EIA Magelungens strand

Cheng, Ishin

Ekholm, Tor

Ekström, Christoffer

Hämäläinen , Isla

Gustafsson, Rasmus

Klerby Blomqvist , Karin

Project group:
Cheng , Ishin
Ekholm, Tor
Ekström, Christoffer
Hämäläinen , Isla
Gustafsson, Rasmus
Klerby Blomqvist , Karin
Supervisor:
Belyazid, Salim

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Foreword

This report is the result of a project work within the course *Case studies in Environmental Impact Assessment* at Stockholm University. The course is a mandatory part of the Master programme *Environmental Management and Physical Planning* at the Department of Physical Geography. This programme is multidisciplinary with both Swedish and international students. The course comprises 15 HEC, i.e. ten weeks of study. The project part covers five weeks with the aim to give the students an opportunity to analyse the environmental impact of a planned project and to get some practice in how to make an Environmental Impact Assessment.

This time we have chosen to study the environmental impact of plans on new residential areas in the Stockholm region. The population in this region is expected to increase rapidly, according to the Regional Development Plan with more than 900 000 inhabitants to the middle of this century. Thus there is a great need for new apartments to be built. However, this could mean a negative impact for some valuable green areas around Stockholm. Many of these areas are important for biodiversity and for recreation. To analyse these conflicts and to suggest mitigation measures have been an important task for the students in this project.

The students alone are responsible for results and conclusions in this report and it cannot be regarded as the position of Stockholm University. The project supervisors have been Salim Belyazid, Bo Eknert, Peter Schlyter, Ingrid Stjernquist and Johanna Gordon, all from the Department of Physical Geography.

We want to thank all those who have been helpful in providing the students with information and materials as well as have taken time to give interviews. Without your help this project could not have been realised.

Stockholm, January 2017
Bo Eknert
Lecturer
Department of Physical Geography, Stockholm University

Authors

Project Hammarbyskogen

Amanda Salguero Engström	Bachelor in *Geography*. (Current: *Master's in Environment and Health Protection*)
Helena Berglund	Bachelor in *Biology-Earth Science*. (Current: *Masters in Geomatics with Remote Sensing and GIS*)
Jenny Schelin	Bachelor in *Biology-Earth Science*. (Current: *Master's in Environmental Management and Physical Planning*)
Malin Jigrud	Bachelor in *Biology*. (Current: *Master's in Environmental Management and Physical Planning*)
Ole van Allen	Bachelor in Earth Science (Current: *Master's in Environmental Management and Physical Planning*)
Patrick Lindén	Bachelor in *Geography*. (Current: *Master's in Environmental Science*)
Ramya Weisner	Bachelor in Earth Science (Current: *Master's in Geology Sciences*)
Sara Zentner	Bachelor in *Political Science*. (Current: *Master's in Urban and Regional Planning*)

Project Larsboda

Maria Isaksson	Bachelor in Geography. *(*Current: *Independent Master's courses)*
Cecilia Lindén	Bachelor in Biology-Earth Sciences. (Current: *Master's in Landscape ecology*)
Xiaomeng Ma	Bachelor in Ecology. (Current: *Master in Environmental Management and Physical Planning*)
Viggo Norrby	Bachelor in Geography. (Current: *Master in Environment and Health Protection*)
Frida Orveland	Bachelor in Biology-Earth Sciences. (Current: *Master's in Environmental Management and Physical Planning*)
Amanda Philipsson	Bachelor in Environmental Science. *(*Current: *Independent Master Courses)*
Kristin Strandberg	Bachelor in Urban and Regional planning. (Current: *Master in Environmental Management and Physical Planning*)

Project Magelungens Strand

Christoffer Ekström	Bachelor in Environmental Science. (Current*: Master's in Landscape ecology*)
Ihsin Cheng	Bachelor in Bioenvironmental systems engineering. (Current: *Double major in Forestry and Resources Conservation*)
Isla Hämäläinen	Bachelor of Geography. (Current: *Master's in Environmental Management and Physical Planning*)
Karin Klerby Blomqvist	Current: *Bachelor´s in Geography*
Rasmus Gustavsson	Bachelors of Criminology. (Current: *Master's in Landscape ecology*)
Tor Ekholm	Bachelor of Biology. (Current: *Master's in Environmental Management and Physical Planning*)

Project Norra Kymlinge

Anna Österman	Bachelor in Biology and Earth Science. (Current: *Independent Master courses)*
Christiane Kaiser	Bachelor in Geography. (Current: *Master's in Environmental Science)*
Jennie Jalkner	Bachelor in Molecular Biology. (Current: *Master's in Environmental Management and Physical Planning)*
Johanna Lennartson	Bachelor in Urban Planning. *(*Current: *Master's in Social science, specializing in Urban Planning)*
Mattias Jaktlund	Bachelor in Geography. (Current: *Independent Master courses)*
Saad Kadif	Bachelor of Biology and Earth Science. (Current: *Master's in Geomatics with Remote Sensing and GIS*)
Tina Koskela	Bachelor in Geography. (Current: *Master's in Environment and Health Protection*)
Sunil Chopra	Bachelor of Environmental Science. (Current: *Masters in Environmental Science)*

Project Riddersvik

Natacha Bjurberg Kessidis	Bachelor in Geography. (Current: Master's in Environmental Management and Physical Planning)
Stina Ljungberg	Bachelor in Environmental Science. (Current: Master's in Environmental Management and Physical Planning)
Mårten Oswald	Bachelor in Marine Biology
Filippa Pershagen	Bachelor in Geography (Current: Master's in Environmental Management and Physical Planning)
Lukas Scholz	Bachelor in Biosciences. (Current: *Master Programme in Ecology and Biodiversity*)
Rikard Stenberg	Bachelor in Geography (Current: Master in Environmental Management and Physical Planning)
Johanna Ström	Bachelor in Environmental Science (Current: *Master's in Environment and Health Protection*)

List of Actors

Act Relative to the Transportation of Dangerous Goods - Förordning om transport av farligt gods

Culture and Recreation Committee- Kultur- och fritidsnämnden, Sundbyberg

Culture Committee- Kulturnämnden, Stockholm Stad

County Administrative Board - Länsstyrelsen

City Planning Office - Stadsbyggnadskontoret

City Planning Committee- Stadsbyggnadsnämnden

Environmental Administration - Miljöförvaltningen

Stockholm County Council - Landstinget

City Museum of Stockholm - Stadsmuseet

Stockholm Stad, Municipality of Stockholm - Stockholms stad

City Council - Kommunfullmäktige

Municipal Executive Committee - Kommunstyrelsen

City District Administration - Stadsdelsförvaltning

Cultural Heritage Law - Kulturmiljölagen

Traffic Office - Trafikkontoret

Swedish Transport Administration - Trafikverket

Swedish Transport Agency - Transportstyrelsen

Swedish Environmental Protection Agency - Naturvårdsverket

Swedish Environmental Code - Miljöbalk

Swedish National Heritage Board - Riksantikvarieämbetet

Swedish National Land Survey - Lantmäteriet

Swedish Society for Nature Conservation Naturskyddsföreningen

Swedish Civil Contingencies Agency - Myndigheten för Samhällsskydd och Beredskap

National Board of Housing, Building and Planning - Boverket

Development Committee - Exploateringsnämnden

National Board of Health and Welfare - Socialstyrelsen

Technical committee: Tekniska nämnden

Land and Environment Court of Appeal - Mark- och miljööverdomstolen

Svea Court of Appeal - Svea hovrätt
Heritage Conservation Act - Kulturminneslagen

Development Administration - Exploateringskontoret

The Greater Stockholm Fire Brigade - Storstockholms brandförsvar

Glossary

Accessibility	Refers to both physical accessibility, such as roads and paths, but also psychological accessibility, such as feeling of privacy and barriers in the landscape
Amphibians	Ectothermic, tetrapod vertebrates of the class Amphibia. Ex: Frogs
Arboretum	A display garden with different trees, mostly for educational purposes
Biodiversity	Refers to species diversity and genetic diversity of terrestrial and aquatic organisms in an area
Biotope	Biological term for a type of environment which constitutes a habitat for a certain assemblage of species of plants and animals
Carbon dioxide sink	A natural or artificial reservoir that accumulates and stores some **carbon**-containing chemical compound for an indefinite period
Chemical status	Refers to the statues of water based on the levels of pollutants in surface water. Classification scale is good or satisfactory / not reaching good status
Comprehensive plan	Covers the entire municipality's area. It shows how the municipality would like the city and land to be and appear in the future and which areas the municipality thinks should and should not be used for building
Coniferous forest	A terrestrial biome found in temperate regions of the world with warm summers and cool winters and adequate rainfall to sustain a forest

Connectivity	In ecology, is the degree to which the landscape facilitates or interfere with the movement of species among resource patches, such as e.g. mating- or feeding grounds
Core area	In ecology an area which qualities make it particularly valuable to plants and animals
Cultural heritage	The legacy of physical artifacts and intangible attributes of a group or society that are inherited from past generations, maintained
Cultural landscape	Refers to landscapes transformed by human activity. For example, farmland, urban landscapes and industrial landscapes
dB, dB(A)	A logarithmic unit used to express the ratio of two values of a physical quantity Ex: dB(A), A-weighting, a sound level unit
Deciduous forest	Forests where a majority of the trees lose their foliage at the end of the typical growing season are called deciduous forests. These forests are found in many areas worldwide and have distinctive ecosystems, understory growth, and soil dynamics
Detailed development plan	Law-binding rules for where new buildings may be located and how they should appear
Dispersal	The movement of individuals (animals, plants, fungi, bacteria, etc.) from their birth site to their breeding site ('natal dispersal'), as well as the movement from one breeding site to another ('breeding dispersal')
Ecoduct	A bridge for increased connectivity for ground-bound animals
Ecosystem Services (ESS)	*Provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; supporting, such as nutrient cycles and crop pollination; and cultural, such as spiritual and recreational benefits

Edge nibbling	Long term removing of small pieces of a specific area
Effect	The physical change of the environment Ex: remove some trees to make a road What the effects result in; for example less nature → less health is the actual impact
Fault scarp	A small step or offset on the ground surface where one side of a fault has moved vertically with respect to the other. It is the topographic expression of faulting attributed to the displacement of the land surface by movement along faults
Fragmentation	The emergence of discontinuities (fragmentation) in an organism's preferred environment (habitat), causing population fragmentation and ecosystem decay
F-6	A school with classes from the preparatory year up to year six
F-9	A school with classes from the preparatory year up to year nine.
Förbifart Stockholm	A bypass with the purpose to improve the accessibility for car traffic in Stockholm
Green corridor	An area of habitat, connecting populations of species, that has been separated by human activities. The exchange of individuals between populations may decrease negative effects such as inbreeding and a reduction of genetic diversity which often occur within isolated populations.
Green compensation	Compensation for lost green areas. Ex: Through management measures, restoration of damaged environments, creating new habitat or by the long-term protection of natural areas that previously lacked protection etc.
Geomorphology	Scientific study of the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface.

