluation of results helps to decide which streets are suitable for speed reduction in terms of reducing traffic noise

Figure C1.2.27 - Level of traffic noise emissions in the Scenario F in the city (in 2009) during the day-time period (6am – 10pm)

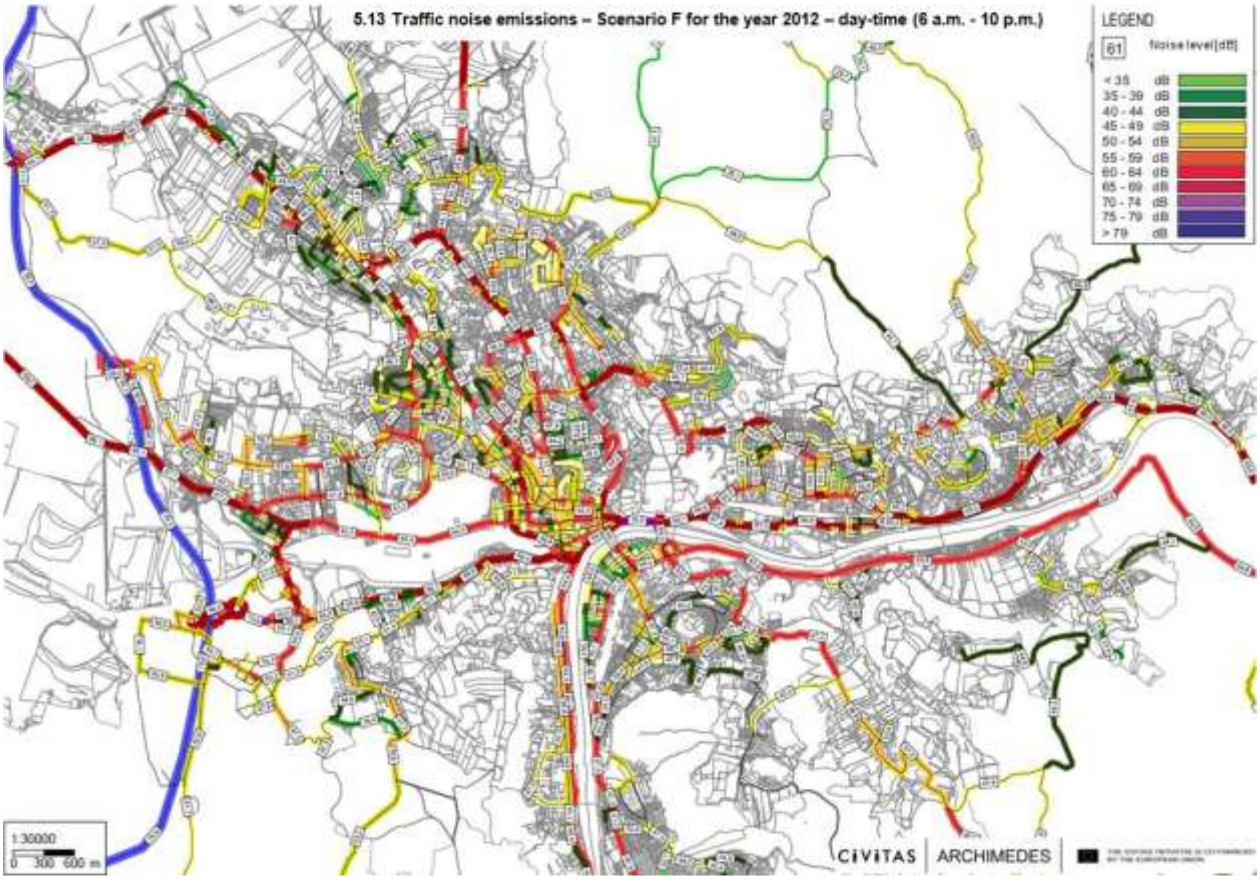


Figure C1.2.28 - Level of traffic noise emissions in the Scenario F in the city (in 2009) during the night-time period (10pm – 6am)

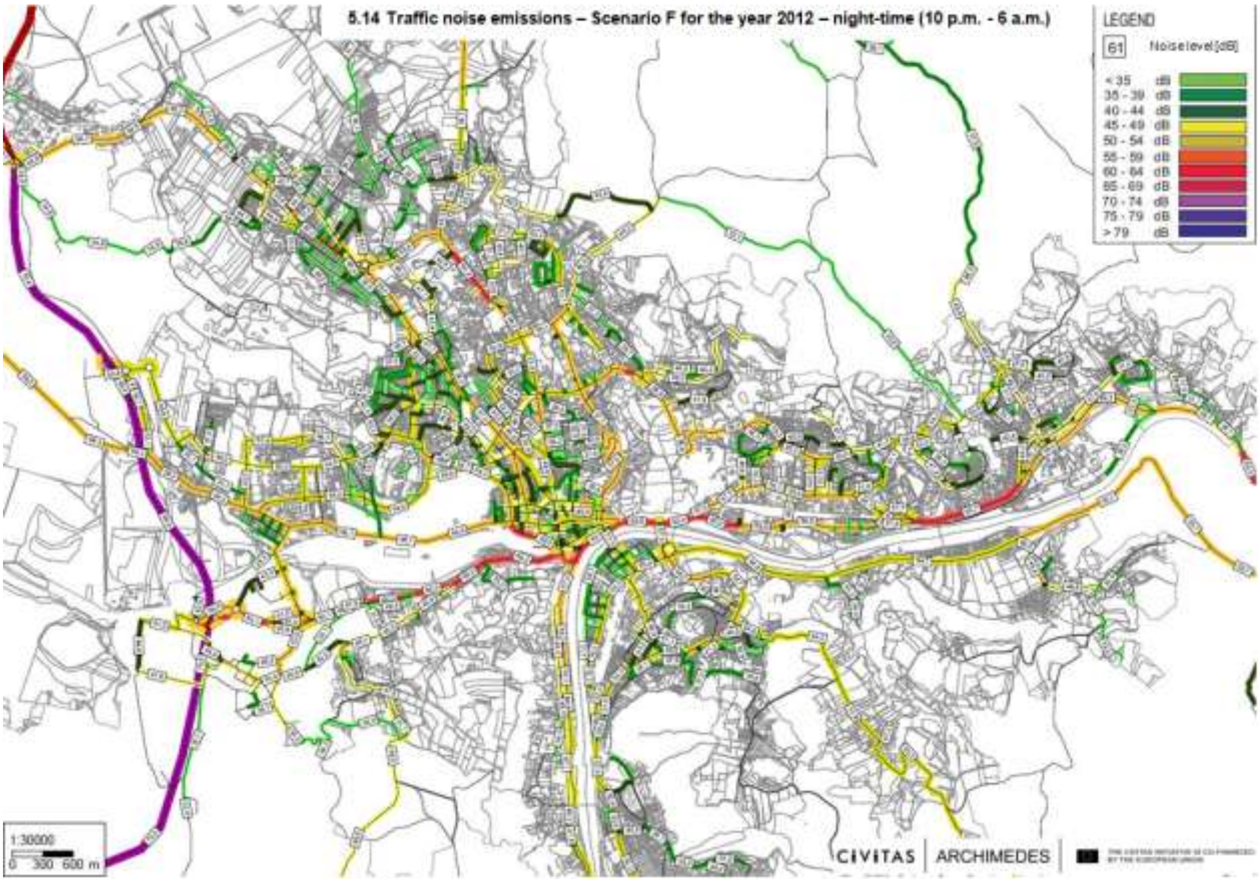
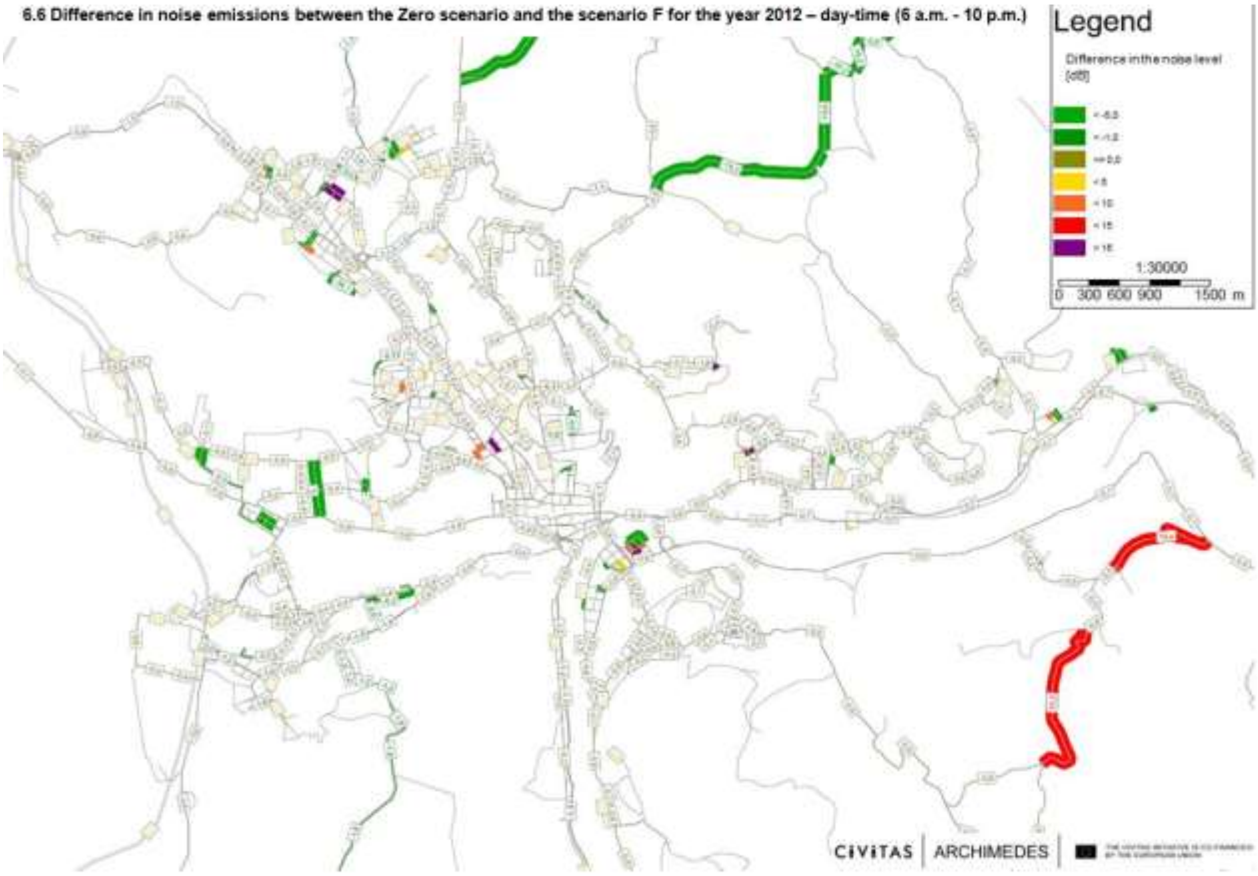


Figure C1.2.29 - Difference in traffic noise emissions between the Zero Scenario and the Scenario F (year 2012) during the day-time (6am – 10pm)



Scenario G

The scenario considers excluding all the freight vehicles with the weight above 3,5 tonnes from the city to determine the roads appropriate for such solution (Please see the maps 5.15, 5.16 and 6.7). This hypothetical scenario presents effectiveness of excluding freight transport from individual streets in the city and evaluation of results helps to decide which streets are suitable for such restriction in terms of reducing traffic noise

Figure C1.2.30 - Level of traffic noise emissions in the Scenario G in the city (in 2009) during the day-time period (6am – 10pm)

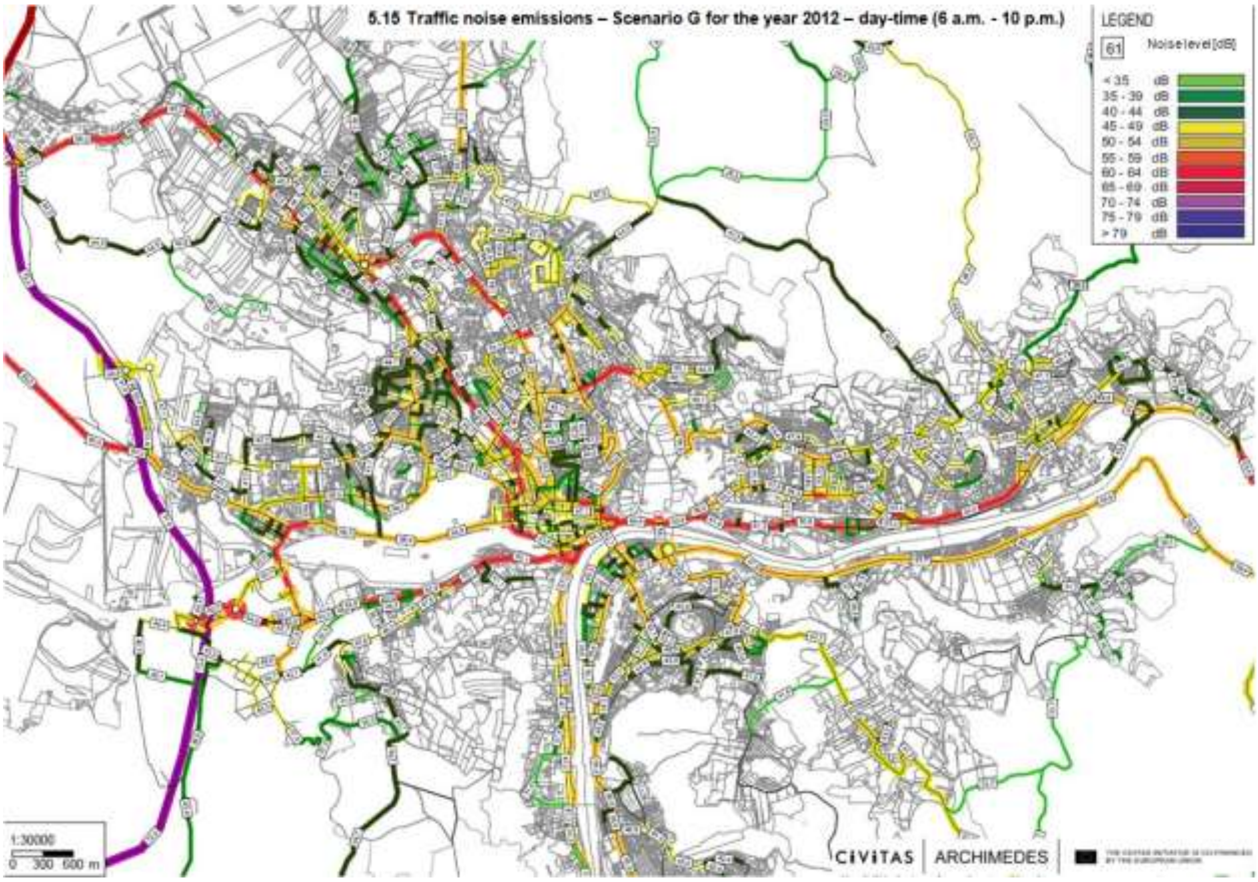


Figure C1.2.31 - Level of traffic noise emissions in the Scenario G in the city (in 2009) during the night-time period (10pm – 6am)

