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Socioenvironmental Justice in Transportation Planning

A Critical Case Study of Bypass Stockholm

Ammar Korshed

Department of Human Geography
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Examiner: Henrik Gutzon Larsen
Supervisor: Guy Baeten

Abstract

This study politicises transportation planning by applying a socioenvironmental justice perspective on the case of Bypass Stockholm. The theoretical framework includes nature-society and time-space relationships, socioenvironmental justice, and urban transportation concepts. Qualitative interviews, text analyses, and quantitative mapping of geographical distributions of social data are performed in order to analyse planning practices, policies, priorities, and potential distributions of socioenvironmental risks and benefits. The results of this study indicate that negative externalities will to a disproportional extent fall upon socioenvironments where less privileged populations reside. Benefits from increased transportation opportunities created by the bypass will mainly benefit others than the exposed populations in these areas. The Bypass Stockholm project will mainly improve the socioenvironments and (auto)mobility of privileged populations.

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1. Introduction

1.1. Politicising Socioenvironmental Change

Urbanisation and transportation planning are parallel developments that go hand in hand with each other. Both of the processes are generated by human agency and they are subsequently social phenomena with political dimensions.

The environmental sustainability discourse has been established on the political agenda with the purpose of transcending conventional socioenvironmental divides and conflicts by claiming a common, universal public interest (Baeten 2000:71):

> "The sustainability discourse is characterized by a frightening silence when it comes to the sharp socio-political conflicts which are at the heart of every single transport decision, be it the construction of an urban by-pass or parking restrictions in shopping mall-like town centres." (ibid:70)

The liberal political economy conceals the social relations by treating the allocation of scarce resources simply as a technical issue (Harvey 1996:131). *Ecological modernism*, an ideological neoliberal approach, promotes economic growth and to some extent environmental protection, but does nevertheless neglect issues of social sustainability and equity (Gunder 2006). Swyngedouw (2007) poses a warning about the post-political condition and argues that environmental problems need to be politicised. He is also concerned over the lack of attention to fundamental social power relations in the mobility and transportation planning discourse (Swyngedouw 1993):

> "The debate on transportation, communication and mobility can therefore not escape asking serious questions about social justice and emancipation as mobility itself is part and parcel of the process of uneven development and of consolidating asymmetrical power relations." (ibid:323)

Urbanisation and transportation planning are thus results and generators of asymmetrical social power relations. Urban transportation is essentially a political phenomenon adherent with equity and social justice challenges (Mercier 2009:146). The environmental dimension is fundamental in the transportation planning debate thus transports generate and (re)distribute environmental hazards.

The environmental perspective is hence unavoidably political generating conflicts and controversies:

> "Putting the inequalities on the top of the environmental agenda directly challenges the dominant discourses." (Harvey 1996:385)

Environmental justice will be the central guiding principle of this study. It enables politicising of the urban transportation planning agenda from environmental and social justice perspectives. Environmental justice is a complex issue stretching over a multitude of definitions, dimensions, and scales. What is justice, how is it understood, and how should it be defined? These are some of the questions that will be handled in this study.

The environmental justice concept will be applied on a case study about Bypass Stockholm, an enormous road infrastructure investment crossing the western part of the Stockholm region.

1.1. Research Questions and Objective

- ***Is Bypass Stockholm socioenvironmentally just?***
- What is and which factors create socioenvironmental injustices?
- How will socioenvironmental impacts be distributed due to the construction of Bypass Stockholm?
- Who end up as the winners respectively the losers?

The questions will be answered *qualitatively*, i.e. by descriptive outlines of the expected outcomes based on the theoretical and empirical material presented throughout the study.

I do not intend to make a stand about if Bypass Stockholm should be constructed or not. Instead, the aim of this study is to raise consciousness about the project from a justice perspective, and to evaluate potential risks and benefits created by the project, in a wider urban transportation context.

1.2. Scope and Limitations

In this study, urban transportation planning will be divided into two components: (1) *physical* transportation infrastructure, and (2) the capacity/potential to access social functions in separate spaces through *mobility*.

Bypass Stockholm is not an isolated project but rather one (major) component within a larger regional development plan. The regional planning includes a

comprehensive spectrum of public transport infrastructure investments, road investments, road user fees, urban development projects, and etcetera. Studying investments in public transport infrastructure are certainly important factors when evaluating whether the regional planning policies are environmentally just. Nonetheless, the scope of this project will solely include those factors that are in direct relation to Bypass Stockholm, i.e. measures that are interdependent with (preconditions for or dependent on) the Bypass Stockholm project. Here, the congestion charges in the city centre, in combination with the bypass, are essential for the urban traffic management and can thus hardly be excluded from the analysis. Subsequently, the congestion charges are incorporated in this study.

Environmental injustices are indeed global problems as well as national and urban ones (Zuindeau 2006). This study is however limited to the urban scale – the metropolitan region of greater Stockholm – partly due to the difficulties to empirically grasp larger geographical scales in a study of this extent.

1.3. Disposition

This study starts with outlining the theoretical framework. Here, discussions about the nature-society relation, justice, socioenvironmental transformation, and transportation and accessibility are elaborated. The second chapter declares the methodological considerations and motivates the research methods used in this study. Further, the empirical results are structured in sections including a contextual outline, followed by planning policies, health assessments, and finally case specific data associated with the Bypass Stockholm project. Finally, the material is intertwined in an analytical discussion whereof the research questions are answered in the concluding chapter. It will be concluded that Bypass Stockholm and associated transportation planning measures reinforce socioenvironmental and transport injustices due to (1) the traffic relocating effect, (2) improvement of mobility in the centre by exclusionary measures, and (3) improved attractiveness of automobility as the vein of future urbanisation.

2. Conceptual Framework

Before examining the issues of equality, justice and sustainability I will first discuss a couple of other essential issues. Transport infrastructure projects and the sustainability debate are intimately related with the interaction between nature and society. Hence, reworking nature will inevitably transform the living environments of communities. How can the relationship between the social and the natural be apprehended?

2.1. The Nature-Society Relationship

In this section I will outline a discussion concerning questions such as "what is nature" and "what the relation between society and nature is like". There are major controversies associated with the answers to such questions. I will start by highlighting two antagonistic philosophic antipodes: an anthropocentric (neoclassical) economic approach and an ecocentric ecologist approach.

The *neoclassical economic approach* regards nature as a source from which society can extract ecosystem goods, services, and cultural benefits (Barbier 2011). From this approach Barbier (2011:338) derives this widespread conception:

> "Economists agree that, to determine society's willingness to pay for the benefits provided by ecosystem goods and services, one needs to measure and account for their various impacts on human welfare."

The anthropocentricity is explicit: nature has no intrinsic value other than the evaluation of nature as a resource that contributes to the human welfare. People and communities have to evaluate those parts of the ecosystem that they wish to sustain by paying in equivalence to their marginal utility of every particular piece of nature. I will come back to the problem of evaluation (pricing) later in this chapter.

The ecocentric *deep ecology* approach outlined by Næss (1989) is normative and idealistic. It subscribes nature an intrinsic value regardless of its contributions to social welfare:

> "The right of all the forms to live is a universal right which cannot be quantified. No single species of living being has more of this particular right to live and unfold than any other species." (ibid:166)

From these two antagonistic extremes, the questions arise of why and what to sustain: nature *per se* or nature as a material resource. This question is fundamental to answer for our ability to evaluate what is important to conserve and to which purpose.

In the philosophical ideas of the Enlightenment, the natural sciences were regarded as tools, which enabled the emancipation of civilisation from the constraints of environment through the *"domination of nature"* (Harvey 1996:123-29). Nature was simply considered as a *"source of value"* – a natural *resource* or as input in the industrial production – needed for economic development (Smith 1990:17):

> "As the sun rose on capitalism, this progressive mastery of nature moved up a gear; for the first time historically, economic in the form of capital accumulation became an absolute social necessity, and the continual extension of the domination of nature became equally necessary." (ibid:61)

Nature was regarded as a resource available for society to dominate and exploit (Harvey 1996:121-25). Similarly, Stiglitz (1980:64) stresses that *"natural resources are basically no different from other factors of production"*. With the development of neoclassical economic theory nature became conceptually degraded to an obstacle for economic development (Smith 1990:17). The restricting mechanisms of nature are described almost in theological terms: the human's mastery over nature provokes a strike back – the *"revenge of nature"* – in the form of unexpected and unwanted natural phenomena or environmental transformations (ibid:62-63).

According to Smith (1990:19), the nature-society duality is characteristic for the traditional modernist view, which he also claims is obsolete. Smith insists on the Marxist approach rejecting this dualism, thus basically no nature is untouched, no human beings are independent from their environments, and consequently nature and society are intertwined and simply inseparable.

From this reasoning, Smith (1990) draws the conclusion that what changes nature will inevitably also change society:

> "The question really is *how* we produce nature and *who* controls this production of nature[1]" (ibid:63-64, emphasis in original)

This quote leads us to the basics of the environmental justice approach, discussed in section 2.3.

I will proceed by inserting a very useful concept into the ontological discussion on the nature-society relationship. Swyngedouw (2007) introduces the concept *socioenvironmental metabolism*, which I will briefly examine here. Obviously, it involves a social dimension and an environmental dimension amalgamated in a metabolic process of continuous socio-physical transformation (ibid:36). The term socioenvironment refers to a conflation of and inseparability between nature and society. Also Næss (1989:165) expresses the importance of considering the unavoidable changes to society which arise from the reworking of nature:

> "We are not outside the rest of nature and therefore cannot do with it as we please without changing ourselves. We must begin to see what we do to ourselves when we say 'only change external nature'. We are a part of the ecosphere just as intimately as we are a part of our own society."

I will return to this topic in passage 2.3.2, where I will attach the interrelation between society, nature and justice into the geographical dimension.

To conclude this section, a monistic conception of the nature-society relation results in a fundamental methodological principle: what changes nature will also inevitably change society, because society is completely integrated with its natural environment.

2.2. Market "Failures"

The breakthrough of eighteenth century liberal political economy incorporated the domination of nature (including human nature) into the market relation (Harvey 1996:130-31). Allocation of natural resources and the human relation to

[1] Smith (1990) uses the concept *production of nature* as an antipode to the *domination of nature* in order to deviate from the dualistic nature-society ontology.

nature became matters of pricing and market exchange. The distribution of environmental degradation is not an exemption.

Market pricing in terms of money is in neoclassical economics the only universal signalling mechanism that enables a rational social evaluation of and comparison between different natural resources or environmental qualities (ibid:150-51). A sophisticated range of methodologies has been developed in order to price nature (see Barbier 2011). There is nevertheless an important ontological objection to the feasibility of pricing nature. Harvey (1996:153) notes that the market pricing of nature requires an isolation of entities, which in reality are parts of a coherent ecosystem, and cannot be removed without distorting the entire ecosystem.

In neoclassical economic theory negative outcomes are systematically categorised as market failures caused by "imperfections" on an otherwise adequately functioning market (Stiglitz 1980). This view can be, and has indeed been, heavily criticised throughout a wide range of academic literature (e.g. Rees 2002). However, I will not engage further in this debate. I only intend to select a couple of these market failures in order to understand how relevant socioenvironmental problems are conceptualised within an economistic framework.

2.2.1. Externalities

In neoclassical economic theory degradation of the environment – i.e. the depletion of natural resources – is efficiently regulated by the market with the price mechanism (Harvey 1996:125). In those cases that the mechanism fails to sustain the environment, the environmental problems that may occur are regarded either as acceptable or as caused by market failures. Stiglitz (1980) explains that environmental degradation is caused by externalisation of harms produced by rational market actors. This occurs because the environment is a *public good* exempted from the system of market exchange, he argues. It is the unpriced externalities – the spin-off effects (waste, pollution, noise, danger, etc.) that private actors produce from their economic activity and distribute upon socioenvironments without the obligation to compensate the affected populations – that create negative impacts upon people's livelihood (Harvey 1988:57-58). In

short, externalities are the negative outcomes from private activities that are unevenly paid for by the public in different locations.

Externalities are however not simply minor issues even if the theories above might give this impression. The total value of the externalities – paid for by the society through environmental degradation – is estimated to more than twice the global GNP (Galiana 1998:44).

The externality problem can in theory be fixed with a couple of different measures. The market imperative is dominating planning practices for sustainability (Gunder 2006). What is common for market oriented solutions is that they all attempt to integrate the (socio)environment into a pricing scheme through regulations in order to make the users pay the "fair" price (social value) for the produced externalities (Harvey 1996:154). Different types of instruments are discussed in Niskanen & Nash (2008). The expected outcomes from these market solutions in relation to socioenvironmental metabolism will be addressed in the next passage. It will be elaborated on how the market distributes externalities and which factors that determine this distribution.

Externalities are however not necessarily negative:

> "An externality arises when one individual's activity imposes *costs* or *benefits* on other unrelated parties, but this individual does not take into account these external effects when making his or her decision." (Liu 2001:26, my emphasis)

Also positive externalities consisting of benefits that are not paid for are relevant in the transport infrastructure context. When a road is built by public funds, the intention is in fact to diffuse positive externalities to the private sphere. Individuals' and businesses' ability to compete is dependent on their ability to capitalise on the externalities produced by public infrastructure (Swyngedouw (1993).

2.2.2. Uneven Distribution

The *ecological modernisation* concept that is derived from the sustainability discourse, established by the Brundtland Commission in 1987, has granted a hegemonic position for the market imperative (Gunder 2006:215-17; Harvey 1996). Harvey (1996) continues by claiming that this concept was widely embraced by politicians because it does not challenge capitalism. Instead it

declares that capitalist economic growth shall not be compromised with and that it is fully compatible with and necessary for achieving environmental sustainability, he explains. The market imperative is, according to Gunder (2006), a fundamentally conservative tendency, which protects status quo and maintains "business as usual". Ecological modernisation attempts to solve environmental problems with *"economization of ecology"*, i.e. evaluation of the environment and natural resources in monetary terms (Bellamy Foster, et al. 2011:255).

The externality problem – motivating commodification of nature – is often referred to as the constructed analogy *"tragedy of the commons"*[2]. Magdoff & Bellamy Foster (2011:70, emphasis in original) respond to it with the following sentences:

> "Indeed, it is not the existence of the commons itself that is at fault here, but the fact that under a capitalist system public wealth is often left unprotected and robbed for individual gain, as opposed to being sustainably managed as a shared heritage. Hence, we should properly refer to *the tragedy of the private exploitation of the commons*."

With this quote, they argue against the proposed necessity of commodification of nature as a means to sustain it from degrading exploitation. It is rather the economisation that encourages and allows the degradation of environments by those who wish and can afford to, they argue.

Rees (2002:255) explains the inadequacy of market solutions:

> "[T]he modern market model eschews moral and ethical considerations, ignores distributive equity, abolishes 'the common good', and undermines intangible values such as loyalty to person and place, community, self-reliance, and local cultural mores."

Some of the shortcomings of market oriented solutions in relation to sustainability issues have now been mentioned. It is significant for the proceeding of this study to clarify how market mechanisms distribute nature and socioenvironmental degradation in theory.

[2] Population growth and the desire to consume deplete public resources (commons) because they are free of charge, it is argued. The solution, it is proposed, is to suspend the free access to these resources, i.e. to eliminate the commons (Hardin 1968).

Harvey (1996), among others, engages in this topic and provides insights about the outcomes when nature is evaluated in monetary terms. He writes that money as a form of social power always provides asymmetrical social power relations between population groups. In more concrete terms, monetary evaluation of socioenvironmental qualities and quantities results in unequal distribution of environmental harms and goods according to peoples' uneven purchasing power. This conclusion is confirmed by Bullard's (2000), among others', research results. User fees and sales taxes – often recommended by economists because of their non-distorting effect on the economy – are regressively distributive, because low-income populations need to spend a relatively larger proportion of their income on suchlike additional expenditures (Deka 2004:340). Baeten (2000) argues that policies that price the usage of transport infrastructure are based on a Neo-Malthusian ideology. In principle, the problem of over-crowded transport infrastructure is managed in a way that out-prices the "redundant" users and allows only viable (i.e. profitable) traffic according to market principles, he argues.

Market oriented solutions to sustainability issues may be propagated by mainstream economists as efficient in economic terms. However, in reality they have not so much to offer when it comes to justice and equitable distribution.

The market is however not the only institution with the ability to allocate goods among populations and spaces, and it is clearly insufficient when it comes to distributing goods to low-income groups (Baeten 2000:80). Commodification of transport provision results in a regressive *"transport redistribution from poor to rich"* (ibid:83).

Ultimately, as Harvey (1988:59) argues, there is no method of distribution that is free from political considerations and standpoints:

> "[A]ny theory of the distribution of external costs and benefits involves those ethical and political judgements about the 'best' distribution of income which most of us prefer to avoid."

Politics is the ultimate process for securing and reinforcing justice (Rajan 1996:48). However, politicisation of sustainability is not a simple task since inequality is not only caused by asymmetric *purchasing* power in combination with commodified socioenvironments. Socioenvironmental inequality is also a

result from asymmetrical *political* power and participation among different unequal population groups (Liu 2001:28; Holifield 2010:52).

In order to re-politicise the environmental issues there is a need to reorient our attention. Instead of simply focusing on an imaginary universal sustainability for all, there is a need to consider the socio-spatial dimension of human needs and environmental impacts. Environmental justice makes a useful concept in order to reorient urban planning away from technocratic quasi-solutions, towards a political perspective of justice.

2.3. Towards a Theory of (Socio)Environmental Justice

The environmental justice concept springs from the 1970s and 1980s social struggle movements in USA (Dobson 1998:19; Agyeman 2005:14-15; Boone & Fragkias 2013:50). Originally, it was associated with the civil rights movement, and thus internalised the dimension of racism into the uneven spatial distribution of environmental harms (Bullard 2000; García & Rubin 2004:246). The movement addressed the co-localisation between economic and environmental problems and was mainly anthropocentric (Dobson 1998:19; Schlosberg 2007:7). By integrating the monistic nature-society conceptualisation with the environmental justice perspective, it turns neither into a pure anthropocentric nor an ecocentric approach, but into a socioenvironmental one. Society and nature are inseparable; justice to human beings is also justice to their environment and *vice versa*. Bullard (2000:159) withholds that *"[t]here can be no environmental justice without social justice"*.

The main goal of the environmental justice political movement was a *"just distribution of environmental goods and bads among human populations"* (Dobson 1998:21) by putting *"the survival of people in general, and of the poor and marginalized in particular, at the centre of its concerns"* (Harvey 1996:386).

Environmental discrimination on the basis of the racial composition of neighbourhoods is more significant in an American context (Bullard 2000). In a Swedish (Stockholm) context Rönnbäck (2005) has shown that mainly the class character of a neighbourhood indicates the probability of environmental discrimination.

Environmental justice has to a certain extent been adopted in American environmental policies. US EPA's Office of Environmental Equity defines environmental justice as following:

> "Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies." (Cited in Liu 2001:11)

Forkenbrock & Schweitzer (1999:97) explains the ambitions of the policy:

> "When minority populations or low-income populations would be adversely and disproportionately affected by a project, before the project can go forward it must be clearly established that the project is not only meritorious, but also less harmful to those protected populations than other alternatives would be."

In summary, environmental justice policies take into account *"how benefits, burdens, and costs of public policies are distributed among different social and economic groups"* (Liu 2001:12).

Until this point, only the so called distributional perspective has been discussed. There is an ongoing debate within the academic field of environmental justice about the significance of distributional justice in relation to other justice perspectives. Walker (2010) emphasises the importance of procedural justice, which implies that there cannot be sufficient justice without participation of the affected population in the decision making. Liu (2001:12) divides the conventional approach into two parts: environmental *equity* refers to the distribution of actual outcomes and environmental *justice* is the political procedure that is required to ensure the fair distribution. Schlosberg (2004; 2007) is an eminent critic of the focus on distributional justice, pointing out that it is the political process that actually creates maldistribution:

> "Inequitable distribution, a lack of recognition, and limited participation all work to produce injustice" (Schlosberg 2004:528-29).

Schlosberg's recognition perspective is worth questioning. He explains that the recognition aspect explains the underlying social and cultural conditions that

create maldistribution (Schlosberg 2007:15). Recognition of the rights of low-income or ethnic minority populations leans towards an idealistic, liberal approach that explains the lack of equal distribution with cultural and identity factors. Fraser (2000) warns about the narrow focus on recognition, which risks establishing identity politics with its simplistic explanation of maldistribtuion as a result of misrecognition of certain identities. Identity politics contributes to the displacement of the fundamental material explanations of social inequalities, i.e. the significance of economic inequalities and the class divisions of capitalist society (ibid:110).

Bullard (2000) is critical towards the insufficiency of the procedural perspective, which downplays the importance of material distribution of harms, benefits and resources. He argues that not only *intended* impacts have to be taken into consideration. Also the factual *unintended* effects, which may occur despite satisfactory participatory planning processes, have to be highlighted and combated (ibid:122-24). Further, procedural justice requires an implausible (medical, meteorological, acoustic, etc.) expertise among the populations in question if they are to be able to evaluate and avert potential risks. A sufficient political socioenvironmental approach would demand mobilisation of the resources necessary for producing the appropriate knowledge for the benefit of underprivileged populations.

The debate is not as polarised as one can get the impression of. Schlosberg (2007) declares that there is no dichotomy between distributional and recognition justice, and that a pluralist conception of justice is a strength. He conflates the different justice approaches by arguing that *"broad and authentic public participation, is often seen as the tool to achieve both distributional equity and political recognition"* (ibid:34). Fraser (2010) does also indicate the significance of all the different approaches by concluding that none of them by itself is comprehensive enough.

The strength of the environmental justice concept is its ability to generate questions about injustices and inequalities from a bottom-up perspective. It might pose *"the questions that go to the heart of environmental injustice: Who is most affected? Why are they affected? Who created the problem? What can be done to remedy the problem? How can the problem be prevented?"* (Bullard 2000: 116).

However, an overview of the academic literature reveals that the concept of environmental justice is not too well defined, and there is nothing close to a uniform methodology and theoretical conception:

> "Applying the Kuhn structure, theories of environmental justice and equity are apparently in the preparadigm period." (Liu 2001:18)

The multifaceted theoretical conception can partly be traced to the political-philosophical problem of justice. Some fundamental questions that ought to be discussed are how we define justice and how the notion of justice can be applied on processes of socioenvironmental transformation.

2.3.1. Justice as the Social Struggle over Material Distribution

Questions about justice are philosophical and invites to a multitude of interpretations. What is just, justice to whom, and which means are appropriate to achieve justice, are some essential and contested questions. Rajan (1996:36) describes justice *as "the political cement that connects normative ideals to the concrete outcomes of specific policies"*. Deka (2004:333-34) defines *social justice* as an ambition to correct market failures and progressively redistribute resources from well-off groups to the poor segments of the population with the objective to provide enough goods and services according to the basic needs of the entire population. Here, the *normative* ideal is a more equal distribution of resources and the *concrete* political measures are market interventions in order to achieve goals that the market fails to satisfy.

A more far-reaching justice conception does not find it satisfactory enough to simply recognise and counteract potential harms inflicted on minorities and low-income groups. The reach of environmental justice ought to embrace a progressive, distributive transportation planning (García & Rubin 2004:243; Martens, et al. 2012). This approach would require distributive measures granting additional transportation benefits for underprivileged groups.

They way to legitimise a normative standpoint is of great difficulty. No single philosophical conception of justice is superior to the others, thus all of them are legitimately criticised and used by different interests in different situations (Liu 2001:25). David Harvey (1996:399) explains the complexity of this problem with the following sentence:

> "[T]here is no way to define a philosophical and discursive answer to intense questions of social relations, power, beliefs, and institutions in relation to environmental practices".

It is not philosophical arguments that determine what is just and unjust, he continues, but it is rather the continuous social power struggle that in reality defines justice. This explanation turns the political-philosophical concept of justice into a matter determined by social conflicts. In abstract terms, justice will not be defined by idealistic thoughts but from material conditions and processes.