Habitat	Refers to the living environment where a plant or animal species live under specific conditions
Hard surface	Refers to the area that does not allow rainwater infiltrated
Hibernation	Is a state of inactivity of animals, where body temperature, heartbeat and metabolic rate drop
Impact	What the effects result in; for example less nature → less health is the actual impact. Ex: Habitat fragmentation due to removed trees
Infrastructure	Refers to physical structures and functions in society. Includes the roads, sewerage, electricity supply and waste management
Makrophyte	An aquatic plant that grows in or near water
National Interest	Areas with values regarded as important on a national level e.g. natural and cultural environments that are of importance to preserve
Natura 2000	An area or network protected by the EU to promote certain natural environments
Newly arrived	Recently immigrated persons with residence permission where the municipality is responsible for finding housing options for them.
Noise	Refers to unwanted sound in air, ground and water. Noise pollution can affect human and animal health.
Orientability	The capacity of an area to be orientated by a person with visual or cognitive deficiencies

Recreation area	Refers to an area that is attractive for various recreational activities for the public. For example, the areas suitable for walking, jogging and playing or just enjoyment of surroundings
Recreational values	Values that involve the availability for walking, playing and other leisure activities
Red listed species	Classification of threatened species measuring conservation status of individual species, developed by the IUCN.
Safety distance	Guidelines regarding the distance to residential areas from different elements, e.g. cultural objects and industrial facilities, that has been established by statutory authorities e.g. National Board of Housing, Building and Planning and The Environmental Protection Agency
Storm water	Refers to the water on surfaces that cannot be infiltrated. Origin of the water is from rain, melting and flushing water or emergent groundwater.
Socioduct	A broader bridge that is built to reduce social barriers between areas and create social connectivity
Soil condition	Soil structure, stratigraphy and quality
SS	Suspended Solid
Stockholms Green Wedges	A collection of 10 large nature areas in Stockholm county which extends from the suburbs outside Stockholm and inwards toward the city center. Providing green infrastructure close to developed areas

Usability	The degree to which an area an environment is accessible and orientable for persons with disabilities
Water condition	Refers to abiotic factors such as chemical and physical conditions, as well as the ecological status, in the aquatic environment within an area
Water recipient	The term for water bodies that receives waste products through the transportation of water
Wetland	A land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem
Wooded bog areas	A bog is an area of moist, soggy ground, usually with peat formed by the decay and carbonization of mosses and other vegetation in the bog

Abbreviations

Zn - Zinc

Cu - Copper

Cr - Chromium

Cd - Cadmium

Hg - Mercury

EIA - Environmental Impact Assessment

EIS - Environmental Impact Statement

EPA - Environmental and Protection Agency

ESS - Ecosystem Services

EQS - Environmental Quality Standards

EQO - (The Swedish) Environmental Quality Objectives

NO_2 - Nitrogen dioxide

N - Nitrogen

Ni - Nickel

NOx - Nitrogen Oxides

P - Phosphorus

PAHs - Polycyclic aromatic hydrocarbon

RUFS - Regional utvecklingsplan för Stockholm

PBL (The Planning and Building Act) - Plan- och bygglag

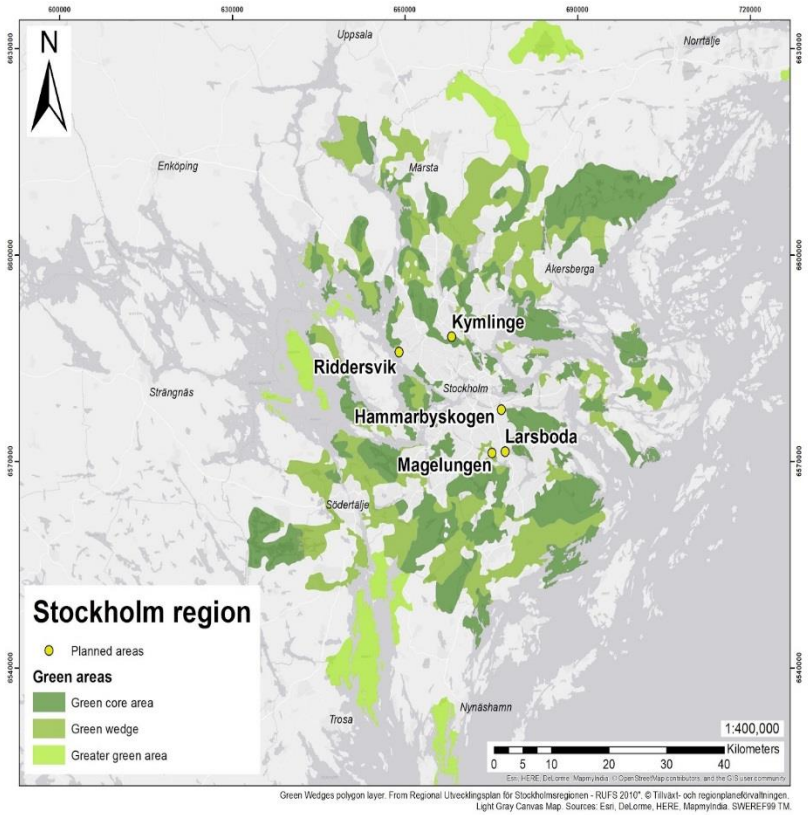
SPO (Species Protection Ordinance) - Artskyddsförordningen

Part 1 -
Common Introduction

Table of Contents: Common Introduction

1. Background and Purpose

This report consists of Environmental Impact Assessments of five areas in the Stockholm region. The areas are currently unexploited and the planning processes are all in different stages. The common denominator is that they are all are located in green areas within a region with growing population and housing shortage (Länsstyrelsen, 2016).



Map 1. Map marking the project areas and important green areas as pointed out in the Regional Development Goals (RUFS, 2010:156).

To give the reader the background and to explain why we make Environmental Assessments, the following section explains the planning and legal framework and environmental objectives common to the individual assessments in this common report.

2. The Swedish Planning Process

The legal framework for the Swedish planning process is defined primarily in the Plan and Building Act (SFS, 2010:900) and in the Environmental Code (SFS, 1998:808). It is the Swedish municipalities that have a monopoly on planning in Sweden (Nyström & Tonnell, 2012). But the framework for the planning process is set by the government through the Plan and Building Act. The County Administrative Boards (*Länsstyrelserna*) monitor that the planning in the municipalities follow the national interests and goals, they also are required to act as an advisor for both the constructor and the municipality.

The municipalities can act both as an authority and a property owner (Boverket, 2016a). The municipality writes and approves the Comprehensive Plan (*översiktsplan*), Detailed Development Plans (*detaljplaner*) and Area Regulations (*områdesbestämmelser*) (Nyström & Tonell, 2012). In every municipality there is a local Building Authority (*byggnadsnämnd*) that is constituted of trustees and public servants that approves and monitor the plans from a legal point of view (Boverket, 2016a).

The developer (*byggherre*) is the person or organisation that has been commissioned to construct the project (or parts of it). They have the overall responsibility to make sure that the

project fulfills current laws and that monitoring is done in a proper way (Boverket, 2016a; Byggherrarna, 2016).

The Comprehensive Plan is there to regulate the development of the municipality as a whole. It must display the intended use of water and land and the end result present the *"usage/conservation of land and water, localization and dimensions of buildings, infrastructure and service"* (Nyström, 1999:119). The Comprehensive Plan should be accepted by the City Council (kommunfullmäktige), every four years and the Council should decide whether the plan shall be extended or is in need of renewal (Boverket, 2016b). It is not legally binding, and can therefore not be appealed against. Though whenever the municipality should choose to develop areas in such a way that they do not conform to the Comprehensive Plan, they must present their reasons for doing so through a programme (Nyström och Tonell, 2012).

The Detail Development Plan is more of a small scale, detailed document that is legally binding. This process is initiated by the municipality or developer. The initial phases of planning are not regulated in law, therefore an agreement is often struck in the beginning between the involved parties to divide the costs of the planning process (Iverlund & Ultenius, 2008). At the start of the process a promemoria is written by the Town Planning Office, which describes the project. Should the Detailed Development Plan differ from the Comprehensive Plan, a programme might also be developed. Before the programme stage there will often be a pre-study of the area, with the purpose to find out whether the project should be done at all (ob. cit).

At the next stage investigations are carried out; possible impacts are examined from an economic, environmental and social perspective. The Environmental Assessment (*miljöbedömning*) also helps to inform the decision of whether an Environmental Impact Assessment (EIA) will be necessary. During the development of the Detailed Development Plans the municipality is required to consult the County Administrative Board (*Länsstyrelsen*), the Land Surveying Authorities (*Lantmäteriet*) and other municipalities that may be affected by the proposed plan (Iverlund & Ultenius, 2008). They must also arrange so the people that might get affected by the plan, as well as relevant authorities and organizations, can have their opinions stated (Nyström & Tonell, 2012).

Referral and consultation documents are then developed and the proposed plan will be tried against the Plan and Buildings Act. Once approved the proposed plan must be presented in a public space for at least 3 weeks (Nyström & Tonell, 2012). The presented plan must at least contain; a map of the plan with conditions, a description of the plan, description of implementation, an account of the consultation process, a base map, list of real estate, illustrations and if applicable the program and the EIA (Iverlund & Ultenius, 2008). During this time different stakeholders can state their issues with the plan. At the end of the time of presentation, the municipality must compile the opinions on the plan in a verdict (ob. cit.). Should the plan substantially change in light of the stakeholders' critique then the plan must be presented to the public in the same fashion once more.

Once the presentation period is over either the County Administrative Board approves the plan or, if the plan is considered to be of minor importance, they delegate the decision to the Municipal Board (*kommunstyrelsen*). The decision is followed by a period (*besvärsskede*) lasting three weeks during which the individuals that did not have their

complaints catered to during the time of presentation may appeal against the plan with the County Administrative Board as first instance, and the government as second instance (Iverlund & Ultenius, 2008). Should the plan not be appealed against or the appeal be denied, then the plan will enter into legal force at the end of the three-week period.

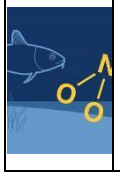
3. Environmental and Planning Objectives

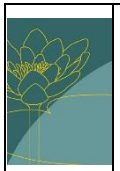
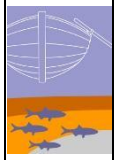
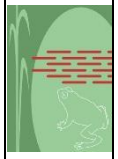
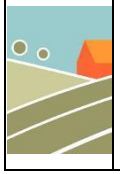
3.1. Environmental Objectives

The Swedish Environmental Objectives (EOs) are aiming to safeguard the environment. They are consisting of three parts; the Generational Goal, 16 Environmental Quality Objectives (EQOs) and 24 Milestone Targets. The Generation Goal provides guidance to solve current environmental problems within one generation. The EQOs are a set of environmental qualities that are further specified and are supposed to be reached by 2020 (Table 1). The Milestone Targets represent necessary steps towards the achievement of the Generational Goal and the EQOs (Naturvårdsverket, 2016a; 2016b).

Table 1: The Swedish Environmental Quality Objectives and their official description (Naturvårdsverket, 2016a), an assessment of the prospects of achieving them by 2020 as well as current trends in the environment (Naturvårdsverket, 2016b). The table also contains the official illustrations of the EQOs by Tobias Flygar (Miljömål.se, 2012)

	Environmental Quality Objectives	**Description**	**Will be reached by 2020?**	**Trend**
	**Reduced Climate Impact**	"In accordance with the UN Framework Convention on Climate Change, concentrations of greenhouse gases in the atmosphere must be stabilised at a level that will prevent dangerous anthropogenic interference with the climate system. This goal must be achieved in such a way and at such a pace that biological diversity is preserved, food production is assured and other goals of sustainable development are not jeopardised. Sweden, together with other countries, must assume responsibility for achieving this global objective."	No*	Negative

	**Clean Air**	"The air must be clean enough not to represent a risk to human health or to animals, plants or cultural assets."	No	Positive
	**Natural Acidification Only**	“The acidifying effects of deposition and land use must not exceed the limits that can be tolerated by soil and water. In addition, deposition of acidifying substances must not increase the rate of corrosion of technical materials located in the ground, water main systems, archaeological objects and rock carvings.”	No	Positive
	**A Non-Toxic Environment**	“The occurrence of man-made or extracted substances in the environment must not represent a threat to human health or biological diversity. Concentrations of non-naturally occurring substances will be close to zero and their impacts on human health and on ecosystems will be negligible. Concentrations of naturally occurring substances will be close to background levels.”	No	Neutral
	**A Protective Ozone Layer**	“The ozone layer must be replenished so as to provide long-term protection against harmful UV radiation.”	Yes	Positive
	**A Safe Radiation Environment**	“Human health and biological diversity must be protected against the harmful effects of radiation.”	Partly	Neutral
	**Zero Eutrophication**	“Nutrient levels in soil and water must not be such that they adversely affect human health, the conditions for biological diversity or the possibility of varied use of land and water.”	No	Neutral