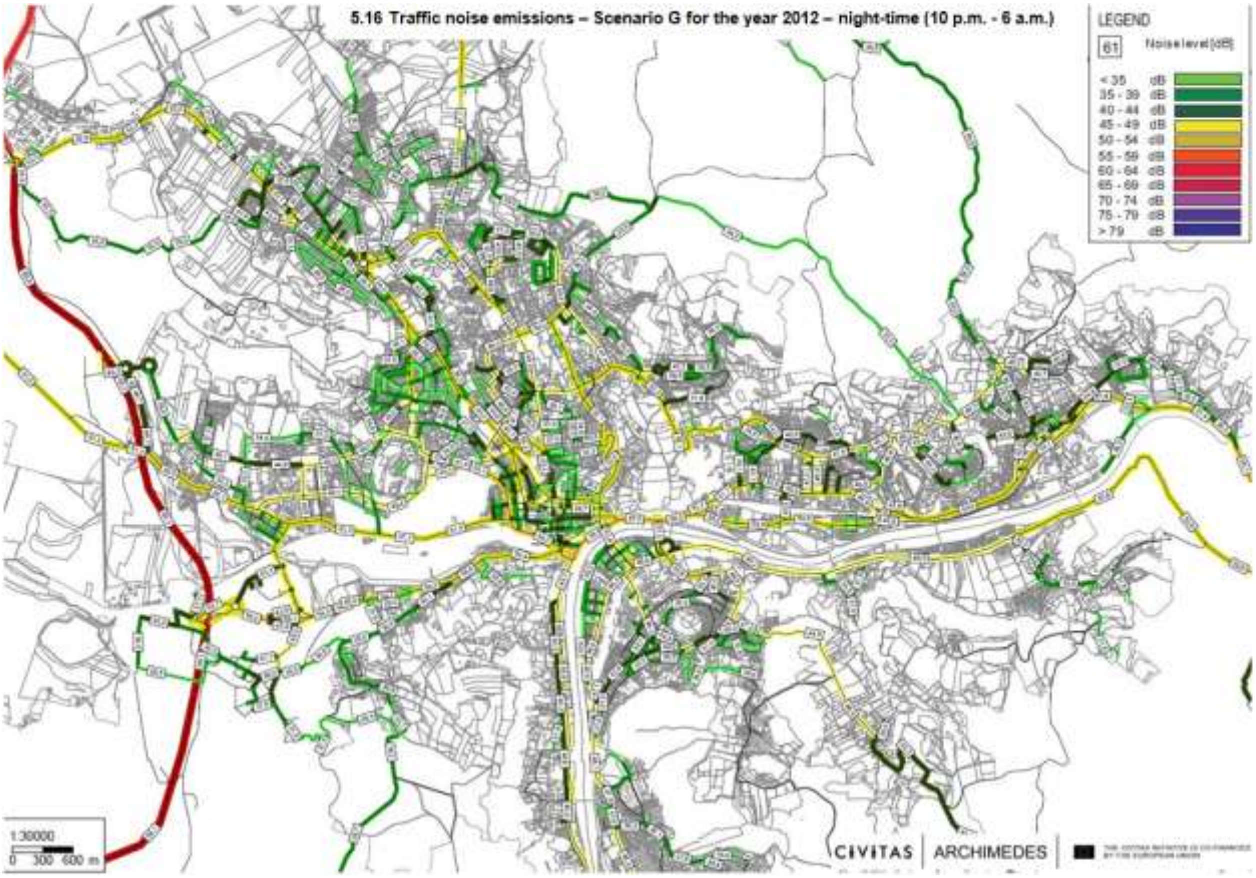
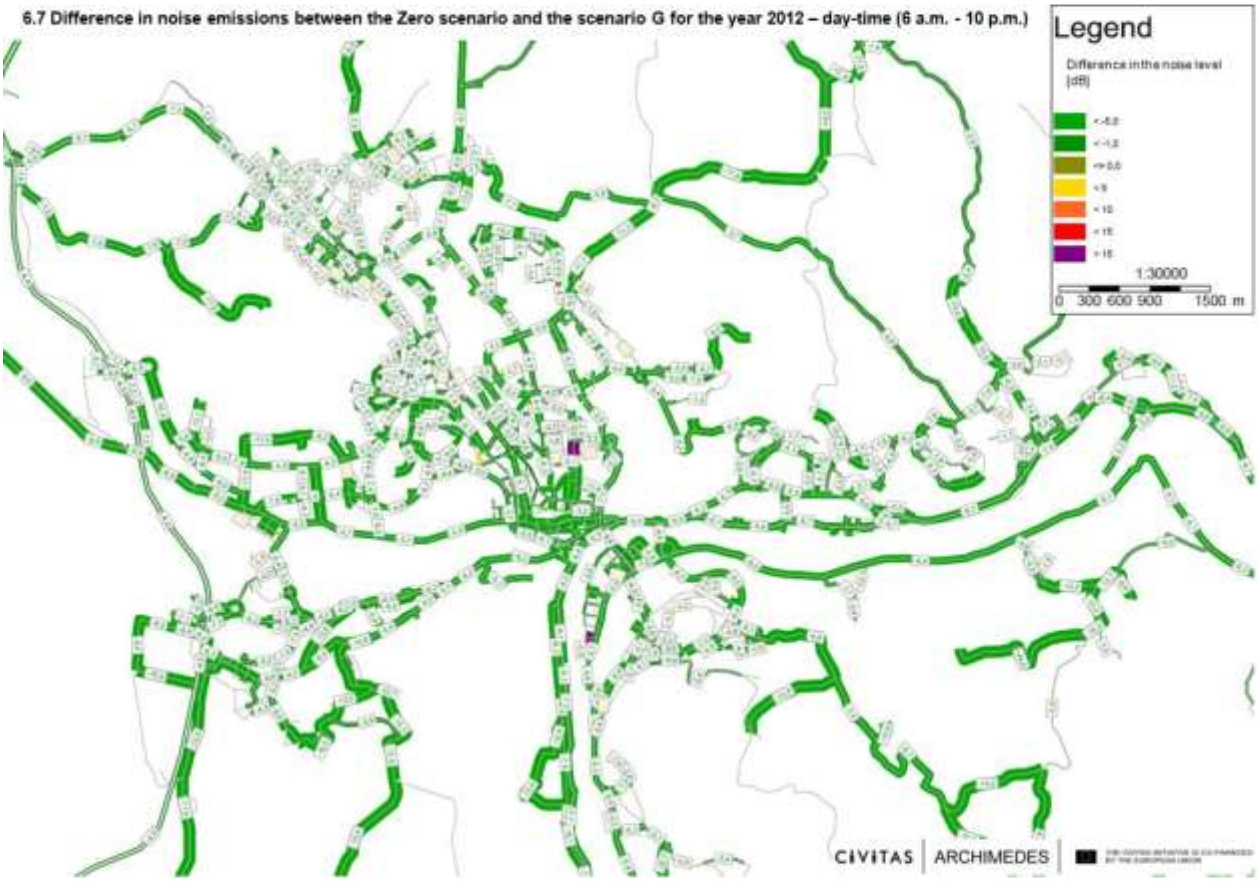
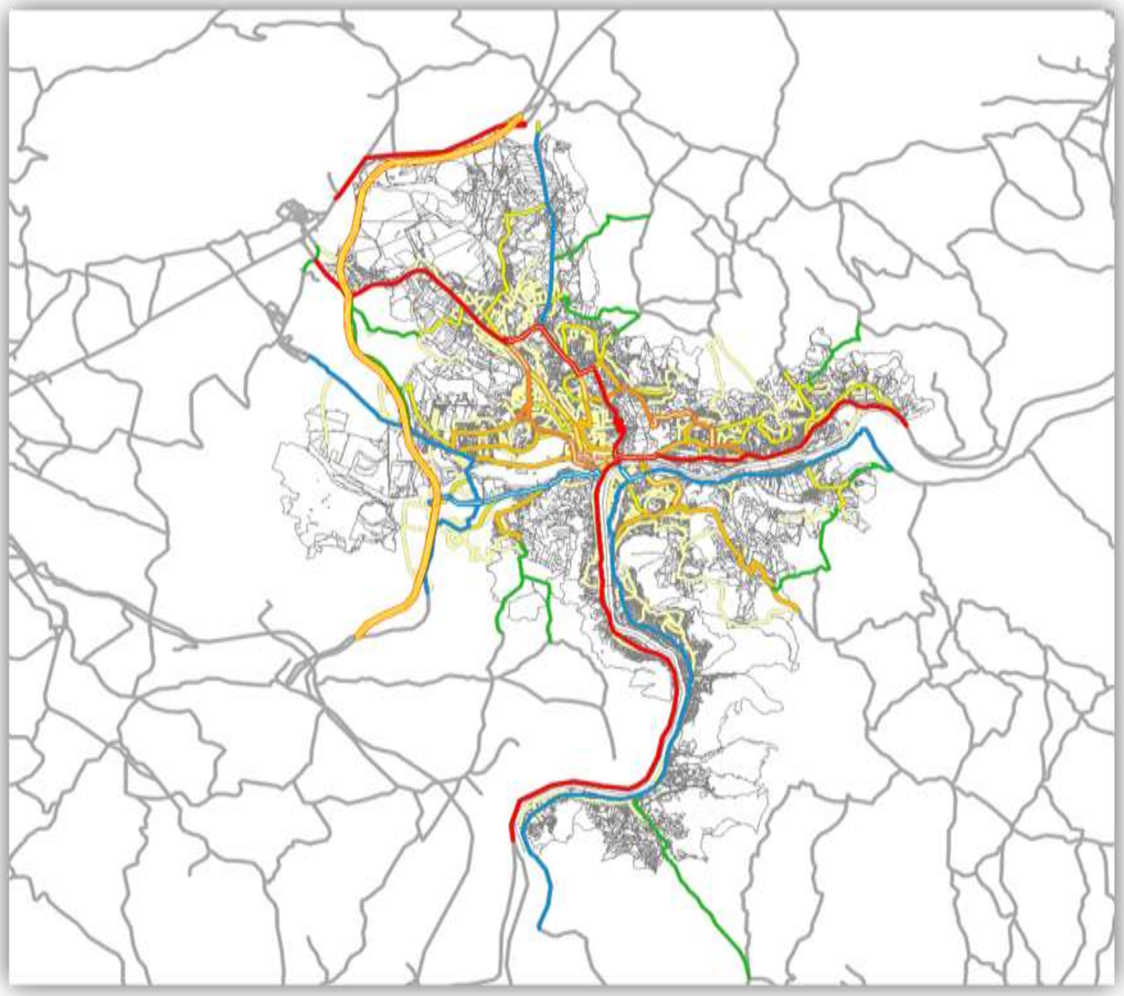


Figure C1.2.32 - Difference in traffic noise emissions between the Zero Scenario and the Scenario G (year 2012) during the day-time (6am – 10pm)



Assessment of effects of implementing specific noise reducing measures is based on identification of changes in distribution of transport performances on the affected road network and of resulting economic effects. Changes in distribution of transport load were analysed by mathematical calculations of the traffic model of the city and subsequently of the Czech Republic and of European road network. The scope of the road network used for measure evaluation is presented in the following figure.

Figure C1.2.33 - The scope of the evaluated model network



C1.3 Building the Business-as-Usual Scenario

The BaU scenario is based on continuously updated traffic model that serves, together with the derived noise emission model, as groundwork for evaluation of proposed scenarios. The BaU scenario was developed with the prognosis for the year 2020, in accordance with the Master Plan of Ústí nad Labem, existing modal split, mobility patterns, car ownership, car use, rate between fuel prices and transit prices. Expected changes in volumes, numbers, prices and transport relationships foreseen in the year 2020 were calculated for the whole evaluation period.

C2 Measure results

For measure evaluation, only variants E and F were calculated, compared and assessed in relation to the Zero variant. The reasons for this are the following:

• The first four scenarios (variant A, B, C and D) represent operation of specific bypasses of the city centre. The variant E considers implementation of all these bypasses constituting all together a city ring road, the most optimal solution resulting from the four proposals, minimising negative effects of traffic on sensitive parts in the city. Thus, within the variant E, all partial variants A, B, C and D are hidden and they separately represent individual steps required for implementation of the E variant.

• The scenario G (exclusion of vehicles over 3.5 tons from the city) is a hypothetical solution, which is in current situation not feasible in the city as transport services of the city would be not fulfilled and it cannot be substituted by other modes of transport, as revealed within the measure 67 Efficient Goods Distribution in Ústí nad Labem (please see the document T67.1 Noise reduction in Ústí nad Labem). The proposed scenario was used to assess noise reduction reached by excluding fright traffic from individual city streets. In sensitive parts of the city, where noise reduction achieved by excluding freight traffic was significant, where such solution was mostly required and where there existed suitable alternative routes, the solutions was recommended for implementation in the city. Based on the results of the noise model, specific solutions were proposed for specific streets or their sections and the solutions were included in the SUTP of Ústí nad Labem. Flat application of the scenario G on the city is not recommended and thus it was not evaluated.

C2.1 Economy

2a – Operation costs

Changes of transport load were calculated by the traffic model based on statistics of daily transport performances on individual roads in the city. To quantify economic costs of vehicle operation, it is necessary to distinguish these performances according to vehicle categories.