Now, I will further discuss the question of justice for whom. If justice is determined by power struggles between social groups that all demand "their" justice, then justice is demanded by and for *groups* and not simply for *individuals* (Schlosberg 2007:38). In order to address injustice, it is not enough to simply study the underprivileged groups, but we also need to direct our attention towards the privileged and powerful groups (Boone & Fragkias 2013).

I will come back to the question about which groups that require justice in chapter 3. Now, I will highlight the temporality of the targeted groups of this study. Dominant sustainability discourses have become highly aware of *inter-generational* environmental justice in the aftermath of the Brundtland report, but have to a considerable extent neglected *the intra-generational* justice between social groups in present time (Baeten 2000). Also Dobson (1998:257) warns about this pitfall:

> "[A]dopting future generations as the overarching community of justice might leave the present generation unprotected, and given that burdens generally fall hardest on the weakest and most vulnerable, we might well find that justice for future generations is bought at the cost of injustice for the present poor and vulnerable."

In summary, it is not possible to solve the issue of justice in a philosophical way without resorting to specific ideologies or social interests. Justice is a materialistic subject determined by processes of struggle based on conflicting social power relations. Injustice cannot be reduced to simply a matter for individuals and future generations. Rather, it is a vital issue for social groups residing in today's society, which suffer from the lack of social and environmental justice.

2.3.2. The Socio-Spatial Dimension: Putting Justice into Geography

From subscribing a temporal dimension (intra-generational) to justice I want to proceed to the discussion about the spatial dimension. Environmental injustice is impacting upon certain groups in the present time, but *where* is it impacting? If the impacts are concrete and material, then subsequently they can be localised.

In the cradle of the environmental justice movement, activists observed a tendency that disempowered neighbourhoods were disproportionately exposed to hazardous sources and deterioration of their local environments (Harvey 1996:368-69; Bullard 2000). However, the geography of environmental injustice is not only based on empirical arguments. Harvey (1988:60) points out that *"location is an absolutely vital factor in understanding the impact of externality effects in a city system"* and the spatial allocation of externalities is determined by local political activity. Hence, affluent groups have superior political power and *"can command space whereas the poor are trapped in it"* (ibid:171).

Spaces are not uniform, but very diverse. There is no single nature, as Swyngedouw (2007:36) expresses it, but a large variety of uneven socioenvironments. Socioenvironmental metabolic processes may occur in conflict between different spaces – some socioenvironments may benefit and other may deteriorate from the same process – and the uneven outcomes are not neutral but are determined by unequal social power relations (ibid:37). Zuindeau (2006) stresses the importance of *inter-territorial equity*, because sustainability in one territory may be upheld on the basis of the exporting of sources of unsustainability to other territories.

Gunnarsson-Östling's (2011:70) research highlights the asymmetry between the spatial origins and the impacts of environmental problems. Walker (2010:33) explains that the concept *geographies of responsibility* problematises the *"co- or dislocation of the consumption and production of environmental inequalities"*. These concepts allow us to highlight the injustices caused by the spatial asymmetry (mismatch) between the creation of and exposure to environmental hazards.

An orientation towards the socio-spatial dimension makes the appropriate foundation that enables analyses of environmental change through a justice perspective. Because environments and human society are inseparable the *socioenvironment* becomes the appropriate spatial unit of this study. The focus on

universal results will not be sufficient. Hence, socioenvironmental metabolism creates uneven and sometimes conflicting results among different socioenvironments.

2.4. Accessibility and Mobility

This chapter will discuss urban mobility and accessibility, and how transportation infrastructure is developed within this context. The discussion will deal with theoretical dimensions of the time-space relation, transport paradigm, and distributional issues.

2.4.1. Organising Time and Space

What is the role of time and space in the functioning of capitalism and how do the forces of capitalism shape spatiotemporal processes? The dynamics of socio-spatial organisation have to be understood in their political-economic context (Swyngedouw 1993:306).

Because all social activities are inevitably territorialised, spatial separation creates a barrier that delays connectedness between activities (Harvey 1985:9). Capitalism powers the development of the productive forces and hence needs to minimise the spatial barrier that disconnects and brakes economic activities.

Urry (2000:108-10) explains that under capitalism time became commodified in the form of socially constructed *labour time*, representing the value and structuring the production process of labour. The constant inequilibrium of capitalism – generating periodic crisis – can be temporarily circumvented through the acceleration of the turnover of capital (Harvey 1982:82). Acceleration of the physical movement within the production process is essential here, which in fact makes capitalism dependent on the continuous development of infrastructure in order to maximise the circulation and accumulation of capital (Swyngedouw 1993; Sachs 1992).

Marx (1857[2000]:94) points out that it is not money that realises market exchange, but it is rather the means of transportation that makes commodities travel across space and time and change owners. In the capitalist economy the labourer is reduced to variable capital (Harvey 1982:381) and labour is merely a production factor in the production process. Labour is thus also subjected to the acceleration of physical movement. Particularly skilled labour, termed human capital, has become an increasingly important production factor in the post-

industrial economy (Johansson 2008:12) and needs to be allocated with a minimum of time-space restrictions in order to serve the production and accumulation processes.

David Harvey (1985:15, emphasis in original) interprets Marx as following:

> "Marx insisted, labor *time* that defined money, while the *price of time* or *profit* was the fundamental dimension to the capitalist's logic of decision. From this Marx could derive what he saw as a necessary impulsion under capitalism to annihilate the constraints and frictions of space, together with the particularities of place. Revolutions in transport and communications are, therefore, a necessary rather than a contingent aspect of capitalist history."

Time-consuming mobility is required to overcome the obstacle constituted by geographical distances between different territorialised activities. Simultaneously transportation makes a transaction cost that slows down resource allocation in the capitalist economy. Geographical mobility of labour is essential for the enhancement of *"fluidity of capital"* (Harvey 1988:381).

> "The more production comes to rest on exchange value, hence on exchange, the more important do the physical conditions of exchange – the means of communication and transport – become for the costs of circulation. Capital by its nature drives beyond every spatial barrier. Thus the creation of the physical conditions of exchange – of the means of communication and transport – the annihilation of space by time – becomes an extraordinary necessity for it." (Marx 1857[2000]: 507)

The quote above implies that there is no limit for capitalisms appetite for cutting distances by compressing the amount of time consumed on transportation. This requires a never-ending development of transportation technology and infrastructure.

Because the price of labour time is fundamental to profit generation, "wasted" time on space transcendence needs to be minimised (Urry 2000:110-11) in order to maximise productivity. The following relationship between labour productivity (LP), production value (P) and labour time (t) is universally accepted in neoclassical microeconomic theory: LP = $\frac{P}{t}$ (Freeman 2008:5). A minimisation of

production time, including time required to overcome spatial barriers, raises labour productivity without necessarily increasing the output value of every produced unit. This relationship implies that a higher nominal production value gives a larger *absolute* increase of productivity for every reduction of labour time. On aggregated level, the economy gains productivity if transportation time can be minimised and potentially converted into working hours. The national economy gains more productivity from cutting transportation time for qualified *high-productive* labour than for others.

It is not only the increased mobility of labour that is important here. In order to reduce the time of turnover of the capital circulation process, there is a pressure towards a minimisation of the time consumed for commodities to reach the markets (Marx 1885[2007]:174-75). Transcendence of spatial separation becomes a competitive advantage for firms and widens the variety of goods that can be consumed when reach areas are expanded (Sachs 1992:164).

Development of transport infrastructure offers more mobility, over greater distances, and in a shorter amount of time. It enhances the optimisation (minimisation) of the use of transportation time, which compresses spatial distances and improves socioeconomic connectedness.

The annihilation of space by time can be intensified through the continuous development of physical infrastructure and the means of transportation (Harvey 1985:27). This development will inevitably imprint certain mobility patterns in society:

> "At any given moment in time, society will show a particular set of transportation, communication and mobility patterns which give coherence and form to the geography of everyday life." (Swyngedouw 1993:310)

Regeneration of transportation technology and infrastructure is not a final solution to capitalisms drive towards endless growth in productivity. Historical-geographical conditions, in the form of fixed infrastructure, liberate social activities from their *embeddedness in space*, and simultaneously produce new *territorial configurations* (Swyngedouw 1993:306).

2.4.2. The Automobility System

Automobility has undoubtedly been among those socio-technological systems that have had the greatest impact on urbanism in the industrialised world and beyond. Sachs (1992:100) argues that *"[t]echnology is the material reproduction of a culture"*. Automobility is therefore more than a technological system for transportation and it cannot be reduced to simply a desire derived from human nature (Rajan 1996). Automobility has to be understood as a complex system of ideological, cultural, social, and political-economic practices (Lundin 2008; Paterson 2007; Sachs 1992).

The term *automobility* is derived from a combination of autonomy and mobility (Paterson 2007:7), or autonomous with the capacity to move (Sheller & Urry 2003:173). The ideology behind the triumph of automobility builds upon the imagination that the car liberates the individual from *"the tyranny of space"* (Lundin 2008:155-56), and from the constraints of time. The private automobile distinguishes the high-status individuals and families from the mass society (Sachs 1992; Rajan 1996:80; Mercier 2009). Automobility is indeed a bourgeois ideological phenomenon, imprinting liberal individualism by promoting individual utility on the expense of the public utility (Paterson 2007). It reduces other individuals to obstacles that restrict the mobility of every individual motorist (ibid.). The ideology of automobility is paradoxical in a number of ways.

Cars as "independence machines" are totally dependent on road infrastructure, which entangles the individual mobility to public goods (Sachs 1992:101). Another contradiction is the one of mass automobility.

On one hand the mass ownership of cars is necessary for the economic viability of infrastructure investments, and on the other hand the mass character of automobility creates congestion, accidents, regulations and other restrictions, which reduce speed and the freedom of movement for every single motorist (Paterson 2007:53).

> "What most damages the automobile's attractiveness is its success. --- Because its attraction requires the exclusion of the masses, the

> democratization[3] of car ownership destroys its advantages." (Sachs 1992:175)

The only solution to the tendency towards declining attractiveness and flexibility of mass automobility is to further expand the spaces wherein the car is granted monopolistic access (Urry 2007:124). Investments and increased capacity will boost the attractiveness (increased speed and reduced restricting factors) of the particular mode of transportation (Smidfelt Rosqvist & Hagson 2009). This so called "predict and provide" principle creates a self-fulfilling prophecy, which induces higher total demand on transportation and results in a spiral effect of constant under-provision of infrastructure capacity for the particular mode of transportation (Smidfelt Rosqvist, et al. 2010; Lundin 2008:272). According to this hypothesis there is no quantity that can be considered as enough. Reinvestments in additional capacity generate in additional demand and eventually a new state of scarcity arises.

Automobility has historically been systematically prioritised and depoliticised, treated as a product of an organic, spontaneous development (Lundin 2008:271; Rajan 1996:44-45). Nevertheless, the promotion of automobility is highly political because there are always, sometimes conflicting, choices and priorities to be made when automobility is provided additional spaces and resources.

2.4.3. Justice in Mobility and Accessibility

Distributional effects from infrastructure investments tend to be absent in conventional socioeconomic analyses (SIKA 2009:109). The intention here is to expose some distributional issues in transportation and accessibility planning.

The automobile privatises large quantities of resources, and separates and isolates the individual driver from his/her social context (Mercier 2009). The high fixed cost of buying a car in combination with rising fuel prices due to expected future oil shortage (peak oil) will raise the costs of automobility and make it more exclusive (Roseland & Connely 2005; Mercier 2009). If automobility is allocated larger quantities of resources and simultaneously smaller proportions of the population can afford being motorists, there arise an important equitable

[3] Sachs (1992) uses the term democratization when referring to the transformation of automobility from an exclusive privilege only for the wealthy into the mass consumption of cars. Democratization is however not an adequate term to use because it implies that democracy is achieved through increased individual consumption rather than through collective practices.

distribution issue. By commodifying mobility (Paterson 2007:115), automobility privatises privileges and paves for inequalities. In contrary, the development of the public transportation system – if financed by progressively – socialises and equalises mobility (Deka 2004:340).

Restricting the car by increasing its costs in a high-speed, automobile society is problematic from an equity perspective. It is argued that mobility should not be reduced but redistributed from those who have in abundance to those in shortage (Baeten 2000). *Social exclusion*[4] is intensified by *relative* inaccessibility to transportation in relation to the general level of mobility (Urry 2007:192). Just transportation planning needs to follow redistributive principles, which pursue the narrowing of the accessibility-gap between the groups with the lowest and the highest access to social necessities and functions (Martens, et al. 2012).

Geographical mobility for the labourer is ultimately crucial for her/his chances to escape from *"the worst aspects of exploitation"* (Harvey 1982:380).

> "Given the importance and power of mobility, those trapped in place, stripped of their capacity to move across space, will suffer in an age in which mobility has become an even more profitable and extremely powerful commodity itself." (Swyngedouw 1993:322)

The *mobilities paradigm*[5] requires from people to either have access to modes of high-speed transportation, spend more time on traveling, or accept shrinking opportunities of consumption, employment and recreation. Therefore, despite their success of reducing traffic volumes, congestion charges and increased fuel prices are regressive instruments that tend to socially exclude the poor (Lucas 2006:808), in favour of the rich who can enjoy less congested roads (Baeten 2000:82).

Smidfelt Rosqvist, et al. (2010:9) emphasise that *"[m]obility is only the means to reach the utility of accessibility"*. *Accessibility* is a fundamental factor of social inclusion (Bocarejo & Oviedo 2012; Urry 2007) and is obtained for the price of overcoming distance – i.e. territorial separation of social activities – either through using *time* for transportation (mobility) or through *spatial* proximity

[4] Social exclusion implies economic, political, societal, personal, spatial, or temporal disadvantage (Bocarejo & Oviedo 2012:144).

[5] Urry (2007) uses this concept to entitle a society built upon the necessity of high-speed transportation and ever-increasing mobility.

(Harvey 1988:57). Space is not homogeneous hence different spaces offer different opportunities:

> "In other words, space by its very nature is divided into center and periphery and not every point on a plane can be equidistant from the important centers of opportunities." (Martens, et al. 2012:687)

Accessibility deficit[6] to territorialised social functions disempowers and deprives people, and forces those exposed to *transport poverty*[7] to spend more time and money on travelling if they wish to overcome the lack of accessibility (ibid.). Deka (2004) writes about *captive shoppers*, which are the low-income populations that lack mobility and hence are forced to consume from local suppliers often with limited assortment and higher prices due to their spatial monopolistic position and relatively small clientele.

Time spent on commuting can be interpreted as unpaid working hours or as a reduction of the wage. Accessibility deficit in combination with transport poverty generates a regressive redistribution of income from low-income relatively immobile populations in deprived neighbourhoods to mobile middle- and high-income groups. Swyngedouw (1993:323) concludes that the social inequalities are accentuated by disparities in the capacities to move across space.

[6] The concept infers low accessibility to vital social functions (Lucas 2004:41).
[7] A concept used by García & Rubin (2004) to describe the disproportional under-provision of mobility for under-privileged population groups.

3. Methodological Discussion and Research Considerations

3.1. Philosophy of Science

Yet, in the mid-19th century Marx (1844[1959]:48) wrote that the social and natural sciences need to be intertwined:

> "Natural science will in time incorporate into itself the science of man, just as the science of man will incorporate into in itself natural science: there will be one science."

Political Ecology turned this idea into a scientific field. Gezon & Paulson (2005) explain it as a merger of ecology and political economy, which conflates natural science with social science:

> "Political ecology's originality and ambition arise from its efforts to link social and physical sciences to address environmental changes, conflicts, and problems." (Paulson, et al 2005:17)

This study aims to politicise the social practice of urban transportation planning by integrating natural scientific knowledge into the analysis. Political Ecology analyses the global impact on local conditions (ibid:10). This will however not be done in this study due to limitations of the scope.

Critical Political Ecology does not limit its scope to studying objects and events in isolation, but includes *"associated power relations through which things become constituted and organised"* in the research (Swyngedouw & Heynen 2003:915). Thus, Bypass Stockholm cannot be appropriately understood in isolation. Other associated transportation planning policies, actors and measures need to be included in a more comprehensive research methodology.

Nevertheless, Marxist approaches explain particularities with overarching social structures/contexts, which inevitably create difficulties with fully entrenching explanations in empirical data (Bryman 2004:146).

Objectivity is a contested issue in the scientific discussions about qualitative, intensive research. Winchester & Rofe (2010:12-13) defend the qualitative methodology by making the point that neither the qualitative nor the quantitative research can be regarded as neutral and free from subjective influences. Sayer (2012) defends the critical, normative account within the social sciences by

arguing that epistemological objectivity refers to what is true about objects, which is separate from the normative values of the researcher. There is no contradiction between objective knowledge and normativity:

> "We should therefore stop equating value-freedom with objectivity." (Sayer 2012:190)

Habermas (1972:303-6) argues that because scientific knowledge consists of socially produced interpretations of the real world, it is always subjective and tied to particular social interests. The normative approach goes well in line with Political Ecological research:

> "These discussions are part of a quest to ask questions and gather information in ways that facilitate struggles for greater social and environmental justice." (Paulson, et al. 2005:34)

This study is normative and reflects certain values of the author. The choice of research question takes to some extent a normative position in favour of social (socioenvironmental) justice, i.e. favouring a more equal distribution of resources and the protection of underprivileged population groups.

3.2. Methodological outline

Critical realism recaptures causality from the positivist paradigm and employs it in a flexible methodology of explanations with *generative mechanisms* (Brante 2001), also called *causal mechanisms* (Bryman 2004:35). Jackson (2011:74-75) explains that the critical realist knowledge-claim, *transfactualism*, reaches beyond observable correlations by using *generative causal properties*, which can explain causalities and not simply examine regularities. Causal mechanisms are derived from the particular power and authority of objects and phenomena (institutions and individuals) to generate change (Sayer 2012). Subsequently, there are valid grounds to regard the declared intentions, narratives and plans of central organisations – that has the authoritative power to plan and govern the urbanisation of Stockholm – as relevant material for analysing probable future outcomes in the particular case. Similarly, the causal mechanisms of distributive institutions (markets and bureaucratic administrations) are also strong analytical devices.

This study explains potential outcomes by attaching theoretically deduced causal mechanism to the empirically investigated planning and transportation policies and practices. Hence, critical realism does not *predict* outcomes but only indicate *eventual* outcomes based on the properties of phenomena and processes (Jackson 2011:111).

The social science methodology propagated by David Harvey operates by isolating and abstracting parts of the studied object, which enables the researcher to reveal underlying social conditions, relationships, mechanisms and structures that are associated with every object, in order to fully understand and explain the entire context on a deeper level (Cloke, et al. 2004:291-92). The theoretical foundation in the former chapter will make the reference frame that facilitates the abstraction of the concrete plans and future infrastructure associated with Bypass Stockholm. In this study, potential capabilities and generative mechanisms of processes, structures and objects enable interpretations and conclusions based on the presented material.

3.3. Research design

This study uses a combination of qualitative and quantitative methodologies in order to answer the research questions. Bryman (2004:140) explains the different strengths of each of the methodologies:

> "Quantitative research can establish regularities in social life while qualitative evidence can allow the processes which link the variables identified to be revealed."

Combining these methodologies is typically either done for triangulation/validation reasons or for addressing different aspects of the research question (Read & Marsh 2002). In this study, the combination is motivated almost exclusively by the latter reason. Spatial distributions and relations are mapped with quantitative data while planning policies and practices are studied with qualitative text analysis and interviewing.

An *intensive* research methodology is applied in order to provide explanations by finding *"the causal processes and mechanisms behind a particular event"* (Cloke et al. 2004:289). This study also aims to discover the socio-spatial distribution of potential impacts and accessibility gains from reorganised traffic

flows. For this purpose an extensive methodology may *"contribute answers to questions regarding the quantities and distributions of phenomena"* (ibid.).

Based on the theoretical discussion in the former chapter, I will adopt a conception of justice based on material rather than discursive conditions. Distributive justice – i.e. equal distribution of socioenvironmental costs and benefits among different socioeconomic groups – will be in the forefront of this study. Recognition is an integral part of this approach, when analysing the policies and mechanisms that distribute socioenvironmental resources. Procedural justice, which is indeed relevant, will not be studied here partly because considerable research has already been made with this perspective (see e.g. Isaksson 2001; Gunnarsson-Östling 2011). As mentioned in the former chapter, procedural justice alone cannot protect socioenvironments from degradation.

3.3.1. Interviews

Interviewing is an interactive and animated process of data construction that is context dependent (Holstein & Gubrium 2011). This means that replicability of the data collection is not possible, because replications of interviews take place in different contexts that inevitably generate different narratives. According to Bryman (2004:38-39), replicability is unnecessary in the social sciences.

The interviewing in this study is not primarily concerned with *existing* objects but with discovering the intentions, motives, and priorities of powerful actors in their planning of *future* objects and processes. The data acquired through the interviews are interpreted with a deductive methodology. Deductive research employs the generality of the theoretical framework in order to interpret the particularities of the dictums of the interviewees (Cloke, et al. 2004:216).

Cloke, et al. (2004:290) recommends that interviewees for intensive research are selected on the basis of their properties and relations to others. The sampling in this study is based on *centrality*. Centrality sampling motivates the relevance of the information provided by the interviewees on the basis of their central position in the particular scientific, bureaucratic or political context (Esaiasson, et al. 2009:291). The central positions make the interviewees representable for the views and perspectives of their respective organization, institution or to some extent for their research field. Individuals that are part of the interviewee sample of this study are selected on the grounds of their formal position, professional

authority, or scientific expertise. The politician and the planner have substantially more power to influence the priorities and objectives of the infrastructure project than anyone else. Distinguished scientists are plausibly the most relevant sources that can be found within their specific fields of research. This does obviously not imply that their dictums are correct or unbiased.

All of the interviewees have accepted that their names figure in this study and five of them have on request respondent validated the statements that are connected to their names. Respondent validation is also a useful tool for handling the uncertainties associated with data interpretation (Bryman 2004:77).

Qualitative interviewing is an interactive method with various structure levels described as a *"conversation with purpose"* (Cloke, et al. 2004:149). The role of the interviewer is important for the quality of the information extracted. The inter-subjectivity between the researcher and researched requires from the interviewer to *"acknowledge a constructive and critical tension here between methodological rigour and dramaturgical spontaneity"* (ibid:152).

The advantage with *unstructured interviewing* is that it allows the interviewee to more freely express her/his experiences and opinions (Valentine 2005:111). Absence of structure increases the risk of missing out on interesting and relevant discussions. The opposite, *questionnairing*, is a quantitative and standardised strategy that does not allow unstructured reflections or follow-up questions (Cloke, et al. 2004:130-33).

This study operates in between these strategies by using *semi-structured interviews*. The intentions and the subjective interpretations motivating the informants' behaviour and priorities are in the forefront of my interest and I also wish to ventilate a number of key issues. For this purpose I need to formulate a guideline for the interviews in order to actually gain the relevant information. However, the types of questions in the interview guide are adapted to the expertise of each of the particular interviewees.

3.3.2. Text Analysis

Texts are not simply written words hence they also influence social interactions and agency (Prior 2011). This is the reason why central, planning documents are studied here. They construct a social reality that motivates and legitimises certain concrete actions. In this study, planning documents are mainly studied as sources

whereof the researcher can discover the intentions, arguments, priorities, and actions of powerful actors involved in the planning decision making.

Bowen (2009) emphasise the issue of trustworthiness and authenticity of documents used in research. Here, this is achieved by the selection of official documents on the principle of centrality and by collecting original sources and as far as possible avoiding third party interpretations. For instance, the opinions and intentions of the Swedish Transport Administration or the City of Stockholm are collected from documents with their signature. Planning and transport policy data are collected from political documents such as government propositions.

3.3.3. Quantitative Mapping

In this study, GIS is used to display geographical relationships and for mapping the geographical distribution of various data on choropleth maps. Topographic data are mainly extracted from the national land surveying office, Lantmäteriet. Geocoded attribute data are obtained from different public sources, whereof County Council of Stockholm's Area Database[8] (Områdesdatabasen) is the most important. Admission to this data base requires a request for temporary authorisation based on the purpose of the use.

The geographical unit used in the maps, Area Division 2010 (Områdesindelning 2010), is the smallest available due to secrecy and personal integrity policies. There are 1417 unique areas of various spatial and population size in Stockholm County.