	**Flourishing Lakes and Streams**	"Lakes and watercourses must be ecologically sustainable and their variety of habitats must be preserved. Natural productive capacity, biological diversity, cultural heritage assets and the ecological and water-conserving function of the landscape must be preserved, at the same time as recreational assets are safeguarded."	No	Neutral
	**Good-Quality Groundwater**	"Groundwater must provide a safe and sustainable supply of drinking water and contribute to viable habitats for flora and fauna in lakes and watercourses."	No	Neutral
	**A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos**	"The North Sea and the Baltic Sea must have a sustainable productive capacity, and biological diversity must be preserved. Coasts and archipelagos must be characterised by a high degree of biological diversity and a wealth of recreational, natural and cultural assets. Industry, recreation and other utilisation of the seas, coasts and archipelagos must be compatible with the promotion of sustainable development. Particularly valuable areas must be protected against encroachment and other disturbance."	No	Neutral
	**Thriving Wetlands**	"The ecological and the ecological and water-conserving function of wetlands in the landscape must be maintained and valuable wetlands preserved for the future."	No	Negative
	**Sustainable Forests**	"The value of forests and forest land for biological production must be protected, at the same time as biological diversity and cultural heritage and recreational assets are safeguarded."	No	Neutral
	**A Varied Agricultural Landscape**	"The value of the farmed landscape and agricultural land for biological production and food production must be protected, at the same time as biological diversity and cultural heritage assets are preserved and strengthened."	No	Negative

	**A Magnificent Mountain Landscape**	"The pristine character of the mountain environment must be largely preserved, in terms of biological diversity, recreational value, and natural and cultural assets. Activities in mountain areas must respect these values and assets, with a view to promoting sustainable development. Particularly valuable areas must be protected from encroachment and other disturbance."	No	Negative
	**A Good Built Environment**	"Cities, towns and other built-up areas must provide a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be protected and developed. Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources."	No	Positive
	**A Rich Diversity of Plant and Animal Life**	"Biological diversity must be preserved and used sustainably for the benefit of present and future generations. Species habitats and ecosystems and their functions and processes must be safeguarded. Species must be able to survive in long-term viable populations with sufficient genetic variation. Finally, people must have access to a good natural and cultural environment rich in biological diversity, as a basis for health, quality of life and well-being."	No	Negative

**the deadline for the Environmental Quality Objective of 'Reduced Climate Impact' is 2050 instead of 2020*

3.2. Regional Objectives

The Regional Development Plan (commonly known as *RUFS*) from 2010 was developed by the Regional Development Office (Tillväxt- och Regionplaneförvaltningen, Stockholms Läns Landsting) and is the strategic development plan for all 26 municipalities in Stockholm. The Office is working on the next development plan, RUFS 2050 (RUFS, 2016). However, this plan is still in its consultation phase and might change considerably before final approval. Because of this, the focus is still on the current version from 2010.

It points out a number of important development goals for the region. By using 6 strategies with subsequent planning objectives and then followed by specific goals, RUFS shows the ideal direction of development. Two of those strategies are of specific importance for

the development proposals scrutinized in this environmental impact assessment are discussed shortly below.

One of the strategies is to "*secure existing values for future needs".* It concerns for instance the natural-, cultural- and recreational environments and states that such environments should be both protected and to be further developed. Its second objective is about climate, energy and transports. This part states that the region should decrease its effect on the environment and that the transportation systems need to be efficient. The negative effects from transportation systems should be limited.

Another strategy is to "*develop a multi-centric and dense region".* The planning goal is that the city becomes *multi-centric* and has a compact city structure. Today Stockholm is a mono-centric region with a very mono-centric city center, which puts a lot of strain on our transport infrastructure. With a growing population, the demands on all kinds of traffic infrastructure will continue to increase. Instead of leading everyone into the inner city over the Central Station, the plan point towards that new housing areas should be planned close to important core access points where they could be combined with public services. Such regional cores should be further developed. This would also make transverse travelling easier (i.e. bus or tram from east to west). One of the goals is also that people should have a good access to work places, green spaces, water and technical infrastructure.

Additional points are that the density of the built environment should increase and that it becomes more varied. An attractive city environment with public spaces, parks and green environment should be built, that also create possibilities for dynamic evening economies in the city's core areas.

The same strategy also includes goals about *green wedges and beaches*. Following this the people in the region should have "*good access to nature in close proximity to residential areas*. This means that those *assets should be secured, developed and the access to the green wedges should increase".*

It becomes clear that the problem with these goals is that that they are in conflict with each other. On the one hand, existing values should be protected for future needs. On the other hand, they are to be changed/developed for the needs of a growing population. As the RUFS-goals are not legally binding, it is up to the municipalities to make their own judgments of the importance between them.

3.3.Comprehensive Plan

In the following section, the Planning Objectives from the Stockholm Comprehensive Plan are presented in more detail. This plan is relevant for four out of five projects (Hammarbyskogen, Larsboda, Magelungen and Riddersvik) but not for the Kymlinge projec. This project it is located within the municipality of Sundbyberg. However, as the project is not mentioned in their Comprehensive Plan, this plan is not presented below.

The Stockholm City Plan (Stockholms stad, 2010) is the Comprehensive Plan showing water and land use as well as development of the built environment for the near future. An updated version of the plan is now out on consultation between 2016-11-10 and 2017-01-10. Since a final version has not been agreed on politically, we have chosen to use the 2010 version.

The plan points out four strategies that will help the city grow in a more sustainable way:

"*strengthen central Stockholm, focus on strategic nodes, connect city areas* and *create a vibrant urban environment"* (Stockholms stad, 2010).

The first focuses on how with the rapid city-growth, the inner city is expanding outside the historic city borders. Growth should be focused along the outer parts of the underground lines, which provides citizens with good public transportation access and enables more people to go by bike or walk to their destinations. Some of these are well connected to the city core but not between each other and a stated goal is to improve those connections.

The document mentions some risks when densifying: air- and noise pollution, increased pressure on logistics that can cause risks and that development might destroy green areas in a time when the need for recreational green space increases.

The second strategy focus on specific core areas and mentions Kista, Vällingby, Spånga, Brommaplan, Skärholmen, Farsta, Fruängen, Älvsjö and Högdalen. Four of the five environmental impact assessment (EIA) projects produced in this document are located in close proximity to those cores. The fifth project connects with two expanding inner city areas, Hammarby Sjöstad and Gullmarsplan.

The third and fourth strategy goals of *connecting city areas* and *creating a vibrant urban environment* put more focus on the quality of city areas. Workplaces and offices should be found around the city, which could decrease the pressure on both road- and public transportation infrastructure, and citizens could walk more often or use their bicycles. Access to schools, services, parks or green spaces should be improved. Evening activities like visiting restaurants, cafes or entertainment should be found locally. Environments that are used continually throughout the day and into the evening expand the citizens' sense of security and greatly increase the attractiveness of areas.

4. Legislation

4.1. EU Directive

In order to prevent further environmental deterioration, the EU Directive 85/337/EEC was implemented in 1985. According to the Directive, an EIA is required for two classes of projects, one mandatory (Annex I) and one discretionary (Annex II):

"Projects of the classes listed in Annex I shall be made subject to an assessment... for projects listed in Annex II, the Member States shall determine through: (a) a case-by-case examination; or (b) thresholds or criteria set by the Member State whether the project shall be made subject to an assessment... When [doing so], the relevant selection criteria set out in Annex III shall be taken into account" (EU Directive 85/337/EEC, Article 4).

In other words, all projects listed in Annex I are considered as having significant effects on the environment and require an EIA. For projects listed in Annex II, the authorities are required to decide whether an EIA is needed with the "screening procedure", which determines the effects of projects on the basis of thresholds/criteria or a case-by-case examination. Moreover, the authorities should also take into account the projects listed in Annex III.

The EIA Directive of 1985 has been amended three times, in 1997, 2003 and 2009. The implementation and development of the Directive greatly influenced the EIA systems in EU Member States. The EIA is viewed as a significant technique for incorporating environmental considerations into the planning process (Glasson *et al.*, 2013).

The EIA Directive is transposed into Swedish legislation mainly by the Environmental Code (SFS, 2000:61) and the Ordinance on Environmental Impact Assessments (SFS, 1998:905). The Environmental Code contains several provisions regarding the preparation of the EIA. It also contains chapter 6, with General Regulation on Environmental Impact Statements (EIS) and Environmental Impact Assessments (EIA). Over the past decades, EIA has become an important tool in project planning in Sweden and its applications are likely to expand further (Edvardsson, 2004).

4.2.Swedish Environmental Legislation

4.2.1. Swedish Environmental Code

National interests - Riksintressen

National interests are geographical areas determined to contain unique or otherwise important values or qualities of national concern. The term national interests are used in the Swedish Environmental Code regarding two different types of areas. One type stems from chapter 4 which states that *"the government may declare an area to be of national interest"*. The other type is described in chapter 3 of the Environmental Code and "*it is the responsibility of the relevant authorities to assert claim and oversight of the areas".*

How national interests relate to other interests is supposed to be presented in the municipalities comprehensive plans in a way that clarifies how tradeoffs and judgements are to be considered (Boverket, 2016a).

Basic provisions concerning the management of land and water areas

Authorities, organizations, companies and individuals are obliged to follow the basic provisions concerning the management of land and water areas conditioned by the Swedish Environmental Code (SFS 1998:808) in chapter 3. Land and water areas shall be used for the purposes for which they are best suited in view of their situation (chapter 3 section 1) while land and water areas that are, from an ecological point of view, particularly vulnerable shall be protected against damaging measures to the extent possible (chapter 3 section 3). Protection against damaging measures, to the extent possible, shall also apply land and water areas as well for the general physical environment that are important in regards to public interest due to their natural or cultural value for outdoor recreation. The need for green spaces in and near urban areas shall be given special consideration according to chapter 3 section 6.

Protection of areas

Nature reserves

According to chapter 7 section 8 (SFS, 1988:808), decisions regarding the establishment or alteration of nature reserves must not conflict with Detailed Development Plan or Area Regulations in accordance to the Planning and Building Act (SFS, 2010:900). Minor modifications may be made if this does not conflict with the purposes of the plans or regulations.

Shore protection areas

Shore protection applies by the sea, lakes and watercourses with the purpose of assuring public access to outdoor recreation facilities and to maintain good living conditions for plant and animal species on land and water, according to chapter 7 section 13 (SFS 1998:808). Land and water areas shall be protected up to 100 m from the shoreline. However, the government may extend this area to not more than 300 m from the shoreline if necessary, according to chapter 7 section 14 (SFS 1998:808). Within a shore protection area, it is, according to chapter 7 section 15 (SFS, 1988:808), prohibited to:

1. erect new buildings;

2. alter buildings in order to serve a purpose that is significantly different from previous use;
3. digging or other preparations for the purpose of construction work referred to in point 1 and 2;
4. measures which significantly affects the living conditions for animal and plant species.

According to chapter 17 section 18 (SFS, 1998:808), the County Administrative Board may grant exemptions from the shore protection in an area if it is:

1. obvious that the area lacks significance in the provision of the intended shore protection,

2. the shore protection applies to a small lake or watercourse and the areas significance for the shore protection is little, or

3. if the area, according to the Planning and Building Act (SFS, 2010:900), is part of a Detailed Development Plan and is needed for building of a defense facility, public road or rail road.

The same section also states that conditions regarding the municipality's possibility to withdraw the shore protection through provisions in a Detailed Development Plan are found in chapter 4 section 17 in the Planning and Building Act (SFS, 2010:900).

According to chapter 7 section 18 b, the municipality may allow exemption from the shore protection if there is special circumstances that motivates it. The exemption is reviewed by the County Administrative board and can be repealed if the exemption is not satisfactory as to the criteria listed in the Environmental Code.

Environmental Impact Statements

The purpose of an Environmental Impact Assessment (EIS) is to identify and describe the direct and indirect impact of a planned activity or measure on several factors, including:

"*people, animals, plants, land, water, air, the climate, the landscape and the cultural environment, on the management of land, water and the physical environment in general, and on other management of materials, raw materials and energy*", according to chapter 6 section 3 (SFS 1998:808).

Enabling the overall assessment of the impact on human health and the environment is another purpose of an environmental impact assessment.