To calculate economic effects for operation costs of users, the evaluation methodology for economic efficiency of investments of the Directorate of Roads and Highways of the Czech Republic was used. Values were derived from the transport economic model HDM-4 and input data were calibrated for the Czech Republic. For each vehicle category, economic costs were quantified according to their operation costs per 1vehkm. Data on operation costs of freight vehicles were obtained from the Association of Freighters and from information on compensations for using personal vehicles according to the Law 119/92 Coll., as amended.

The operation costs of motorcycles **(M)** are set proportionally to personal vehicles **(PV)**, the operation costs of buses **(B)** are considered to be at the same value as heavy freight vehicles **(HF)**. Values for light freight vehicles **(LF)**, as well as personal and heavy freight vehicles, were derived from the methodology HMD-4. All the values are given as economic prices, i.e. without taxes. The exchange rate for CZK/EUR was estimated as 26CZK/1EUR.

PV	3,90 CZK/vehkm	0,15 EUR/vehkm
LF	10,95 CZK/vehkm	0,42 EUR/vehkm
HF	17,43 CZK/vehkm	0,67 EUR/vehkm
B	17,43 CZK/vehkm	0,67 EUR/vehkm
M	1,95 CZK/vehkm	0,08 EUR/vehkm

Based on identified daily traffic performances and operation costs of individual vehicle categories, daily "social" costs were calculated for vehicle operation on the evaluated road network for 0 variant, E variant and F variant.

Operation costs of users are considered to cover also savings/losses in fuel consumption. It was not feasible to determine the average consumption of the entire vehicle fleet in the city in the future scenario (based on differences in prospective fleet composition, technical level, engine efficiency, etc.). Therefore, the changes in consumption were considered in the total operating costs of users (based on constant prices according to HDM-4).

Table 1 – Calculations for “0 variant”

VEH. CATEGORY	DAILY TRANSPORT PERFORMANCE [VEHKM]			OPERATION COSTS		**DAILY OPERATION COSTS**					
						2011		**2013**		**2042**	
	2011	2013	2042	CZK/vehkm	EUR/vehkm	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]
PV	1 361 848	1 471 474	1 877 744	3,90	0,15	5311208	204277	5738749	220721	7323201	281662
LF	106 720	113 560	137 706	10,95	0,42	1168582	44822	1243486	47695	1507876	57836
HF	159 208	201 684	314 876	17,43	0,67	2774993	106669	3515351	135128	5488286	210967
			TOTAL / YEAR			3 377 995 655	**129 855 614**	3 831 618 818	**147 293 815**	5 226 567 524	**200 919 629**

Table 2 – Calculations for “E variant”

VEH. CATEGORY	DAILY TRANSPORT PERFORMANCE [VEHKM]			OPERATION COSTS		**DAILY OPERATION COSTS**					
						2011		**2013**		**2042**	
	2011	2013	2042	CZK/vehkm	EUR/vehkm	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]
PV	1 361 848	1 492 409	1 899 263	3,90	0,15	5311208	204277	5820395	223861	7407127	284890
LF	106 720	115 009	138 188	10,95	0,42	1168582	44822	1259354	48304	1513158	58039
HF	159 208	202 505	310 238	17,43	0,67	2774993	106669	3529668	135679	5407457	207860
			TOTAL / YEAR			3 377 995 655	**129 855 614**	3 872 436 920	**148 863 016**	5 229 625 914	**201 037 707**

Table 3 - Calculations for "F variant"

VEH. CATEGORY	DAILY TRANSPORT PERFORMANCE [VEHKM]			OPERATION COSTS		**DAILY OPERATION COSTS**					
						2011		**2013**		**2042**	
	2011	2013	2042	CZK/vehkm	EUR/vehkm	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]	Price [CZK]	Price [EUR]
PV	1 341 265	1 474 124	1 865 298	3,90	0,15	5230933	201190	5749082	221119	7274662	279795
LF	104 903	113 897	137 199	10,95	0,42	1148686	44059	1247172	47837	1502330	57624
HF	158 342	202 220	314 791	17,43	0,67	2759906	106089	3524687	135487	5486808	210910
			TOTAL / YEAR			3 335 926 371	**128 238 451**	3 840 143 248	**147 621 461**	5 206 287 070	**200 139 837**

For the operation costs, diversion of results in both directions may occur after the measure implementation (i.e. reduction of costs or increase of costs). Increase of costs can be expected in case of extending the trip in order to avoid entering certain streets with paid access. On the contrary, reduction of costs can be achieved if, for example, new infrastructure would be implemented shortening the distance and/or travel time.

2 b – Capital costs

In the Zero variant, no investment costs are expected because no noise reducing measures are implemented.

The E variant, on the contrary, requires construction of new road network bypassing sensitive zones of the city and thus reducing negative impact of traffic noise. Price Normative for Construction of Roads published by the Ministry of Transport of the Czech Republic in 2008 was used as the basis for determination of the investment costs. The length of the road network was based on the proposals of bypasses described in the document of the task 11.3.6 Noise Reduction.

Table 4 – Calculations for the "E variant"

	Length [km]	Price/1km [CZK]	Price [CZK]	Price [EUR]
Terrain road section (4 lanes, divided directions)	4	201 mil.	804 mil.	30,9 mil.
Bridges (4 lanes, divided directions)	2,2	970 mil.	2 134 mil.	82 mil.
Tunnels (3 lanes, directions not divided)	13	1 500 mil.	19 500 mil.	750 mil.
TOTAL:			**22 438 mil.**	**862,9 mil**

In the variant F, the study deals with the possibility of noise reduction as a result of implementing traffic calming restrictions in the city. It is evaluated by a macroscopic model of the city considering flat speed reduction by 10% in the city. Application of individual speed reducing tools, such as road signs, speed humps, speed measuring radars, etc., is not specifically addressed. This is the subject of further analyses by relevant microscopic studies. Therefore, costs for applying traffic calming restrictions was not enumerated and for calculation of investment costs, expert knowledge of transport practitioners in the city was used, based on knowledge of budget allocated on average into local transport infrastructure in the city and the usual prices of road signs and traffic calming elements in the Czech Republic (for both material and work).

Expert estimate for capitals costs of the variant F: **60 mil. CZK / 2,3 mil €**

(Investment costs of the variant F are estimated based on experiences with traffic calming in the city**)**

2c – Maintenance costs

For calculation of operation costs and costs for maintenance of road infrastructure, the standard methodology for calculation of economic efficiency in the Czech Republic HDM-4 was used.

Roads	339 000 CZK/km	13 039 €/km
Local roads	486 000 CZK/km	18 692 €/km
Highways	1 230 000 CZK/km	47 308 €/km

The length of the road network was calculated by a computer traffic model.

Table 5 – Calculations for the "divided directions" variant

	Length [km]	Maintenance costs [CZK]	Maintenance costs [EUR]
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18,0	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2042):		5 342 534 400	205 481 760

Table 6 - Calculations for "E variant"

	Length [km]	Maintenance price [CZK]	Maintenance price [EUR]
(Construction period: 2011 - 2012)			
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18,0	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2012):		333 908 400	12 842 610
(Operation period: 2013 – 2042)			
Roads of the I, II, III class	100,1	33933900	1305203,9
Local roads	230,9	112217400	4315982,8
Highways	37,2	45756000	1759857,6
TOTAL/year:		**191 907 300**	**7 381 044**
TOTAL (2013 – 2042):		5 757 219 000	221 431 320
TOTAL (2011 – 2042):		6 091 127 400	234 273 930

Table 7 - Calculations for "F variant"

	Length [km]	Maintenance price [CZK]	Maintenance price [EUR]
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2042):		5 342 534 400	205 481 760

The following table present comparison of values of economic indicators between the Zero variation (B-a-U) and the variant E. The comparison was based on results of the CBA, where the E variant appeared to be economically the most efficient and profitable solution. The variant F resulted as economically unprofitable scenario.

Table 8 – Results in economy indicators

INDICATOR	Before (2011)	BaU (2042)	After (E variant) (2042)	Difference: After - Before	Difference: After - BaU
2a – Operation costs	**129 855 614 €/day**	**200 919 629 €/day**	**201 037 707 €/day**	**+54,73%**	**+0,06%**
2b – Capital Costs	**0 €**	**0€**	**862,9 mil. €**	**862,9 mil. €**	**862,9 mil. €**
2c – Maintenance Costs	**6 421 305 €/year**	**6 421 305 €/year**	**7 381 044 €/year**	**0,00%**	**+14,95%**

C2.2 Energy

No indicators.

C2.3 Environment

Noise Impact

The number of population affected by noise from traffic was determined from traffic model. The outputs were length intervals of road sections with specific noise levels (e.g. 35,564 km of roads are during a day loaded with 50 to 54 dB). The number of population affected by this noise is calculated according to the average density of population (292 persons/km^2), in conditions of 8/24 night-time traffic and 16/24 of day-time traffic. The results show proportion of population exposed to noise levels above 60 dB compared to the total population of Ústí nad Labem, which was 95 003 of people on 26th February 2011.

Table 9 – Noise impact for "0 variant" (2011 - 2042)

NOISE LEVEL [dB]			Road length		Density of population [per 1km]	Number of affected residents	Amount of residents affected by noise >60 dB
			Day time 6am - 10pm [km]	Night time 10pm – 6am [km]			
50	-	54	35,564	46,007	292	11 399,61	-
55	-	59	40,589	52,355	292	12 995,47	-
60	-	64	50,817	18,853	292	11 725,83	24648,79
65	-	69	45,73	9,053	292	9 781,95	
70	-	74	2,747	2,923	292	819,14	
75	-	79	11,929		292	2 321,87	
	>	79			292	0,00	
Total proportion of residents affected by excessive traffic noise:							**25,95%**

Table 10 – Noise impact for "E variant" (2013 - 2042)

NOISE LEVEL [dB]			Road length		Density of population [per 1km]	Number of affected residents	Amount of residents affected by noise >60 dB
			Day time 6am - 10pm [km]	Night time 10pm – 6am [km]			
50	-	54	42,283	51,202	286	12 961,86	-
55	-	59	43,078	62,428	286	14 185,42	-
60	-	64	57,54	12,107	286	12 142,63	23671,86
65	-	69	34,585	11,294	286	7 681,95	
70	-	74	13,687	0,682	286	2 678,53	
75	-	79	6,121		286	1 168,75	
	>	79			286	0,00	
Total proportion of residents affected by excessive traffic noise:							**24,92%**

Table 11 – Noise impact for "F variant" (2011 - 2042)

NOISE LEVEL [dB]			Road length		Density of population [per 1km]	Number of affected residents	Amount of residents affected by noise >60 dB
			Day time 6am - 10pm [km]	Night time 10pm – 6am [km]			
50	-	54	38,484	53,442	292	12 691,54	-
55	-	59	41,352	51,107	292	13 022,52	-
60	-	64	59,546	8,361	292	12 403,76	22511,44
65	-	69	33,284	8,943	292	7 348,75	
70	-	74	0,729	3,033	292	437,07	
75	-	79	11,929		292	2 321,87	
	>	79			292	0,00	
Total proportion of residents affected by excessive traffic noise:							**23,70%**

Noise level

Noise burden exceeding the standard level was calculated by the traffic model. The standard noise limits for road traffic are stated by the Law 258/2000 Coll., on Protection of public health, paragraphs §30-34, and further specified in detail in the Government regulation 148/2006 Coll., on Protection of health from adverse effects of noise and vibrations. The existing limits of 70dB for day-time period and 60dB for night-time period were used for the calculations. Due to the fact, that for the period 2011-2042 it is not possible to exactly predict development of transport, technical level and emitted noise, simplification was made by using the annual constant for noise burden. It was assumed that in the future, the gradually renewed vehicle fleet will produce less noise but the traffic intensity will increase.

Table 12 - Noise burden exceeding the acceptable limit

			0 VARIANT		E VARIANT		F VARIANT	
			Road length		Road length		Road length	
NOISE LEVEL			Day	Night	Day	Night	Day	Night
[dB]			6am - 10pm [km]	10pm - 6am [km]	6am - 10pm [km]	10pm – 6am [km]	6am - 10pm [km]	10pm - 6am [km]
50	-	54	35,564	46,007	42,283	51,202	38,484	53,442
55	-	59	40,589	52,355	43,078	62,428	41,352	51,107
60	-	64	50,817	18,853	57,54	12,107	59,546	8,361
65	-	69	45,73	9,053	34,585	11,294	33,284	8,943
70	-	74	2,747	2,923	13,687	0,682	0,729	3,033
75	-	79	11,929		6,121		11,929	
	>	79						
Length of the road section with noise level over the limit [km]			14,676	30,829	19,808	24,083	12,658	20,337
Difference (E-0, F-0) [km]					**5,132**	**-6,746**	**-2,018**	**-10,492**
Difference (E-0, F-0) [%]					**34,97**	**-21,88**	**-13,75**	**-34,03**
			> 70 dB	> 60 dB	> 70 dB	> 60 dB	> 70 dB	> 60 dB

Emissions:

Quantity of air pollutants caused by traffic was determined by the traffic model. Data on emissions were identified for evaluated variants Zero, E and F in relevant years. However, CO_2 emissions and particulates could not be calculated by the existing traffic model, because the current version used by the city does not feature such application.