The GIS maps are constructed with quantitative data. However, the maps are analysed qualitatively with descriptive interpretations of the geographical relations and attributes that are displayed in the maps. Indeed, mapping environmental injustices is a subjective practise based on assumptions (Maantay 2002). Quantification of socioenvironmental impacts would require more detailed data, which is not possible to obtain due to the temporality of the hazardous source (the road does not exist yet) and the spatiality of the social data (smaller spatial units are not available to the public). Maantay (2002:164, my emphasis) expresses the methodology used in this study properly:

> "Spatial studies of environmental justice analyze the characteristics of the population *potentially* exposed to a hazardous land use."

[8] Produced and administrated by Statistics Sweden.

Underprivileged population group used in this study is a vague expression. Maantay (2002) describes that income and race are the most frequently used indicators for the group called *disadvantaged* in environmental justice research. In this study, the underprivileged populations will be operationalised as populations with low income and low level of education.

3.4. Source and Research Assessment

3.4.1. Validity and Reliability

Governmental organisations have large financial, legal and bureaucratic resources to their disposal and have consequently superior capacities to collect accurate data and produce comprehensive studies (Cloke, et al. 2004:Ch2). Although official information is often highly accessible and useful in many ways there are reasons to be conscious about potential pitfalls. Official sources are indeed not neutral thus they are always produced with certain purposes, typically with the aim to diffuse government policies and influence the public opinion (ibid.). For this reason, Cloke, et al. (2004:54) urges researchers to pose the following critical questions about official information in order to unveil political biases of the information:

- Why was the information constructed?
- To which government policies does it relate?
- Have policy concerns influenced which and how data were constructed?

Additionally, researches must be aware of whom is represented, whose interests are portrayed and if there are any rhetorical devices in the texts (ibid.). Prior (2011:101) recommends questioning how the process that produced a document was socially organised.

The Regional Development Plan (RUFS 2010) and the planning documents produced by the Swedish Transport Administration (e.g. 2011) are technocratic and depoliticising but nevertheless political. No considerations are made about socioeconomic inequalities, which reflect the dominant political discourse and particularly the transport policy goals. Agitational, sometimes banal, rhetoric about e.g. economic growth, competitiveness, and the general public good permeate the argumentations that are legitimising the planning in many of the documents. Most of the public documents produced about Bypass Stockholm are

published by organisations that are involved in the planning. The organisations that have published the public documents and reports are either governmental, or financed or appointed by the state. Generally, this does not give the producers the authority to take initiatives that conflict with the political objectives and they have indeed strong incentives to promote rather than oppose the project. This is obvious in the case of Swedish Transport Administration, which actively propagate in favour of the project. One exception is SIKA, which published a very critical report (see SIKA 2007).

3.4.2. Geographical problems

There are several geographical units used in this study that might cause confusion. Therefore, the definitions will follow here:

1) Eastern Central Sweden is the largest unit referring to the sum of the provinces[9] Gävleborg, Västmanland, Östergötland and Södermanland, and the counties[10] of Uppsala, Örebro and Stockholm.

2) The Stockholm (metropolitan) region is a *functional region* or a regional labour market[11].

3) Stockholm County is a regional administrative unit.

4) The City of Stockholm is the municipality of Stockholm containing the regional centre with the largest concentrations of population, functions, and socioeconomic activities.

5) Finally, city district[12] is the smallest unit referring to a geographical unit containing a neighbourhood.

The classical geographical problem, the Modifiable Area Unit Problem (MAUP), refers to the inaccurate results that arise from arbitrary drawing and redrawning of boundaries of the spatial units (Maantay 2002:165). This is caused by the uneven demographic distribution within each area. The smaller the areas of analysis are, the more the problem can be mitigated (ibid.). However, there are no further disaggregated data available and hence the risk of some limited inaccuracies due to MAUP need to be accepted.

[9] *Landskap* in Swedish is a historical geographical classification.
[10] *Län* in Swedish is an administrative geographical unit.
[11] Local labour market region would be the direct translation from the Swedish *lokal arbetsmarknadsregion (LA)*.
[12] Translation of *stadsdel*.

Analyses regarding future socioenvironmental conditions are highly problematic for various reasons. The analysis in this study is based upon current local socio-spatial data that might not be relevant in a future scenario because of potential neighbourhood changes, e.g. regarding local class compositions or ethnic minority concentrations. However, the high residential immobility in Stockholm[13] has plausibly a braking effect on neighbourhood transformation.

[13] Residential mobility is reduced by the shortage of rental housing (Karpestam 2013). Low income households have even less opportunities to move due to the shortage of affordable rental apartments.

4. Empirical Results

4.1. Regional Trends

4.1.1. Urbanisation

Stockholm metropolitan region is – with its knowledge intensive business structure and outstanding population size – uncontestably the primary economic node in Sweden (RUFS 2010). Stockholm is going through a rapid urbanisation process. The fast population growth by 400 000 inhabitants within the last 30 years period is to an equal extent a result from high fertility rate as well as from immigration flows (RUFS 2010:35). Older population prognoses for the Stockholm County has been breached and at the moment the population is expected to reach 2.5 million already in 2030 (Swedish Transport Administration 2012:61)[14].

Engström (2008) concludes from his research that urbanisation patterns in the Swedish post-industrial urban economy are ambivalent. The regional enlargement tendency – the spatial widening of the functional region[15] – unfolds accompanied by increasing compaction in the urban cores. Along with the increasing attractiveness of urban living, the demand for more affordable housing in country side environments in the regional periphery is also growing (ibid; Brattström 2014, interview). Demand for peripheral dwelling in combination with a troublesome housing shortage in the central districts of Stockholm create incentives for municipalities in neighbouring counties to offer housing in attractive environments with commuting possibilities to central Stockholm (Brattström 2014, interview). Inflated property prices in the inner city work as a push factor for peripheral residency and consequently *career commuters* are currently the largest group of commuters (35%) in the Stockholm region (Torége, et al. 2008:6-7).

Housing shortage is especially predominant among low-income households while upper-income households enjoy a rich supply of co-ops and newly built expensive rental apartments (County Administrative Board in Stockholm County

[14] The population in the region is counted to 2.16 million by the expiry of 2013 (Statistics Sweden 2014).
[15] A region based on functional, economic relations and is self-sufficient on labour (Statistics Sweden 2010).

2007). These asymmetric preconditions on the housing market indicate which groups that are geographically flexible in terms of their (re)location choices of residence, and which groups that have less opportunities to move away from socioenvironmental degradation or closer to vital functions (employment, consumption, and leisure facilities).

4.1.2. Traffic and Commuting

The intensive urbanisation process will require large quantities of additional housing and transport infrastructure in the nearest future (RUFS 2010). Since 1970 approximately half of the growth of the functional region developed through spatial expansion and the other half through densification (Trafikanalys 2011:19). The spatial expansion of the region was made possible by large increases in commuting distances. The average commuting distance in the Stockholm region was 10 km in the beginning of the 1970s, which grew to 18.4 km in the middle of the 2000s (Housing Administration 2005:83). In a steadily growing region the capacity of the current transportation infrastructure will be breached if the investments are lagging and high-speed mobility continues to be a precondition for accessibility. The Swedish Transport Administration's (2012) prognoses predict large increases in transportation demand the forthcoming decades[16] mainly generated by population growth and real income increases. No investments in additional road capacity have been made in the regional north-southern passage since 1967 and the current traffic volumes are double the intended capacity on the main thoroughfare Essingeleden (City of Stockholm 2010:5; RUFS 2010:47). For this reason, the existing road infrastructure is described as sensitive for disruptive incidents and in need for expensive, continuous, substantial maintenance (RUFS 2010; Swedish Transport Administration 2011).

Also rail bound transportation is – including the planned investments – overstressed and both commuter train railways and the subway tracks are in need of additional capacity in order to match the increasing transportation demand (Swedish Transport Administration 2012:122).

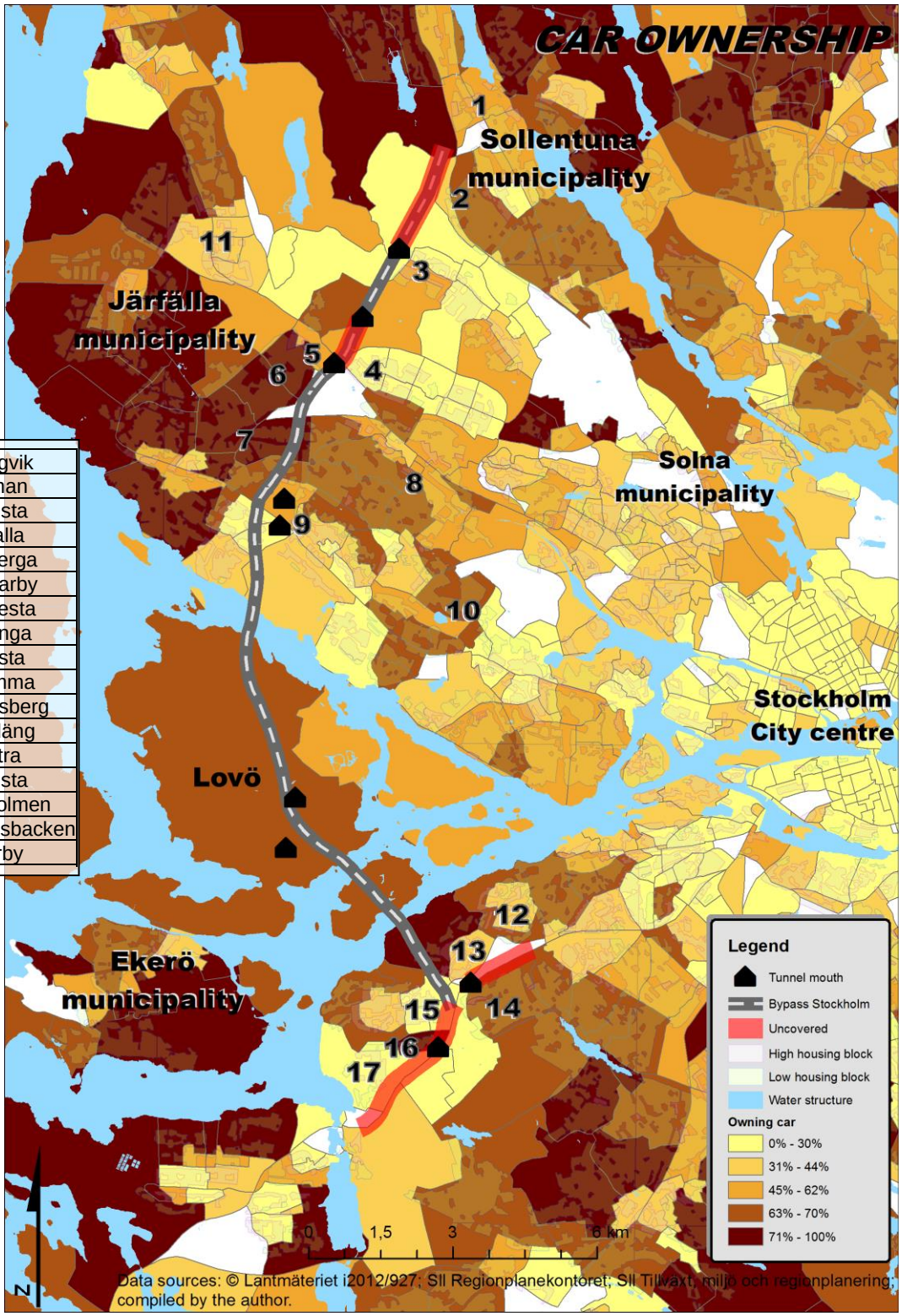
Congestion related costs were estimated to 6.32 billion SEK whereof merely 800 million SEK were private automobility related (Trafikanalys 2011:165). Commuting by public transport in the Stockholm region consumes in average

[16] 67% traffic increase for car transportation and 80% increase for public transportation.

50% more time than commuting the same distance by car (Regional Planning and Traffic Office 2008). The average speed of the bus services has been steadily declining between 2002 (27.4 km/h), 2006 (25.9 km/h), and 2007 (25.6 km/h) (SL 2011:12). The average daily travelling distance for individuals is 22 km by car and 9 km by public transport (SIKA 2007:19). During the peak hour 42% of the trips are made by car and 39% by public transport while the car trips make as much as 95% of the *traffic stock*[17] but only less than half of the *person transportation stock*[18] (WSP 2007:5).

Geographical disparities in car ownership are less significant than the income related disparities between low-income groups (low ownership rate) and higher-income groups (high ownership rate) (Pyddoke 2009:31).

[17] The aggregated driving distances of all modes of transportation.
[18] The aggregated travelling distance of all individuals.



1	Häggvik
2	Töjnan
3	Hjulsta
4	Akalla
5	Vålberga
6	Barkarby
7	Kälvesta
8	Spånga
9	Vinsta
10	Bromma
11	Jakobsberg
12	Bredäng
13	Sätra
14	Smista
15	Skärholmen
16	Lindholmsbacken
17	Vårby

Map 1. Geographical distribution of car ownership in relation to the total population. The data is from 2002.

Map 1 illustrates the geographical disparities of car ownership in the region. A comparison with the patterns of the maps in passage 4.1.4 supports Pyddoke's conclusion.

Low income populations make fewer car trips than middle and high income groups (Trivector 2005:66). Car ownership is exclusively for those who can afford to drive and is a matter of class (Wiklund 2014, interview). Fuel prices have increased substantially since 1990 (Figure 1). Figure 2 illustrates that the share of the population that owns a car in the Stockholm region has been steadily declining since 2002. There is a trend towards a declining proportion of adolescent with driver's licenses (Sandow & Westin 2006:74-75).

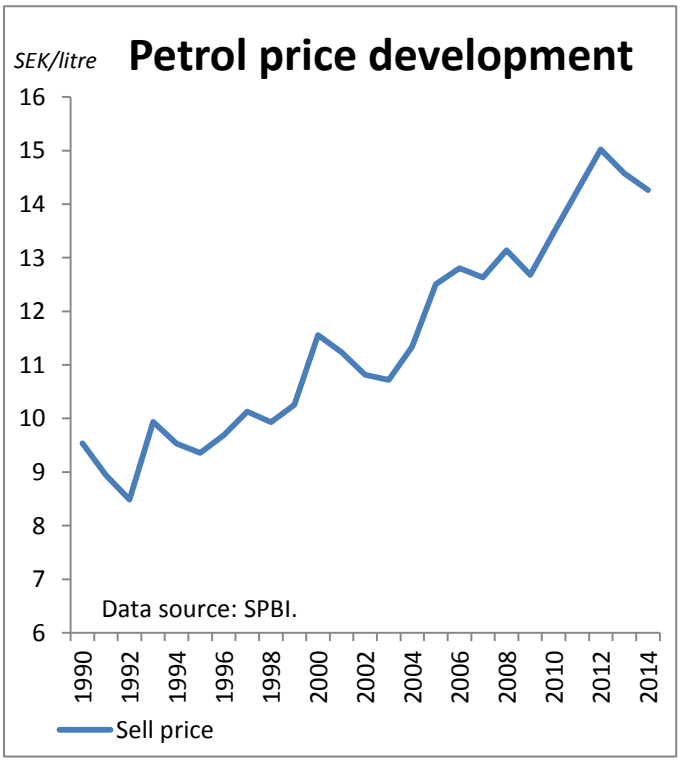


Figure 1. Inflation adjusted prices per litre of gasoline.

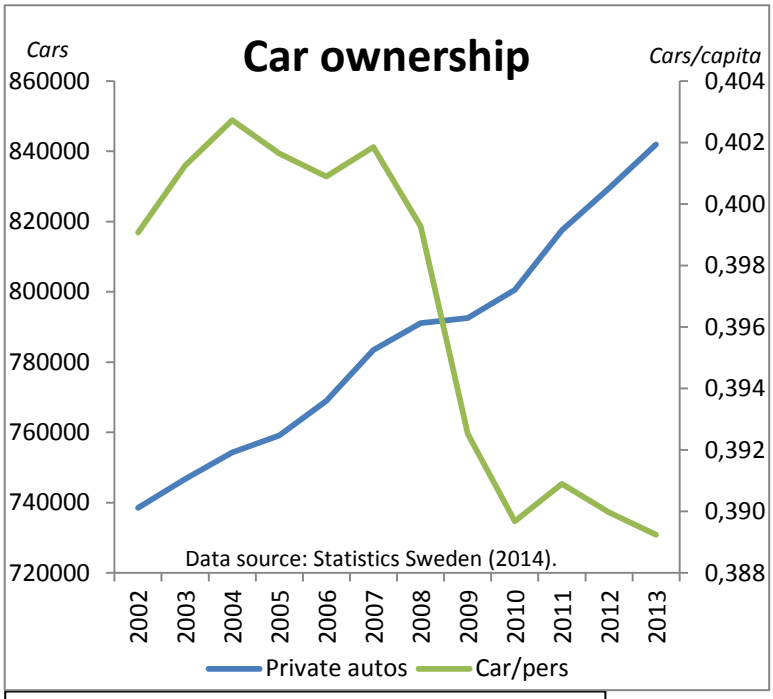


Figure 2. Total car ownership and car ownership in relation to population size in Stockholm County.

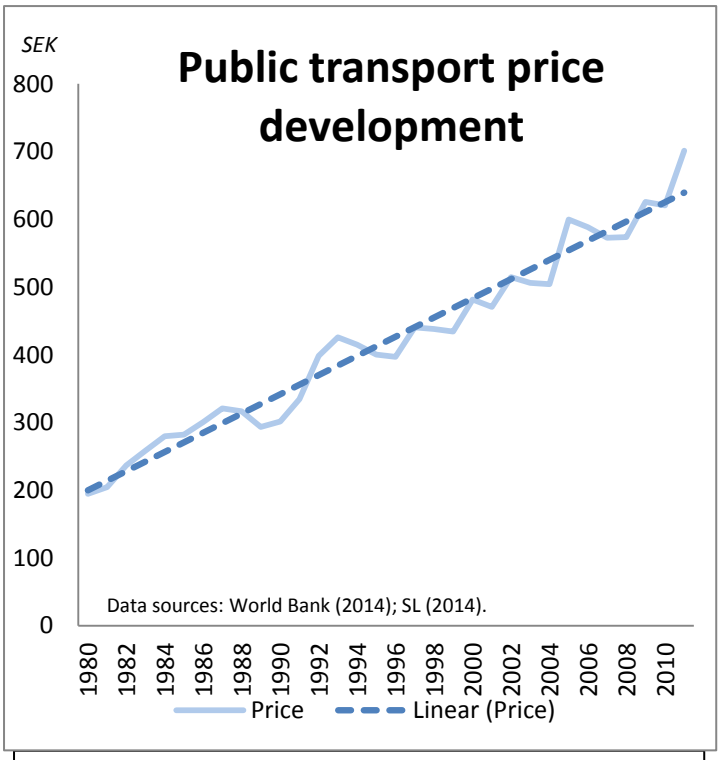


Figure 3. Inflation adjusted prices for a monthly single zone commutation ticket in Stockholm County.

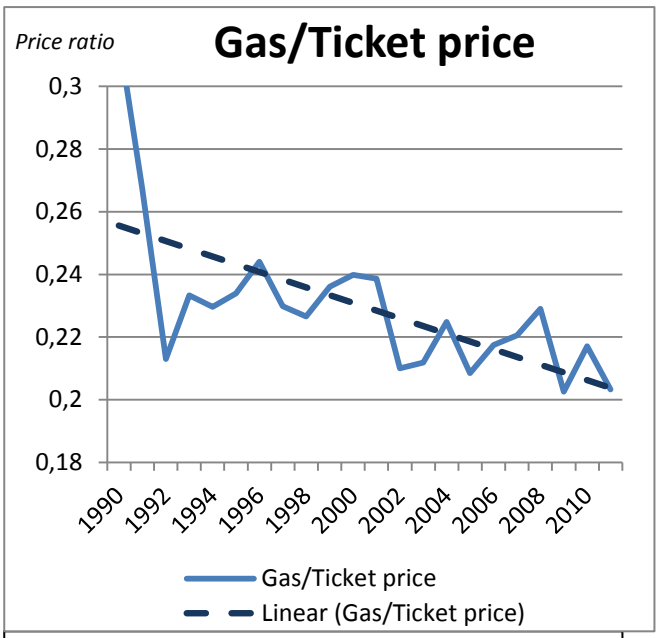


Figure 4. Ratio between gasoline price (SEK/10 litre) and commutation ticket price (monthly single zone ticket). Data is based on figure 3 and 4.

Also public transportation has become less affordable in Stockholm County (see Figure 3). The ticket price increase has actually been more distinct than the fuel price increase since 1990 (see Figure 4).

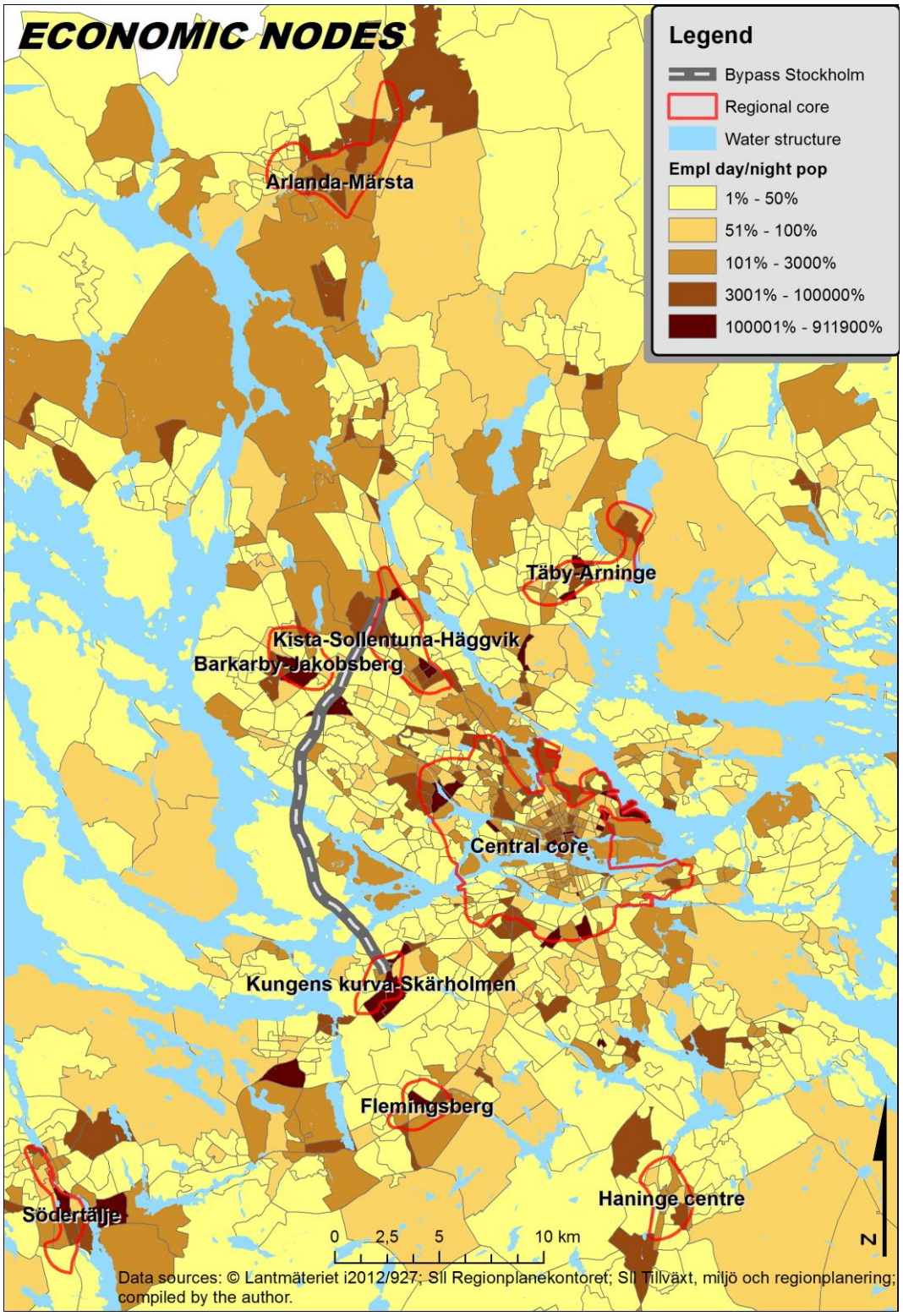
Socioeconomic status is significant for the willingness to commute and consequently functional regions vary in size according to different social characteristics of different population groups (Vinnova 2010; SIKA 2004:1; Statistics Sweden 2010:57-59; Nutek 2006:10). The asymmetric utility generated by regional enlargement is described as following: well-educated, men and high-income groups are the major winners, while low-educated, women and low-income groups end up with no or limited benefits (Housing Administration 2005; Dahl, et al. 2003). There is no correlation between individual income level and commuting *time* whereas a positive correlation exists when considering commuting *distance* (Housing Administration 2005). The unequal benefits result from the asymmetric commuting behaviour. *Elite commuters*[19] commute longer distances often by car while women, lower educated and low income groups commute shorter distances using other modes of transport (Dahl, et al. 2003).