Authorities or municipalities that establish or alters a plan or program, shall conduct an environmental assessment if the implementation is presumed to have significant impact, according to chapter 6 section 11 (SFS, 1998:808). Within the framework of an environmental assessment, the authority or municipality shall establish an environmental impact assessment to identify, describe and assess the significant impacts the plan or program is assumed to imply, according to chapter 6 section 12 (SFS, 1998:808), which further states that the environmental impact assessment shall include:

1. A summary of the content of the plan or program and main purpose
2. A description of the environmental conditions and the probable development of the environment if the plan or program is not implemented
3. A description of the environmental conditions in the areas that are likely to be affected
4. A description of present environmental problems in areas of particular importance for the environment

5. A description of how relevant environmental objectives have been considered in the plan or program
6. A description of the expected significant impact on biodiversity, population, human health, ground, water, air climate, natural resources, landscape, built-up areas, cultural heritage and the connection between these aspects
7. A description of planned measures to prevent or mitigate negative effects on the environment
8. A summarizing statement of how assessments have been made, reasons behind the chosen alternatives and problems when compiling the document
9. A description of how measures being planned for following up and monitoring of the environmental impacts
10. A non-technical summary of points 1-9.

4.2.2. Planning and Building Act

The Planning and Building Act (SFS, 2010:900) regulates provisions concerning the planning of water and land areas as well as construction. The overarching purpose is, according to chapter 1 section 1, to promote societal progress, with regard to the freedom of the individual, a clean and sustainable habitat for people in today's society and future generations. It states, in section 2, same chapter, that planning the use of land and water areas is a municipal responsibility.

The Planning and Building Act further regulates provisions on Comprehensive Plans (chapter 3), Detailed Development Plan (chapter 4-6) and Building Permits (chapter 9). According to chapter 3, every municipality must have a current Comprehensive Plan (section 1) that provides guidance for decisions on how the land and water areas are to be used and how the built environment is to be used, developed and protected (section 2). Chapter 4 section 2 regards the requirements for regulation by means of a Detailed Development Plan and includes that a municipality must examine the suitability of a land or water area for built environment and construction works for:

"*new construction works (…) if the construction works require a building permit (…) and the use of the construction works will have a significant impact on its surroundings (…)"* (SFS, 2010:900).

4.2.3. Heritage Conservation Act

The Heritage Conservation Act (SFS 2015:852) refers to the protection and preservation of cultural environments in Sweden. The act contains regulations for protection of certain cultural valuable objects and monuments. The act's main purpose is to avoid damage on the cultural environment during construction work, but also to consider objects and monuments during the planning process. The County Administrative Board has the main responsibility for the work with cultural heritage in each county, while the Swedish National Heritage Board ("Riksantikvarieämbetet") has the supervision for all of Sweden.

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Part 2 -
EIA Magelungens strand

Table of Contents:
EIA Magelungens strand

1. Non-Technical Summary

1.1 Swedish - Svenska

Magelungens strand är ett område i Farsta stadsdel som ligger vid sjön Magelungen mellan Farsta Strand och Fagersjö. Stockholms stad har pekat ut detta som ett möjligt område för stadsutveckling och har arbetat med planer för området sedan 2010, nu med en detaljplan för 750-1000 nya bostäder. Planområdet ligger i den gröna kilen Hanveden och har ekskogar i en strandmiljö, vilket är mycket ovanligt att hitta i Stockholmsområdet. Sjön Magelungen är en livsmiljö för amfibier och strandlinjen är viktig för fiskars reproduktion. Enligt planerna i promemorian för området skulle även planerade byggnader inkräkta på strandskyddszonen.

I denna miljökonsekvensbeskrivning har fyra alternativa framtider för området prognostiserats och jämförts. Nollalternativet bedömer effekten om området är kvar som det är. Noll-plusalternativet bedömer effekterna av att försöka förbättra villkoren för identifierade naturvärden. Alternativ ett är kommunens plan, som fokuserar på att bygga längs Magelungsvägen och mot kusten. Ett alternativ, där vi försöker skydda naturvärdena genom att samla byggnationen utanför känsliga områden.

Genom ek-kartläggning, litteraturstudier och intervjuer undersöks effekterna på den naturliga miljön, inom och anslutning till planområdet under en 20-årsperiod. På grund av tillgången till uppgifter, bedöms de sociala konsekvenserna endast för en tioårsperiod.

Både alternativ ett och alternativ två kommer att förändra landskapsvyer i området. I båda alternativen kommer tillgängligheten för fotgängare till fornlämningarna, såsom stensättningar, älvkvarnar och hällristningar att öka. I Alternativ ett kommer flertalet fornminnen att förstöras av byggnader medan det i alternativ två endast är ett fåtal som påverkas. Att låta området vara (nollalternativet) kommer inte att leda till några väsentliga effekter inom den 20-åriga tidsperioden, men i ett längre perspektiv kommer ekskogen inte att kunna konkurrera med tall och gran. Skulle staden välja att inte bebygga området är det därför nödvändigt att förvaltningsplanen i noll-plusalternativet upprätthåller naturvärden och förbättrar anslutning till omgivande naturområden.

Alternativ ett kommer att ha betydande negativa konsekvenser för den biologiska mångfalden eftersom en stor andel av skogsområdet kommer att omvandlas till bostadsmark. Därmed sker en förlust av delar av värdefulla och sällsynta områden av ekskog. Alternativ två kan ha en stor positiv inverkan på miljön i området på grund av hänsynen till naturvärden, dels genom att tätare ekskogsbestånd skyddas från byggnation, dels genom en förbättrad möjlighet till utbyte mellan arter på vardera sidan Magelungsvägen genom byggandet av en ekodukt och en grodtunnel. Buller och luftföroreningar är redan förekommande i området. Alla alternativ utom nollalternativet kan komma att förbättra buller- och luftmiljö, eftersom byggnader, bullerskydd och förändrade hastighetsbegränsningar beräknas minska dessa i området.

Att bygga i området kommer att leda till ett ökat behov av tjänster såsom närbutiker, vård, skola och småföretag. Om dessa tillgodoses kan alternativ ett och två leda till positiva effekter i Fagersjö, där det för närvarande finns en upplevd brist på tillgång till tjänster. Hur tjänsterna kommer att utvecklas i

området beror på i vilken ordning området bebyggs. Dock finns det en risk att alternativ två resulterar i färre närliggande tjänster för människorna i Fagersjö eftersom byggnationen kommer att koncentreras närmare Farsta strand.

Idag används området för fritidsaktiviteter som relaterar till den skogsliknande miljön. Om området görs om till ett bostadsområde, kan dessa typer av aktiviteter minska. Samtidigt kan kajparken i alternativ ett dock uppmuntra till fler promenader i området, och det finns också en möjlighet att den kan fungera som en integrerande mötesplats för människor från Fagersjö och Magelungens strand. Byggprojekten kan därmed fungera som en motkraft till segregationen som för närvarande finns i Fagersjö. Stadskontorets undersökning bland unga i området visade även att ungdomarna i Farsta känner sig obekväma i skogsområden. Det är möjligt att denna typ av urbant skogsområde skulle kunna underlätta naturmöten för unga.

Skulle Magelungens strand förbli obebyggd finns det en risk att segregationen i Fagersjö kommer att förvärras. Under de senaste åren har människor lämnat området. Studier har visat att de personer som är mest benägna att flytta är personer med bättre ekonomi, det är därför möjligt att utanförskap kan komma att cementeras i Fagersjö om området inte genomgår någon form av förändring. Fler tjänster och sociala mötesplatser i Magelungens strand skulle kunna öka Fagersjös attraktionskraft för medelinkomsttagare.

Det största problemet i en miljökonsekvensbeskrivning, som denna, är att väga frågan om behovet av fler bostäder mot förlusten av sällsynta och värdefulla naturområden. Syftet med en miljökonsekvensbeskrivning är att kunna väga riskerna mot fördelarna för olika alternativ. Under vår bedömning har vi funnit att målbilden för Stockholms kommun är oklar när det kommer till huruvida bostäder eller naturmiljöer borde värderas högre, vilket har försvårat denna bedömning. Vi bedömer att Magelungens strand det finns goda anledningar att bygga i Magelungens strand, så länge de möjliga negativa konsekvenser som listats i följande rapport mitigeras i största möjliga mån. För att exploatering skall göras möjlig behöver Stockholms kommun fatta ett beslut om huruvida behovet av bostäder och en förbättring av sociala förhållanden i Fagersjö skall väga tyngre än bevarandet av ett naturområde som är sällsynt även på nationell nivå.

1.2 English

Magelungens strand is an area in Farsta city district, situated along in Lake Magelungen between Farsta Strand and Fagersjö where the city of Stockholm in working on a detail plan for 750-1000 new dwellings. The city has been working on programmes in this region since 2010, pointing out this area as a possible area for urban development. The plan area is situated in the Hanveden green wedge and hosts oak forests in a shoreline environment, which is very rare to find in the Stockholm area. Lake Magelungen is a habitat for amphibians and the shoreline water environment is important for the reproduction of fishes. As the plans are laid out in the promemoria for the area, buildings would also infringe on the shoreline protection zone. We have assessed and compared four alternatives. The Zero Alternative assesses the impact if the area is left as it is. The Zero Plus Alternative assesses the impact of management seeking to improve the conditions of identified natural aspects. Alternative One is the municipality's plan, proposing building along Magelungsvägen and towards the shoreline. We have also constructed an Alternative Two, attempting to take the natural values into consideration by scaling back buildings in sensitive areas.

Through oak-mapping, literature studies and interviews this Environmental Impact Statement assesses the effects on the

natural environment within and in connection to the plan area for a 20-year period. Due to availability of data, the social impacts are only assessed for a ten-year period.

Both Alternatives One and Alternative Two will change the landscape scene of the area. In these scenarios accessibility for pedestrians to relics in the area, such as traces of settlements, cairns and petroglyphs might increase. But in the first alternative some relics will be destroyed by buildings whilst in the second only some will be influenced. Allowing the area to stay as it is today will not lead to any significant impacts within the 20-year period, but in a longer perspective the oak forest will not be able to compete with pine and spruce, replacing the oak forest. Therefore, the management plan in alternative Zero Plus is necessary to maintain natural values and improve connectivity to surrounding natural areas.

Alternative One will have major negative impact on biodiversity as large forested areas will be turned into residential land, and parts of the most valuable areas of oak forest will disappear. Alternative Two might have a major positive impact on the ecology of the area due to the consideration of natural values by avoiding the oak forests and strengthening of connectivity through the building of an ecoduct and a frogtunnel. There is a presence of noise and air pollution in the area. All alternatives but the Zero Alternative may improve noise and air quality, as buildings, noise barriers and reduced speed limits are introduced in the area.

Building in Magelungens strand will lead to an increased need of services, if these are cared for, Alternative One and Two can result in positive effects on Fagersjö, where there currently is a perceived deficiency in access to services. How services could develop in the area depend on the order of construction and it is likely that Alternative Two will result in less services for the people in Fagersjö.

Today the area is used for recreational activities related to the forest-like environment. Should the area be made into a residential zone, these type of activities might decrease as people value untouched environments. The wharf park which is included in Alternative One might however encourage walks in the area even more, and may also act as a space for interaction between the populations of Fagersjö and Magelungens strand. The building projects could also act as a counterforce to segregation, currently identified in Fagersjö. Young people who feel uncomfortable in the forested areas, might feel more comfortable to spend time in nature in this type of urban forested area.

Should Magelungens strand remain unbuilt there is a risk that the segregation in Fagersjö will be enforced. For the past few years people have been leaving the area, and studies have shown that the people most likely to move are the people who are more financially stable. Adding services and spaces of interaction in Magelungens strand could increase the attractiveness of Fagersjö for middle income households.

The main problem in an assessment like this one is weighing the issue of Stockholm needing more housing against the loss of rare and valuable natural areas. The purpose of an Environmental Impact Statement is to make it possible to compare the risks and benefits of different alternatives. During our assessment we have found that the end goal for the municipality is unclear, which makes such a comparison difficult. We believe that there are good reasons to choose to build housing in Magelungens strand as long as adverse negative impacts are mitigated. Though, in order for exploitation to occur a decision must be made by the Municipality of Stockholm on whether the need for housing and social well-being in Fagersjö should be valued higher than a natural area that are rare even on a national scale.