Table 13 – Quantity of traffic pollutants

		TRAFFIC POLLUTANTS			
		NOx	SO_2	CO	HC
Variant	Year	[g/day]	[g/day]	[kg/day]	[g/day]
0	2011	2 171 978	190 359	1 708	523 771
	2013	4 211 806	355 537	2 486	1 052 508
	2042	4 449 986	371 350	2 733	894 951
E	2011	2 171 978	190 359	1 708	523 771
	2013	4 348 482	362 838	2 460	1 045 727
	2042	4 430 978	367 154	2 658	876 120
F	2011	2 119 475	189 857	1 801	546 250
	2013	4 180 842	358 979	2 702	1 101 881
	2042	4 222 459	359 103	2 866	901 752

Table 14 – Results in environment indicators

INDICATOR	Before (2011)	BaU (2042)	After (E variant) (2042)	Difference: After - Before	Difference: After - BaU
Noise impact	25,95%	25,95%	24,92%	- 1,03 %	- 1,03 %
Noise level (day)	14,676 km	14,676 km	19,808 km	5,132 km (+34,97%)	5,132 km (+34,97%)
Noise level (night)	30,829 km	30,829 km	24,083 km	-6,746 km (-21,88%)	-6,746 km (-21,88%)
No. 8 – CO_2 emissions	*Not rated*				
No. 9 - CO emissions	1708 g/day	2733 g/day	2658 g/day	950 g/day (+55,62%)	-75g/day (-2,74%)
No. 10 – NO_x emission	2 171 978 g/day	4 449 986 g/day	4 430 978 g/day	2 259 000 (+10,4%)	-19008 (-0,43%)
No. 11 – Particulate emissions	*Not rated*				

C2.4 Transport

The transport performance of goods vehicles in the city was established by the traffic model. It was presumed that the supply vehicles are of a light freight category **(LF)** or a heavy freight category **(HF).**

Table 15 - Daily performance of goods vehicles

	Vehicle category	Daily transport performance [vehkm/day]		
		2011	**2013**	**2042**
0 VARIANT	LF	106 720	113 560	137 706
	HF	159 208	201 684	314 876
	Total:	**265 928**	**315 244**	**452 581**
E VARIANT	LF	106 720	115 009	138 188
	HF	159 208	202 505	310 238
	Total:	**265 928**	**317 515**	**448 426**
F VARIANT	LF	104 903	113 897	137 199
	HF	158 342	202 220	314 791
	Total:	**263 245**	**316 117**	**451 990**

Table 16 – Results in transport indicators

INDICATOR	Before (2011)	BaU (2042)	After (E variant) (2042)	Difference: After - Before	Difference: After - BaU
No. 25 – Goods vehicles moving in demo areas	265 928 km/day	452 581 km/day	448 426 km/day	+68,63%	-0,92%

C2.5 Society

No indicators

C2.6 Cost Benefit Analysis

The CBA follows standard economic procedures for the evaluation period of proposed scenarios, which differ in their costs and benefits. The rate of return was calculated to reveal efficiency of investments and regulations, and the amount of expected operation costs for users.

Criteria applicable for the CBA:

- **Operation costs** – These costs are the key economic indicators influencing majority of the scenarios processed by the traffic model. Different distribution schemes of freight traffic in demo areas resulting from the restrictive measures introduced in the city cause variances in the generated costs.
- **Number of people affected by noise** – Population benefiting from the measures introduced in individual scenarios was identified and benefits were quantified by available recommended values related to external costs from transport. Such variables include benefits for inhabitants exposed to lower noise burden, leading to potential economic benefits, such as higher work performance and other.
- **Absolute changes in noise levels** – For more restrictive scenarios, results deliver significant improvements in lowering the total noise level in demo areas. Such changes were quantified in order to give an assumption of potential economic benefits.
- **Freight traffic trips** – Beside noise reduction, one of the major objectives of the measure is to reduce the amount of total freight traffic trips in demo areas. Different scenarios assess these traffic volumes and deliver results that determine economic benefits, changes in operational costs compared to benefits for inhabitants, etc.

Given the nature of these measures, dealing rather with external costs and impacts of transport, the economic assessment includes beside the precise model quantifications also estimations of costs and benefits based on up-to-date available best practise values that have been recommended by official EU-level research exercises, such as the IMPACT study.

Economic indicators of all do-nothing and pro-active scenarios are based on approved values recommended for CBA (in Euro) for the Czech Republic, based on the document CBA Recommendations for CIVITAS Evaluation, J. Piao and J. Preston. These values are preferably used instead of Czech values in order to keep consistency within the Archimedes project. In case a recommended value was not available, Czech values recommended by national government were utilised according to the methodology for evaluating efficiency of transport structures HDM-4. This methodology is commonly used by the Directorate of Roads and Highways of the Czech Republic (http://www.rsd.cz/technicke-predpisy/hdm-4).

The indicators involve the following figures:

1. Ten car categories;
2. General traffic growth for years 2005 to 2040 per three main categories;
3. Standard economical prices per car category;
4. Standard economical prices per car tyre;
5. Standard prices per fuel and oil;
6. Maintenance costs;
7. Salary for drivers;
8. Standard interest rates;
9. Value of time per car use;
10. Yearly fix expenses per car category;
11. Lifetime of car fleet;
12. Operating hours per year per category;
13. Operating kilometres per year per category;
14. Travel time price for passengers;
15. Average car occupancy per car;
16. Average car occupancy per bus;
17. Discount rate;
18. Average economical loss from accidents per accident type and road category;

Step one – appraisal case – do something, compared to do nothing, do minimum or BAU scenarios.

In this step, the active scenario was defined, involving a proposal of complex organisational arrangements leading the major traffic flow through less environmentally sensitive areas. The scenario proposes completion of the road infrastructure allowing transit traffic to bypass the densely populated areas.

Step two – determination of the project life from technical, market and economic criteria;

Expected project life is proposed to be 30 years, which is the usual project life in economic calculations, including PPP projects.

Step three – determination of the key impacts of the project;

Key impacts include decrease of noise level and optimisation of goods distribution within the city logistics, with the main benefit for residential areas. Measurable impact is noise level and traffic volume, especially in goods transport.

Step four – determination of the main parties affected by the project;

Affected parties involve city residents, road users, freight companies, public transport operator, and city as the investor and owner of the new infrastructure.

C2.6.1 Evaluation Period for CBA

Time period for the CBA was set to be 32 years (2011 – 2042) based on assumed construction time of 2 years required by the E variant and subsequent operation time of 30 years. The discount rate is 5,5 %.

C2.6.2 Method and Values for Monetisation

Values recommended for the CIVITAS ARCHIMEDES project were used for the calculations. In case required values were not available, standard values used in the Czech Republic were used instead. (Source of data is mentioned at relevant figures).

- Values are constant, derived from price levels of 2010
- Exchange rate was 26 CZK/EUR
- Values from 2002 were converted to values 2010 by following rules:
  - EUR of 2002 was converted to CZJ of 2002 by the exchange rate of 30,56 CZK/EUR
  - Estimated inflation between the years 2002 and 2010 was 21,12%
  - CZK 2010 were converted to EUR 2010 by the exchange rate 26 CZK/EUR (i.e. $€_{2010} = 1{,}42 \cdot €_{2002}$)

Inputs for the CBA were:

- Investment costs
- Costs for operation and maintenance of the road infrastructure
- Residual value
- Operation costs of users
- Costs caused by noise burden

C2.6.3 Life Time Costs and Benefits

Costs for implementation of the “0 variant”:

Construction period: no

Total costs: **0 CZK / 0 €**

Costs for implementation of the “E variant”:

Construction period: two years (2011 – 2012)

Source: Price norms for road constructions, Ministry of Transport, Czech Republic 2008

Length of the road network results from the proposal of bypasses described in the task 11.3.6 Noise Reduction.

Table 17 – Capital cost in the evaluation period for the “E variant” (not discounted)

	Length [km]	Price/1km [CZK]	Price [CZK]	Price [EUR]
Terrain road section (4 lanes, divided directions)	4	201 mil.	804 mil.	30,9 mil.
Bridges (4 lanes, divided directions)	2,2	970 mil.	2 134 mil.	82 mil.
Tunnels (3 lanes, directions not divided)	13	1 500 mil.	19 500 mil.	750 mil.
TOTAL:			**22 438 mil.**	**862,9 mil**

Costs for implementation of the “F variant”:

Construction period: one year (2011) - Implementation of traffic signs and traffic calming elements.

Expert estimate: **60 mil. CZK / 2,3 mil €**

Costs for maintenance and operation of the road infrastructure:

Costs for maintenance:

Roads of the I, II, III class	339 000 CZK / km	13 039 € / km
Local roads	486 000 CZK / km	18 692 € / km
Highways	1 230 000 CZK / km	47 308 € / km

Source: values were taken from the methodology of the transport economic model HDM-4.

Length of the road network was calculated by the traffic model of the city.

Costs for maintenance and operation of the road infrastructure for the “0 variant”:

Construction period: no

Operation period: 2011 – 2042

Table 18 – Maintenance cost in the evaluation period for the “0 variant” (not discounted)

	Length [km]	Maintenance price [CZK]	Maintenance price [EUR]
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2042):		5 342 534 400	205 481 760

Costs for maintenance and operation of the road infrastructure for the "E variant":

Table 19 – Maintenance cost in the evaluation period for the E variant (not discounted)

	Length [km]	Maintenance price [CZK]	Maintenance price [EUR]
(Construction period: 2011 - 2012)			
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18,0	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2012):		333 908 400	12 842 610
(Operation period: 2013 – 2042)			
Roads of the I, II, III class	100,1	33933900	1305203,9
Local roads	230,9	112217400	4315982,8
Highways	37,2	45756000	1759857,6
TOTAL/year:		**191 907 300**	**7 381 044**
TOTAL (2013 – 2042):		5 757 219 000	221 431 320
TOTAL (2011 – 2042):		6 091 127 400	234 273 930

Costs for maintenance and operation of the road infrastructure for the "F variant":

Construction period: 2011

Operation period: 2012 – 2042

Table 20 – Maintenance cost in the evaluation period for the "E variant" (not discounted)

	Length [km]	Maintenance price [CZK]	Maintenance price [EUR]
Roads of the I, II, III class	100,6	34103400	1311723,4
Local roads	227,8	110710800	4258037,6
Highways	18	22140000	851544
TOTAL / YEAR:		**166 954 200**	**6 421 305**
TOTAL (2011 – 2042):		5 342 534 400	205 481 760

Residual value:

Source: based on the methodology of the transport economic model HDM-4.

$$S_V = \frac{\max\{0; W_L - (Y - y^*)\}}{W_L} \cdot UNDISCST$$

SV	=	Residual value of the structure
WL	=	Life time [years]
Y	=	Last year of analyses
y*	=	Year of launch / initiation of operation
UNDISCST	=	Undiscounted economic costs

Average life-time of transport structures is estimated to be 50 years. Life-time period of wearing layers is 25 years.

Residual value for the "0 variant":

Residual value: **0 CZK / 0 €**

Residual value for the "E variant":

$$S_V = \frac{\max\{0; W_L - (Y - y^*)\}}{W_L} \cdot UNDISCST = \frac{\max\{0; 50 - (2042 - 2013)\}}{50} \cdot 862900000 = 362\,420\;000€$$

Residual value for the "F variant":

$$S_V = \frac{\max\{0; W_L - (Y - y^*)\}}{W_L} \cdot UNDISCST = \frac{\max\{0; 25 - (2042 - 2013)\}}{25} \cdot 2300000 = 0€$$

Operation costs of users:

Transport performance was derived from the traffic model.

Prices for 2010 were taken from the methodology of the transport economic model HDM-4.

Table 21 – Operation cost in the evaluation period (not discounted)

PV	3,90 CZK/vehkm	0,15 EUR/vehkm
LF	10,95 CZK/vehkm	0,42 EUR/vehkm
HF	17,43 CZK/vehkm	0,67 EUR/vehkm
B	17,43 CZK/vehkm	0,67 EUR/vehkm
M	1,95 CZK/vehkm	0,08 EUR/vehkm

Operation costs of users for the "O variant":

Table 22 – Operation cost in the evaluation period (not discounted)

Vehicle category	Daily transport performance [vehkm]			Operation costs		DAILY OPERATION COSTS					
						2011		2013		2042	
	2011	2013	2042	CZK / vehkm	EUR / vehkm	price [CZK]	price [EUR]	price [CZK]	price [EUR]	price [CZK]	price [EUR]
PV	1 361 848	1 471 474	1 877 744	3,90	0,15	5311208	204277	5738749	220721	7323201	281662
LF	106 720	113 560	137 706	10,95	0,42	1168582	44822	1243486	47695	1507876	57836
HF	159 208	201 684	314 876	17,43	0,67	2774993	106669	3515351	135128	5488286	210967
			TOTAL / YEAR			3 377 995 655	**129 855 614**	3 831 618 818	**147 293 815**	5 226 567 524	**200 919 629**

Operation costs of users for the "E variant":

Table 23 – Operation cost in the evaluation period (not discounted)

Vehicle category	Daily transport performance [vehkm]			Operation costs		DAILY OPERATION COSTS					
						2011		2013		2042	
	2011	2013	2042	CZK / vehkm	EUR / vehkm	price [CZK]	price [EUR]	price [CZK]	price [EUR]	price [CZK]	price [EUR]
PV	1 361 848	1 492 409	1 899 263	3,90	0,15	5311208	204277	5820395	223861	7407127	284890
LF	106 720	115 009	138 188	10,95	0,42	1168582	44822	1259354	48304	1513158	58039
HF	159 208	202 505	310 238	17,43	0,67	2774993	106669	3529668	135679	5407457	207860
			TOTAL / YEAR			3 377 995 655	**129 855 614**	3 872 436 920	**148 863 016**	5 229 625 914	**201 037 707**

Operation costs of users for the "F variant":

Table 24 – Operation cost in the evaluation period (not discounted)

Vehicle category	Daily transport performance [vehkm]			Operation costs		DAILY OPERATION COSTS					
						2011		2013		2042	
	2011	2013	2042	CZK / vehkm	EUR / vehkm	price [CZK]	price [EUR]	price [CZK]	price [EUR]	price [CZK]	price [EUR]
PV	1 341 265	1 474 124	1 865 298	3,90	0,15	5230933	201190	5749082	221119	7274662	279795
LF	104 903	113 897	137 199	10,95	0,42	1148686	44059	1247172	47837	1502330	57624
HF	158 342	202 220	314 791	17,43	0,67	2759906	106089	3524687	135487	5486808	210910
			TOTAL / YEAR			3 335 926 371	**128 238 451**	3 840 143 248	**147 621 461**	5 206 287 070	**200 139 837**

Costs of traffic accidents:

Values for losses caused by traffic accidents were recommended for CIVTAS Archimedes project.