[19] Highly educated men with higher incomes.

The Housing Administration (2005) withholds a sceptical attitude warning for social, environmental, and private economic unsustainable effects and furthermore class biases created by policies promoting regional enlargement and increased commuting.

4.1.3. Spatial Distribution of Functions

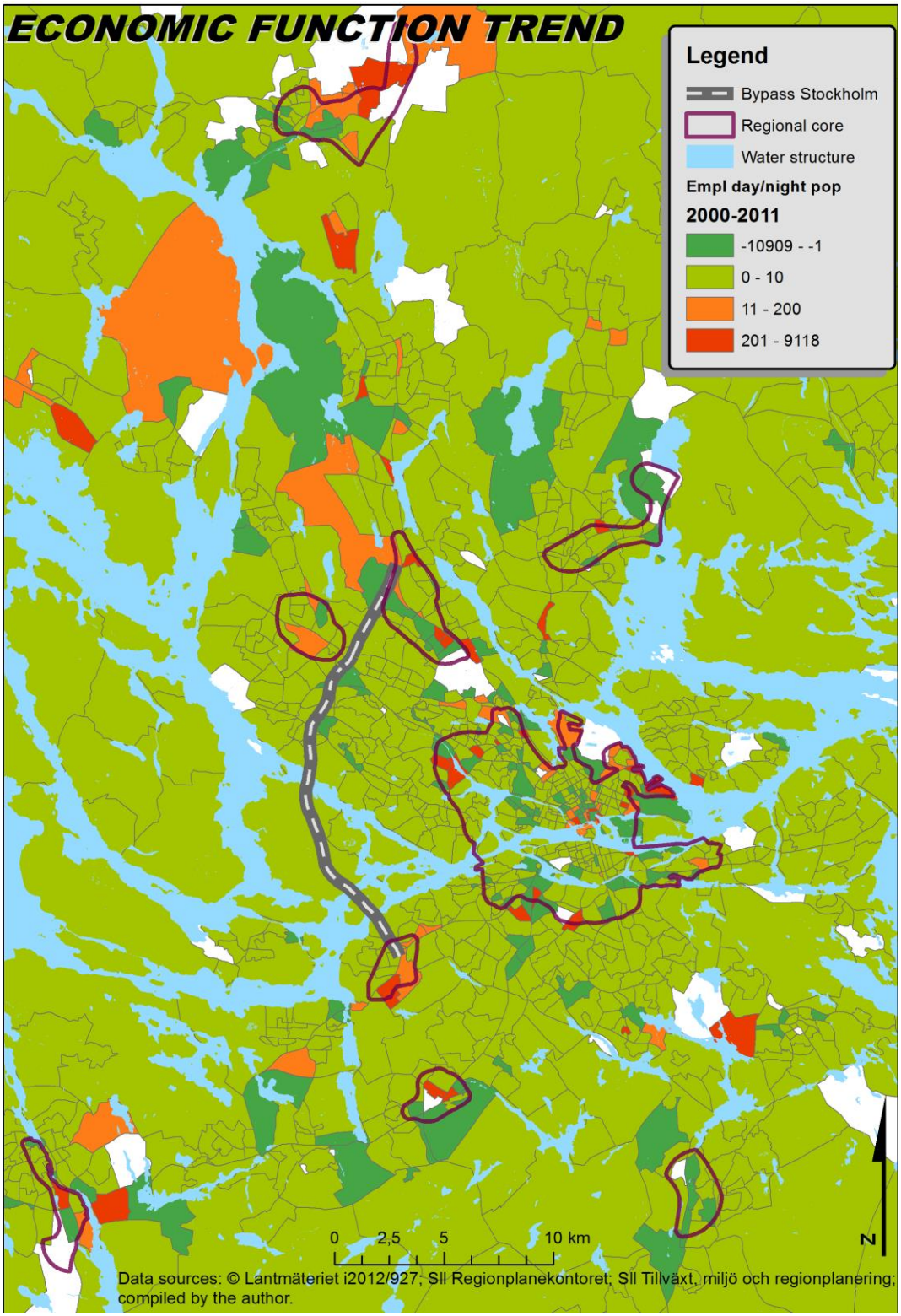
Stockholm's planning policies have historically organised the urban structure in a way that intentionally separated populations and functions, which made Stockholm to one of the most segregated cities in Europe (County Administrative Board in Stockholm County 2006:5). The suburbanisation trend since the 1960s – with the parallel generalisation of high-speed mobility – sprawled the location of housing while economic activity agglomerated in the central districts, resulting in a development towards a monocentric urban structure (RUFS 2010:98).



Map 2. Economic nodes in the Stockholm region (see RUFS 2010) and geographical distribution of employed day/night population ratio. Data from 2011.

The day/night population ratio is used by the state agency Trafikanalys (2011:81) to indicate concentrations of economic activity in different locations. Map 2 illustrates the concentration pattern of economic activity in the Stockholm

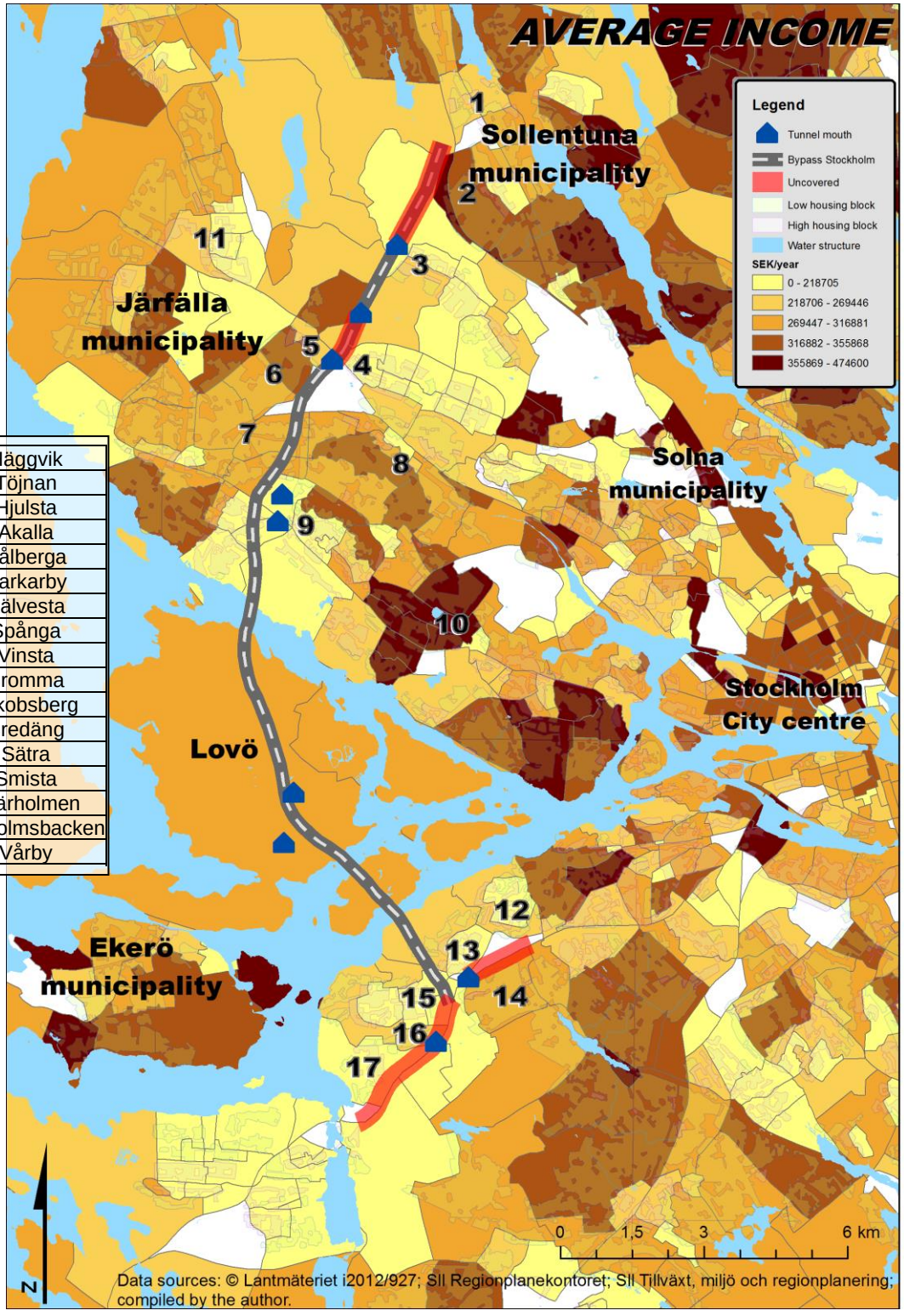
region in 2011. Concentrations are mainly located in and around the regional cores pointed out in the regional development plan (see section 4.2).



Map 3. Geographical illustration of the difference in employed day/night population ratio between 2000 and 2011.

Map 3 provides an indication on the development of spatial agglomerations (and drainages) of economic functions over time (between 2000 and 2011). The map illustrates a trend where especially the regional cores Arlanda-Märsta, Kungens kurva-Skärholmen, Kista-Sollentuna-Häggvik, Flemingsberg and parts of the central core are attracting economic activity. The opposite development is identified in Haninge centre and Täby-Arninge where either economic activity has declined alternatively that the residing night population has increased more than the economic activity.

4.1.4. Social Geography

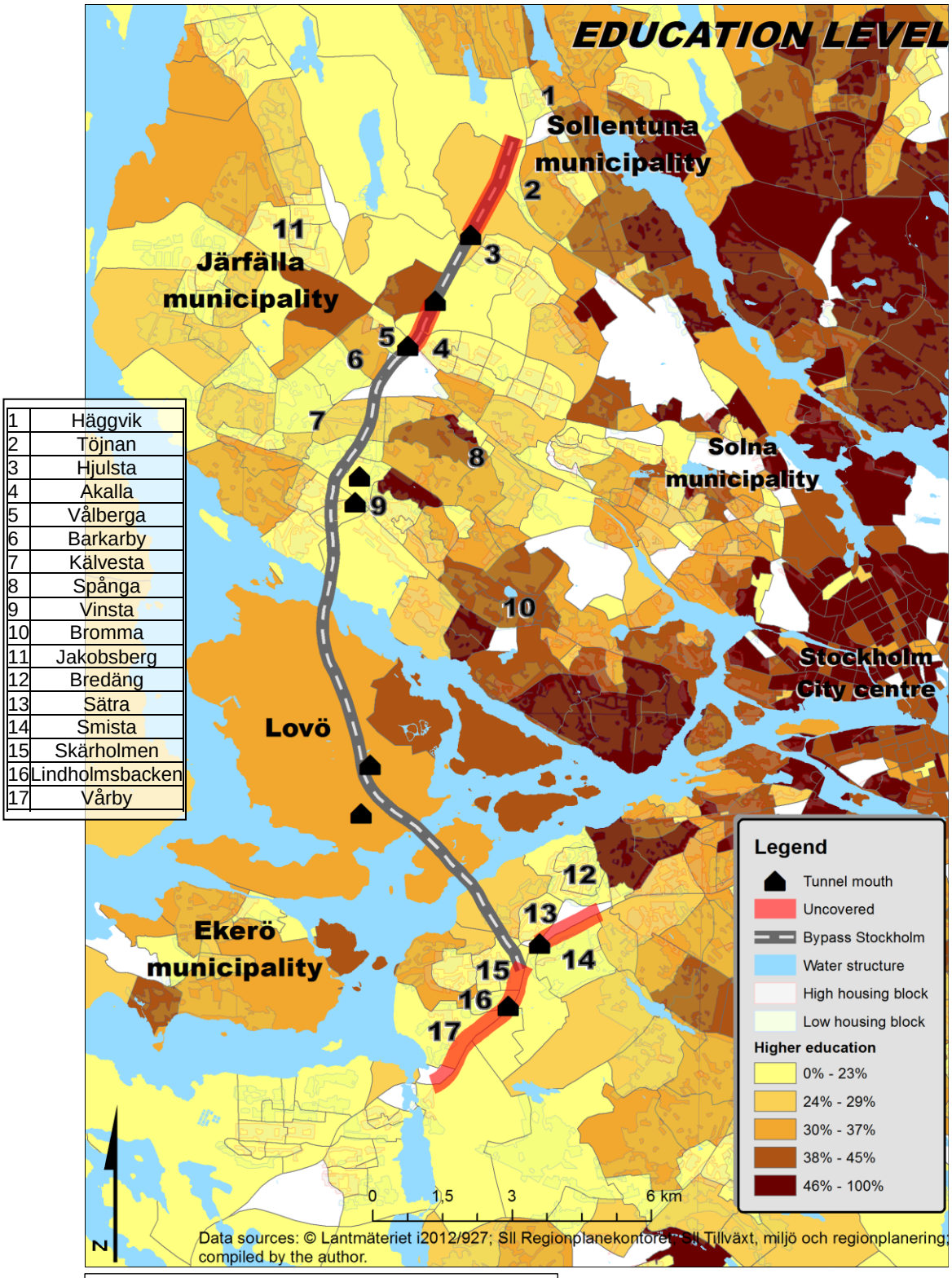


1	Häggvik
2	Töjnan
3	Hjulsta
4	Akalla
5	Vålberga
6	Barkarby
7	Kälvesta
8	Spånga
9	Vinsta
10	Bromma
11	Jakobsberg
12	Bredäng
13	Sätra
14	Smista
15	Skärholmen
16	Lindholmsbacken
17	Vårby

Map 4. Average income levels in the Stockholm region.

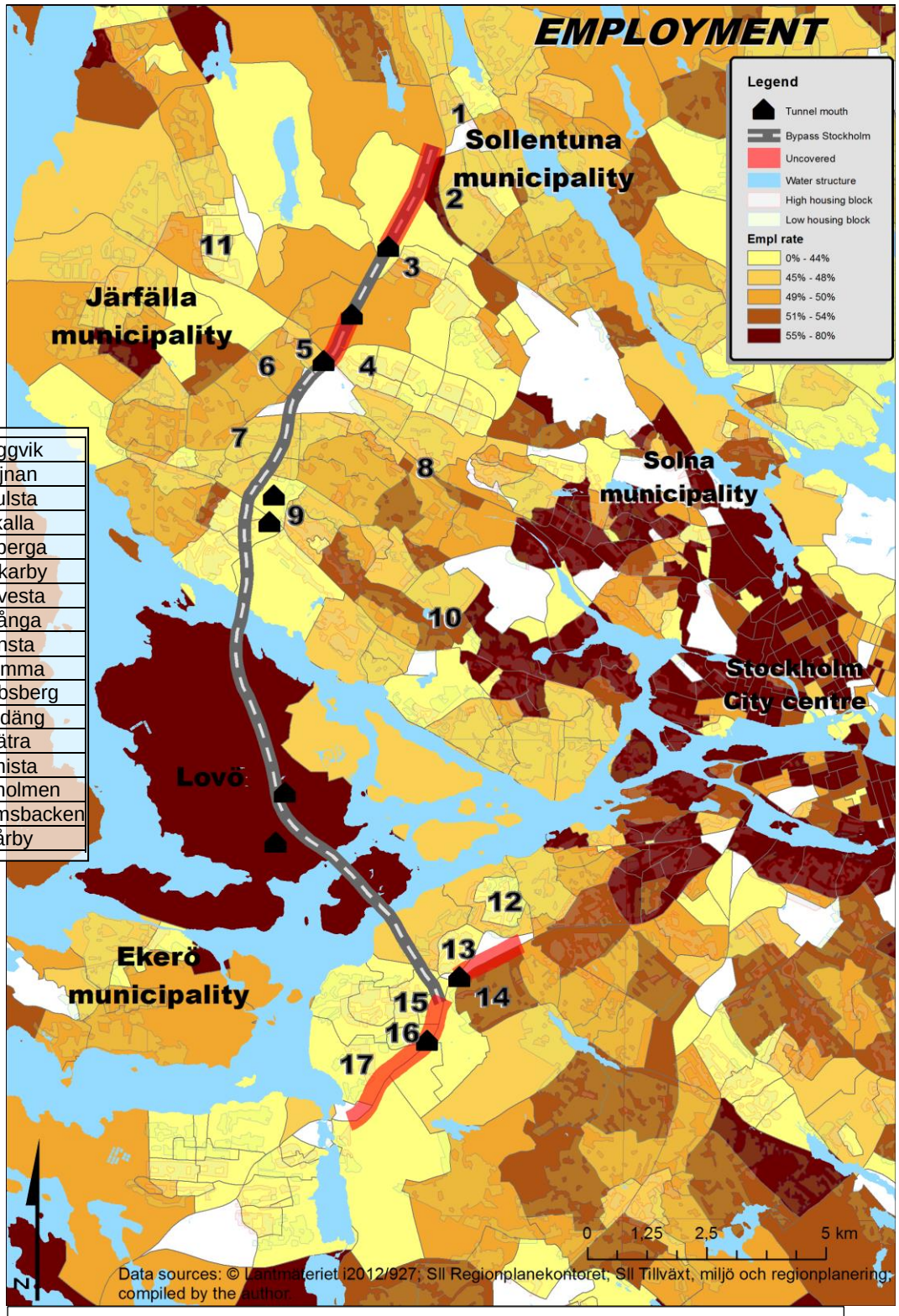
Map 4 illustrates that income levels are relatively high in Bromma, Solna, Sollentuna, Danderyd, Ekerö, the inner city and to some extent in Järfälla. Along Bypass Stockholm, income levels are low in Akalla, Hjulsta, Skärholmen, Vårby,

Bredäng, Sätra, and parts of Vinsta. Almost all of them are densely populated areas with mainly high apartment blocks. Incomes are higher in Töjnan, Barkarby, and western Spånga. Smista, Kälvesta, Vålberga, Lindholmsbacken and Lovö (sparsely populated) have middle income populations. High- and middle-income areas along the bypass are all dominated by villa and townhouse dwellings.



Map 5. Education levels in the Stockholm region.

Map 5 shows the proportion of the night population with higher education (3 years or more) for the different areas. Similar patterns can be identified as in the previous map, except for Smista, Kälvesta and Lindholmsbacken that have relatively low education levels.



1	Häggvik
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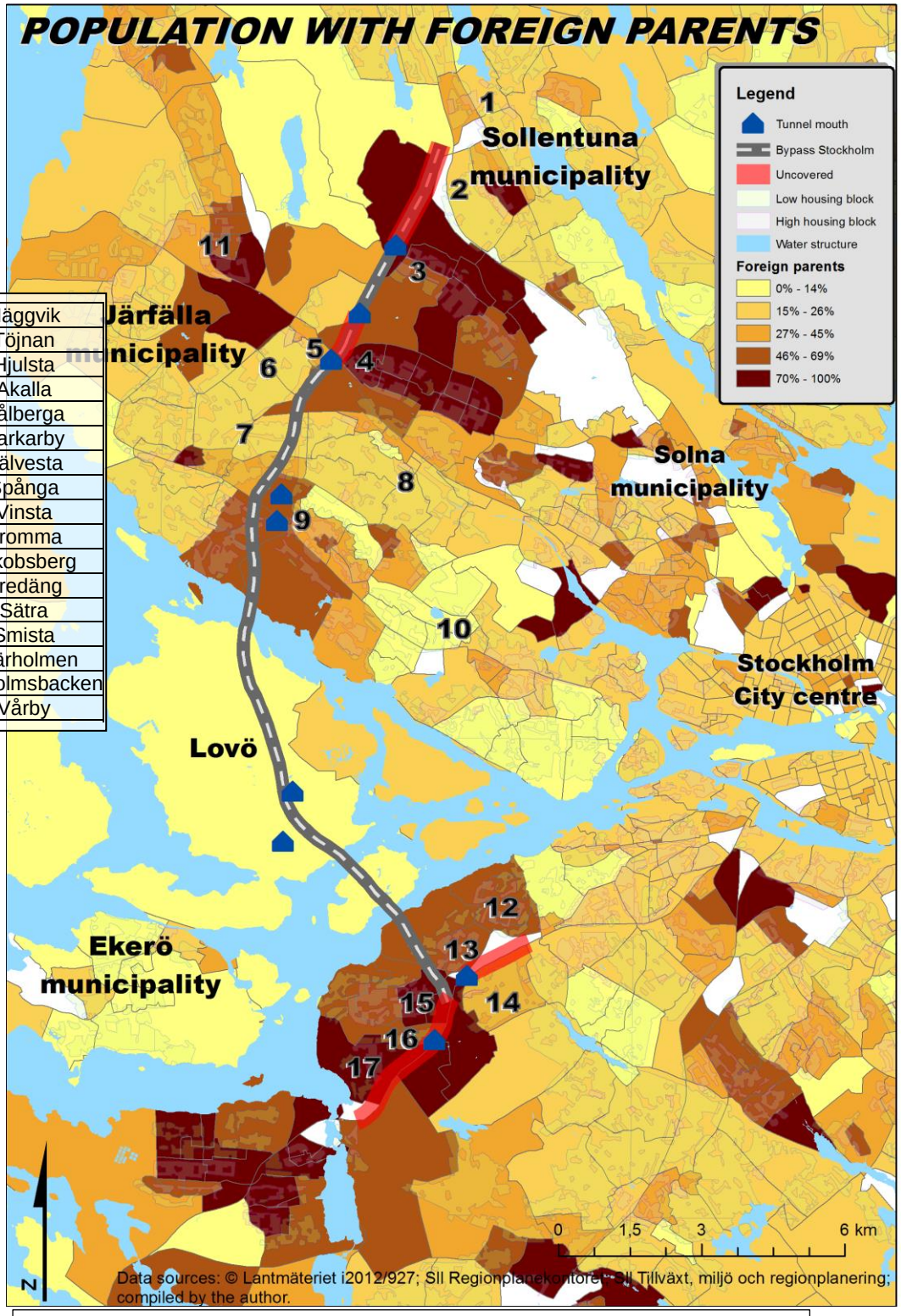
5	Vålberga
6	Barkarby
7	Kälvesta
8	Spånga
9	Vinsta
10	Bromma
11	Jakobsberg
12	Bredäng
13	Sätra
14	Smista
15	Skärholmen
16	Lindholmsbacken
17	Vårby

Map 6. Employment rate is here calculated as the ratio between number of employed and the total nigh population. Also infants and elderly are included because they are also a part of the population and are important to include in the justice assessment.

The pattern in map 6 is similar to the two previous maps. Smista shows high employment rate, while Lindholmsbacken deviates from the previous pattern with low employment rate. Töjnan, Kälvesta, and western Spånga have middle-range employment rates.



1	Häggvik
2	Töjnan
3	Hjulsta
4	Akalla
5	Vålberga
6	Barkarby
7	Kälvesta
8	Spånga
9	Vinsta
10	Bromma
11	Jakobsberg
12	Bredäng
13	Sätra
14	Smista
15	Skärholmen
16	Lindholmsbacken
17	Vårby

Map 7: The proportion of population with foreign parents in the Stockholm region.