2. Introduction

2.1 Background

2.1.1 Plan History

The location for the planned housing project is Magelungens strand which is situated in Farsta in the Municipality of Stockholm (Stadsbyggnadskontoret, 2016).

This project is part of two programs for this south part of Stockholm, in pursuance with the suggested comprehensive plan of Stockholm which includes the goal to build 140 000 new accommodations until 2030. Stockholm region has an increasing demand on housing and currently not enough is being built to meet future demands (Graseman, 2013). Most of the municipalities in the county of Stockholm estimates that they have a deficit of accommodations. The idea is that building 750-1000 new dwellings in the planned area will help meet the demand for new housing. The two programs, "Program för sambandet Högdalen-Farsta" and "Program för tyngdpunkt Farsta" is about development visions in Farsta and Högdalen areas (Stadsbyggnadskontoret, 2011, 2016b). The programs main purpose is to connect these two urban areas. In particular, this housing plan will, according to the programs, connect Fagersjö and Farsta. Currently, Fagersjö and Magelungens strand are isolated from Farsta and the shoreline along the planned area is inaccessible from many places. To manage this problem, the housing plan also includes inviting promenades increasing walkability in the area, through connecting promenades and park environments. Another vision in the programs included in the promemoria is that this project, among others in Farsta, will turn Farsta towards the lakes ("vända Farsta mot sjöarna") by building next to the lake and by building houses of mixed height.

Further on the project will also focus on improved traffic systems that will encourage walking, cycling, combined transportation and public transportation. The project will also contribute to a clarity in the urban structure and ground floor businesses will make the area more alive. The area preserves valuable biodiversity as it hosts old oaks and pines which have been classified as very ecologically important.

This housing project is a part of 8 000 dwellings and job sites etc. within Farsta, as a part to develop Farsta. Although acting as a connective urban area, Magelungens strand will stand apart from the original plan for Farsta borough (Stadsbyggnadskontoret, 2016). The project will be characterized by effective land use and high housing density. Both rented and co-operative tenure apartments will be built. The land is owned by the municipality of Stockholm. According to the promemoria the project aims to adopts the goals of Stockholm to grow sustainably, whilst conserving natural values, developing city life and making sure that the city is inclusive.

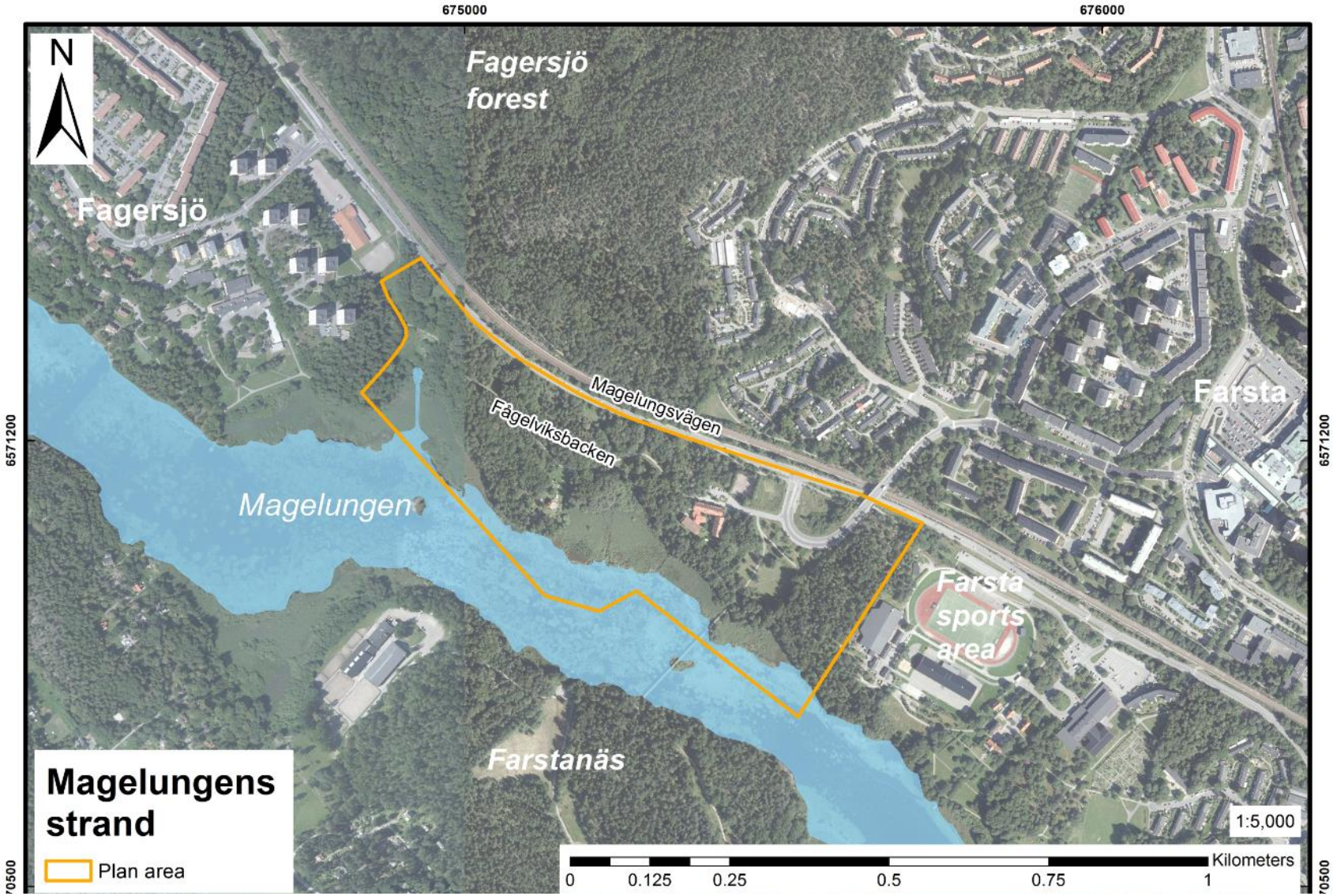


FIGURE 1. OVERVIEW MAP OF PLAN AREA.

The vision work name that is used to clarify the purpose of the project is called “Det naturnära vardagslivet - jämlikt och resurseffektivt” refer to an everyday life close to nature, that is equitable and resource efficient. The overarching urban principles that the structural plan in development will be based on are the following:

- Mixed forms of tenure in dwellings, open blocks and buildings of mixed heights open to the lake and closed towards the street Magelungsvägen. Two parking houses will be built.
- There are two streets in the area: Magelungsvägen is the bigger road and Fågelviksbacken is more of a walking street with gravel. Magelungsvägen will have qualities including biking paths and bus stops. Fågelviksbacken will be a walking promenade with possibilities for connecting streets. In addition, a bridge for walking and biking will be built over Magelungsvägen to connect the area with Fagersjö and Fagersjöskogen.
- Ecosystem services will connect natural utilities with social values for an including neighborhood. Natural areas be conserved and developed into places to meet, places between other areas and also along the shoreline.

2.1.2 Planning Process

Planning work for Magelungens strand is still at an early stage, a draft detail plan is being made at the time of writing and is estimated to be put up for public comments in August 2017 (Sjöberg, 2016, personal communication, 9 December). Consultations with the people who already have buildings in the area have already been initiated (Ericsson & Wedell, 2016, personal communication, 21 December).

The project will be financed through plan agreements. At the time of writing approximately 800 apartments have been contracted to the developers Maxera Bostad AB, Familjebostäder AB, Primula Byggnads AB, Folkhem Trä AB, and Erik Wallin AB (Exploateringskontoret, 2014a; Exploateringskontoret, 2014b; Exploateringskontoret, 2016). The current contracted developers are currently working on their proposals and during this time planning for public spaces, including parks, streets and green areas will be initiated as well. The planning process will examine what type of apartments should be built and how many there can be in total.

There are several aspects of the proposed area that will need more detailed investigations according to the promemoria. Any form of exploitation within this zone will need approval from the County Administrative Board. During the current planning process, the Exploitations Office is attempting to avoid this zone more than in the earlier stages, but need for approval still stands in some parts of Magelungens strand (Pehrsson, 2016, personal communication, 9 december; Sjöberg, 2016, personal communication, 9 December).. The area is part of the Hanveden green wedge and is classified as an ecologically valuable important area according to the ESBO. With regards to biodiversity inventories have been made in the area in connection to the planning process; interaction zones for biodiversity have been investigated and an inventory made of bats and trees (Pehrsson, 2016, personal communication, 9 December).

Although building in the area will require removing some natural areas and building within the shoreline protection zone the programs and the promemoria show an intent to strengthen natural values through this plan. There is also an optimism from the Stockholm Environmental Office that the project will be sensitive to natural values (Pehrsson, 2016, 9 December). In addition, there are some historical remains that have a strong legal protection and if they are affected by the development

permission is needed from the County Administration Board (Johansson et al 2013). Thereafter they will decide on what measures needs to be taken and whether an archeological excavation has to be done.

The City Building Office used the promemoria as a foundation to gather necessary data for the screening process. This information is gathered from the City Museum of Stockholm, the Environment Administration and The Greater Stockholm Fire Brigade. Afterwards, a consultation with County Administrative Board assessed whether the planned project will have significant environmental impacts or not. This resulted in the project not requiring an EIA done in accordance with the Environmental code and the Planning and Building Act (Sjöberg, 2016, personal communication, 9 December).

The position the City Planning Office takes on this project is that they are very positive on development in this area. They suggest that the City Planning Committee give them green lights to start the planning work.

2.2 EIA Boundaries

2.2.1 Spatial Boundaries

The area of investigation for this Environmental Impact Assessment is based on the plan area of the project. The plan area is located by the northern shore of the Lake Magelungen in the city district of Farsta which in turn lies within the Municipality of Stockholm. It is surrounded by Lake Magelungen in the southwest, Magelungsvägen in the northeast, the neighborhood of Fagersjö in the northwest and Farsta IP in the southeast. However, the planned project is likely to also affect other surrounding areas, the so called influence area. The aspects, which are estimated to be affected outside the boundaries of the plan area are; the landscape scene, cultural heritage, ecology, water environment, services and population. Changes in the landscape scene will influence the landscape of Farsta district as a whole and how the plan area is seen from surrounding areas, which is why the spatial boundaries are wider for the landscape scene aspect. The predicted impacts on cultural heritage and ecology may be important even regionally and nationally if nationally significant values are affected. The spatial boundaries for the water environment is Lake Magelungen since the evaluated impacts will have an effect on the lake as whole. The impacts on population concerns the potential future inhabitants in the plan area and the population of Fagersjö, since one of the purposes of the project is to combat segregation by physically connecting Fagersjö to Farsta. Recreational issues cover the plan area, whilst when assessing social services, we look mostly outside the plan area.

2.2.2 Temporal Boundaries

The temporal boundaries include the construction and operational phase of the project plan since these phases are predicted to affect the surrounding environment. Projects can have both short-term and long-term impacts on the environment which also affect the definition of temporal boundaries. According to Hedlund & Kjellander (2007) a reasonable timespan for an EIA is 10-30 years approximately. If temporal boundaries are too wide, the uncertainty of the impact assessment can increase. The temporal boundaries of this EIA is set to 20 years from today (2016-2036), since it is estimated as a reasonable time perspective to be able to monitor and to see the results of the probable impacts.

Exceptions for two environmental aspects have been made in order to make a reasonable assessment. The assessment for impacts on population, as the prognosis for population growth in the Stockholm region is only available until year 2025, is therefore only set for a ten-year period. The assessment of

Ecology includes slow processes such as tree vegetation succession and these are taken into consideration even though there is a major possibility that no change will happen within the twenty-year timespan.