Table 25 – Savings from accident reductions in the evaluation period (not discounted) in the Czech Republic

	Fatality	Severe injury	Slight injury	Average injury	Damage only
€$_{2002}$ PPP, factor prices	932 000	125 200	9 100	67 150	
€$_{2010}$ PPP, conversion factor prices	1 323 440	177 784	12 922	95 353	6 346
	Recommended values			Derived value	HDM-4 value

Table 26 – Relative accident rate (source: values are taken from the methodology of the transport economic model HDM-4)

Relative accident rate [no. of accidents /100 mil. vehkm per year]	Fatalities	Injuries	Damage only
I class roads	1,75	25,52	139,8
II and II class roads	1,72	41,06	172,96
4-lane road without the middle belt	1,64	31,17	152,17
4-lane road with the middle belt	1,64	31,17	152,17
4-lane highways and speedways	0,52	7,01	73,99
6-lane highways and speedways	0,52	7,01	73,99
Through roads of II, III class and local roads	2	49,9	201,6

Costs of traffic accidents for the "0 variant":

Table 27 – Savings from accident reductions in the evaluation period for the 0 variant (not discounted)

ROAD CATEGORY	Transport performance [vehkm]			Relative accident rate			Foreseen no. of accidents / year 2011			Foreseen no. of accidents / year 2013			Foreseen no. of accidents / year 2042			Costs [$€_{2010}$ / year]		
	Day-time 2011	Day-time 2013	Day-time 2042	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	2011	2013	2042
Highways and speedways	146 852 368	177 897 530	256 969 348	0,52	7,01	73,99	1	10	109	1	12	132	1	18	190	2 681 750	3 248 683	4 692 656
I class roads	154 853 871	165 043 392	190 699 766	1,75	25,52	139,80	3	40	216	3	42	231	3	49	267	8 728 492	9302834,8	10748982
II and III class roads	120 522 021	129 085 808	175 638 836	1,72	41,06	172,96	2	49	208	2	53	223	3	72	304	8 784 989	9409213,1	12802517
Local roads	171 909 925	180 125 479	227 260 753	2,00	49,90	201,60	3	86	347	4	90	363	5	113	458	14 929 257	15642724	19736115
											TOTAL / YEAR					**35 124 488**	**37 603 455**	**47 980 270**

Costs of traffic accidents for the "E variant":

Table 28 – Savings from accident reductions in the evaluation period for the variant E (not discounted)

ROAD CATEGORY	Transport performance [vehkm]			Relative accident rate			Foreseen no. of accidents / year 2011			Foreseen no. of accidents / year 2013			Foreseen no. of accidents / year 2042			Costs [$€_{2010}$ / year]		
	Day-time 2011	Day-time 2013	Day-time 2042	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	2011	2013	2042
Highways and speedways	146 852 368	269 223 021	360 035 350	0,52	7,01	73,99	1	10	109	1	19	199	2	25	266	2 681 750	4 916 427	6 574 799
I class roads	154 853 871	106 223 251	85 771 568	1,75	25,52	139,80	3	40	216	2	27	149	2	22	120	8 728 492	5987379,1	4834599,6
II and III class roads	120 522 021	108 694 757	97 372 641	1,72	41,06	172,96	2	49	208	2	45	188	2	40	168	8 784 989	7922886	7097603,9
Local roads	171 909 925	176 481 104	313 727 239	2,00	49,90	201,60	3	86	347	4	88	356	6	157	632	14 929 257	15326234	27245166
													TOTAL / YEAR			**35 124 488**	**34 152 926**	**45 752 169**

Costs of traffic accidents for the "F variant":

Table 29 – Savings from accident reductions in the evaluation period for the variant F (not discounted)

ROAD CATEGORY	Transport performance [vehkm]			Relative accident rate			Foreseen no. of accidents / year 2011			Foreseen no. of accidents / year 2013			Foreseen no. of accidents / year 2042			Costs [$€_{2010}$ / year]		
	Day-time 2011	Day-time 2013	Day-time 2042	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	fatalities	injuries	damages	2011	2013	2042
Highways and speedways	146 627 645	185 201 467	265 449 097	0,52	7,01	73,99	1	10	108	1	13	137	1	19	196	2 677 646	3 382 064	4 847 509
I class roads	150 611 656	160 455 620	184 364 458	1,75	25,52	139,80	3	38	211	3	41	224	3	47	258	8 489 376	9044240,4	10391886
II and III class roads	118 344 014	129 231 243	172 070 660	1,72	41,06	172,96	2	49	205	2	53	224	3	71	298	8 626 231	9419814,1	12542429
Local roads	170 062 788	178 549 299	223 925 932	2,00	49,90	201,60	3	85	343	4	89	360	4	112	451	14 768 845	15505843	19446508

TOTAL / YEAR	**34 562 098**	**37 351 961**	**47 228 331**

Time savings:

Costs of time savings in performed trips:

Table 30 – Time saving in the evaluation period for the variant F (not discounted)

CZECH REPUBLIC VALUES	PV	LF	HF
€$_{2002}$ PPP, factor prices	26,57	26,57	21,31
€$_{2010}$ PPP, conversion factor prices	37,73	37,73	30,26

Time savings for the “0 variant”:

Table 31 – Time saving in the evaluation period for the 0 variant (not discounted)

VEHICLE CATEGORY	Year savings [person-hours]			Time price [€]	Price €$_{2010}$ / year		
	2011	2013	2042		2011	2013	2042
PV	16 468 751,73	17 794 451,23	22 707 446,81	37,73	621 356 121,65	671 373 968,08	856 738 344
LF	813 850,06	866 016,54	1 050 149,51	37,73	30 706 074,45	32 674 284,45	39 621 511
HF	10 021 246,40	12 694 878,44	19 819 677,05	30,26	303 244 920,39	384 149 560,70	599 747 392
			TOTAL / YEAR		**955 307 116**	**1 088 197 813**	**1 496 107 246**

Time savings for the “E variant”:

Table 32 – Time saving in the evaluation period for the variant E (not discounted)

VEHICLE CATEGORY	Year savings [person-hours]			Time price [€]	Price $€_{2010}$ / year		
	2011	2013	2042		2011	2013	2042
PV	16 468 751,73	16 675 714,53	21 221 781,50	37,73	621 356 121,65	629 164 703,62	800 685 083
LF	813 850,06	808 331,84	971 239,38	37,73	30 706 074,45	30 497 875,28	36 644 279
HF	10 021 246,40	12 025 370,10	18 422 885,33	30,26	303 244 920,39	363 890 104,22	557 480 195
			TOTAL / YEAR		**955 307 116**	**1 023 552 683**	**1 394 809 557**

Time savings for the “F variant”:

Table 33 – Time saving in the evaluation period for the variant F (not discounted)

VEHICLE CATEGORY	Year savings [person-hours]			Time price [€]	Price $€_{2010}$ / year		
	2011	2013	2042		2011	2013	2042
PV	17 667 119,21	19 417 132,86	24 569 675,36	37,73	666 569 807,53	732 596 772,58	926 999 110
LF	864 183,10	938 276,71	1 130 238,39	37,73	32 605 109,82	35 400 617,13	42 643 216
HF	10 482 285,63	13 386 967,11	20 839 219,59	30,26	317 196 059,57	405 092 302,18	630 598 953
			TOTAL / YEAR		**1 016 370 977**	**1 173 089 692**	**1 600 241 279**

Costs of noise burden:

Table 34 – Values of noise costs recommended for CIVITAS evaluation for roads in the Czech Republic

L_{den} dB(A)			(€$_{2002}$ PPP, factor prices, per year per person exposed)	(€$_{2010}$ PPP, conversion factor prices, per year per person exposed)
50	-	54	**13,5**	**19,2**
55	-	59	**38,2**	**54,2**
60	-	64	**65,8**	**93,4**
65	-	69	**93**	**132,06**
70	-	74	**149**	**211,58**
75	-	79	**200**	**284**
	>	79	**232,5**	**330,15**

Costs of noise burden for the "0 variant":

Table 35 – Noise cost in the evaluation period for the "0 variant" (not discounted)

Noise level dB(A)	Noise cost [€/person/year]	Road length		Density of population [person/km]	Costs of noise impact [€$_{2010}$/year]
		Day time 6am – 10pm [km]	Night time 10pm – 6am [km]		
50 - 54	19,2	35,564	46,007	292	218872,506
55 - 59	54,2	40,589	52,355	292	704354,335
60 - 64	93,4	50,817	18,853	292	1095192,26
65 - 69	132,06	45,73	9,053	292	1291804,6
70 - 74	211,58	2,747	2,923	292	173314,636
75 - 79	284	11,929		292	659410,219
> 79	330,15			292	0
		TOTAL / YEAR			**4 142 948,56**

Costs of noise burden for the "E variant":

Construction period of city bypasses: two years, 2011 – 2012

Operation period: 2012 – 2042

Table 36 – Noise cost in the evaluation period for the "E variant" (not discounted)

Noise level dB(A)	Noise cost [€/person/year]	Road length		Density of population [person/km]	Costs of noise impact [$€_{2010}$/year]
		Day time 6am – 10pm [km]	Night time 10pm – 6am [km]		
50 - 54	19,2	42,283	51,202	286	248867,777
55 - 59	54,2	43,078	62,428	286	768849,527
60 - 64	93,4	57,54	12,107	286	1134121,59
65 - 69	132,06	34,585	11,294	286	1014478,69
70 - 74	211,58	13,687	0,682	286	566722,408
75 - 79	284	6,121		286	331925,589
> 79	330,15			286	0
		TOTAL / YEAR			**4 064 965,59**

Costs of noise burden for the "F variant":

Table 37 – Noise cost in the evaluation period for the "F variant" (not discounted)

Noise level dB(A)	Noise cost [€/person/year]	Road length		Density of population [person/km]	Costs of noise impact [$€_{2010}$/year]
		Day time 6am – 10pm [km]	Night time 10pm – 6am [km]		
50 - 54	19,2	38,484	53,442	292	243677,496
55 - 59	54,2	41,352	51,107	292	705820,718
60 - 64	93,4	59,546	8,361	292	1158511,2
65 - 69	132,06	33,284	8,943	292	970476,031
70 - 74	211,58	0,729	3,033	292	92474,2818
75 - 79	284	11,929		292	659410,219
> 79	330,15			292	0
		TOTAL / YEAR			**3 830 369,95**

C2.6.4 COMPARE THE LIFETIME COSTS AND BENEFITS

Initially, investment and operation costs were calculated for individual variants and processed into the Cost data entry page. Benefits in comparing the E and F variant with the Zero variant were assessed as positive for positive values and negative for negative values. (Table 38)

Foreseen benefits of each variant were calculated and processed into the Benefit data entry page. Results were assessed as positive or negative according to the value of each variant compare to the 0 variant (Table 39).

Finally, net present value was calculated (Calculation of net present values) with the following results:

- NPV (variant E) = 350 989 252 €
  BCR (variant E) = 1,51
- NPV (variant F) = -1 384 198 347 €
  BCR (variant F) = -600,83

For the CIVITAS evaluation, discount rate of 5,5 % was recommended for Ústí nad Labem (Table 40 a Table 41).

The discounted costs are presented in the following tables in two versions:

- Version I – tables, in which the data were originally calculated and which contain more information
- Version II - tables in the form defined by the template for MERTs, presenting summary and comparison of results for individual evaluated scenarios

Table 38 – Lifetime cost of the variants 0, E, F (discounted) – table format version I

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital cost (€)	var 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	var E	431 450 000	431 450 000	0	0	0	0	0	0	0	0	0	0	0	0	0
	var F	2 300 000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating and Maintenance cost (€)	var 0	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
	var E	6 421 305	6 421 305	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044
	var F	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
salvage value	var 0															
	var E															
	var F															
Total (€)	var 0	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
	var E	437 871 305	437 871 305	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044
	var F	8 721 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
Changes	Change E - 0	431 450 000	431 450 000	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739
	Changes F - 0	2 300 000	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Capital cost (€)	var 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	var E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	var F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating and Maintenance cost (€)	var 0	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
	var E	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044
	var F	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
salvage value	var 0																	0
	var E																	-362 420 000
	var F																	0
Total (€)	var 0	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
	var E	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	7 381 044	-355 038 956
	var F	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305	6 421 305
Changes	Change E - 0	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	-361 460 261
	Changes F - 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 39 – Lifetime benefits of the variants 0, E, F (discounted) – table format version I