Map 7 illustrates a distinct relationship between a large population with foreign origin (first or second generation immigrants) and uncovered road sections or tunnel mouth localisations. The exceptions are Lovö (sparsely populated), Smista and Töjnan with relatively low proportions of migrants.

In summary, socioeconomic indicators (income, education, employment) are more prosperous in the central and northern parts of the Stockholm area and also in Ekerö, Bromma and to some extent parts of Järfälla and Spånga. Along Bypass Stockholm, Akalla, Hjulsta, (parts of) Vinsta, Skärholmen, Vårby, Sätra, and Bredäng have poor indicators. Töjnan, Barkarby, Lovö, Kälvesta, and to some extent Smista, Vålberga, Lindholmsbacken and western Spånga indicate positive socioeconomic standards.

4.2. Planning Policy

> "[T]he Stockholm region shall become Europe's most attractive metropolitan region" (RUFS 2010:128, my translation).

This is the overarching vision for the regional planning in Stockholm. In accordance to this vision, the regional planning strategy advocates a development of a polycentric urban structure, wherein central Stockholm[20] is the prime centre, complemented with 8 regional centres[21] (RUFS 2010:138). The polycentric regional structure was ordinated already in the 1966 regional plan, which sketched an urban structure similar to the one presented in RUFS 2010: (1) one central, primary core without upper growth and compaction limits (the capacity of the transportation system, environmental and aesthetical issues are the only constraining factors), (2) secondary cores (*"semi-central work place concentrations"*) and peripheral cores, which are attractive for the localisation of business' sectors that are less dependent on personal interaction, have lower productivity, and hence prefer lower land rents rather than a central location (Stockholm Area Regional Planning Office 1967:59-62). A parallel development strategy is the regional enlargement ambition that is supposed to increase reach areas for businesses, and improve employment and consumption opportunities for residents (RUFS 2010).

[20] The central regional core includes Stockholm inner city, central parts of southern and western Stockholm, part of Nacka, Solna and Sundbyberg (RUFS 2010:138).
[21] Barkarby-Jakobsberg, Kista-Sollentuna-Häggvik, Täby centre-Arninge, Arlanda-Märsta, Kungens kurva-Skärholmen, Flemingsberg, Haninge centre, and Södertälje (ibid.).

Also the European Union recommends the development of polycentric regional structures as a strategy to *"ensure regionally balanced development"* and utilise the economic potential of regions (European Commission 1999:20). The EU recommendations were internalised into the regional planning of Stockholm in 2001 (Brattström 2014, interview).

Regional enlargement combined with polycentricity increases the prospects of localising business and human capital (labour) on a larger spatial area and unburdens the inner city (Johansson 2008:12). Targeted transport infrastructure investments are required to develop these planning strategies (Prop. 2008/09:93; RUFS 2010).

4.3. Transportation Planning

Transport infrastructure investments are regarded as crucial for the accessibility to new residential developments and establishments of businesses (City of Stockholm 2009).

> "The overall objective of the transport policy is to ensure a socioeconomic efficient and sustainable transport provision for citizens and businesses throughout the country." (Prop. 2008/09:93 p. 14, my translation)

This is the overarching national transport policy goal, which is subdivided and categorised into one *functional* goal, accessibility, and several *deference* goals, safety, environment and health (ibid.). Accessibility improvements are interpreted by the Road Investigation as the reduction of travelling costs (in time and money) and the ability to access additional destinations without increased sacrifices (Road Administration 2005). The investigation admits however that accessibility gains are in reality fully dependent on the individuals' income levels and access to cars.

Central priorities of the transportation policies are to strengthen the competitiveness and specialisation of the business community in order to generate economic growth and welfare, promote increasing commuting and regional enlargement, improve traffic safety, public health, gender equality, and inter-generational environmental sustainability (Prop. 2008/09:93; 2012/13:25). Increased commuting is clearly a political objective and is heavily subsidised through tax deductions for work trips and expenditures for distant employment (SOU 2007:35). Politically, commuting over longer distances is conceived as

desirable due to a perceived popular demand to dwell and work in separate locations (Rosencrantz 2014, interview). However, commuting is generally considered as a burden and an economic and temporal cost and is only desirable if it is associated with opportunities of higher income and a more stimulating work place (Vinnova 2010:24).

Promotion of intra-generational environmental sustainability and local environmental protection are scarce in the political planning documents and distributional and environmental justice concerns regarding class and ethnicity are totally absent in the transport policies (see e.g. Prop. 2008/09:93; Swedish Transport Administration 2013a).

Central transport policy principles are consumer sovereignty, and competition and coordination between the different modes of transportation (Prop. 2008/09:93; 2012/13:25). Conditions for public transport, walking and cycling are presupposed to improve but not necessarily in relation to automobility (Swedish Transport Administration 2013a:15).

According to the regional development plan, it is only possible to transfer a limited share of the traffic from automobility to public transport. Historical experiences – the correlation between economic growth and increased car usage – are held as motives for future road investments (RUFS 2010:84). In the original regional plan the more efficient public transportation system was expected to dominate in the central core while the car traffic was subscribed an essential role for the transversal commuting between the peripheral cores (Stockholm Area Regional Planning Office 1967:59-62). The conservative member of parliament, Rosencrantz (2014, interview), declares that the car has indeed an important role in the future, and consequently there is a need for more roads – including Bypass Stockholm – in order to dissolve traffic jams and unburden the inner city road network. Wiklund (2014, interview) from the Left Party is not convinced, arguing that the massive resources spent on Bypass Stockholm maintains the future dominance of the automobility system. Also Green Party representative Karlsson (2014, interview) advocates an alternative employment of the public resources, which could have been spent on further development of the public transport system instead of being spent on road infrastructure.

Bypass Stockholm is however not the only investment in the north-southern transportation system. It is withheld that the road project is only one piece of a

more comprehensive transport development plan including investments in roads and railways (Rosencrantz; Melander 2014, interviews). Public transport is regarded as the main mode of transportation as the transportation system will require additional capacity along with the regional growth (RUFS 2010:140):

> "Stockholm metropolitan region needs a public transit that is attractive and accessible for everyone." (ibid:54, my translation)

It is also stated that every new road project needs to prioritise and improve the competitiveness of public transportation (Stockholm Negotiation 2007:9). 18.4 billion SEK out of the total planned investment amount of 100 billion SEK will be spent on doubling the track capacity on the Saltsjö-Mälarsnitt railway system[22] (Swedish Transport Administration, et al. 2010). Older figures indicate the following distribution of future investments: 35 billion SEK on road investments, 10 billion SEK on railways, and approximately 13-14 billion SEK on public transportation (WSP 2007:21).

Planned investments in transport infrastructure are expected to increase the average speed of public transport from 22 km/h to 26 km/h until 2030, while the average automobile speed is estimated to remain constant on 33 km/h (WSP 2007:8). With the planned regional transport infrastructure investments the public transport system will experience a larger increase in person transportation stock than the automobile system, while the opposite development is predicted for the traffic stock (ibid:24, 28).

4.4. Traffic Management

Rosencrantz (2014, interview) withholds that while the car is an important mode of transportation for many people, also in the future, an attractive development of the urban milieu requires a reduction of the urban car traffic. Increased traffic volumes are considered as inevitable in the growing metropolitan region and negative health effects in central districts need to be relocated by constructing bypass roads through less densely populated areas (RUFS 2010:86).

> "Street space in the central parts of the region is a scarce resource. By putting a price on using it while capacity is created in public transport

[22] The construction of Mälarbanan and Citybanan will expand the north-southern railway capacity from 2 to 4 tracks.

> and on outer traffic routs congestion can be avoided and more efficient traffic can be achieved." (Stockholm Negotiation 2007:8, my translation)

The congestion charging is an important traffic management instrument used to reduce traffic in the inner city and to raise funds for road investments (Stockholm Negotiation 2007:31). The objectives are expressed as *"efficient usage of the traffic system"* and *"optimising"* the road passability. Efficient allocation of road space implies a distribution according to the market principle of consumer sovereignty – *"to those who value it the most"* (City of Stockholm 2006:19).

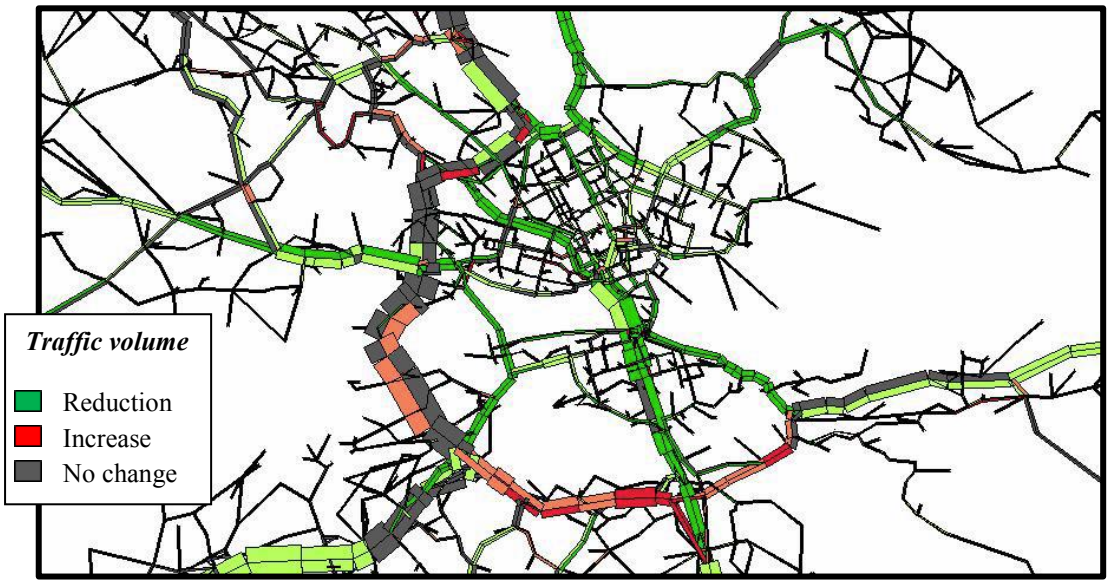
The evaluation of the *Stockholm Trial*[23] generated the following insights: (1) simply increased capacity in the public transport system does not reduce road traffic volumes, (2) neither congestion charges nor additional road investments can eliminate, rather only mitigate, congestion, and (3) relocation of car traffic to circular roads (e.g. Essingeleden experienced an 4-5% increase) was modest (City of Stockholm 2006).

The Stockholm Trial managed to: (1) reduce the average daily traffic volume over the charging passages with 22%, mostly for the spatiotemporally unbound traffic[24] with spill-over effects outside the charging area, (2) improve passability on the central road network by reducing congestion related delays[25], (3) to reduce traffic generated PM_x particles with 10% in the inner city (5% in Stockholm County) while noise reductions were negligible[26] (ibid.). Mainly the middle-income groups reduced their car usage in the inner city, thus low-income groups were to a large extent already commuting with public transport, and high-income groups did not experience enough incentives to change commuting behaviour[27] (ibid.). Motorists residing in the inner city are not affected by the charges, but have actually increased their free of charge inner city driving and taken advantage of mitigated congestion (ibid.).

[23] Introduction of congestion charges in the city centre supplemented by additional capacity in the public transport system.
[24] Traffic which is spatiotemporally bound is typically related to economic activity such as commuting to work.
[25] Queue delays were cut by 1/3 during morning rush hours and by ½ during afternoon rush hours on the arterial roads.
[26] Significant noise reduction or increase requires massive shifts in traffic volumes.
[27] The charges are considered as low in proportion to higher income levels.

Other winners of the Stockholm Trial were the commercial traffic (faster mobility) and those valuing reduced travelling time higher than the price of the charge, while the losers were motorists that were out-crowded from the central road system due to too high perceived costs associated with the charges (ibid.).

Reliable logistics are fundamental for the business community, which requires freight traffic flows to be relocated away from congested roads (RUFS 2010:56; Rosencrantz 2014, interview). Mitigation of congestion in the centre, even if requiring additional charges, is desirable for commercial traffic because congestion charges make such a small proportion of the total tariffs (Sundberg; Wiklund 2014, interviews).



Map 8. The road traffic relocation effect of the congestion charges between April 2005 and 2006 (City of Stockholm 2006:8).

The mitigation of traffic in the centre is clearly visible in map 8. Some traffic increases occurred on the circular roads.

The congestion charges were made permanent the 1st of August 2007 (Transport Agency 2014). Raised congestion charges in combination with additional fees on Essingeleden will make travelling to/through the city centre substantially more expensive (Prop. 2013/14:76). The maximum daily charge will be raised from 60 to 105 SEK. According to the government proposition, the revenues from additional fees will finance the development of the subway system.

Additional costs on driving have the greatest impact upon the population groups with low incomes, who responds primarily by reducing their other

consumption, secondary by reducing the cost of the car, and in the last resort by abandoning automobility (Pyddoke 2009).

4.5. Socioenvironmental Consequences

There is an obvious correlation between socioeconomic status and general health status (Burström, et al. 2011), which is stronger in more unequal societies (Wilkinson & Pickett 2009). Sweden is the sixth least unequal country among the OECD members[28] but has nevertheless experienced the sharpest increase in inequalities since the 1990s[29] (OECD 2011). The inequality effect on health is significant from municipality level and beyond (Rostila, et al. 2012). Research results in a Stockholm context indicate that the risk of developing myocardial infarction is higher for individuals living in areas of lower socioeconomic status (Kölegård Stjärne, et al. 2002).

4.5.1. Health Effects and Diffusion of Air Pollution

Road traffic is the most important emissions source of harmful air pollution. In 2005-2006, 4000 Stockholm residents dwelled in areas where the rates of air borne particles exceeded the standard rate and 300 000 lived in an area with rates just below the standard rate (Swedish Transport Administration 2011). The inflow routs to the city, particularly E4/E20, and a number of inner city streets are the most significant local sources of harmful air pollution (ibid.). Air polluting particles have not decreased in Stockholm since the measurements started in 1997, the national and regional environmental quality goal for 2010 was not reached, and the standard recommended by WHO is exceeded in large parts of the region (Karolinska Institute 2009:7 p. 32). Air pollution has a major impact on public health causing a larger number of premature deaths than traffic accidents (Kjellström, et al. 2009:54). Exposure to locally generated particles increases the risk for negative respiratory health effects (Willers, et al. 2013) and high local rates of SO_2 increases the risk of lung cancer (Nyberg, et al. 2000).

Abrasion from the road surface and brakes dominates the creation of particle emissions (combustion particles makes approx. 10% of the particles) and the rate is highly dependent on the usage of studded tyres (Johansson 2014, interview; LVF 2013:6). The Swedish Transport Administration's (2011) predictions assume

[28] Gini-coefficient: 0.259.
[29] The Gini-coefficient increased by 4.8% between mid-1990s and mid-2000s. Canada is on second place with 3.5%.

50% studded tyre usage and an 800µg/m^3/day particle rate in the tunnel. Current studded tyre rate is 41-55% in the inner city (Brydolf, et al. 2013) and 60 % in Stockholm County (Swedish Transport Administration 2013:112).

There is no floor rate for the harmfulness of air pollutions, but every additional dose of exposure accumulates to the individual long term exposure and may also cause short term acute health effects for vulnerable individuals (Road Administration 2009c). Studies indicate that health effects from long term exposure to coarse PM_{10} particles start yet from the low rate of 10µg/m^3 (WHO 2000:187, 191). The dose-response of particle rates is linear, which implies that for every increase of PM_{10} particle rate by 10µg/m^3 the number of premature deaths increases constantly by 4.3% (Kjellström, et al. 2009:53). The dose-response for fine-grained $PM_{2.5}$ particles is 6% (8% for heart and lung diseases) (Boesch, et al. 2008:56).

$PM_{2.5}$ particle rates, sulphate rates or black soot concentrations are better indicators for negative health effects than PM_{10} particle rates (WHO 2000:192; Boesch et al. 2008:53). NO_2 rates are also useful predictors particularly for measuring health effects from pollution specifically caused by local road traffic (Kjellström, et al. 2009:55). NO_2, soot and ultrafine $PM_{0.1}$ particles can be measured up to 500-1000 metres from major roads (ibid.). Soot – mainly generated from diesel engines irrespective of catalytic conversion effect – is among the most harmful air polluting substances causing mortality and morbidity, but is not regulated by national standards (SLB-analys 2013). Air pollution expert Johansson (2014, interview) argues that soot should be regulated and measured separately.

Newly exhausted combustion gases (particularly from diesel engines) and smaller $PM_{2.5}$ particles are more harmful than larger PM_{10} particles and health effects such as cardiovascular diseases, allergies, asthma, and obstruction of infant lung development are more frequent in proximity to busy motorways (Road Administration 2009c). Environmental analyses for Bypass Stockholm do however not declare predictions for the rates of smaller particles that are aggregated within the PM_{10} estimations. Wind speed and direction are fundamental factors for and proportional to the diffusion of traffic generated air

pollution (Johansson 2014, interview). Temperature inversion[30] is also an important factor for the atmospheric dilution efficiency of polluted air on ground level (ibid.). Other sources of uncertainty are the emission standards of the future vehicle fleet and if the traffic volumes breach the prognoses (Johansson 2014, interview).

4.5.2. Health Effects and Diffusion of Traffic Generated Noise

When current noise standards were set in 1997 the scientific knowledge about the health risks from traffic generated noise was limited (Pershagen & Nilsson 2013). Now, there are comprehensive results indicating that high noise levels cause insomnia, stress-related symptoms, cardiovascular diseases, high blood pressure, diabetes, and reduced cognitive functioning[31], which motivate restrained noise standards (ibid; Road Administration, et al. 2009:72; Nilsson 2014, interview). Increased risk for myocardial infarction is identified from long-term exposure to noise levels from 50 dB(A) and above (Selander, et al. 2009). Individuals with auditory impair, with foreign native language, or infants learning the language are more sensitive to noise disturbances and require 10-20 dB(A) lower noise levels than other individuals in order to apprehend speech (Road Administration, et al. 2009:72).

The decibel (dB) scale is logarithmic which means that a small increase in decibel requires a large increase in traffic volumes (Pershagen & Nilsson 2013). A 10 dB(A) increase is in reality a doubling of the sound volume and 1 dB(A) corresponds to the smallest audible increase (Bolin 2014, interview). Larger traffic flows do not increase noise levels significantly (at most up to ~2 dB(A)) (Nilsson 2014, interview). The government is currently in the process of increasing the standards for traffic generated noise levels in densely populated areas from 55 to 65 dB(A) at the building facades, with the precondition that at least one side is kept silent (Ministry of Social Affairs 2014). This is criticised by Pershagen & Nilsson (2013) for ignoring scientific knowledge and reducing the ambition levels.

[30] If the air is colder near the ground the air does not mix vertically.
[31] Negative effects on learning, memorisation and concentration ability has been observed from aviation generated noise disturbance (Nilsson 2014, interview).

Innovations in engine designs will not have any noise mitigating effects, because traffic noise in speeds higher than 30 km/h is manly generated from the friction between tyres and road surface (Nilsson 2014, interview).

In order to combat high traffic noise levels in populated areas, noise barriers (screens or embankments) are installed next to the road or near residential areas. The noise mitigating effect of roadside barriers declines with the distance from the road (significant effects up to 100-150 metres from the road), but have nevertheless sufficient effect next to busy roads particularly if the barriers are high (Nilsson & Berglund 2006:2185). Dwellings on higher altitudes (upper floors) do not experience as efficient noise mitigation effect as the lower floors (Nilsson 2014, interview). The diffraction effect establishes a noise source on the top of the barriers and diffracts the noise towards ground level (Bolin 2014, interview). This effect is further reinforced with downwind and cold air temperature (ibid.). Additionally, road side barriers create disturbing low-frequent noise that is not captured with the conventional A-weighted scale (Nilsson, et al. 2008).

Another noise mitigating measure is the application of porous (silent) asphalt. Porous asphalt requires prohibition of studded tyres, and its life span is short requiring regular maintenance work and high expenses (Nilsson; Bolin 2014, interviews).

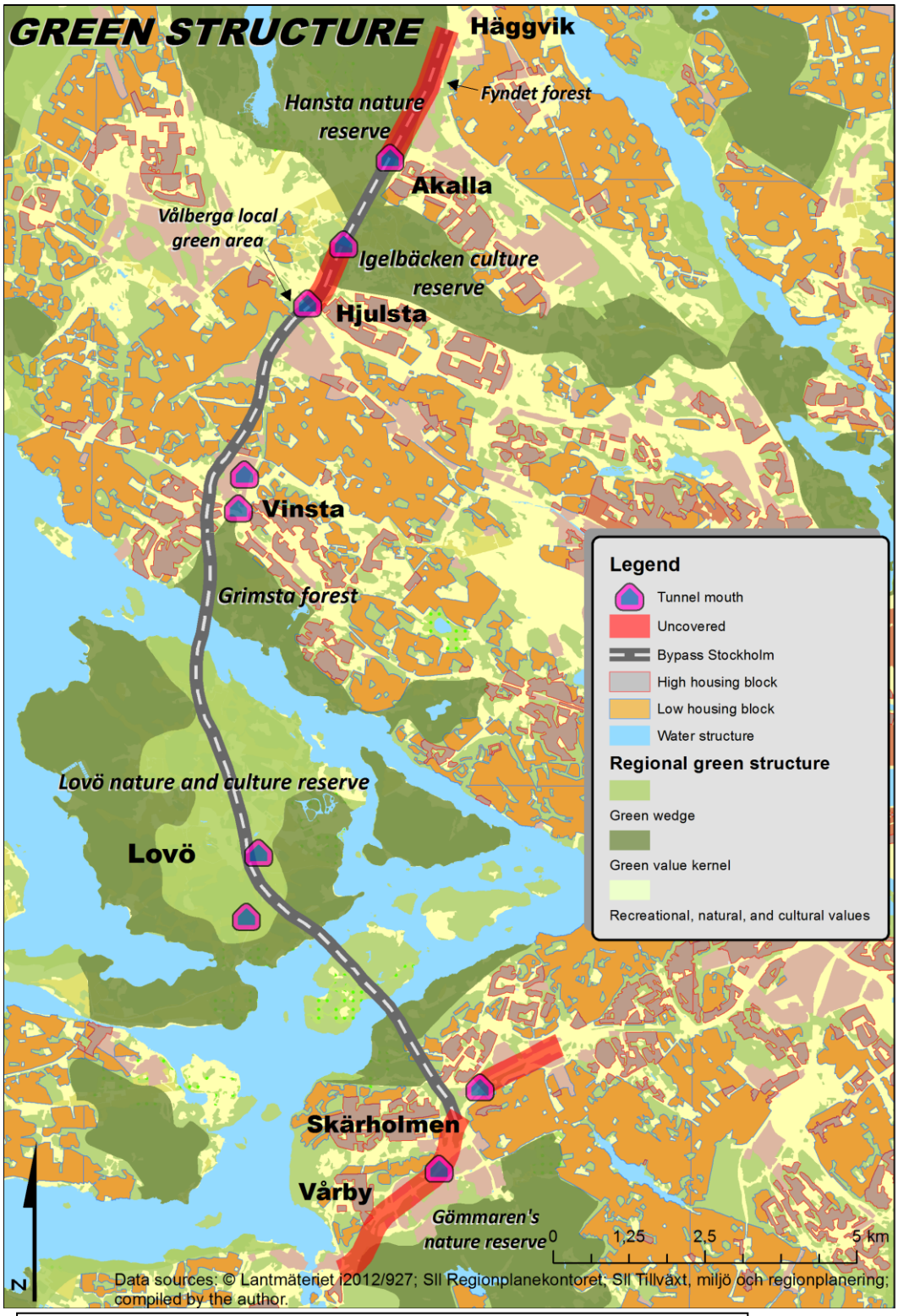
Engineering calculation models used for road traffic noise mapping are simplifications of scientific models and consequently the accuracy of their results are limited (Bolin 2014, interview):

> "Mapping of road traffic noise in urban areas according to standardized engineering calculation methods systematically results in an underestimation of noise levels at areas shielded from direct exposure to noise, such as inner yards." (Hornikx, et al. 2014:293)

Altogether, these uncertainties and potential sources of inaccuracy associated with noise effect modelling complicate and question the reliability of the official noise impact assessment. It is not declared how or if these sources of uncertainty are taken into account in the Environmental Consequence Declaration (see Swedish Transport administration 2011).