The detail plan of the plan area is estimated to be ready year 2017 which will include an investigation of the area of buildable land surface, urban planning principles and an overall structural plan (Stadsbyggnadskontoret, 2016). With reference to the project's urban planning process the building companies have made a preliminary time schedule of the construction phase. The building companies have planned to start the construction in years 2017 and 2018 and to finish between 2018-2020 (Exploateringskontoret, 2014a; Exploateringskontoret, 2014b; Exploateringskontoret, 2016). According to the preliminary construction schedules people will start moving into the area sometime between 2018-2020, we therefore consider this time period as start of the operational phase.

2.3 Scope

The subject boundaries are defined considering relevant environmental aspects that have been included in the process. The aspects which are estimated to be affected by the project plan in Magelungens strand are landscape scene, ecology, cultural heritage, water environment, noise, air quality, services, recreation and population. The project plan is estimated to have a significant impact on the natural environment which is why the aspects of natural landscape, flora and fauna and water environment are taken into consideration. The air quality is likely to be affected both by the construction and the operational phase of the planned development. The noise aspect is considered since the noise levels of the area already exceed thresholds for buildings and living environments. Further on, cultural heritage is taken into consideration as there are historical remains in the area. The EIS also covers social aspects such as the projects rootedness in the local community and effects on segregation and recreation, the sense of safety and the state of mental health through access to natural areas. These aspects are described and discussed with regards to baseline conditions, the predicted impacts and the mitigation measures that could be taken in order to avoid, remedy or mitigate identified impacts. Consideration is also shown to the buildings currently in the area and the purposes of their existence. A further aspect is services since there will be an increase in the demand for services, such as schools and general practitioners, as people move to the area.

As one of the purposes of the planned project is to connect the socially and physically isolated community in Fagersjö to the central parts of Farsta borough, the population aspect is also included in this assessment. This EIS describes the social conditions as they are today in Fagersjö and what possible impact the development in Magelungens strand might have on the population there. It also considers what effects making changes to this area could have on people's mental well-being, and how different manifestations of nature could affect future inhabitants of the development.

2.4 Thresholds for Significant Environmental Impacts

To be able to describe the implications on the environmental aspects terms like effect and impact are used. In common language these may be synonyms but within this project they have set definitions:

Effect: is the physical change in the environment

Impact: is the consequences that the physical change leads to.

A five stage scale is used to classify the environmental impacts, the names and general definitions are explained in the table

below (see **Table 1**). The impact scale takes only the size of the impact into consideration. For some of the environmental aspects clear regulation and guidelines are defined, these can be found under chapter 3. Methods.

Predictions should always include an estimate of probability (Glasson, Therivel, & Chadwick, 2005). The probabilities assessed in this document represent the authors' views. Thereby they can never be objective. Due to several factors, these assessments must not to be mistaken as an exact prediction but rather indicate a rough estimate of certainty (UK Ministry of Defense, 2010). The used expression list (see **Table 2**) is a slightly modified version of the one in the Strategic Trends Program (UK Ministry of Defense, 2010). The listed expressions are used in italics throughout this document.

TABLE 1. FIVE STAGE SCALE TO ASSESS IMPACT.

Major positive impact	*Major positive impact on national, regional or municipal interests and objects. Alternatively improvement of currently exceeded environmental quality standards, national guidelines or environmental thresholds.*
Minor positive impact	*A positive impact that does not constitute a Major positive impact.*
No impact	*No notable impact*
Minor negative impact	*A negative impact that does not constitute a Major negative impact.*
Major negative impact	*Major negative impact on national, regional or municipal interests and objects. Alternatively exceeding environmental quality standards, national guidelines or environmental thresholds; or clearly worsen currently exceeded environmental quality standards, national guidelines or environmental thresholds.*

TABLE 2. LIST OF EXPRESSIONS USED TO DESCRIBE PROBABILITY (UK MINISTRY OF DEFENSE, 2010).

Assessment of Probability	
Description	Associated Probability Range
Will	Greater than 90%
Likely	Between 60% and 90 %
May	Between 10 % and 60 %
Unlikely	Less than 10 %

2.5 Swedish Environmental Quality Objectives

If housing is added to Magelungens strand this will have implications on the following of the Swedish Environmental Quality Objectives (the EQOs) (for information on the EQOs see Naturvårdsverket, 2016).

2.5.1 Sustainable Forests

Building residential housing in Magelungens strand may decrease the forested area by up to 50 percent, thus posing a risk to biodiversity. Biodiversity is referred to in both the objectives Sustainables Forests and Rich Diversity which is described below. Concurrently this objective also strives to achieve better access to forest areas, something that would be achieved if exploitation occurs.

2.5.2 Rich Diversity

On top of the risk of decreasing a forested area, Magelungens strand is also identified as an Ecologically Particularly Important Area (ESBO) (Miljöförvaltningen, 2014). This means that this area is especially important to the maintenance of biodiversity within the Municipality of Stockholm. Another possible negative impact on biodiversity due to exploitation would be a decrease in connectivity in one of Stockholm's green wedges, resulting in habitat fragmentation.

2.5.3 Flourishing Lakes and Streams, and Zero Eutrophication

These two objectives could potentially be affected by the planned development in Magelungens strand as the project area is located within the watershed of Lake Magelungen. Added traffic will increase local pollution and phosphorous in this area, and ground surfaces being made hard, will in turn lessen the infiltration capacity of the area, in turn risking that comparatively more unfiltered stormwater flows into the lake. This will especially be an issue during the construction phase, as there may be an increase in pollutants from heavy machinery used, and exposed soil may result in an increase in erosion of nutrients.

2.5.4 Clean Air

A decrease in forested area will limit the local air purification ability, and an increase in traffic due to the new inhabitants will also add to air pollution. It must be noted that the pollution levels today are well below quality standards (see chapter on Air Pollution). It is also likely that there will be a temporary spike in air pollution during the construction phase from the building process.

2.5.5 Conclusion

Apart from increasing accessibility to nature our conclusion is that building in Magelungens strand interfere with the Swedish Environmental Quality Objectives.

2.6 Shore Protection

Parts of the planned housing area, in the project at hand, are located in shore protection zone. The general area of shore protection includes land and water area within 100 meters from the shoreline at normal water level (MB chapter 7§14). In shore protection areas it is not allowed to take certain actions such as building and digging. It is however possible, under certain specific circumstances, to repeal shore protection and build in a protected area. One example of a specific reason could be that the area is needed to satisfy a public or other very important interest that cannot be met elsewhere. Another is if the area is inaccessible to public use, and the aim is to improve accessibility. If a new building or a new type of building is to be built in an area exempted from shore protection, the shore protection is reinstated, and a new exemption must be made. In most cases, it is the municipality who examines and decides on the approval of the dispensation and the suspension of shore protection. The suspension should not affect the purpose of shore protection adversely. The municipal decision can be appealed to the Land and Environmental Court of Appeal (Naturvårdsverket & Boverket, 2010).

The shore protection is exempted as of today, but will be reinstated with the planning process when the detail plan is finished. This means that there is a need for exemption of the shore protection in order to build as planned (Stadsbyggnadskontoret, 2016). According to the City Planning Office (2016), the specific reason for applying for exemption in Magelungens strand is the need for satisfying another very important interest; connecting the isolated neighborhood of

Fagersjö to Farsta. In this specific case, the municipality of Stockholm will make a decision considering which interest is more important, that is; connecting the two areas or protecting the shoreline. Regarding the probability that an exemption would stand if appealed, there has been one very similar case in Stockholm in recent time. In the detail plan of Arenastaden new dwellings were planned to be built in the shore protection zone surrounding the lake Råstasjön. The intended reason for repealing the protection was to satisfy a public interest (housing in an attractive setting) that could not be met elsewhere and also that parts of the shore protection zone had already been engaged by other activities (Svea hovrätt, 2016). The process was appealed in Land and Environmental Court of Appeal and overruled, as the specific reasons for the suspension were not deemed adequate. The shore protection zone was assessed not being engaged by other activities significantly enough and, the municipality had not adequately studied the possibility of satisfying the need of building in some other area, according to the Land and Environmental Court of Appeal (Svea hovrätt, 2016). However, the planning process for the building project in Magelungens strand is still ongoing and the extent to which the shore protection will need to be suspended will depend on the final construction plan, which in turn can affect the court's final decision.

2.7 Developmental Goals in Farsta

This section is based on two developmental programs, *Program för tyngdpunkt Farsta* and *Program för sambandet Högdalen-Farsta*, where the plan area of Magelungens strand is included. The district of Farsta has made a strategy of building 8000 new dwellings in the region with the aim of contributing to the municipality's demand of new housing (Stadsbyggnadskontoret, 2016). Between the programs there are a few goals for Farsta's development that correlate: the developing and building of new areas should contribute to reduced environmental impact by using sustainable technical solutions and promoting the ecosystem services. The natural environment should be protected. Building in wide natural environments should be avoided and the connection of green areas should be strengthened to support the distribution of species. Especially shoreline zones with high natural values should be left undisturbed by leaving distribution corridors along the shoreline.

In the programs a suggested mitigation to building in green corridor zones is to build green roofs or using favorable garden design (Stadsbyggnadskontoret, 2016). The functions in ecologically particularly important areas should as far as possible be developed and protected, by complementing with new vegetation, for instance. Old trees are said to be prioritized, especially old oaks and pine trees.

3. Methods

3.1 Structured Street Interviews

To get a better grasp on the local opinions of the plans, we performed short structured interviews. Three persons were positioned in Fagersjö at the south entrance road, around the grocery shop, pizzeria and bus station and three persons walked around the mall at Farsta Centrum. We asked all people passing by, and had a prepared interview form in both English and Swedish (see appendix). The structured interviews were performed between 17.00 and 19.00 on the fifth of December 2016, the time frame was chosen to ensure that there would a mix of participants.

We briefly explained the possible benefits that could come from the project as they are described in the promemoria, and the

natural values in the area that could get affected by the development. We used maps from the promemoria to show the participants the location of the site and the placement of the planned buildings. At a later stage we have found out that the placement of the buildings has changed somewhat from the plan in the promemoria. Using the new maps might have affected the result, but since the majority of people interviewed were positive to the plans as they are put forward in the promemoria, we deem the possible effect to likely be insignificant to the results.

3.2 Oak Data

To better evaluate effects on connectivity and stands of especially ecological important oaks (*Quercus robur*), individual oak trees were positioned in field using smartphones with a Pdf-Maps application (Avenza Systems inc, 1.7.3 Build 31). The values of ecological importance that were recorded were: the circumference measured at 150 centimeter height, crown form, presence of hollows and threats (see Appendix 1). Threats identified were the presence of buildings, roads or ant hills within ten meters, notable wear from humans and need for management reducing overgrowth. These ecological values are a sub-selection of ecological values recorded by Ekologigruppen AB for Stockholm Municipality (Nilsson, 2007). These values were later quantified using a reduced classification system (based on Nilsson, 2007). Since fewer variables were recorded than in the frameworks full classification, the classification accuracy is reduced. An oak classified as III in this study could be classified as II, and an oak classified as II could be classified as either III or I according to a full evaluation. The data was collected at Magelungens strand on the fifth of December 2016. Only oaks with a circumference greater than 40 cm in diameter were recorded. This was to reduce data collection time and was based on field observations of oaks. The positioning error was up to ten meters.

To evaluate connectivity between oaks, we performed a simple buffer analysis. Buffer distance was based on the hermit beetle (Lat. *Osmoderma eremita*, Swe. *Läderbagge*). Distances of 250 and 500 meters were used, as 500 meters has been described as a threshold distance for the species (Svensson et al. 2011).

3.5 Telephone and Personal Interviews

Semi-structured interviews have been done over the phone to clarify information that we have not been able to receive through literature studies with: M. Sjöberg is responsible for the Magelungens strand project at the Stockholm Exploitations Office was asked general questions concerning the project. M. Pehrsson is the person at the Environmental Office tasked with supervising the project and was asked questions concerning their opinions on the project and what mitigations are important to ensure that natural values are kept. H. Virgin works with lake quality at the Stockholm Environmental Office and was asked about the state of Lake Magelungen today, how the development might impact the lake in the future and what mitigation she thought were necessary. A. Mölgård coordinates housing for newly arrived persons in the Stockholm area at the Stockholm Executive Office and was asked questions on the nature of the refugee housing currently situated in the area and what could be expected to happen to the housing and the people that reside there should the area get developed. A. Averstedt who at the moment of writing is responsible for schooling in Farsta District Administration was also contacted and asked questions regarding the schooling situation in Farsta today and the plans for the future.