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue		var 0 (€)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		var E (€)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		var F (€)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Changes (€)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External cost/benefit	Operation coast	var 0	129 855 614	138 574 714	147 293 815	149 142 981	150 992 147	152 841 313	154 690 479	156 539 645	158 388 811	160 237 977	162 087 143	163 936 309	165 785 475	167 634 641	169 483 807
		var E	129 855 614	139 359 315	148 863 016	150 662 143	152 461 271	154 260 398	156 059 525	157 858 653	159 657 780	161 456 907	163 256 034	165 055 162	166 854 289	168 653 416	170 452 543
		var F	128 238 451	137 929 956	147 621 461	149 432 439	151 243 418	153 054 396	154 865 375	156 676 353	158 487 331	160 298 310	162 109 288	163 920 267	165 731 245	167 542 224	169 353 202
		Change E - 0	0	-784 601	-1 569 201	-1 519 163	-1 469 124	-1 419 085	-1 369 046	-1 319 008	-1 268 969	-1 218 930	-1 168 892	-1 118 853	-1 068 814	-1 018 775	-968 737
		Changes F - 0	1 617 163	644 758	-327 646	-289 458	-251 271	-213 083	-174 896	-136 708	-98 521	-60 333	-22 146	16 042	54 229	92 417	130 604
	Accidents costs	var 0	35 124 488	36 363 971	37 603 455	37 961 276	38 319 097	38 676 918	39 034 739	39 392 561	39 750 382	40 108 203	40 466 024	40 823 845	41 181 667	41 539 488	41 897 309
		var E	35 124 488	34 638 707	34 152 926	34 552 899	34 952 873	35 352 847	35 752 821	36 152 795	36 552 769	36 952 743	37 352 717	37 752 691	38 152 665	38 552 639	38 952 613
		var F	34 562 098	35 957 030	37 351 961	37 692 526	38 033 090	38 373 655	38 714 219	39 054 784	39 395 348	39 735 913	40 076 477	40 417 042	40 757 606	41 098 171	41 438 735
		Change E - 0	0	1 725 264	3 450 529	3 408 376	3 366 224	3 324 071	3 281 918	3 239 765	3 197 613	3 155 460	3 113 307	3 071 155	3 029 002	2 986 849	2 944 697
		Changes F - 0	562 390	406 941	251 493	268 750	286 007	303 263	320 520	337 777	355 034	372 290	389 547	406 804	424 061	441 317	458 574
	Time saving	var 0	955 307 116	1 021 752 465	1 088 197 813	1 102 263 656	1 116 329 498	1 130 395 341	1 144 461 183	1 158 527 026	1 172 592 868	1 186 658 711	1 200 724 553	1 214 790 396	1 228 856 238	1 242 922 081	1 256 987 923
		var E	955 307 116	989 429 900	1 023 552 683	1 036 354 644	1 049 156 605	1 061 958 567	1 074 760 528	1 087 562 489	1 100 364 450	1 113 166 411	1 125 968 372	1 138 770 334	1 151 572 295	1 164 374 256	1 177 176 217
		var F	1 016 370 977	1 094 730 334	1 173 089 692	1 187 819 057	1 202 548 422	1 217 277 787	1 232 007 152	1 246 736 517	1 261 465 882	1 276 195 247	1 290 924 612	1 305 653 977	1 320 383 342	1 335 112 708	1 349 842 073
		Change E - 0	0	32 322 565	64 645 130	65 909 011	67 172 893	68 436 774	69 700 656	70 964 537	72 228 418	73 492 300	74 756 181	76 020 062	77 283 944	78 547 825	79 811 706
		Changes F - 0	-61 063 860	-72 977 870	-84 891 879	-85 555 401	-86 218 924	-86 882 446	-87 545 969	-88 209 491	-88 873 014	-89 536 537	-90 200 059	-90 863 582	-91 527 104	-92 190 627	-92 854 149
	Noise cost	var 0	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949
		var E	4 142 949	4 142 949	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966
		var F	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370
		Change E - 0	0	0	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983
		Changes F - 0	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579
Changes in total benefit (€)		E - 0	0	33 263 229	66 604 441	67 876 208	69 147 975	70 419 743	71 691 510	72 963 278	74 235 045	75 506 812	76 778 580	78 050 347	79 322 115	80 593 882	81 865 649
Changes in total benefit (€)		F - 0	-58 571 729	-71 613 591	-84 655 453	-85 263 531	-85 871 609	-86 479 687	-87 087 766	-87 695 844	-88 303 922	-88 912 001	-89 520 079	-90 128 157	-90 736 236	-91 344 314	-91 952 392

Measure title: **Noise Reduction + Efficient Goods Distribution in ÚNL**

City: **City Name** *Project:* **Project name** *Measure number:* **x.y**

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
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	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	0	0	0	0
171 332 973	173 182 139	175 031 305	176 880 471	178 729 637	180 578 803	182 427 969	184 277 135	186 126 301	187 975 467	189 824 633	191 673 799	193 522 965	195 372 131	197 221 297	199 070 463	200 919 629
172 251 671	174 050 798	175 849 925	177 649 053	179 448 180	181 247 307	183 046 434	184 845 562	186 644 689	188 443 816	190 242 943	192 042 071	193 841 198	195 640 325	197 439 453	199 238 580	201 037 707
171 164 181	172 975 159	174 786 138	176 597 116	178 408 095	180 219 073	182 030 052	183 841 030	185 652 009	187 462 987	189 273 966	191 084 944	192 895 923	194 706 901	196 517 880	198 328 858	200 139 837
-918 698	-868 659	-818 620	-768 582	-718 543	-668 504	-618 466	-568 427	-518 388	-468 349	-418 311	-368 272	-318 233	-268 194	-218 156	-168 117	-118 078
168 792	206 979	245 167	283 355	321 542	359 730	397 917	436 105	474 292	512 480	550 667	588 855	627 042	665 230	703 417	741 605	779 792
42 255 130	42 612 952	42 970 773	43 328 594	43 686 415	44 044 236	44 402 058	44 759 879	45 117 700	45 475 521	45 833 343	46 191 164	46 548 985	46 906 806	47 264 627	47 622 449	47 980 270
39 352 586	39 752 560	40 152 534	40 552 508	40 952 482	41 352 456	41 752 430	42 152 404	42 552 378	42 952 352	43 352 326	43 752 300	44 152 274	44 552 247	44 952 221	45 352 195	45 752 169
41 779 300	42 119 864	42 460 429	42 800 993	43 141 558	43 482 122	43 822 686	44 163 251	44 503 815	44 844 380	45 184 944	45 525 509	45 866 073	46 206 638	46 547 202	46 887 767	47 228 331
2 902 544	2 860 391	2 818 238	2 776 086	2 733 933	2 691 780	2 649 628	2 607 475	2 565 322	2 523 170	2 481 017	2 438 864	2 396 711	2 354 559	2 312 406	2 270 253	2 228 101
475 831	493 088	510 344	527 601	544 858	562 114	579 371	596 628	613 885	631 141	648 398	665 655	682 912	700 168	717 425	734 682	751 939
1 271 053 766	1 285 119 608	1 299 185 451	1 313 251 293	1 327 317 136	1 341 382 978	1 355 448 821	1 369 514 663	1 383 580 506	1 397 646 348	1 411 712 191	1 425 778 033	1 439 843 876	1 453 909 718	1 467 975 561	1 482 041 403	1 496 107 246
1 189 978 178	1 202 780 139	1 215 582 100	1 228 384 062	1 241 186 023	1 253 987 984	1 266 789 945	1 279 591 906	1 292 393 867	1 305 195 829	1 317 997 790	1 330 799 751	1 343 601 712	1 356 403 673	1 369 205 634	1 382 007 595	1 394 809 557
1 364 571 438	1 379 300 803	1 394 030 168	1 408 759 533	1 423 488 898	1 438 218 263	1 452 947 628	1 467 676 993	1 482 406 358	1 497 135 723	1 511 865 088	1 526 594 453	1 541 323 818	1 556 053 183	1 570 782 548	1 585 511 913	1 600 241 279
81 075 588	82 339 469	83 603 350	84 867 232	86 131 113	87 394 994	88 658 876	89 922 757	91 186 639	92 450 520	93 714 401	94 978 283	96 242 164	97 506 045	98 769 927	100 033 808	101 297 689
-93 517 672	-94 181 194	-94 844 717	-95 508 239	-96 171 762	-96 835 285	-97 498 807	-98 162 330	-98 825 852	-99 489 375	-100 152 897	-100 816 420	-101 479 942	-102 143 465	-102 806 988	-103 470 510	-104 134 033
4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949	4 142 949
4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966	4 064 966
3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370	3 830 370
77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983	77 983
312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579	312 579
83 137 417	84 409 184	85 680 951	86 952 719	88 224 486	89 496 254	90 768 021	92 039 788	93 311 556	94 583 323	95 855 090	97 126 858	98 398 625	99 670 393	100 942 160	102 213 927	103 485 695
-92 560 470	-93 168 549	-93 776 627	-94 384 705	-94 992 784	-95 600 862	-96 208 940	-96 817 019	-97 425 097	-98 033 175	-98 641 253	-99 249 332	-99 857 410	-100 465 488	-101 073 567	-101 681 645	-102 289 723

Table 40 – Lifetime cost/benefits of CIVITAS measure – E variant (discounted) – table format version II

	Capital cost	Operation cost	Maintenance cost	Other cost (salvage value)	Savings from accident reductions	Savings Journey time savings	Savings from reductions of environmental emissions	Operation costs of users	Total cost	Total Benefit	Cumulated cost
Year 1	431 450 000	6 421 305		0	35 124 488	955 307 116	4 142 949	129 855 614	437 871 305	1 124 430 167	686 558 862
Year 2	431 450 000	6 421 305		0	34 638 707	989 429 900	4 142 949	139 359 315	437 871 305	1 167 570 871	729 699 566
Year 3	0	7 381 044		0	34 152 926	1 023 552 683	4 064 966	148 863 016	7 381 044	1 210 633 591	1 203 252 547
Year 4	0	7 381 044		0	34 552 899	1 036 354 644	4 064 966	150 662 143	7 381 044	1 225 634 652	1 218 253 608
Year 5	0	7 381 044		0	34 952 873	1 049 156 605	4 064 966	152 461 271	7 381 044	1 240 635 715	1 233 254 671
Year 6	0	7 381 044		0	35 352 847	1 061 958 567	4 064 966	154 260 398	7 381 044	1 255 636 778	1 248 255 734
Year 7	0	7 381 044		0	35 752 821	1 074 760 528	4 064 966	156 059 525	7 381 044	1 270 637 840	1 263 256 796
Year 8	0	7 381 044		0	36 152 795	1 087 562 489	4 064 966	157 858 653	7 381 044	1 285 638 903	1 278 257 859
Year 9	0	7 381 044		0	36 552 769	1 100 364 450	4 064 966	159 657 780	7 381 044	1 300 639 965	1 293 258 921
Year 10	0	7 381 044		0	36 952 743	1 113 166 411	4 064 966	161 456 907	7 381 044	1 315 641 027	1 308 259 983
Year 11	0	7 381 044		0	37 352 717	1 125 968 372	4 064 966	163 256 034	7 381 044	1 330 642 089	1 323 261 045
Year 12	0	7 381 044		0	37 752 691	1 138 770 334	4 064 966	165 055 162	7 381 044	1 345 643 153	1 338 262 109
Year 13	0	7 381 044		0	38 152 665	1 151 572 295	4 064 966	166 854 289	7 381 044	1 360 644 215	1 353 263 171
Year 14	0	7 381 044		0	38 552 639	1 164 374 256	4 064 966	168 653 416	7 381 044	1 375 645 277	1 368 264 233
Year 15	0	7 381 044		0	38 952 613	1 177 176 217	4 064 966	170 452 543	7 381 044	1 390 646 339	1 383 265 295
Year 16	0	7 381 044		0	39 352 586	1 189 978 178	4 064 966	172 251 671	7 381 044	1 405 647 401	1 398 266 357
Year 17	0	7 381 044		0	39 752 560	1 202 780 139	4 064 966	174 050 798	7 381 044	1 420 648 463	1 413 267 419
Year 18	0	7 381 044		0	40 152 534	1 215 582 100	4 064 966	175 849 925	7 381 044	1 435 649 525	1 428 268 481
Year 19	0	7 381 044		0	40 552 508	1 228 384 062	4 064 966	177 649 053	7 381 044	1 450 650 589	1 443 269 545

Year 20	0	7 381 044	0	40 952 482	1 241 186 023	4 064 966	179 448 180	7 381 044	1 465 651 651	1 458 270 607
Year 21	0	7 381 044	0	41 352 456	1 253 987 984	4 064 966	181 247 307	7 381 044	1 480 652 713	1 473 271 669
Year 22	0	7 381 044	0	41 752 430	1 266 789 945	4 064 966	183 046 434	7 381 044	1 495 653 775	1 488 272 731
Year 23	0	7 381 044	0	42 152 404	1 279 591 906	4 064 966	184 845 562	7 381 044	1 510 654 838	1 503 273 794
Year 24	0	7 381 044	0	42 552 378	1 292 393 867	4 064 966	186 644 689	7 381 044	1 525 655 900	1 518 274 856
Year 25	0	7 381 044	0	42 952 352	1 305 195 829	4 064 966	188 443 816	7 381 044	1 540 656 963	1 533 275 919
Year 26	0	7 381 044	0	43 352 326	1 317 997 790	4 064 966	190 242 943	7 381 044	1 555 658 025	1 548 276 981
Year 27	0	7 381 044	0	43 752 300	1 330 799 751	4 064 966	192 042 071	7 381 044	1 570 659 088	1 563 278 044
Year 28	0	7 381 044	0	44 152 274	1 343 601 712	4 064 966	193 841 198	7 381 044	1 585 660 150	1 578 279 106
Year 29	0	7 381 044	0	44 552 247	1 356 403 673	4 064 966	195 640 325	7 381 044	1 600 661 211	1 593 280 167
Year 30	0	7 381 044	0	44 952 221	1 369 205 634	4 064 966	197 439 453	7 381 044	1 615 662 274	1 608 281 230
Year 31	0	7 381 044	0	45 352 195	1 382 007 595	4 064 966	199 238 580	7 381 044	1 630 663 336	1 623 282 292
Year 32	0	7 381 044	-362 420 000	45 752 169	1 394 809 557	4 064 966	201 037 707	-355 038 956	1 645 664 399	2 000 703 355
Total	862 900 000	234 273 930	-362 420 000	1 268 339 615	38 220 170 612	130 234 878	5 517 725 778	734 753 930	45 136 470 883	44 401 716 953

Table 41 – Lifetime cost/benefits of CIVITAS measure – F variant (discounted) – table format version II

	Capital cost	Operation cost	Maintenance cost	Other cost (salvage value)	Savings from accident reductions	Savings from Journey time savings	Savings from reductions of environmental emissions	Operation costs of users	Total cost	Total Benefit	Cumulated cost
Year 1	2 300 000		6 421 305	0	34 562 098	1 016 370 977	3 830 370	128 238 451	8 721 305	1 183 001 896	1 174 280 591
Year 2	0		6 421 305	0	35 957 030	1 094 730 334	3 830 370	137 929 956	6 421 305	1 272 447 690	1 266 026 385
Year 3	0		6 421 305	0	37 351 961	1 173 089 692	3 830 370	147 621 461	6 421 305	1 361 893 484	1 355 472 179
Year 4	0		6 421 305	0	37 692 526	1 187 819 057	3 830 370	149 432 439	6 421 305	1 378 774 392	1 372 353 087
Year 5	0		6 421 305	0	38 033 090	1 202 548 422	3 830 370	151 243 418	6 421 305	1 395 655 300	1 389 233 995
Year 6	0		6 421 305	0	38 373 655	1 217 277 787	3 830 370	153 054 396	6 421 305	1 412 536 208	1 406 114 903
Year 7	0		6 421 305	0	38 714 219	1 232 007 152	3 830 370	154 865 375	6 421 305	1 429 417 116	1 422 995 811
Year 8	0		6 421 305	0	39 054 784	1 246 736 517	3 830 370	156 676 353	6 421 305	1 446 298 024	1 439 876 719
Year 9	0		6 421 305	0	39 395 348	1 261 465 882	3 830 370	158 487 331	6 421 305	1 463 178 931	1 456 757 626
Year 10	0		6 421 305	0	39 735 913	1 276 195 247	3 830 370	160 298 310	6 421 305	1 480 059 840	1 473 638 535
Year 11	0		6 421 305	0	40 076 477	1 290 924 612	3 830 370	162 109 288	6 421 305	1 496 940 747	1 490 519 442
Year 12	0		6 421 305	0	40 417 042	1 305 653 977	3 830 370	163 920 267	6 421 305	1 513 821 656	1 507 400 351
Year 13	0		6 421 305	0	40 757 606	1 320 383 342	3 830 370	165 731 245	6 421 305	1 530 702 563	1 524 281 258
Year 14	0		6 421 305	0	41 098 171	1 335 112 708	3 830 370	167 542 224	6 421 305	1 547 583 473	1 541 162 168
Year 15	0		6 421 305	0	41 438 735	1 349 842 073	3 830 370	169 353 202	6 421 305	1 564 464 380	1 558 043 075
Year 16	0		6 421 305	0	41 779 300	1 364 571 438	3 830 370	171 164 181	6 421 305	1 581 345 289	1 574 923 984
Year 17	0		6 421 305	0	42 119 864	1 379 300 803	3 830 370	172 975 159	6 421 305	1 598 226 196	1 591 804 891
Year 18	0		6 421 305	0	42 460 429	1 394 030 168	3 830 370	174 786 138	6 421 305	1 615 107 105	1 608 685 800
Year 19	0		6 421 305	0	42 800 993	1 408 759 533	3 830 370	176 597 116	6 421 305	1 631 988 012	1 625 566 707