4.5.3. Natural Landscape Degeneration

The regional green structure of Stockholm is organised such that coherent green wedges – with a minimum width of 500m – cut through the urban landscape and provide the urban population with recreation and relaxation opportunities in quiet environments (RUFS 2010:147-48). It is stated that green areas shall be protected from fragmenting and intruding developments/constructions (ibid:157).



Map 9. The intrusion of Bypass Stockholm on the regional green structure.

Map 9 illustrates that the Järva wedge will be cut by the uncovered road section that will run through a large area of the green wedge. Two tunnel mouths will be

established at Lovö, an uncovered road section[32] will run next to Gömmaren's nature reserve, and another uncovered road section next to Hansta nature reserve.

Barrier and disturbance effects – interrupting ecological processes and connectivities – are the most significant threats to the biological habitat that are caused by road constructions (Road Administration, et al. 2009:88). Concerns are raised about that focus is limited to restricting indoor traffic noise levels while ignoring the outdoor noise levels e.g. in courtyards and in green areas (Karlsson; Nilsson 2014, interviews; Pershagen & Nilsson 2013).

Stress-induced illnesses – which are globally among the most widespread health problems – can be pre-empted with stress restoration in green spaces (Grahn & Stigsdotter 2010). Research results indicate that the risk of developing stress-related illnesses is reduced with time spent in green spaces and that the proximity to such spaces is indispensable hence the lack of proximity is generally not being compensated by trips to more distant alternatives (Grahn & Stigsdotter 2003). The stress restoration effect declines in noisy environments but the Swedish Transport Administration lacks a model for evaluating and regulating disturbances in green areas (Nilsson 2014, interview). Barrier effects and aesthetical deterioration of local green structures have a disproportionally high negative impact upon populations with limited mobility, and the risks for ill-health increases when these groups adopt more sedentary lifestyles (Swedish Transport Administration 2011).

4.6. Bypass Stockholm

The regional road capacity in north-southern direction is considered as under-dimensioned and in need of additional capacity in order to meet increasing future traffic volumes (RUFS 2010:56). While radial[33] transport infrastructure is well developed, transversal routs between regional cores are identified as in need of improvements (ibid:99; Trafikanalys 2011:44). It is withheld that public transport, in the form of express bus routes, are fundamental for commuting on the transversal road system that inter-connects the regional cores (RUFS 2010:142).

A western north-southern road connection occurred for the first time in a regional planning document from the middle of the 1960s (Stockholm Area

[32] Enlargement of the existing continental highway.
[33] Routs that are directed towards and outwards from the city centre.

Regional Planning Office 1967), and has ever since reappeared with different shapes and titles.

4.6.1. Introduction

> "Allowing the communication capacity to come in a later stage is probably the most expensive thing to do in a long range planning context if people's well-being and economic efficiency are considered as positive criteria of appraisal." (Kristensson 1967:108, my translation)

The economics professor Kristensson's work was very influential for the priorities made in 1966 regional plan (Stockholm Area Regional Planning Office 1967) and has influence regional planning ever since. Kristensson's (1967) vision stresses the importance of circular roads for the regional development – towards a hierarchical structure of central and peripheral cores – if an unsustainable traffic situation in the centre is to be avoided. The central objectives of the Bypass in a regional planning context are termed as following:

> "Bypass Stockholm is in the medium term a key object for increasing road capacity over Saltsjö-Mälarsnitt for car and bus traffic as well as for commercial transports. The bypass reduces congestion on the arterial roads, the northern and southern parts of the county are held together, the links become efficient between the terminals and ports. The central regional core is unburdened while the outer regional cores are inter-connected and developed." (RUFS 2010:141, my translation)

Bypass Stockholm will become a six lane 90 km/h speed limited freeway, stretching 25 km, whereof 21 km will be newly constructed, and 18 km will run through two tunnel sections (Swedish Transport Administration 2011). According to the predictions, daily around 140 000 vehicles are expected to run on Bypass Stockholm in 2035 (ibid.). Bypass Stockholm was adopted by the government under certain conditions. Measures are required to be taken in order to keep negative consequences for natural, cultural and other landscape values to a minimum, construction disturbances need to be declared, and air pollution in the atmosphere and in the tunnels need to be curbed (Ministry of Environment 2009).

Location	Items	Note
Kungens kurva	Two tunnel mouths; entrance ramps; enlarged, uncovered continental highway; one additional interchange.	Densely populated areas.
Lovö	Two tunnel mouths; enlarged county road; two small roundabouts.	Sparsely populated; high culture landscape value.
Vinsta	Two tunnel mouths; two roundabouts.	High intensity of non-motorised traffic/pedestrians.
Hjulsta	Large, elevated (bridge); uncovered interchange; large roundabout; two continental highways; tunnel mouth.	Densely populated residential area.
Hansta	Interchange; uncovered submerged road section; tunnel mouth.	Densely populated area.
Häggvik	Interchange; uncovered road section; tunnel mouth.	

Table 1. Summary of the potentially hazardous sources of Bypass Stockholm (Swedish Transport Administration 2011).

4.6.2. Geographical Relocation

The current road infrastructure in north-southern direction is described as unsustainable, because predicted increases of the traffic volumes are expected to overstress the vulnerable traffic artery Essingeleden (Swedish Transport Administration 2011). Bypass Stockholm will relocate the continental highway E4 from central Stockholm to the western part of the region.

The construction of the bypass, in combination with the introduction of congestion charges on Essingeleden and raised charges in the city centre, will relocate traffic volumes from the centre[34] to the western periphery of the region (Swedish Transport Administration 2011). Traffic volumes in north-southern direction are expected to increase with additionally 40 000 vehicles per day until 2035 with the establishment of the bypass, while 60 000 fewer vehicles will pass Essingeleden in comparison with the zero-alternative[35] (ibid.).

[34] The reduction of traffic volumes on the central road network is predicted to 6% (Swedish Transport Administration 2011).
[35] A hypothetical comparison alternative without any new investments

Karlsson (2014, interview) is not convinced about the traffic relocating effect of Bypass Stockholm *per se*, hence motorists driving on the inner city road network have central destinations that are out of reach for the bypass. This argument makes sense from a geographical perspective and implies that it is mainly traffic from Essingeleden that will be relocated. The road traffic reductions in the inner city are entirely achieved by the congestion charges (ibid.). The traffic prognoses for the zero-alternative do actually not include congestion charges over Essingeleden but the charges are included in the scenario with the bypass (Road Administration 2009e:7-8). Therefore, it is uncertain to what extent the traffic reduction effect on the central road network is achieved by the bypass respectively by the charges. Forecasts indicate that 41% of the total amount of car journeys on the bypass will not consist of relocated traffic from other routs but new, induced traffic (Transek 2006:4).

A central objective of the bypass is to relocate the long-distance road traffic (particularly the nationwide freight transport) to the regional periphery without passing and burdening the inner city roads (Rosencrantz 2014, interview; Swedish Transport Administration 2011b). SIKA's (2007) forecast for 2020 predicts that only 211 vehicles per day (out of 400 000 vehicles passing Saltsjö-Mälarsnitt) will pass the region without having their start or destination within the region. This makes SIKA draw the conclusion that the project's objective of facilitating long-distance through-traffic is irrelevant.

According to Wiklund (2014, interview), the willingness to relocate road traffic from the centre indicates that the political majority acknowledges the environmental problems caused by the traffic. The bypass does not curb the problems but hence *"exports the problems of the inner city to the suburbs"* (ibid.).

Another central objective is to integrate the metropolitan region – to counteract the separation between the northern and southern parts of the region – and to improve the prospects for a *polycentric* regional structure (City of Stockholm 2010). This is argued to be crucial in order to create possibilities for increased commuting between the northern and southern parts of the region, without passing the heavily congested centre (Rosencrantz 2014, interview). The bypass will also improve Stockholm's regional connections westwards with the wider Eastern Central Sweden region and enlarge the functional region by contributing to the integration of neighbouring counties (Brattström 2014, interview).

4.6.3. Financing

The Stockholm Negotiation (2007:12) assigned investments worth 40 billion SEK for transport infrastructure investments in the Stockholm region for the period 2008-2019[36]. 500 million SEK in annual revenues are accounted from the existing congestion charges to the financing of the bypass and an additional 270 million SEK annually from forthcoming charges on Essingeleden (ibid.). 200 million SEK of the accumulated revenues from 2006 and 2007 were directed to investments in the public transportation system (Ministry of Finance, et al. 2006), while the rest has and will be spent entirely on road infrastructure (Wiklund 2014, interview).

Political initiatives have recently been taken in order to delegate responsibility for collecting congestion charges from the state to municipal level (Prop. 2009/10:80 pp. 225-28; SOU 2013:3). A clause was inscribed along with the delegation, binding the City of Stockholm to co-finance the bypass through the congestion charge revenues *alternatively* with other optional funds (Stockholm Negotiation 2007:43). Political documents secure that inflation enumerated congestion charge revenues for a 30 years period are bound to finance the project (City of Stockholm 2009). Spending the entire revenues from the congestion charges on the bypass is contradicting the result of the consultative referendum in 2006[37], which prescribed that revenues shall fund not only road investments but also investments in public transportation (Wiklund 2014, interviews). Karlsson (2014, interview) is concerned about the shortage of funds for needed investments in public transportation infrastructure and would subsequently prefer to reallocate the resources spent on the bypass to this purpose.

Total investment costs are estimated to 27.6 billion SEK (2009 price level) (Swedish Transport Administration 2011), which was later enumerated to 31.5 billion SEK[38] (2012 price level) (Pettersson, et al. 2012). However, the total costs in 2009 years price level – including the financing costs/interest of 17.1 billion SEK – becomes 44.6 billion SEK (Vikström 2013).

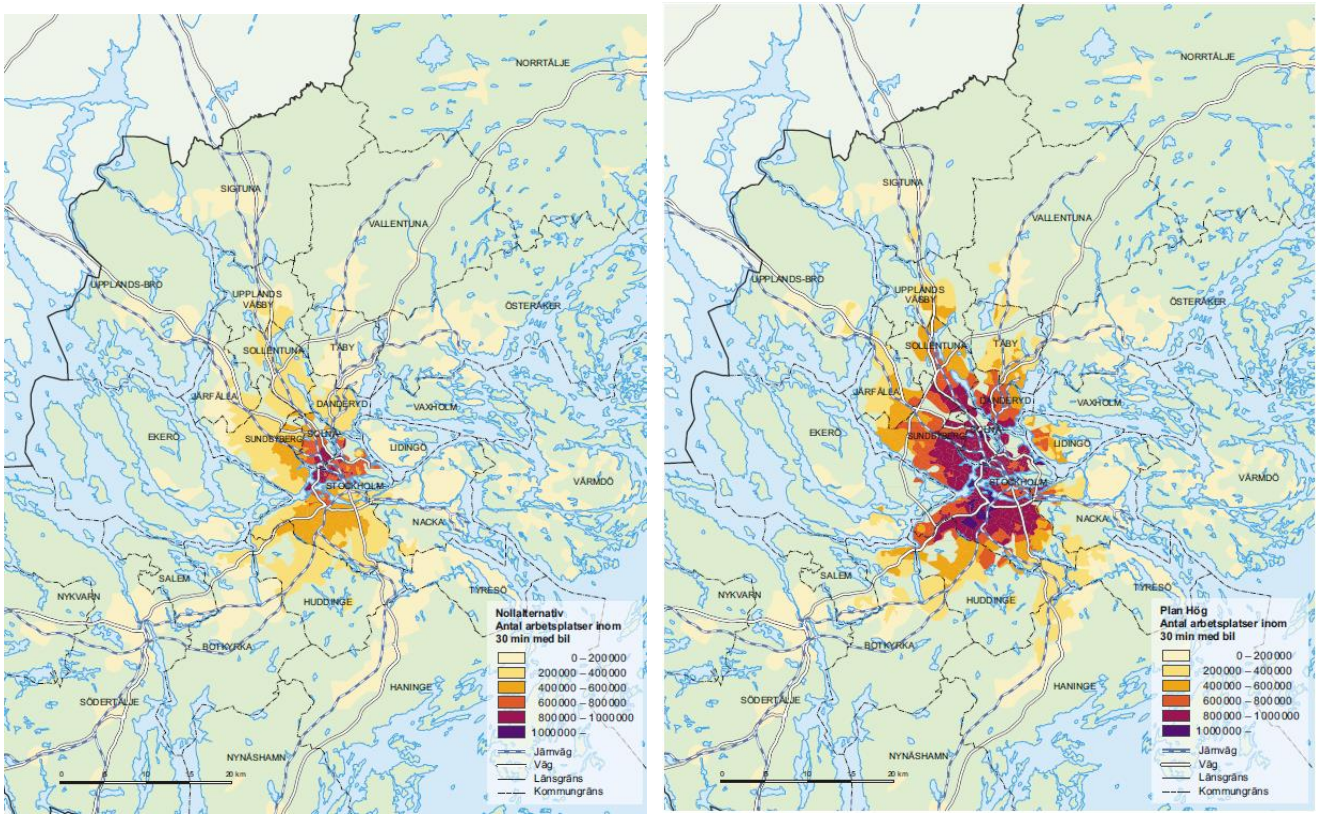
[36] Overall transport infrastructure investments granted for the entire nation are 522 billion SEK for the period 2014-2025 (Ministry of Economy 2014:5).

[37] On the back side of the "Yes" ballot the voters in the referendum – concerning whether making the congestion charges permanent or not – had to consider the following term of condition: *"Revenues from environmental charges shall be returned to Stockholm for investments in e.g. public transport and the municipal road network."* (Municipality Executive Board 2005:appendix 1, my translation)

[38] 27.1 billion SEK from congestion charges and 4.4 billion SEK from state funds.

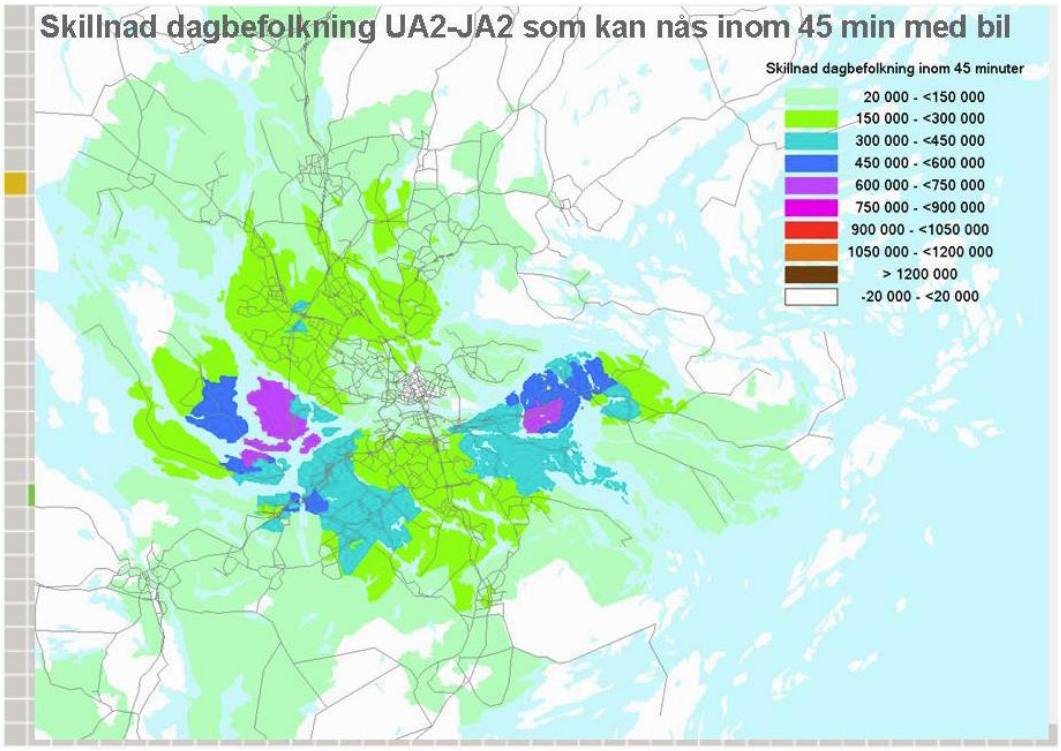
4.6.4. Accessibility

One important aim with the project is to facilitate and integrate the regional housing and labour markets by equalising accessibility over the region by car and public transportation (bus connections) (City of Stockholm 2010).



Map 10. Accessibility to work places within 30 min car trip in the zero-alternative and with the comprehensive investment alternative in 2035 (RUFS 2010:196).

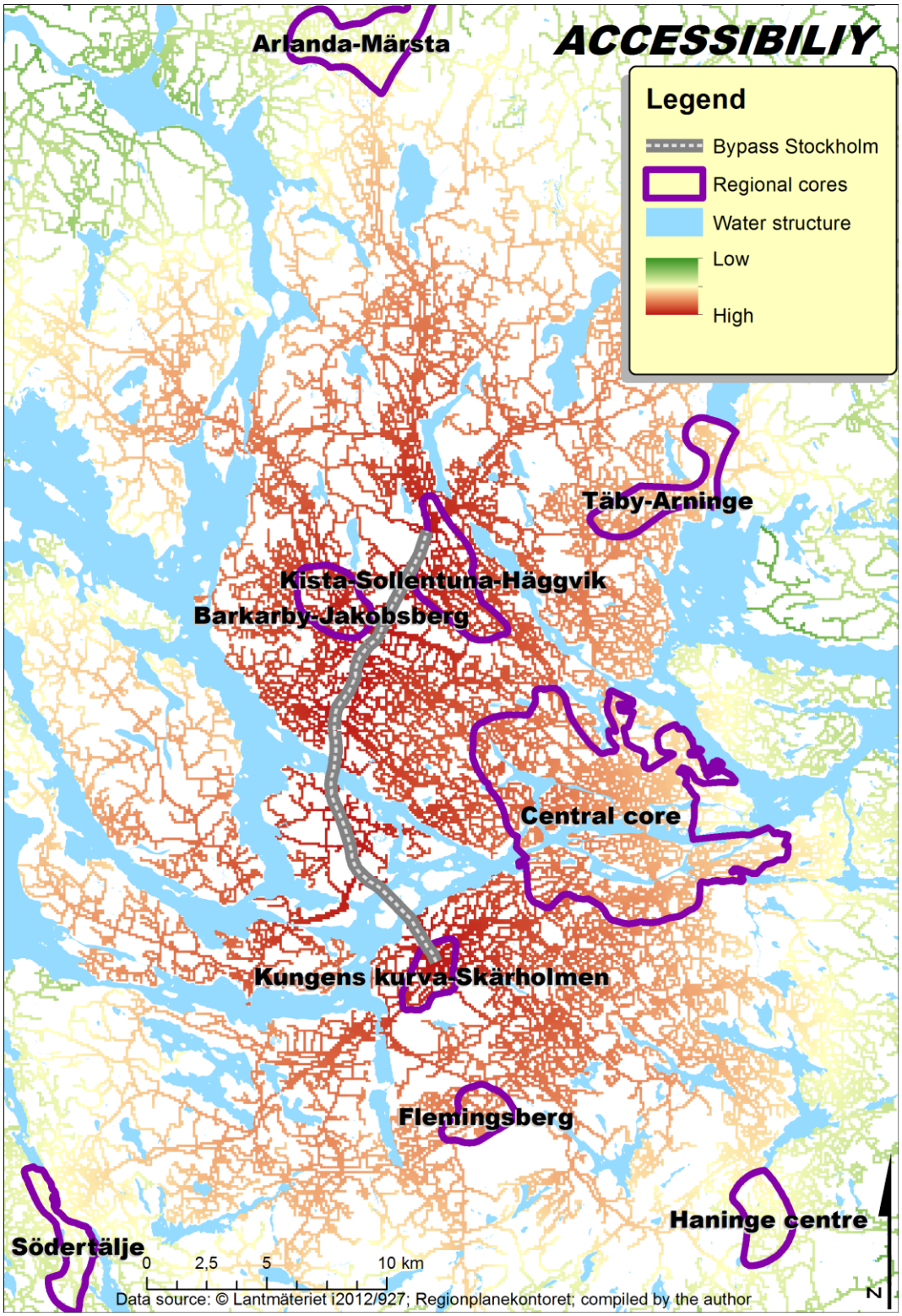
Map 10 shows the difference in accessibility to supplies of employment opportunities between the zero-alternative and the development alternative (with eastern and western bypass roads). Substantial improvements for car owners can be identified over large areas all over the region.



Map 11. Accessibility improvements to day populations within 45 min car trip in 2030, generated by Bypass Stockholm and an eastern bypass (WSP 2007:34).

As illustrated in map 11, social connectivity will improve due to the bypass. The largest improvements will be in Ekerö municipality, south-western parts of City of Stockholm, limited parts of Huddinge and Botkyrka municipalities, and to a smaller extent in Järfälla municipality and the north-western parts of City of Stockholm.

Ekerö will improve its accessibility even further with the planned widening of the Ekerö road 261 to Brommaplan from 2 to 4 lanes (Swedish Transport Administration 2013b). Ekerö municipality is keen on the improved accessibility achieved with the bypass, providing shorter time-distance to the southern parts of the region, e.g. to Huddinge Hospital, Södertörn University College and Södermalm (Eriksson 2014, interview).



Map 12. Accessibility to the bypass via the regional road network based on a GIS network analysis.

According to map 12 the road accessibility improvements from Bypass Stockholm are concentrated mainly to the western parts of the region. Car owners in Bromma, the north-western and south-western parts of City of Stockholm, Järfälla, Ekerö and Sollentuna municipalities, and Kungens kurva in Huddinge

municipality will experience the largest driving accessibility gains. The regional cores Kista-Sollentuna-Häggvik, Barkarby-Jakobsberg, and Kungens-kurva-Skärholmen will benefit more than the other cores from improved accessibility by car.

Bypass Stockholm will improve the accessibility to a number of attractive destinations. Recreational environments on the archipelago of Mälaren – especially Drottningholm world heritage on Lovö – will become more accessible for visitors from larger parts of the region (Swedish Transport Administration 2011).

Bypass Stockholm will enhance the potential for developing new residential, production, and commercial sites, by creating new travelling patterns (Melander 2014, interview). Kungens kurva in the south-west is pointed out as an important economic node – "Northern Europe's largest commercial site"[39] – that will become more accessible for a larger population, which in turn creates a foundation for development of commerce and other functions in the neighbouring areas (ibid.).

An important advantage with the bypass is that it improves opportunities for exploitation of new land in the region[40] more than other alternatives (Transek 2006). This is also one of the explicit objectives of the project:

> "One of the main reasons for building a new north-southern connection is to make more land attractive for homes and workplaces." (Road Administration 2009d:13, my translation)

Land developments are already planned along Bypass Stockholm and the road will *"have a structuring effect on the land use in the region and particularly near the interchanges"* (Swedish Transport Administration 2011:63).

An important urban development project is Barkarby city in Järfälla municipality, located near the northern section of Bypass Stockholm. After the 10 year long construction period it is expected to contain 5000 new dwellings and 6000 work places (Järfälla municipality). The most spectacular upcoming development along the bypass is probably the Stockholm Port, located in direct

[39] Kungenkurva.se

[40] The socioeconomic analysis compares Bypass Stockholm with Diagonal Ulvsunda – an alternative project running closer to the city centre – and concludes that the bypass provides 10-20% higher accessibility to unexploited land for potential developments (Transek 2006:7).

connection with the Hjulsta interchange. The architectonic design of the structure was developed in an architecture competition and the project will contain 5000 dwellings and 6000 work places (City of Stockholm 2013).

Karlsson (2014, interview) argues that the bypass with related land developments creates new travelling patterns based on automobility. This is supported by the Swedish Transport Administration (2011:VIII, my translation):

> "Bypass Stockholm results in increased mobility and accessibility to a large housing and labour market, which can promote economic development and welfare. Simultaneously the car as the means of transportation is strengthened in the region and it has the consequence that the car's negative health impacts increase e.g. air pollution, traffic noise, traffic accidents, barrier effects and inactivity."