The people listed above have been found through the different channels of the Stockholm Council Administration, either as they were listed online the contact person in their field or because they were suggested as a person to contact by other people within their administrations.

On the seventh of December 2016 representatives of the Town Building Office, the Exploitations Office and Farsta District Administration were present in central Farsta to inform locals of the new suggested Comprehensive Plan for Stockholm. A member of our group attended this event and used semi-structured interviews to gather information. The material from this event represented in this Environmental Impact Statement came from communications with L. Klingwall from the City Building Office and J. Ekholm and C. Rivard from the City District Administration.

During the work on an Environmental Impact Assessment parties that could be affected by the development should be contacted and be allowed give their opinions. To achieve this the association 'Ett förenat Fagersjö' have been contacted through email, but they have not responded. Attempts have also been made to get an interview with the people living and working at the company Din Hemtjänst on Nykroppagatan 51, but they have explained that they cannot find the time to take part.

We did manage to do an interview in person with A. Ericsson, Administrative Supporter, and N. Widell, Unit Manager, of the psychiatric clinic Psykiatriska slutenvården Ytterö (Nykroppagatan 35) on the 21st of December 2016. The aim of the interview was to see how a future housing development might affect their operation and what mitigations they would like to see in place to milder these effects.

3.6 Literature Studies

To assess the possible impacts on Magelungens strand due to the different alternatives we have read through planning, legal and scientific documents on the various aspects that the project touches on.

3.7 Mapping

Maps were used throughout the report to assess and visualize impacts on the plan area, especially for aspects on noise and air pollution, cultural heritage, ecology and water. We created the maps using Arcmap 10.4.4 (ESRI 2011). We used orthophotos and data from Lantmäteriets geodatasamverkan, Swedish National Heritage Board Relic Information System and Stockholm Municipality Environmental Administration.

4. Description of the Area

Magelungens strand is located in Farsta, in the south of Stockholm municipality. More precisely, the area is situated on the northern shore of Lake Magelungen between Fagersjö and Farsta sport area. In the north part, the area is separated from Fagersjö forest by the road Magelungsvägen and Nynäsbanan. There is variation in topography with the highest parts being found near Magelungsvägen and from there the ground slopes downhill towards the lake. The higher land areas are dominated by exposed bedrock with a few shallow sandy, silty moraine soil features (SGU, 2016; Johansson et al., 2013). The soil of the lower land areas consists of postglacial clay. The plan area is covered mostly by broad-leaved trees together with lower vegetation.

There is one road in the plan area, Fågelviksbacken, which runs through the area from Farsta to Fagersjö. Magelungens strand is part of the Farsta district which is a borough with tower blocks dominating the landscape and acting as points of reference (Stadsbyggnadskontoret, 2016). Farsta district consists of higher multiple family houses in the central core and slightly lower multiple family houses in outer areas. The future urban development in Magelungens strand would not follow the

original general plan for Farsta and would act as a connecting part of the district.

5. Alternatives

5.1 Boundaries for Alternatives

There are some different reasonable options of the planned development proposing alternative location, scale and site layout of the plan. One of the main stated purposes of building in the area is to create a more continuous cityscape, connecting Fagersjö with Farsta Centrum. The proposed exploitation alternative is therefore created and evaluated based on this. In addition, it is also important that the alternatives contribute significantly to the Stockholm's municipalities goal of reaching 40 000 dwellings by 2020 (Stadsbyggnadskontoret, 2016). This means that any alternative containing housing should attempt to generate a similar amount of dwellings compared to the original plan. This implies that approximately the same amount of land is used or that taller buildings are planned. The "zero-alternative" and "zero plus -alternative" are also important alternatives as these show how the natural area can be expected to develop if, as today, left to natural development or if a green management is set up for the area. In total, including zero-alternatives, there are four alternatives considered within this EIA.

In the early work with this Environmental Impact Assessment the alternative of building in southern part of Fagersjöskogen was also considered. But after conversations with people working within Farsta borough and working with the regional plan for Stockholm, we came to the conclusion that this alternative would not be able to meet the intended effects of the project. There was no local political support for making changes in this area, the current politicians have even attempted to make the area into a nature reserve (Rivard, 2016, personal communication, 8 December). Additionally, it had been estimated that the cost of building here would be so high that the project would need to be vastly scaled up to be profitable thereby possibly compromising natural areas further than in either of our other alternatives (Klingwall, 2016, personal communication, 8 December).

5.2 Zero Alternative

The Zero Alternative is the "no action" option which means that the development plan for the area will not be implemented. This alternative will be used to illustrate how the area will develop if Magelungens strand is simply left to natural development.

5.3 Zero Plus Alternative - Enhance Natural Values

The Zero Plus Alternative means not implementing the planned development but still implementing a management plan. The plan should improve and maintain the natural, cultural and recreational values already identified at the site, such as the oaks, walkways and the function as a green wedge. Oaks are valuable both from a local and national perspective and the management of oaks is very important (Nilsson, 2007). The greatest threat today to oaks in the area is overgrowth and lack of maintenance. In Sweden at these latitudes, oaks must be managed in order to rejuvenate (Drakenberg, 2007; Sjörs, 1971). Half of the Stockholm oak population is heavily shaded and in a bad condition, requiring light and a more intense management. Today, the green areas in the plan area are managed extensively in form of clearing the vegetation (Exploateringskontoret, 2007). The Development Administration has suggested an implementation of a sign programme to make the walkway clearer in the plan area, that will be included in the management plan (Exploateringskontoret, 2007). This alternative includes establishment of a noise barrier to improve the recreational value of the area, as the noise level of the whole area already

exceeds thresholds for recreational areas. The road in conjunction with the railway also acts a barrier for people and ground-bound animals (Pehrson, 2016, personal communication, 9 December). Today ground bound animals must pass fences and sudden drops or utilize a bridge close to Farsta sports area or a rail crossing in western Fagersjö. To increase connectivity, this alternative also includes building of an ecoduct and a frog tunnel, similar to the ecoduct constructed in Hammarby Sjöstad. It will connect Magelungens strand for Fagersjö forest with a lush environment and will also contain a walk and bicycle-lane. The purpose is to increase ground-bound connectivity for animals and humans between the areas.

5.4 Alternative One - The Proposed Plan

The municipality's proposed plan for developing and building the plan area is hereafter referred to as Alternative One (see **Figure 1**). It is based on the start promemoria published by the Stockholm City Planning Office on the 22nd of February 2016 (Stadsbyggnadskontoret, 2016). The plan is to build 750 to 1000 new dwellings together with services such as shops and restaurants along Magelungsvägen in Magelungens strand. This assessment is performed under the assumption that the proportion of rental and condominiums is 40 percent rental and 60 percent condominium apartments, as is stated in the start promemoria and confirmed as a reasonable estimate by M. Sjöberg at the Exploitations Office (2016, personal communication, 14 December). Parts of the housing is planned to be situated in shore protection area, which would lead to a need for suspending the shore protection. Magelungsvägen is planned to be turned into an urban street with a bike path, a few bus stops and services. The road crossing through the plan area, Fågelviksbacken, is planned to become more of a street for pedestrians. A pedestrian and cycle bridge is planned to be built above the railway next to the plan area, to increase public access to Fagersjö forest. A part of the shoreline in western parts of the project area is planned to be made more accessible by building pathways going out onto the water, other areas are planned to be left inaccessible to protect the bird life. The forest between the planned buildings and the lake is to be thinned out to increase view towards Magelungen and to enhance the oak habitat (Sjöberg, 2016, personal communication, 13 December).

5.5 Alternative Two - Shoreline and Oak Consideration

Alternative Two is based on Alternative One, with aims to build new dwellings but with greater consideration of the shoreline protection zone, aims of maintaining good connectivity for oaks and increasing connectivity for ground-moving animals. This alternative suggests not building housing nor walkways within the shoreline protection zone, but rather in between where the protection zone stretches up towards Magelungsvägen (see **Figure 2**). These stretches often coincide with many valuable oak areas and the connectivity northward could be strengthened by adding ecoducts and frog tunnels. The area east of the psychiatric clinic is dominated by low environmental qualities and a road connecting traffic between Magelungsvägen and Farsta. The design of this alternative would consist of 3 high-rises with 250 apartments each in the eastern area, and remaining housing would constitute about a third to a quarter of those planned in Alternative one. Total number of dwellings would be 950 to 1100. The stretch from east to west will be built with walking streets and residential houses with bottom floor services parallel to Magelungsvägen, outside the zone of the shoreline protection.

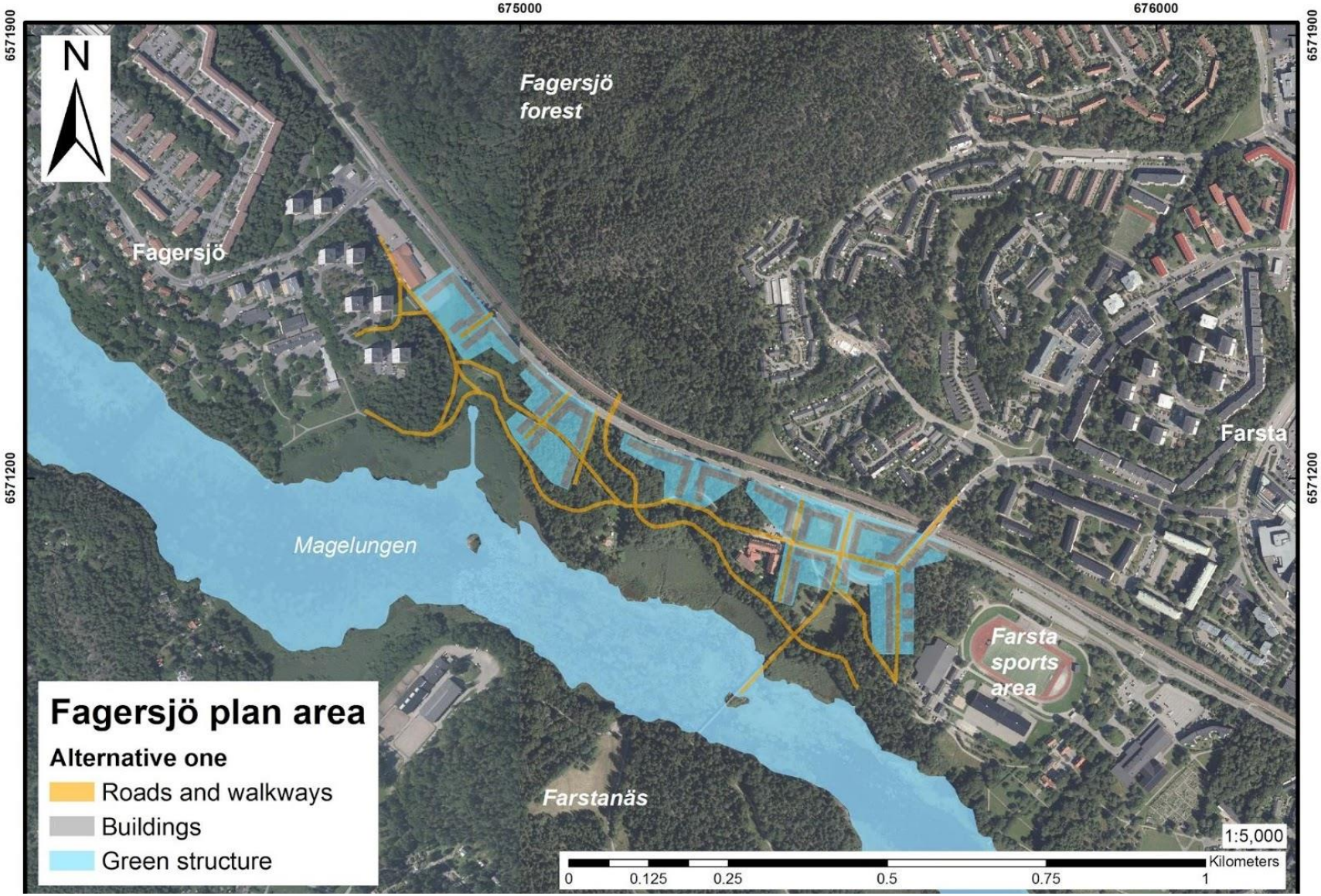


FIGURE 2. MAP SHOWING PLANNED CONSTRUCTION FOR ALTERNATIVE ONE.