Year 20	0	6 421 305	0	43 141 558	1 423 488 898	3 830 370	178 408 095	6 421 305	1 648 868 921	1 642 447 616
Year 21	0	6 421 305	0	43 482 122	1 438 218 263	3 830 370	180 219 073	6 421 305	1 665 749 828	1 659 328 523
Year 22	0	6 421 305	0	43 822 686	1 452 947 628	3 830 370	182 030 052	6 421 305	1 682 630 736	1 676 209 431
Year 23	0	6 421 305	0	44 163 251	1 467 676 993	3 830 370	183 841 030	6 421 305	1 699 511 644	1 693 090 339
Year 24	0	6 421 305	0	44 503 815	1 482 406 358	3 830 370	185 652 009	6 421 305	1 716 392 552	1 709 971 247
Year 25	0	6 421 305	0	44 844 380	1 497 135 723	3 830 370	187 462 987	6 421 305	1 733 273 460	1 726 852 155
Year 26	0	6 421 305	0	45 184 944	1 511 865 088	3 830 370	189 273 966	6 421 305	1 750 154 368	1 743 733 063
Year 27	0	6 421 305	0	45 525 509	1 526 594 453	3 830 370	191 084 944	6 421 305	1 767 035 276	1 760 613 971
Year 28	0	6 421 305	0	45 866 073	1 541 323 818	3 830 370	192 895 923	6 421 305	1 783 916 184	1 777 494 879
Year 29	0	6 421 305	0	46 206 638	1 556 053 183	3 830 370	194 706 901	6 421 305	1 800 797 092	1 794 375 787
Year 30	0	6 421 305	0	46 547 202	1 570 782 548	3 830 370	196 517 880	6 421 305	1 817 678 000	1 811 256 695
Year 31	0	6 421 305	0	46 887 767	1 585 511 913	3 830 370	198 328 858	6 421 305	1 834 558 908	1 828 137 603
Year 32	0	6 421 305	0	47 228 331	1 600 241 279	3 830 370	200 139 837	6 421 305	1 851 439 817	1 845 018 512
Total	2 300 000	205 481 760	0	1 339 223 517	43 711 065 866	122 571 840	5 482 587 865	207 781 760	50 655 449 088	50 447 667 328

Table 42 – Lifetime cost/benefits of the reference measure/case – 0 variant (discounted) – table format version II

	Capital cost	Operation cost	Maintenance cost	Other cost (salvage value)	Savings from accident reductions	Savings from Journey time savings	Savings from reductions of environmental emissions	Operation costs of users	Total cost	Total Benefit	Cumulated cost
Year 1	0		6 421 305	0	35 124 488	955 307 116	4 142 949	129 855 614	6 421 305	1 124 430 167	1 118 008 862
Year 2	0		6 421 305	0	36 363 971	1 021 752 465	4 142 949	138 574 714	6 421 305	1 200 834 099	1 194 412 794
Year 3	0		6 421 305	0	37 603 455	1 088 197 813	4 142 949	147 293 815	6 421 305	1 277 238 032	1 270 816 727
Year 4	0		6 421 305	0	37 961 276	1 102 263 656	4 142 949	149 142 981	6 421 305	1 293 510 862	1 287 089 557
Year 5	0		6 421 305	0	38 319 097	1 116 329 498	4 142 949	150 992 147	6 421 305	1 309 783 691	1 303 362 386
Year 6	0		6 421 305	0	38 676 918	1 130 395 341	4 142 949	152 841 313	6 421 305	1 326 056 521	1 319 635 216
Year 7	0		6 421 305	0	39 034 739	1 144 461 183	4 142 949	154 690 479	6 421 305	1 342 329 350	1 335 908 045
Year 8	0		6 421 305	0	39 392 561	1 158 527 026	4 142 949	156 539 645	6 421 305	1 358 602 181	1 352 180 876
Year 9	0		6 421 305	0	39 750 382	1 172 592 868	4 142 949	158 388 811	6 421 305	1 374 875 010	1 368 453 705
Year 10	0		6 421 305	0	40 108 203	1 186 658 711	4 142 949	160 237 977	6 421 305	1 391 147 840	1 384 726 535
Year 11	0		6 421 305	0	40 466 024	1 200 724 553	4 142 949	162 087 143	6 421 305	1 407 420 669	1 400 999 364
Year 12	0		6 421 305	0	40 823 845	1 214 790 396	4 142 949	163 936 309	6 421 305	1 423 693 499	1 417 272 194
Year 13	0		6 421 305	0	41 181 667	1 228 856 238	4 142 949	165 785 475	6 421 305	1 439 966 329	1 433 545 024
Year 14	0		6 421 305	0	41 539 488	1 242 922 081	4 142 949	167 634 641	6 421 305	1 456 239 159	1 449 817 854
Year 15	0		6 421 305	0	41 897 309	1 256 987 923	4 142 949	169 483 807	6 421 305	1 472 511 988	1 466 090 683
Year 16	0		6 421 305	0	42 255 130	1 271 053 766	4 142 949	171 332 973	6 421 305	1 488 784 818	1 482 363 513
Year 17	0		6 421 305	0	42 612 952	1 285 119 608	4 142 949	173 182 139	6 421 305	1 505 057 648	1 498 636 343
Year 18	0		6 421 305	0	42 970 773	1 299 185 451	4 142 949	175 031 305	6 421 305	1 521 330 478	1 514 909 173
Year 19	0		6 421 305	0	43 328 594	1 313 251 293	4 142 949	176 880 471	6 421 305	1 537 603 307	1 531 182 002

Year 20	0	6 421 305	0	43 686 415	1 327 317 136	4 142 949	178 729 637	6 421 305	1 553 876 137	1 547 454 832
Year 21	0	6 421 305	0	44 044 236	1 341 382 978	4 142 949	180 578 803	6 421 305	1 570 148 966	1 563 727 661
Year 22	0	6 421 305	0	44 402 058	1 355 448 821	4 142 949	182 427 969	6 421 305	1 586 421 797	1 580 000 492
Year 23	0	6 421 305	0	44 759 879	1 369 514 663	4 142 949	184 277 135	6 421 305	1 602 694 626	1 596 273 321
Year 24	0	6 421 305	0	45 117 700	1 383 580 506	4 142 949	186 126 301	6 421 305	1 618 967 456	1 612 546 151
Year 25	0	6 421 305	0	45 475 521	1 397 646 348	4 142 949	187 975 467	6 421 305	1 635 240 285	1 628 818 980
Year 26	0	6 421 305	0	45 833 343	1 411 712 191	4 142 949	189 824 633	6 421 305	1 651 513 116	1 645 091 811
Year 27	0	6 421 305	0	46 191 164	1 425 778 033	4 142 949	191 673 799	6 421 305	1 667 785 945	1 661 364 640
Year 28	0	6 421 305	0	46 548 985	1 439 843 876	4 142 949	193 522 965	6 421 305	1 684 058 775	1 677 637 470
Year 29	0	6 421 305	0	46 906 806	1 453 909 718	4 142 949	195 372 131	6 421 305	1 700 331 604	1 693 910 299
Year 30	0	6 421 305	0	47 264 627	1 467 975 561	4 142 949	197 221 297	6 421 305	1 716 604 434	1 710 183 129
Year 31	0	6 421 305	0	47 622 449	1 482 041 403	4 142 949	199 070 463	6 421 305	1 732 877 264	1 726 455 959
Year 32	0	6 421 305	0	47 980 270	1 496 107 246	4 142 949	200 919 629	6 421 305	1 749 150 094	1 742 728 789
Total	0	205 481 760	0	1 355 244 325	40 741 635 466	132 574 368	5 491 631 988	205 481 760	47 721 086 147	47 515 604 387

Table 43 – Calculation of NPV for the variant E

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Undiscounted cash flow															
Changes in total cost (€)	431 450 000	431 450 000	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739
Changes in total benefit (€)	0	33 263 229	66 604 441	67 876 208	69 147 975	70 419 743	71 691 510	72 963 278	74 235 045	75 506 812	76 778 580	78 050 347	79 322 115	80 593 882	81 865 649
Net cash flow (€)	-431 450 000	-398 186 771	65 644 702	66 916 469	68 188 236	69 460 004	70 731 771	72 003 539	73 275 306	74 547 073	75 818 841	77 090 608	78 362 376	79 634 143	80 905 910
Discount Factors															
Discount Rate	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%
Base Year	2011														
Discounted cash flow															
Changes in total cost (€)	431 450 000	408 957 346	862 280	817 327	774 717	734 329	696 047	659 760	625 365	592 763	561 861	532 569	504 805	478 488	453 543
Changes in total benefit (€)	0	31 529 127	59 840 921	57 804 306	55 817 404	53 880 564	51 993 969	50 157 643	48 371 471	46 635 217	44 948 528	43 310 957	41 721 966	40 180 941	38 687 198
Net cash flow (€)	-431 450 000	-377 428 219	58 978 641	56 986 979	55 042 686	53 146 235	51 297 922	49 497 883	47 746 107	46 042 454	44 386 668	42 778 388	41 217 161	39 702 453	38 233 655
Cumulative cash flow (€)	-431 450 000	-808 878 219	-749 899 578	-692 912 599	-637 869 913	-584 723 677	-533 425 755	-483 927 872	-436 181 766	-390 139 312	-345 752 644	-302 974 256	-261 757 095	-222 054 642	-183 820 987
Changes in NPV (€)	350 989 252														

	16	17	18	19	20	21	22	23
	2026	2027	2028	2029	2030	2031	2032	2033
	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739
	83 137 417	84 409 184	85 680 951	86 952 719	88 224 486	89 496 254	90 768 021	92 039 788
	82 177 678	83 449 445	84 721 212	85 992 980	87 264 747	88 536 515	89 808 282	91 080 049
	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%
	429 899	407 487	386 244	366 108	347 022	328 930	311 782	295 528
	37 239 996	35 838 543	34 482 002	33 169 498	31 900 126	30 672 958	29 487 042	28 341 413
	36 810 098	35 431 056	34 095 758	32 803 390	31 553 105	30 344 028	29 175 260	28 045 885
	-147 010 890	-111 579 833	-77 484 076	-44 680 686	-13 127 581	17 216 447	46 391 707	74 437 592

	24	25	26	27	28	29	30	31	32
	2034	2035	2036	2037	2038	2039	2040	2041	2042
	959 739	959 739	959 739	959 739	959 739	959 739	959 739	959 739	-361 460 261
	93 311 556	94 583 323	95 855 090	97 126 858	98 398 625	99 670 393	100 942 160	102 213 927	103 485 695
	92 351 817	93 623 584	94 895 351	96 167 119	97 438 886	98 710 654	99 982 421	101 254 188	464 945 956
	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%
	280 122	265 518	251 676	238 555	226 119	214 331	203 157	192 566	-68 743 923
	27 235 093	26 167 097	25 136 435	24 142 119	23 183 159	22 258 572	21 367 380	20 508 613	19 681 313
	26 954 971	25 901 578	24 884 759	23 903 564	22 957 041	22 044 241	21 164 223	20 316 047	88 425 236
	101 392 563	127 294 142	152 178 901	176 082 465	199 039 505	221 083 747	242 247 969	262 564 016	350 989 252

Table 44 – Calculation of NPV for the variant F

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Undiscounted cash flow															
Changes in total cost (€)	2 300 000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Changes in total benefit (€)	-58 571 729	-71 613 591	-84 655 453	-85 263 531	-85 871 609	-86 479 687	-87 087 766	-87 695 844	-88 303 922	-88 912 001	-89 520 079	-90 128 157	-90 736 236	-91 344 314	-91 952 392
Net cash flow (€)	-60 871 729	-71 613 591	-84 655 453	-85 263 531	-85 871 609	-86 479 687	-87 087 766	-87 695 844	-88 303 922	-88 912 001	-89 520 079	-90 128 157	-90 736 236	-91 344 314	-91 952 392
Discount Factors															
Discount Rate	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%
Base Year	2011														
Discounted cash flow															
Changes in total cost (€)	2 300 000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Changes in total benefit (€)	-58 571 729	-67 880 181	-76 058 896	-72 611 588	-69 317 001	-66 168 580	-63 160 039	-60 285 351	-57 538 736	-54 914 653	-52 407 792	-50 013 061	-47 725 583	-45 540 683	-43 453 884
Net cash flow (€)	-60 871 729	-67 880 181	-76 058 896	-72 611 588	-69 317 001	-66 168 580	-63 160 039	-60 285 351	-57 538 736	-54 914 653	-52 407 792	-50 013 061	-47 725 583	-45 540 683	-43 453 884
Cumulative cash flow (€)	-60 871 729	-128 751 911	-204 810 806	-277 422 394	-346 739 395	-412 907 975	-476 068 014	-536 353 365	-593 892 101	-648 806 755	-701 214 546	-751 227 607	-798 953 190	-844 493 873	-887 947 757
Changes in NPV (€)	-1 384 198 347														