Some measures, such as bus ramps connecting the bypass with Skärholmen's public transportation node, will be taken for the establishment of express bus routes along the road, but important measures such as separate bus lanes along the highway are ruled out (Swedish Transport Administration 2011). High rates of polluted air in the tunnel may threaten the bus traffic. Maximum PM_{10} particle rates inside the bus compartments are not specified in the Work Environment Authority's (2011) prescription[41]. Transcendence of the maximum values specified by the authority will give the bus union the right to call for a *protection stop*[42] in accordance with the Work Environment Law (1977:1160). If rates of harmful air pollutions inside the tunnel and the bus compartments exceed limits prescribed by the authorities, bus drivers' union officials will not hesitate to take action and stop the bus traffic until satisfying measures are eventually taken (Nielsen 2014, interview). Until now, the Swedish Transport Administration has not presented any concrete plans on how to handle this issue, which is postponed for future considerations (Swedish Transport Administration 2011; Sundberg 2014, interview). Research results on this issue are heterogeneous. Forsberg's (2009) meta-study concludes that 10-15 minutes' driving in a tunnel with 800

[41] The prescription document is highly detailed and is not compatible with the PM_{10} measurements and standards.

[42] According to the Work Environment Law (1977:1160, chapter 6, §7) labour union officials (senior safety steward) have the authority to cancel the work if the work results in "immediate and serious danger to life or health".

$\mu g/m^3$ of PM_{10} particle rate is enough for significant negative health effects[43]. He adds that the temporary particle rates in the long tunnel of the bypass may reach up to 4000 $\mu g/m^3$ during peak hours. A recent study shows a much more efficient filtration process. For PM_{10} and $PM_{2.5}$ particles very small rates were measured in the compartment (in air recirculation mode) (Johansson, et al. 2013). Nevertheless, the study measured the bus compartment soot rate to 23% of the outdoor rate and up to 50% for older cars, and NO_x rates were almost as high inside the vehicle compartments as outdoors. There are no univocal results confirming that the bus traffic will be able to run on the bypass without serious health risks.

Clearly, Bypass Stockholm is primarily planned for the enhancement of automobility and will make society more car-dependent because of the increased commuting by car (Swedish Transport Administration 2011). According to predictions, 10-15 000 travellers will use public transportation on the bypass on an everyday basis, which corresponds to 6-9% of the 170 000 daily commuters (City of Stockholm 2010:30). This can be compared with the 52% market share of the public transport in Stockholm County (Ipsos 2014). Reasons for the relatively low proportion of public transport commuters are explained to be the low altitude and long distance between the bypass and attractive and populated destinations and public transport nodes (City of Stockholm 2010:30).

> "Bypass Stockholm passes sparser areas that are difficult to support with good public transport with frequent services." (Road Administration 2005:216, my translation)

North-southern travelling with public transportation is faster via the city centre, while traveling along the entire bypass by bus is expected to take 25 minutes longer than by car (Swedish Transport Administration 2011).

Today, 42% of all trips are carried out with public transportation and 39% with cars (WSP 2007:5). In 2030, the figures are estimated to become 37% respectively 50% in a scenario with all the arrangements of the Stockholm Negotiation in place (ibid.). Bypass Stockholm will improve the average travelling speed in the region

[43] Assuming 20-50% filtration efficiency.

by car with 3.8% in comparison with the zero-alternative[44], but no improvement for public transport is expected (Road Administration 2005:175).

4.6.5. Environmental Impact

Frequent criticism has highlighted the fact that Bypass Stockholm will increase the car traffic in the region and reproduce an environmentally unsustainable transportation system (Wiklund; Karlsson; Sundberg 2014 interviews). The former Minister of Environment argued against the critics by claiming that *"Bypass Stockholm is being built for the cars of the future"*, referring to low carbon emission or carbon free car engines (Ministry of Environment & Ministry of Economy 2009). This technology-optimistic approach was prevalent already in the infancy of the bypass. It was predicted that traffic generated noise and air pollution were pure technical issues of limited complexity that would be non-existent in the future (Stockholm Area Regional Planning Office 1967). 47 years later we can conclude that this is certainly not the case.

Five residential areas are pointed out as being in the risk zones for high noise levels: Skärholmen, Lindholmsbacken, Bergslagsplan (Vinsta), Hjulsta and Akalla (City of Stockholm 2010:42). The total amount of residents in the region exposed to noise levels exceeding the standard value of 55 dB(A) are expected to be reduced due to the bypass, because the central districts that will experience reduced noise levels are more densely populated than those areas where noise levels are expected to increase (Swedish Transport Administration 2011).

Comprehensive noise mitigating measures are planned next to the uncovered road sections and near residential areas (ibid.). Concerns are raised about the magnitude and location of Hjulsta interchange[45], which, with its proximity to densely populated residential areas, will cause negative environmental effects (ibid.). Noise screens of different heights will be installed at Hjulsta interchange and next to the apartment blocks (Urban Development Office 2012a:14-15). However, the high location of the dwellings in Hjulsta makes it difficult to screen away excessive traffic noise and many residents will become exposed to noise levels exceeding the standard value (Swedish Transport Administration 2011).

[44] 47.1 km/h with the zero-alternative and 48.9 km/h with Bypass Stockholm (Road Administration 2005:175).

[45] Multi-storey interchange, which will become one of the busiest and largest traffic apparatus in the country (City of Stockholm 2010:32).

Noise levels in the yards next to the dwellings will be more problematic to handle than indoor levels, and all green areas near Hjulsta will be exposed to high noise levels (Urban Development Office 2012a:14-19).

Noise levels are only declared for ground level (2m above the ground), which leaves noise levels on higher floors (apartment buildings) uncertain (Urban Development Office 2013a:5).

Also during the four years construction period residential areas will experience exceptionally high noise levels and residents in north-western Hjulsta will be exposed to disturbances from ten years cumulative noise, first from reconstruction work on E18 and later from the construction of the bypass (Swedish Transport Administration 2011).

Structure-borne noise will cause substantial disturbances for thousands of residents during parts of the construction period in northern Skärholmen, Sätra, Hässelby, western Vinsta, Kälvesta, Björkeby and Vålberga, and construction work and soil load transports in connection to the tunnel mouths will cause major disturbances in eastern Vinsta for 3 years (ibid.).

The planned intra-regional traffic relocation is expected to reduce air borne particle emissions (only the combustion generated) in the city centre by 3% until 2030, and to increase emissions in the metropolitan periphery by 8% (WSP 2007:9). The detail plan expresses a concern over the amounts of polluted air exhausted from the tunnel mouths, despite that the ventilation towers will contribute to an elevation and dilution of some of the polluted air (Urban Development Office 2012a:12). Air pollution will decrease along some roads that will experience reduced traffic volumes (Essingeleden, the northern part of E4, Bergslagsvägen between Bergslagsplan and Hjulsta, Solna, Sundbyberg, and the city centre), while areas close to tunnel mouths (Kungens kurva, Vinsta, Hjulsta, Akalla, and Häggvik) will become exposed to increased pollution rates (City of Stockholm 2010:43; Swedish Transport Administration 2011).

The air quality near the tunnel mouths is ultimately dependent on the efficiency and the daily operation period of the ventilation towers (Swedish Transport Administration 2011). The ventilation for the Southern Link tunnel near the tunnel mouths in Årsta and Hammarby are sparsely operated of economic reasons, even when particle rates are high (Johansson 2014, interview).

The average PM_{10} particle rate inside the longer bypass tunnel is predicted to 800-1000µg/m^3/day (1778µg/m^3 with the current 70% rate of studded tyre use[46]) and is expected to cause significant health consequences for frequent travellers (Swedish Transport Administration 2011). Rates of NO_2 in the tunnel will potentially exceed what can be concerned as acceptable and more vulnerable travellers are recommended to use other routs during certain times (Road Administration 2009c).

The total annual effect for the entire region is 11-24 fewer premature deaths and 380-800 fewer cases of illnesses, in comparison with the zero-alternative, but if the high pollution rates inside the tunnel are added to the calculation an additional 39 deaths among motorists are expected (Swedish Transport Administration 2011). This is legitimised as following:

> "Since Bypass Stockholm results in significant improvements to the residents of the region as a whole, the increase of a few premature deaths of motorists is considered as acceptable." (City of Stockholm 2010:43, my translation)

The Environmental Consequence Declaration concludes that the high pollution rates inside the tunnels make the entire project conflict with the national transport policy and public health objectives (Swedish Transport Administration 2011).

The socioeconomic analysis does not take into account the road's interference with natural, cultural and residential environments (Transek 2006:6). Nevertheless, the location of interchanges and uncovered road sections exposes the environments of Lovö and Järvafältet to traffic noise and spatial intrusions, which degrades the ecological coherence and harms local biotopes and recreational values (Swedish Transport Administration 2011). The Järva wedge is classified as a "green value core" and a Class 1 top priority green structure, prescribing that new developments shall be avoided within a certain buffer zone, and that the green structure needs to be improved and certainly not deteriorated (RUFS 2010:157, 164-69). Gömmaren's nature reserve in the south will be negatively affected– with increased barrier effect and fragmentation of the ecosystem – from the widening of the continental highway E4/E20 (Swedish Transport Administration 2011). This area is an important resource for recreation

[46] The number occurs in the analyses made by the Road Administration (2009c).

among residents living nearby (ibid.). Hansta nature reserve will experience dramatic increases of noise levels – 55dB(A) 250 metres into the south-eastern part of the reserve – exceeding standard values for recreational areas (ibid). The natural and cultural landscape of Lovö is classified as an area of national interest and is in a process of becoming nature and culture reserve (ibid.). Drottningholm is listed by UNESCO as a world heritage and Edeby oak pasture is classified as a Natura 2000 area, both requiring protection from intruding developments (ibid.). Lovö interchange will intrude, with traffic noise and major physical barrier effects on the cultural landscape, on the world heritage buffer zone, and seriously harm the Natura 2000 area (ibid.).

The overall judgement of the Environmental Consequence Declaration is that local negative health consequences are unavoidable with the establishment of Bypass Stockholm due to increased air pollution and traffic noise in residential areas and green areas (ibid.).

City district	Noise	Air poll.[a]	Green area	Note
Vårby	67-74 dB(A) during construction period	-	Gömmaren's nature reserve	Apartment houses will experience high noise levels. Low additional impact on the nature reserve.[b]
Lindholmsbacken	Improvement 70-80 dB(A) during construction period	9 µg/m^3 3-4%	Gömmaren's nature reserve	Large increase of PM_{10} rates. Low additional impact on the nature reserve.[b] Construction period is 7-8 years.
Smista	Improvement 70-75 dB(A) during construction period	4 µg/m^3 <2%	Gömmaren's nature reserve	Modest increase of PM_{10} rates. Low additional impact on the nature reserve.[b]
Eksätra/Sätra	70-75 dB(A) during construction period	n/a		Not specified *increase* of PM_{10} rates.
Kungshatt	>55 dB(A) during construction period	-		3-7 villas will be affected.
Lovö	No increase of noise levels 35-45/>45 dB(A) structure-born noise	Insignif.	Edeby oak pasture, Drottningholm, Lovö nature and culture reserve	Comprehensive intrusion in valuable nature and culture landscapes and deterioration of biotopes. 117 and 11 residents will experience 35-45 dB(A) for up to 35 weeks respectively 45 dB(A) for 7-8 weeks.

Hässelby	>45 dB(A) during construction period of 2-10 months			2200 residents will experience loud structure-born noise. Additional 2300 will experience lower levels (35-45 dB(A)).
Vinsta	2-3 dB(A) increase on Kirunagatan, decrease on Viltorpsbacken >45/35-45 dB(A) structure-born noise and 60-75 dB(A) due to construction work on street level	<2 µg/m^3 <1%	Grimsta forest	Total reduction of noise levels. Small increase of air pollution in residential areas near tunnel mouths. Larger increase in crowded public areas (subway station, etc.). No impact on the forest.[c] 1300 residents – mainly in townhouses and villas – will experience structure-born noise >45 dB(A) and additional 1300 35-45dB(A) for 2-11 months. 4 years of construction work will expose residential areas near tunnel mouths and Bergslagsvägen to high noise levels.
Hjulsta	Small improvement for residents exposed to the highest noise levels >58 dB(A)[f] 75-80 dB(A) during construction period	10.6 µg/m^3 [e] >4%	Igelbäcken culture reserve	The amount of residents exposed to noise levels >58 dB(A) and <53 dB(A) will be reduced, 53-58 dB(A) will increase. Cumulative noise disturbance caused by over 10 years total construction period (including E18). Potential relocation of exposed residents. Fragmentation of green wedge, barrier effect, deterioration of ecosystem, damage to biotopes, reduction of recreational value.

Vålberga	Small increase of noise levels, <55 dB(A) <45 dB(A) Structure-born noise, and 80-90 dB(A) due to drilling during construction period	8.3 µg/m^3 [e] >3%	Vålberga local green area	33 residents will experience >55 dB(A) Fragmentation of green area and deteriorated recreational experience.
Akalla	Relocation of noise, general improvement	7.3 µg/m^3 [d] 3%	Hansta nature reserve	Reduced noise levels in the townhouses near the Akalla link, increased levels in the apartment houses in north-western Akalla and in Hansta nature reserve.
Töjnan	Improvement 75-80 dB(A) during construction period	Improv. with 3 µg/m^3 >1%	Hansta nature reserve, Fyndet forest	Reduction of noise levels in the nature reserve and in the forest. Only a few dwelling will experience noise disturbance during construction period.
Häggvik	Improvement	n/a	Fyndet forest	Increased levels of PM_{10} north of Norrortsleden. Reduction of noise levels in the forest.

Table 2. *Summary of the socioenvironmental impacts*. All data in the table above are extracted fromSwedish Transport Administration (2011).

a) The increase of PM_{10} particle rates in comparison with the zero-alternative, and the increase of premature deaths. The latter is based on the risk coefficient proposed by the Swedish Transport Administration.

b) Large intrusions in Gömmaren's nature reserve from the separate road project the Masmo link that will connect to E4/E20.

c) According to the original project plan, Bypass Stockholm was supposed to run on a bridge over Lambarfjärden. This was eventually revised and now the bypass will run through a tunnel preserving vital cultural and ecological values.

d) The Environmental Consequence Declaration eluded the additional air pollution on the uncovered road section (5.8 $\mu g/m^3$) and did only count the particles generated from the tunnel mouth (1.5 $\mu g/m^3$) when assessing the impact from the bypass. The 7.3 $\mu g/m^3$ increase is a too high number because the Akalla link will experience 90-50% traffic reductions in comparison with the current volume.

e) The particle rates might be reduced if the air conditioning system is operated for longer parts of the day. The particle rate increases declared in the Environmental Consequence Declaration do not match the figures presented in the table on page 410.

f) Installation of local noise screens – that are crucial for preventing large increases of noise levels in residential areas – will be regulated through separate agreements.

All comparisons in table 2 are made in relation to the zero-alternative. If comparisons were made with the current traffic situation the declaration would indicate comprehensive degradations of socioenvironments due to increased noise levels and air borne particle rates in most areas along the uncovered sections of the bypass (and connecting road networks).

Local noise level reductions are either achieved through traffic relocation or by installations of noise screens/embankments. Expected local reductions of air pollution are achieved through traffic relocation or by reduced studded tyre usage.

4.6.6. Prognoses

The afternoon peak hour traffic volumes on Bypass Stockholm are expected to become 11 600 cars, which is not far from the 12 500 on Essingeleden in 2007 (Road Administration 2009a:60). Essingelden is currently heavily congested during peak hours and has the same number of lanes as the Bypass will have. The predicted traffic volumes for 2035 on the bypass will become 10% larger than what is required to avoid queues in the tunnels (Swedish Transport Administration

2011). Official traffic prognoses estimate a dramatic increase of car traffic until 2030, which will cause major congestion and queues on the entrance roads to the bypass (County Administrative Board in Stockholm County 2012:8-9).

According to a prognosis for 2035, traffic volumes are estimated to increase with 64% without, alternatively 69% with the construction of Bypass Stockholm[47] (Swedish Transport Administration 2011). The fact that Bypass Stockholm is expected to generate more road traffic in the region – a larger amount of cars will start and arrive in residential areas – may cause harms that are complex to measure (ibid). The president of the Nature Conservation Association of Stockholm, Beatrice Sundberg (2014, interview), doubts that the bypass will mitigate traffic in the inner city. The construction of the bypass is rather making car ownership more attractive, which would increase the propensity to drive in the centre as well, she argues.

> "The future traffic situation is difficult to predict because it is influenced by many factors such as other additional road infrastructure, financial incentives, fuel prices, extended public transport system and new settlements." (Swedish Transport Administration 2011:IV, my translation)

Several of the actors involved in the planning and initiation of the project admit that traffic inducement projections are indeed unreliable and may differ substantially from the actual future traffic volumes (Urban Development Office 2009:35). The traffic prognostication model *Sampers*, used by the Swedish Transport Administration to estimate future traffic volumes and distributions, is unreliable for long term predictions (Swedish Transport Administration 2011:052). Sampers does not include the traffic generating effect from relocation of residents and work places – generated by infrastructure investments – in the analyses (SIKA 2004:1 pp. 30-31). Traffic prognostications do not include the essential factor of a changing regional structure (WSP 2007:9). New developments along the road, such as the Stockholm Port and Barkarby City, will attract traffic flows that are not internalised in the traffic forecasts (Sundberg 2014, interview).

[47] In comparison with the year of 2007.

4.6.7. Alternatives

The Combination Alternative was examined as an alternative to large scale road investment projects. The alternative consists primarily of major investments in public transport[48], moderate improvements and widening of existing north-south bound roads, combined with developed road pricing schemes (Road Administration 2005). The Combination Alternative was rejected by the Road Administration – despite improving the passability in the city centre due to traffic volume reductions – because it is considered as reducing accessibility and unable to fulfil long term transportation needs (Söderman 2006; Road Administration 2005). It is argued, that the development from a monocentric towards a polycentric regional structure requires outer transversal roads (Road Administration 2009f:12-14). SIKA (2007) withholds that the assessment of the Combination Alternative was not transparent and that there are no well-founded motives for rejecting it. In comparison with the Combination Alternative, Bypass Stockholm is better at improving work place accessibility with car for only two municipalities (Ekerö and Järfälla), while the Combination Alternative is advantageous (with car and public transport) for 11 municipalities (ibid.).

Diagonal Ulvsunda, an alternative road investment project, was turned down by the Road Administration due its insufficient support for the polycentric urban structure ordinated by the Regional Development Plan (Söderman 2006).

The Urban Development Office (2012b:27, 32) considers the costs of drawing the Hjulsta interchange and Hansta interchange in tunnels as too high. At least 200-300 million SEK respectively 1.5 billion SEK in additional costs, traffic safety issues, and uninhibited air pollution in an 18% longer continuous tunnel were held as motives for not covering the interchanges (ibid; Svensson 2010).

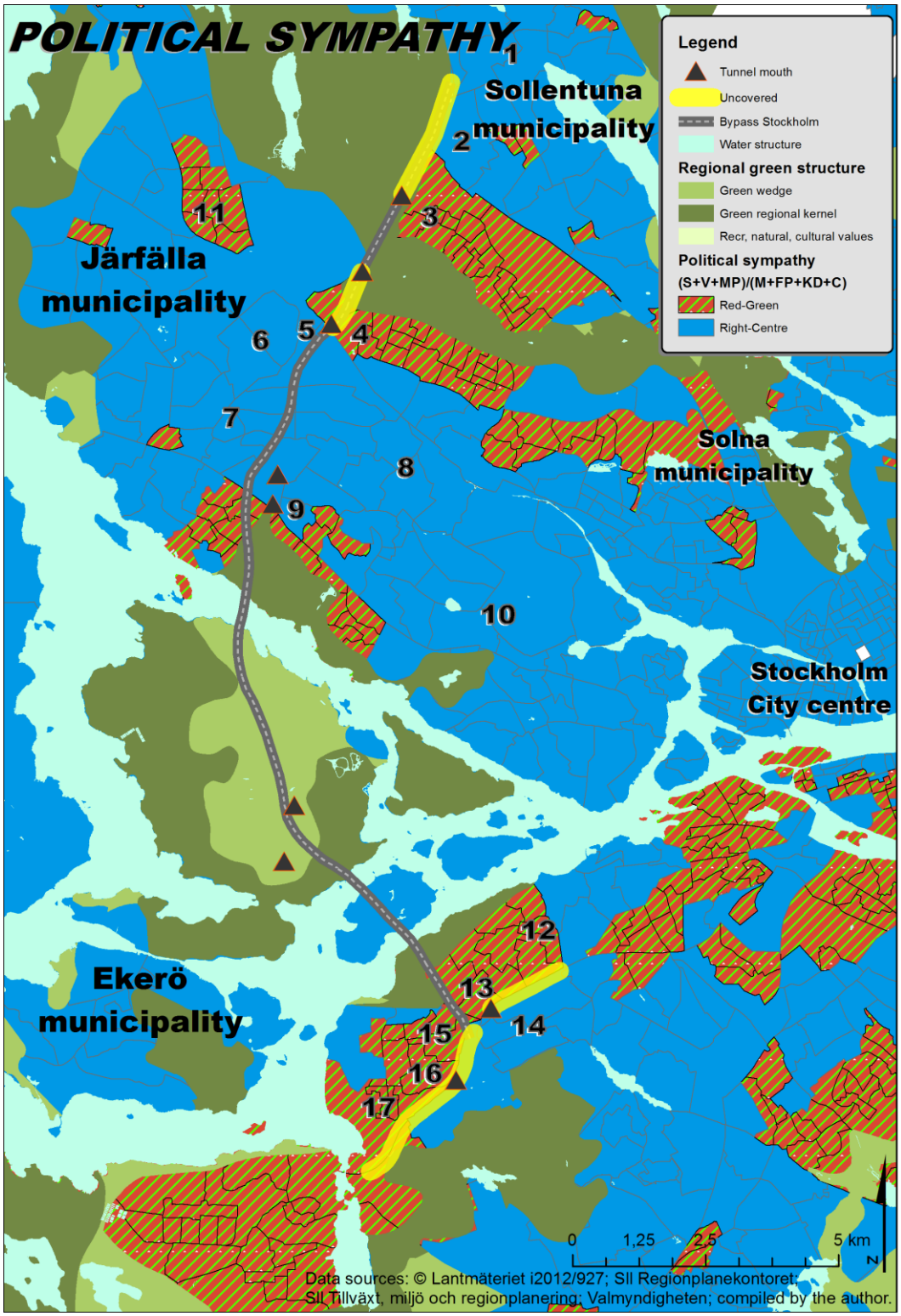
Originally, the bypass was planned to run on a bridge over Lambarfjärden (between Lovö and Grimsta). This alternative would have caused serious intrusions in natural environments[49] (Road Administration 2009b). A tunnel below Lambarfjärden is expected to become more environmentally protective and also slightly cheaper[50] (ibid.). The tunnel alternative was eventually ordinated.

[48] New commuter train line from Alvik to Häggvik and quality improvements of the existing public transport system.
[49] Intrusions in the national interest Mälaren, the Grimsta forest nature reserve and northern Lovö classified as a silent area.
[50] 2.4-2.5 billion SEK for a bridge and 2.3 billion SEK for a tunnel (Road Administration 2009b).

The zero-alternative is a hypothetical scenario with comprehensive urban growth, without new infrastructure projects, and only including already started transport infrastructure projects and existing congestion charges (RUFS 2010:194).

4.6.8. Debate, Discontent and Controversy

The Bypass Stockholm project has been subjected to comprehensive criticism from various organisations and institutions. Wiklund and Karlsson (2014, interviews) are concerned over the unjust allocation of uncovered road sections and tunnel mouths. The uncovered sections are planned in neighbourhoods with less privileged populations – exposing them to harm – while the road is covered in neighbourhoods were the political majority has their voters, Wiklund argues. There are however reasons to raise doubts about Wiklund's argument. It is withheld that the Swedish Transport Administration – not the political authorities – shapes the road (Rosencrantz 2014, interviews). Melander (2014, interview), Swedish Transport Administration communicator, explains that the bypass is developed through a deliberative and interactive process including many stake holders, after which the government finally granted admission for the plan in 2009.



Map 13. Distribution of voting in the 2010 general elections (Parliament votes).

According to map 13 political sympathies are with the red and green parties (the political opposition) in Akalla, Hjulsta, southern Vinsta, Bredäng, Sätra, Vårby and Skärholmen. All these areas are exposed to uncovered road sections

and/or tunnel mouths. The political majority has their voters in Häggvik, Töjnan, Barkarby, Kälvesta, Spånga, northern Vinsta, Ekerö, and Smista. 4 of these areas will be exposed to uncovered sections.

SIKA (2007) is critical towards the Road (today Traffic) Administration's "obsolete" perspective when only proposing a project within their own transportation field (automobility), avoiding to seriously consider a broader and more comprehensive transportation solution. The fact that the Road Administration presupposed the solution (a highway) as a prerequisite for the overarching goals – and adapted their argumentation in order to support this solution – makes the democratic and legal legitimacy of the entire project questionable, SIKA argues.

The problems with high noise levels in residential areas during the construction period and beyond are not solved and measures are postponed to future consideration (see e.g. City of Stockholm 2010:38; Swedish Transport Administration 2011). Due to the long construction period, in some areas up to six years, the disturbances cannot be regarded as only temporary, but rather long term major disturbances imposing severe discomforts and negative impacts upon the livelihood of residents that in some cases may need to be relocated to temporary accommodations (Swedish Transport Administration 2011).

The Nature Protection Association and the State Institute of Road and Transport Research (SIKA) criticise the socioeconomic analysis for being inadequate or even faulty (Ministry of Environment 2009; SIKA 2007). SIKA (2004:1) argues that the measurement *net present value* – used in the socioeconomic analysis – is only adequate if maximising economic growth is the only objective, because the value does not reflect costs associated with negative distributional outcomes and for not fulfilling political objectives.

> "Distribution effects – which geographical or socioeconomic groups who wins or loses from an arrangement – are not taken into account in the socioeconomic calculations." (Transek 2006:7, my translation)

The critical arguments against the project (environmental consequences, emissions, noise and the enhancement of the attractiveness of automobility) are not fully responded to by the government that rather stresses the importance of the project for the regional mobility, accessibility and economy (Urban Development

Office 2012b:5). Isaksson's (2001) research shows in fact that critical opinions have been actively suppressed during the entire planning process despite deliberative practices.

4.7. Summarising the Results

The empirical results support the following conclusions about current transport policies:

(1) Deterioration of peripheral socioenvironments is concerned as legitimate because the project will improve conditions for urbanisation, regional enlargement, a polycentric regional structure, economic growth, mobility for car owners, and mitigating socioenvironmental costs in the inner city. Local deteriorations are legitimised with general improvements.

(2) Traffic mitigation by out-pricing "non-viable" traffic with congestion charges is legitimate because it improves mobility for road space consumers on the central road network.

(3) The traffic planning creates a centre-periphery dichotomy. Central socioenvironments are prioritised higher than peripheral socioenvironments, which is materialised by the (re)location of negative traffic externalities and mobility gains.

(4) Automobility is regarded as essential for future transportation in the metropolitan region. Therefore, predictions of future car commuting demands are systematically provided for with additional road capacity. Bypass Stockholm will function as a frontier for future urbanisation in yet undeveloped territories. Consequently, access to new urban developments will mainly be by car.

(5) Alternatives that do not support automobility or the regional enlargement and polycentricity strategies are ruled out as unwanted.

The following arguments are supported by the sections about socioenvironmental deterioration and health implications:

(1) Noise and air pollution emission modelling and traffic prognoses are oversimplified and not fully reliable. There are many factors of uncertainty. Deviations from the predictions are likely due to volatile daily traffic rhythms and excluded factors such as meteorological and physical effects, and traffic inducing structuring effects.

(2) Long term exposure to high noise and air pollution levels cause serious health effects. Underprivileged groups in more unequal societies have generally worse health status and are more sensitive to negative exposure to traffic generated emissions. Subsequently, the underprivileged populations are in a greater need of stress restoration in proximate urban green areas.

(3) Socioenvironmental implications caused by Bypass Stockholm are all compared with the zero-alternative. It is however a dubious comparison because the zero-alternative can hardly be considered as a plausible scenario for the future. The relevant future scenario is not that of zero investments. Hence, funds that are spent on the bypass will not disappear if the project would be scrapped. Resources could indeed be invested in alternative projects. Ultimately, the construction of the bypass rules out socioenvironmental improvements in those locations that will be exposed to uncovered road sections and tunnel mouths.

(4) Car commuters that will use the bypass more frequently will be in the risk zone for serious health effects due to high exposure to air pollution.

5. Socioenvironmental Justice: Analysis and Discussion

Socioenvironmental justice requires a redistribution of material socioenvironmental benefits from the affluent to the underprivileged and avoiding that the costs fall upon the underprivileged. Transportation justice must in the same way imply a redistribution of mobility from mobile groups to less mobile populations. Generally, these go hand in hand hence populations with high socioeconomic status are more mobile than those with lower status. Socioenvironmental and transportation injustices imply naturally the opposite, which is a redistribution of socioenvironmental qualities respectively mobility from the poor to the affluent.

In order to analyse Bypass Stockholm according to justice principles this chapter will deconstruct the planning in components. The components will be subscribed theoretically grounded causal mechanisms in order to explore potential implications for different socioenvironments and populations.

Factors that theoretically increase the probability of benefiting from the bypass are car ownership, higher income, higher education, employment, improved socioenvironment from reduced local road traffic, and residence or employment near the entrance roads to the bypass (for motorists).

Factors that theoretically create disproportional harm from the Bypass are proximity to uncovered road sections and tunnel mouths, poor health[51], and language difficulties[52].

Based on the material presented in this study, the following arguments are established:

(1) A declining proportion of the regional population are motorists. Increasing fuel prices, high fixed costs for purchasing a car, the patterns illustrated in the maps in this study, and the fact that highly educated and higher-income groups are overrepresented among car commuters indicate that automobility is an exclusive and unequal mode of transportation. Accessibility for underprivileged groups to the public transportation system is also uncertain due to steadily increasing ticket prices. Geographical data in this study indicate that car ownership is generally

[51] The risk of ill-health is higher among populations with low socioeconomic status in unequal societies. The trend in Sweden is towards increasing inequalities.
[52] The propensity is plausibly higher among individuals with two immigrated parents.

lower in socioeconomically deprived areas. However, gasoline-ticket price ratio is declining, which indicates that public transport is becoming less affordable in relation to automobility. This is a serious objection to the argument that automobility is exclusively for the more privileged populations. Nonetheless, it is not possible to make definitive predictions about the future accessibility to different modes of transport for different social groups. It is only possible to make assumptions based on available information. Available data supports that the access to automobility is unequal and that more privileged groups are overrepresented among motorists and long distance commuters.

Bypass Stockholm improves the relative attractiveness and accessibility of automobility. Car owners improve their mobility while non-motorists experience no improvements to their mobility. Mobility is indeed crucial for social inclusion. Despite rhetorical devices implying that the project will create improvements for bus routes, public transport will not become attractive or well-used along the bypass. There are also doubts about how serious health consequences may obstruct future bus traffic on the bypass. Increased opportunities for commuting are offered almost exclusively to motorists.

Large public funds will subsidise road infrastructure[53], and these expenditures have indeed an alternative-cost.

> "How the revenues from the congestion charges are used determine the distribution effects, namely which groups "win" and "lose" in total." (Urban Development Office 2006:20).

Funds from the revenues of the congestion charges that could have been invested in the development of the underprovided public transportation infrastructure and provide mobility for underprivileged groups will now be spent for the enhancement of automobility.

Public subsidies of automobility are not only financial but also in the form of (urban) space, which is redistributed from public use to motorists. Transportation by cars constitutes half the person transportation stock but an overwhelming share (95%) of the total traffic stock. The ratio $\frac{person\ transportation\ stock}{traffic\ stock}$ provides an indication on the efficiency of the different modes of transportation. A larger ratio

[53] The cost of the project equates 8% of the total national infrastructure investments.

implies a large number of person transportation – which is the purpose of mobility – in proportion to vehicle distance and *vice versa*. Automobility is subsequently highly inefficient and requires more (spatial and material) resources per trip counted in person kilometres per vehicle kilometres ($\frac{50\%}{95\%}$), in comparison with the average of all the other modes of transportation ($\frac{50\%}{5\%}$). This indicates a regressive distribution of public funds and space from the entire population exclusively in favour of motorists.

It can be objected that the public transportation system is well developed and will experience further investments in additional capacity. Nevertheless, the analysed object Bypass Stockholm *per se* is supporting a development towards inequity in mobility. The project is indeed not a prerequisite for further developments of the public transportation system.

(2) The rapid urbanisation in the Stockholm region motivates the need for new territories for urban development. However, Bypass Stockholm will create new travelling patterns and urban developments, which will become inter-connected by a road and hence accessible primarily for motorists. It is of course possible to create access to urbanised areas with public transport *ad hoc*, but this is not achieved by or in any way entangled to this project.

(3) Pricing of road usage on Essingeleden and on the central road network commodifies the road space. Motorists are obliged to purchase the right of imposing negative externalities upon socioenvironments in the inner city. Bypass Stockholm together with the congestion charges are creating a system for traffic and associated externality relocation from the central to western peripheral socioenvironments.

The congestion charges mitigate traffic and associated socioenvironmental hazards in the central parts of the region, and improve passability for paying motorists and motorists residing in the inner city by crowding out non-paying motorists. The charges are in the form of user fees, and motorists pay subsequently the same amount irrespective of whom. Charges are only viable for individuals that gains relatively well in terms of productivity (time and produced value). This means that those who gain are those who regard the charge as a relatively small amount in proportion to their gained income. Here, mainly commercial traffic and high-income, well-educated populations will become the

major winners. Indeed, congestion charges are distributing mobility regressively and in contradiction to the justice principles.

Capitalisms dependency on the annihilation of space by time requires congestion to be dissolved in order to enhance labour productivity, the speed of commodity turnover, and hence economic growth. It is primarily necessary to increase mobility for commodities and (skilled) labour that might gain higher productivity. Improving labour market matching by improved mobility is exclusively beneficial for scarce, highly qualified, and high-productive labour. Hence, low-productive labourers can be employed effortlessly (larger supply of unskilled labour) and consequently the enhancement of their mobility is not as necessary. In fact, the mass automobility obstructs the mobility of every individual motorist. In the case of the congested road network in central Stockholm, non-commercial and low-productive labour are actually obstacles in economic terms, which need to be excluded from the roads in order to prepare road space for the economically viable elite-commuters and commercial transports.

(4) Accessibility to vital functions is either achieved via proximity or mobility. Accessibility deficit combined with transport poverty reduce opportunities to employment, consumption, and leisure activities, alternatively require in compensation more time (labour time) and money to be spent on transportation. Low-income households have fewer opportunities to move and reside in areas with high accessibility, partly due to inflated housing prices in central locations. Bypass Stockholm improves mobility for car owners but is unable to offer gains for low-income individuals without cars. The underprivileged groups are forced to spend more time and money on transportation in order to fulfil their needs because they lack the power to purchase spatial proximity to vital functions.

(5) Bypass Stockholm will become a link that connects the regional cores that are pointed out in the Regional Development Plan. Economic activities are largely concentrated to the 9 regional cores and a development towards increasing economic significance of these cores (except for Haninge centre and possibly Täby-Arninge) can be identified since year 2000. The bypass improves the accessibility to the growing economic nodes and thus for employment opportunities only for motorists.

(6) The project improves the possibilities of commuting longer distances by car. Costs of commuting (time and price) in relation to the rewards generated from the destinations (income, cheap and attractive commodities and activities) are essential for the evaluation of the gains from commuting. Therefore, commuting is more viable for those with higher incomes. This is also supported by studies referred to in Sandow & Westin (2006:31-32), which analyses asymmetric commuting behaviour among different social stratums. Benefits of commuting are always dependent on the *relative* costs in relation to the benefits. This makes regional enlargement and increased commuting unequally beneficial according to social characteristics of different population groups.

5.1. Socioenvironmental Distribution of Costs and Benefits

Congestion charges on Essingeleden and the construction of Bypass Stockholm will relocate the traffic flows out from the inner city and to some extent mitigate traffic related socioenvironmental hazards in the metropolitan centre. In contrary, socioenvironmental negative effects will arise in certain locations in the western part of the region.

Standard values for particle rates are not significant when evaluating the socioenvironmental exposure to air pollution. For PM_{10} particles, there is no lower floor for health implications, but the dose-response is linear and starts from very low rates. This means that for every additional increase in particle rates in populated areas a corresponding increase of negative health implications will follow. Thus, the relevant question for the assessment of health risks is if it exist any change of air pollution levels at all in certain spaces, rather than asking whether the standard rates are exceeded.

It has been shown that Lindholmsbacken, Smista, Sätra, Hjulsta, Vålberga, Akalla, parts of Häggvik, and to a small extent Vinsta will experience increased levels of air pollution. Parts of Vinsta, Vålberga, and parts of Akalla will experience increased noise levels, while Lindholmsbacken, Vårby, Smista, Töjnan, and Häggvik will experience reduced noise levels. Vårby, Lindholmsbacken, Smista, Sätra, Vinsta, Hjulsta, Vålberga, and Akalla will experience long term noise levels exceeding 55 dB(A) during the construction period. There are no detailed environmental consequence declarations made for

Skärholmen and Bredäng, and subsequently it will not be possible to clarify the potential impacts.

Skärholmen, Sätra, Bredäng, Hjulsta, Akalla, and parts of Vinsta all have populations with low education level, low proportion in employment, low average incomes and a high proportion of migrants in comparison with other neighbourhoods in the Stockholm region. A similar pattern goes for car ownership, which is lower in these areas compared to other areas located in comparable distance from the inner city. Car ownership is substantially lower in socioeconomically underprivileged areas. Bypass Stockholm increases mobility for car owners and thus for more privileged groups in more prosperous areas.

The mentioned underprivileged areas will also become exposed to uncovered sections of the bypass and/or tunnel mouths, which will become major sources of socioenvironmental harms. The political sympathies in all these areas are with the opposition (red-green).

Populations in Spånga, Bromma, and Järfälla, Ekerö and Sollentuna municipalities, will not be exposed to uncovered road sections but will benefit enormously from increased mobility and accessibility due to high rates of car ownership, population in employment, high education levels, and high income levels. The majority of the populations in these areas sympathises with the political majority (centre-right). Exceptions from the pattern described above are parts of Häggvik (Töjnan) and to some extent Smista that show more favourable socioeconomic indicators, higher car ownership rates, and right-centre sympathies but are located near uncovered sections of the bypass.

There is no evidence in support of the allegations implying that the political majority has *intentionally* planned and shaped the bypass in favour of their sympathisers and ignored the populations in areas where they lack popular support. Nevertheless, the results support an *outcome* that is in line with this scenario.

Lovö, Kälvesta, Barkarby, western Spånga, Smista, and Töjnan all show high or middle range socioeconomic indicators, high car ownership, and low proportion of migrants. The road will be covered next to the first four of the areas, Smista will experience some reductions in air quality and increased noise levels, and Töjnan will experience socioenvironmental improvements.

There are indications of an unequal distribution of socioenvironmental risks due to the planning of Bypass Stockholm. The uncovered road sections and tunnel mouths are to a large extent localised next to less privileged areas exposing their populations for disproportionally high risks. The covered sections are to a large extent localised next to more prosperous areas.

Igelbäckens culture reserve, Vålberga local green area, parts of Hansta nature reserve, Gömmaren's nature reserve, and Lovö nature and culture reserve will all experience deterioration of qualities. Populations in Vårby, Lindholmsbacken, Skärholmen, Hjulsta, Vålberga, and Akalla will become affected from reduced recreational and stress restoration opportunities. It is also populations mainly in densely populated Vårby, Skärholmen, Hjulsta, and Akalla that are in the greatest need of these green areas for mitigating socioeconomically correlated predisposition to ill-health.

There are a wide range of uncertainty factors, which may imply higher exposure to especially air pollution in areas exposed to tunnel mouths and uncovered road sections than what is declared. Higher traffic volumes than predicted, no reduction in studded tyre usage, high peak hour exposure, the operation time of ventilation towers, and oversimplified prognostication models are some factors.

The argumentation about noise level improvements in some areas near the bypass is questionable. Reduced or counteracted increases of noise levels in areas next to the bypass are almost entirely achieved through noise mitigating measures such as screens and specially designed windows. In the planning documents installations of noise screens along existing roads are considered as socioenvironmental improvements achieved from the construction of the bypass. The measures are implicitly conditioned by the construction of the bypass. However, there is no reason why these measures cannot be taken regardless of Bypass Stockholm.

This leads to the question if it is really relevant to use the zero-alternative as a comparison scenario. In the zero-alternative no socioenvironmental protective measures will be undertaken despite that traffic volumes – and accompanying socioenvironmental degradations – are expected to increase. Therefore, the relevance of the zero-alternative as a comparison scenario is dubious.

It is important to emphasise that the future socioenvironmental outcomes are highly uncertain and that it is only possible to evaluate potential risks based on theoretically grounded causalities for the different components associated with the project. However, it can be concluded that there are significant evidences supporting the conclusion that the negative externalities will be disproportionally localised to those socioenvironments where underprivileged population groups reside. Nonetheless, the issue of socioenvironmental injustices in terms of unequal exposure to potential harms are absent from the political and planning agendas.

5.2. Socioenvironmental Justice Evaluation

Bypass Stockholm is urbanising the region on the basis of the car. The increasing socioeconomic importance of the regional cores – that will become inter-connected with the bypass – vitalise the accessibility to these areas. Underprivileged populations have greater difficulties of moving to more accessible locations and hence they are trapped in space and cannot choose accessibility through proximity. This makes these groups more dependent on transportation systems that are regressively distributive. The bypass enhances regional enlargement and commuting over longer distances, which primarily benefit elite commuters.

The project is automobility biased and subsidises the motorists with public funds and space. The congestion charges commodify the central road network, which excludes less privileged and economically non-viable motorists. Reduced congestion improves mobility for privileged groups, inner city motorists, and the commercial traffic.

A territorial relocation of traffic flows away from central more prosperous socioenvironments improves mobility and socioenvironmental standards in the centre. The majority of the negative externalities are imposed upon socioenvironments were populations with lower socioeconomic status dwells. These groups drive cars to a lower extent, are more vulnerable to negative health impacts, and cannot take advantage of Bypass Stockholm to the same extent as the more privileged. The peripheral socioenvironments where more privileged populations dwell will generally become protected because the bypass will be drawn through tunnels.

There is a mismatch between the production and consumption of negative externalities along Bypass Stockholm. The mismatch occurs between the frequent users that benefit from the road and populations that experience losses when their socioenvironments become deteriorated. It is in fact admitted by the Swedish Transport Administration (2011) that the unequal spatial distribution of local environmental harms and regional transport benefits contradicts the national overarching public health goal.

Nevertheless, the results are not univocal. The improved potential for developments in Kungens kurva will plausibly generate employment opportunities for the populations in neighbouring areas with lower socioeconomic standards (Vårby, Skärholmen, Sätra, and Bredäng). The most serious health effects will fall upon motorists and passengers that will be commuting through the tunnels of Bypass Stockholm. These are generally not the most underprivileged groups.

Table 3 summarises the environmental justice implications from the different components of the Bypass Stockholm project. Almost all of them are to some extent socioenvironmentally unjust. This is because all of them redistribute gains and costs in disfavour of underprivileged populations on behalf of the benefit of the more privileged groups.

Factor	J	UJ	Uncertain/ neutral	Note
Transport system feature		X		Supports automobility and improves the attractiveness of automobility in relation to other modes of transport.
Congestion charges		X		Charging is regressive. More affluent groups and those residing in the inner city benefit from improved mobility and socioenvironmental standard. Less privileged groups are excluded from the central road network.
Air pollution			X	Most of the air pollution increases will be in socioeconomically less privileged areas. Motorists travelling on the bypass will become exposed to high pollution rates.
Noise		X		The majority of the noise level increases are in less privileged areas and in areas with high proportion of immigrants that are more sensitive.
Intrusion in green spaces		X		Mainly in proximity to less privileged areas that are in greater need of stress restoration in green spaces.
Financial distribution between the means of transport		X		Prioritising infrastructure for automobility, which provides benefits exclusively for car owners.
Enhancing more distant commuting		X		With the current class biased commuting patterns.
Relocation of traffic		X		Mitigating congestion in the inner city and increasing car traffic in the outskirt.

Table 3. Summary of the evaluation of the components included in the Bypass Stockholm project and associated planning. J = socioenvironmentally just, UJ= socioenvironmentally unjust.

6. Conclusion

This case study has examined the major road project Bypass Stockholm from a socioenvironmental justice perspective. The theoretical concepts environmental justice, socioenvironmental metabolism, nature-society monism, time-space dimension, transportation justice, and urban mobility and accessibility have been applied on empirical material about the specific project, related transportation planning, health effects, and geographical socioeconomic data. Now, the main conclusions that are drawn from the analytical discussion will follow.

Socioenvironmental justice requires a redistribution of socioenvironmental resources from privileged population groups to underprivileged groups. Negative externalities generated by socioenvironmental metabolism – urbanisation and urban transportation processes – need to be distributed according to the principle that they do not fall disproportionally upon underprivileged populations. Additionally, the benefits from the metabolism process need to be distributed equally or progressively among different socioeconomic groups. The negative externalities from Bypass Stockholm are air pollution, noise, and green area intrusion that all have negative health implications. The benefits generated from the bypass (and the congestion charges) consist of improved mobility by car, extended opportunities for commuting, and mitigation of congestion and negative socioenvironmental hazards in the inner city.

Unjust distribution of costs and benefits are created through regressive pricing of road usage (congestion charges), improved attractiveness of automobility (unequal access), increased long-distance commuting (in favour of elite commuters), and traffic relocation from the prosperous centre to less prosperous peripheral neighbourhoods (relocation of health effects).

The results of this study indicate that negative externalities will to a disproportional extent fall upon socioenvironments where less privileged populations reside. Neighbourhoods along the bypass with more beneficial socioeconomic indicators will to a higher extent become protected hence the road will be drawn in a tunnel. The intended traffic relocation from the centre will relief the central more prosperous neighbourhoods from traffic generated ill-health and mobility-obstructing congestions. Benefits from increased transportation opportunities created by the bypass will not benefit the exposed

populations in less prosperous areas to the same extent as other groups, hence they have low access to cars and lower pay-off from commuting because of low education level and low incomes. The highway will generally benefit several of the areas where populations have higher incomes, higher education, are in employment, and have higher access to cars. These areas are also to a high extent protected from the hazardous uncovered road sections and tunnel mouths. The injustice is further reinforced by the higher vulnerability of underprivileged residents due to lower expected health status in an increasingly unequal society.

Bypass Stockholm – with its long term committing large scale investment – becomes a material manifestation of a specific spatial organisation, which reproduces automobility as the vein of urbanisation and urban mobility. In order to function smoothly and offer sufficient mobility for the motorists, automobility must unavoidably be unequal and exclusionary. A socioenvironmentally just transportation planning would require other priorities and practices than those that are associated with the Bypass Stockholm project. Transport inequality can be mitigated if the underprivileged groups are granted more affordable mobility alternatively increased accessibility to local functions. With the current public transportation system justice cannot be achieved thus soaring user fees are out-pricing the underprivileged groups. Just planning would also require that traffic generated negative externalities are reduced to a minimum, because it is primarily the underprivileged groups who lack the ability to move away from socioenvironmental hazardous infrastructure that unavoidably will be affected negatively.

This study opens for further research on the topic of socioenvironmental justice in relation to urban transportation planning. Especially, developments in methodological sophistication are needed for more well-grounded results. An example is the application of spatial regression analyses in GIS that would provide more valid results. However, it is doubtful if quantifications are meaningful or even possible when analysing prospective cases such as Bypass Stockholm.

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