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-92 560 470	-93 168 549	-93 776 627	-94 384 705	-94 992 784	-95 600 862	-96 208 940	-96 817 019	-97 425 097	-98 033 175	-98 641 253	-99 249 332	-99 857 410	-100 465 488	-101 073 567	-101 681 645	-102 289 723
	-92 560 470	-93 168 549	-93 776 627	-94 384 705	-94 992 784	-95 600 862	-96 208 940	-96 817 019	-97 425 097	-98 033 175	-98 641 253	-99 249 332	-99 857 410	-100 465 488	-101 073 567	-101 681 645	-102 289 723
	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-41 460 894	-39 557 604	-37 740 078	-36 004 547	-34 347 401	-32 765 184	-31 254 588	-29 812 445	-28 435 723	-27 121 521	-25 867 061	-24 669 687	-23 526 856	-22 436 134	-21 395 196	-20 401 814	-19 453 859
	-41 460 894	-39 557 604	-37 740 078	-36 004 547	-34 347 401	-32 765 184	-31 254 588	-29 812 445	-28 435 723	-27 121 521	-25 867 061	-24 669 687	-23 526 856	-22 436 134	-21 395 196	-20 401 814	-19 453 859
	-929 408 651	-968 966 254	-1 006 706 333	-1 042 710 880	-1 077 058 281	-1 109 823 465	-1 141 078 053	-1 170 890 498	-1 199 326 221	-1 226 447 741	-1 252 314 803	-1 276 984 490	-1 300 511 345	-1 322 947 480	-1 344 342 675	-1 364 744 489	-1 384 198 347

C2.6.5 SUMMARY OF CBA RESULTS

The economic analysis shows positive results for the variant E proposing construction of the system of bypasses leading traffic away from the sensitive zones in the city. With the defined investment and operation costs and with calculated environmental benefits, the scenario is economically feasible. On the other hand, speed reduction proposed in the variant F proved as economically not effective solutions and thus not feasible.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
2a	+ 5 %	★★★
2b	-	NA
2c	-	NA
	Noise Impact 25 %	★★★
	Noise level - 5 %	O
8	- 5 %	NA
9	- 5 %	★
10	- 5 %	O
11	- 5 %	NA
25	- 15 %	O

NA = Not Assessed **O = Not Achieved** **★ = Substantially achieved (at least 50%)**

★★ = Achieved in full **★★★ = Exceeded**

C4 Up-scaling of results

Scenarios for noise reduction are proposed for the entire city territory. The principle of the scenarios is applicable also for other cities or regions, with regard to local conditions, transport infrastructure and transport requirements.

C5 Appraisal of evaluation approach

Effectiveness of proposed scenarios was assessed through the traffic model. Based on modelling the evaluation scenarios, data about transport performance and emitted pollution were gathered. Transport model is grounded on the national traffic census and calibrated by the coefficient of transport development. Economic indicators were defined by standard methodology used for economic evaluation of effectiveness of road structures in the Czech Republic and by CBA Recommendations for CIVITAS Evaluation, J. Piao and J. Preston.

C5.1 Traffic model of the city

The traffic model covers the entire cadastral territory of the city of Ústí nad Labem. It involves detail transport relations within the city, taking fully into account transport links leading from, to and across the city area. The model of the city simulates all details of the city road network, including directional lines, width ratios, number of driving lanes, permitted speed limit and PT routes. The transport infrastructure outside the city is modelled with fewer details, only to reflect national and international transport relations.

The proposed restrictions regulate traffic in the city centre while preserving routes for transit traffic. Due to the fact, that the city lacks suitable large capacity superior roads bypassing the sensitive area, it was necessary to maintain throughput of the main I and II class arteries.

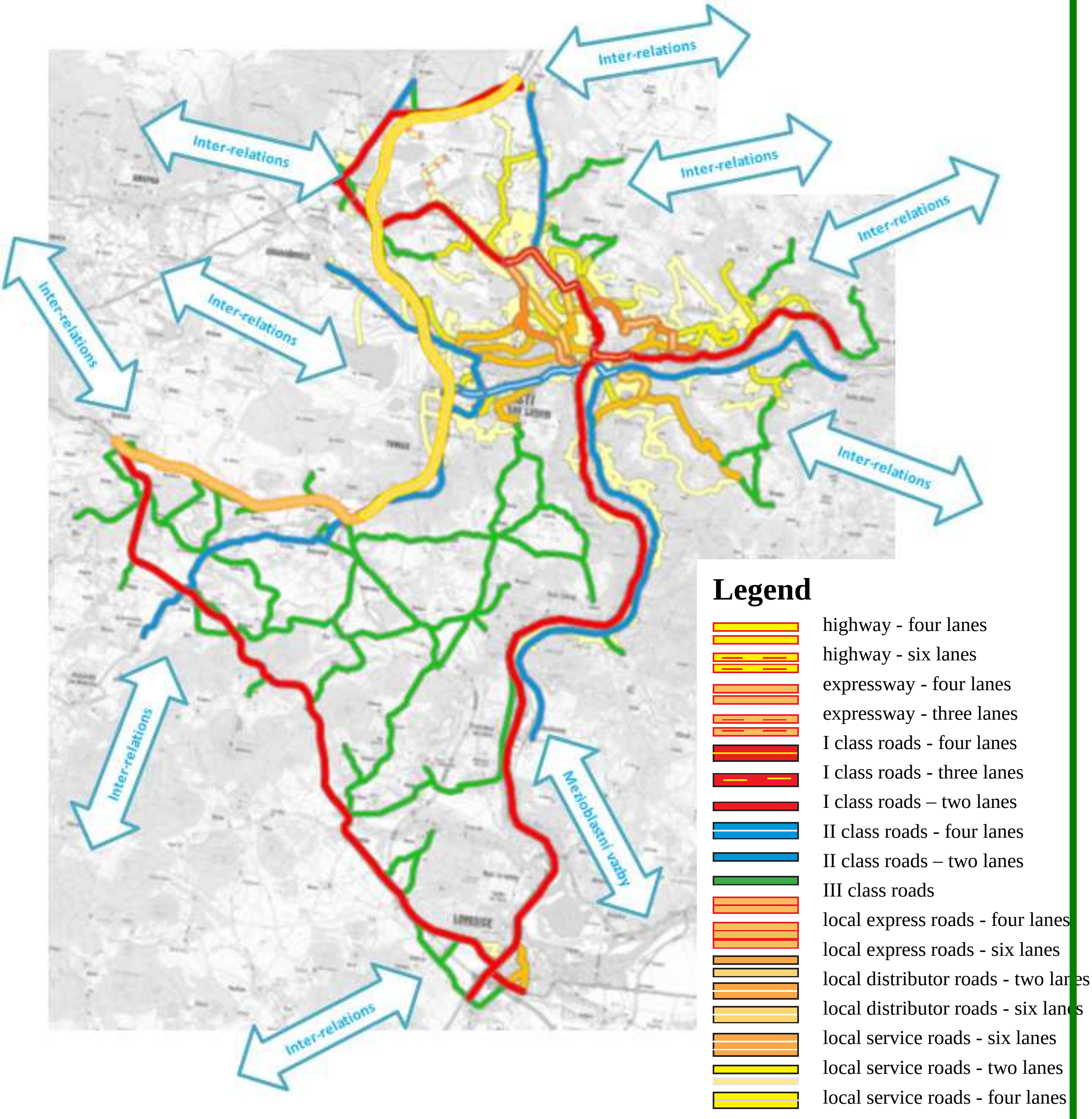
Calibration of the traffic model was realised by the national traffic census from the years 2005 and 2010, which is conducted every five years by the Directorate of Roads and Highways in the Czech Republic. Furthermore, the traffic model calculates with coefficients for predicted traffic growth officially published by the Directorate. These inputs provide an overview of the traffic performance and composition of the traffic flow on major roads on the entire territory of the Czech Republic.

To refine the model, Municipal employees realised traffic counting at selected locations in the city. In addition, data from sensors of traffic light devices, automatic traffic counters and schedules of public transport in the city were used for model calibrations.

Model simulations present the state of traffic in a perspective situation, according to set parameters, based on factors of traffic growth (with respect to the economic and social development), changes in transport infrastructure and changes in the distribution of transport sources and destinations.

Because of exact input data and sophisticated software, model results are considered reliable.

Figure C5.1.1: The physical extend of the city traffic model used for measure evaluation



C6 Summary of evaluation results

- **Key result 1** – reduction of traffic speed is not an efficient tool for noise reduction and results in only slight decrease of traffic noise and therefore is certain decrease in the amount of population exposed to noise levels above 60 dB, however, amount of pollutants increases and heavy traffic level remains in densely populated city areas (with increased time loss).
- **Key result 2** – construction of city bypasses is a feasible and profitable solution, leading the unnecessary traffic away from sensitive areas

C7 Future activities relating to the measure

To significantly reduce unnecessary traffic transiting Ústí nad Labem, it is necessary to finish the highway D8, which remains under construction and faces unrelenting resistance from environmentalists, postponing its completion into uncertainty.

To support noise reduction, it is adequate to regulate entrance to the city centre and establish suitable alternative routes in order to redirect intensive traffic from densely populated areas. At the same time, it is desirable to remain transport services in the area to ensure functions of the city centre.

The complex of solutions for noise reduction was processed into the SUTP of the city, which will be submitted to city authorities for approval and subsequent implementation of the relevant action plan.

D Process Evaluation Findings

D.0 Focused measure

2*	0	No focussed measure
3*	1	Most important reason
6*	2	Second most important reason
8*	3	Third most important reason

*) Reasons from checklist in Guidelines for the Completion of the MERT

D.1 Deviations from the original plan

- **Deviation 1** – Scenario E recommended within the measure and evaluated as the most effective solution proposes implementation of city bypasses leading unnecessary traffic away from sensitive areas in the city. This solution complied with the previous version of the city Master Plan of Ústí nad Labem, which, however, changed during the project period and the latest approved version of the Master Plan does not include it. Moreover, the solution became undesirable due to protests of a local civic association called Stop the Tunnels, which refuses construction of any new motor transport infrastructure in the city. Current political authorities in the city demanded removal of the solution from the SUTP in order to have the document accepted by the city. In the current political atmosphere, city bypasses cannot be included in the SUTP and therefore, the solution was removed.

- **Deviation 2 -** CO_2 emissions and particulates could not be calculated by the existing traffic model, because the current version used by the city does not feature such application.

D.2 Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Political/strategic barrier (1)** – There is no political support for radical but highly efficient solutions, rather soft measures are supported.

- **Institutional barrier (2) -** Integration with the Master Plan of the city, which was being developed within project duration, proved to be complicated.

- **Planning barrier (7) -** Problem of noise in the city is a very complex issue requiring to consider wide range of background information and influencing conditions, such as the necessity to consider extraordinary noise sources, weather, background noise, construction works etc.

- **Problem related barrier (4) -** Traffic model calculations in the current state are based on real-life data. However, prognosis for future years may be imprecise using an inaccurate coefficient of transport development, which is influenced by various factors, such as area development, population development, economic development of region, state and Europe etc.

Implementation phase

- **Organizational barrier (8) -** Noise measurements were possible only during certain periods, which along with traffic closures and construction works in the city hindered the process.

- **Problem related barrier (4)** – When considering individual scenarios, the issue of shifting the problem to different fields appeared (speed, emissions, pollution)

Operation phase

- **Financial barrier (9) -** Results of the measures will be complicated to realise in real life due to high financial demands of implementing new infrastructure and political unwillingness to deal with the problem.

D.2.2 Drivers

Preparation phase

- **Communication driver (5)** – Currently, there are discussions of experts at national scale about lowering permitted noise limits in the city and avoiding shifting the problem elsewhere, which results in more urgent need in addressing the issue in the city.

- **Involvement driver (5)** – Solutions reducing noise impact of traffic, proposing more fluent traffic with lower emissions and improving the living environment in the city is required in the city and demanded by its residents.

- **Institutional driver (2) -** The existing absence of a traffic noise solution for the city results in conflict with the current valid law, therefore the situation needs to be solved urgently. Laws and regulations demand noise improvements.

Implementation phase

- **Technological driver (10)** – Traffic modelling and evaluation proved efficiency of proposed scenarios (mostly the scenario E involving construction of city bypasses), even if the implementation is not currently supported in the city.

Operation phase

- **Positional driver (6) –** The measure is focused on sensitive areas in the city, primarily the city centre, residential areas, schools and hospitals, which are prioritised for improvements and supported by citizens.

- **Problem related (4) –** Pressure of the problem requires implementing a solution and improving the conditions.

D.2.3 Activities

4 Problem related

Preparation phase

- **Planning activities (7)** – Timing of noise measurements was rescheduled to better fit local circumstances and to allow development of an accurate noise map for current and foreseen transport in the city.

- **Problem related activities (4)** – Issue of precise noise measurements were solved by gathering more noise inputs and modelling in more detailed differentiation.

Implementation phase

- **Communication activities (5)** – Discussing the results for noise reducing solutions with the public and with city authorities during the process of SUTP development is ongoing.

- **Technology activities (10)** – Traffic modelling reveals foreseen state and efficiency of proposed solutions and enables visualisation of results and their graphical presentation.

Operation phase

- **No activities** – The measure is not operated in real life.

D.3 Participation

D.3.1. Measure Partners

- **Ústí nad Labem Municipality**

D.3.2 Stakeholders

- **Residents**
- **Car drivers and motorists**
- **General public**

D.4 Recommendations

D.4.1 Recommendations: measure replication

- **Recommendation 1 –** For traffic noise improvements, it is recommended to use the method of traffic modelling to visualise and asses proposed variants, but the model must be calibrated to precise values. It is always recommended to compare model and real-life results measured in the city.
- **Recommendation 2** – Proposed scenarios for noise reduction are addressing sensitive areas in the city and are suitable for exploitation of results to other urban areas, other cities or regions.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

- **Recommendation 1 –** Gain political and public support for approval and subsequent implementation of suitable solutions by extensive communication of results.
- **Recommendation 2 –** Carry through major changes in the transport scheme by preserving consistent pressure towards the set goals.
- **Recommendation 3** – Ensure required resources for measure implementation in the city.