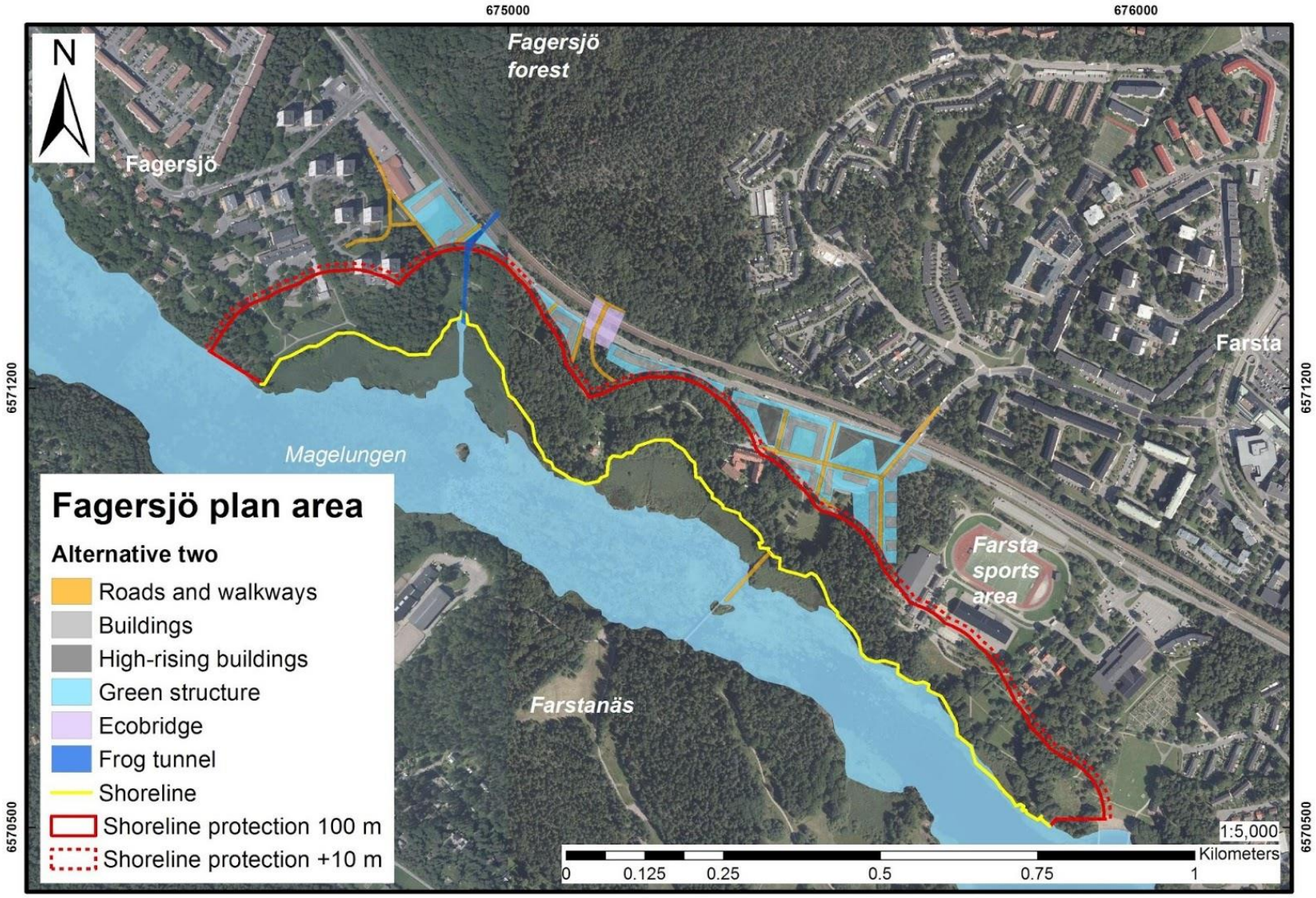


FIGURE 3. MAP SHOWING POSSIBLE PLACEMENT OF BUILDINGS IN PROPOSED ALTERNATIVE TWO

6. Environmental Baseline, Impact Assessment and Mitigation Measures

The following chapter holds impact assessments for each aspect in the area. Each aspect is separately analyzed starting with a general description, followed by a statement of baseline conditions and ended with prediction of impacts and possible mitigations measures. The baseline conditions act as reference against which the magnitude and significance of identified impacts is evaluated.

6.1 Landscape Scene

According to the European landscape convention the landscape is "an area as perceived by people and which characteristics is a result of impacts and interactions of natural and/or anthropogenic factors" (RAA, 2012, p.3). The way in which the landscape is perceived differs among people and it depends on our personalities and backgrounds (op.cit.). The experience of the landscape scene is also affected by common values and norms which govern our perception of things as beautiful, awful, messy or well-arranged. These norms and values can change over time. The impact on the landscape scene is described and discussed in this chapter; the current characteristics of the landscape and the visual impact the different alternatives will have on it.

6.1.1 Baseline of the Landscape Scene

The hilly landscape of Magelungens strand is mainly covered by overgrown broadleaved forest with upcoming lower vegetation. Some parts of the forest are oak dominated. There are differences in topography with the highest parts being located along Magelungsvägen and from the the ground slopes downhill towards the shoreline. The water area by the shoreline is abundant in vegetation such as reedbeds and other kinds of aquatic plants.

There are only a three sets of buildings within the project area; a private house by the shoreline located centrally within the plan area; in the south eastern part there is a psychiatric care clinic with a large parking lot and nearby a tennis court; and on the border to Fagersjö there is two sets of portable housing for newly arrived persons.

The landscape of the plan area can be seen from the opposing (southern) shore of Magelungen, from tower-housing in Fagersjö, from Magelungsvägen and high altitude areas in Fagersjö forest and north of the railroad tracks.

6.1.2 Zero Alternative - Impacts

Physical characteristics of the area will remain, regarding soil types and topography, even if no action is taken. The main impact will apply to the forest which is dominated by broad-leaved deciduous trees today. If there will not be any action taken on the forest, there is a risk that conifer trees outcompete the broad-leaved trees such as oaks over a longer time period than the assessed one (Drakenberg, 2007, Sjörs, 1971). Therefore, it is *likely* that there will be no notable impact on the landscape scenery within in the 20-year period, but in a longer time perspective the impact is *likely* to be notable since the characteristics of the forest will change.

The Zero Alternative can also entail a change in the landscape scene regarding the lake. The Lake Magelungen is considered to be eutrophic and is likely to remain eutrophic if no is action taken in order to improve the water quality (Virgin, 2016, personal communication, 9 December). The eutrophication will be visible in form of vegetation in the lake such as overgrown reed beds. In a longer time perspective (50 years and beyond) the zero alternative can entail upholding of sediment and transformation from open water into a wetland (Skoog, 2000). The impact on the water environment aspect is described and analyzed more in detail in the Water environment section. This in turn is *likely* to have a minor negative impact on the visual qualities of the area.

6.1.2.1 Conclusion

Overall the physical characteristics of the area is estimated to remain somewhat similar in a 20-year-period. Based on this, the conclusion is that the Zero Alternative is *likely* to result in no notable impact.

6.1.3 Zero Plus Alternative - Impacts

The Zero Plus Alternative *will* have a minor positive impact on the landscapes physical characteristics. Most of the plan area will still be covered by trees and other lower vegetation, even though the forest will be thinned to create a better habitat for the oaks. Thinning the forest could have an impact on how the landscape is seen and experienced; whether it will still be considered as a natural forest or seen as more of an urban forest. Ulrich (1986) made a review on studies of what make the liking or preference of unspectacular scenes comparatively high and came up with six characteristics:

1. Complexity
2. An order or pattern is present
3. There is a moderate to high order of depth to the view
4. The surface is even textured and looks favorable to movement
5. A deflected or curving sightline is present
6. Judged threats are negligible or absent

He also claims that seeing water will further heighten the preference. Looking at this list it is identifiable that a thinning of the trees could actually help achieve fulfillment of all these characteristics. It is therefore *likely* that the Alternative Zero Plus could result in a minor positive impact on the perception of the landscape. The only reason that this change is not classified as a major positive impact is that it does not relate to national, regional or municipal interests and objects.

When viewed from the northern side of Magelungsvägen there will be a *likely* minor negative impact on the landscape scene because of the establishment of the noise barrier along Magelungsvägen, although the extent of this impact depends on the design and scale of the noise barrier. It is *unlikely* that there will be any notable visual impacts from the noise barrier when one is standing on Fågelviksbacken. It is also *unlikely* that there will be any notable impact on the landscape scenery when viewed from the southern shore.

6.1.3.1 Conclusion

Overall the improved maintenance of the natural values *will* have a positive impact on the landscape scene, even though the positive impact is reduced by the establishment of the noise barrier. Based on this, the conclusion is that the Zero Plus Alternative *will* result in a minor positive impact on the landscape scene.

6.1.4 Alternative One - Impacts

6.1.4.1 Impacts During Construction Phase

Seeing as people generally dislike temporary fixtures of human origin in natural settings, items such as building cranes, industrial looking fences, unfinished buildings, builders' barracks and so on are highly *likely* to not be appreciated (Ulrich, 1986). There *will* be major negative impacts on the landscape scene during the construction phase because of needed clearing of vegetation and the presence of heavy building machines. Although, the estimated timeframe for the construction phase is two to five years so the impacts on the landscape from the construction is a temporary issue.

6.1.4.2 Impacts During Operational Phase

The impact of the operational phase will be significant and long-term since the physical characteristics of the landscape will change remarkably. Implementing the planned project will result in a reduction of the forest area, but at the same time the loss of natural green areas will be compensated by creating urban green areas (Stadsbyggnadskontoret, 2016). As a compensation for the loss of green surfaces, Stadsbyggnadskontoret has suggested making the shore and park environment more accessible and to create a promenade along the shoreline (Exploateringskontoret, 2016; Exploateringskontoret, 2016b). Another suggestion is to plant one new tree per apartment. How this compensation will eventually be realized is not fully clear though, which makes the exact impact on the landscape scene uncertain. It can be discussed that perhaps replacing older trees with younger ones is not a mitigation that will fully compensate for the lost values. According to research, people especially appreciate old, wide crowned trees (Ulrich, 1986). Within the timeframe of this EIS newly planted trees will not have had time to grow large enough to compensate these losses, thus it is possible to assume that this *will* result in a minor negative impact.

In its operational state the plan area is likely to be characterized by new buildings in different heights with green areas in between, therefore the view towards the planned area from the surrounding areas will be affected significantly. Judging from our interviews with the public that were done in Farsta Centrum and in Fagersjö on the fifth of December 2016 this can be perceived both positively and negatively.

A review of studies of human responses to vegetation and landscape came to the conclusion that adults in North America and Europe tend to prefer natural landscape scenes over urban views, even unspectacular or mediocre natural views (Ulrich, 1986). Although when considering this it is worth to also consider Wohlwill's findings that the like of natural elements, or dislike of man-made ones, could be more reliant on the compatibility between the elements and their surroundings (Wohlwill, 1979; Wohlwill and Harris, 1980 see Ulrich, 1986). Issues listed are properties such as; a large element size, low congruity of shape and high color contrast. By considering these issues, it is thus possible to mitigate some of the negative sentiments that might arise from adding buildings to the planned area. Although avoiding a large element size might be hard to achieve.

Looking at Ulrich's list of preferable characteristics outlined above in the Zero Plus Alternative there is a possibility that many of these qualities could still remain in the area, especially for the people moving into the area. Therefore, it is *likely* that there will be minor positive impacts for these individuals.

Out of the people we spoke to during our interviews in Farsta some were more attracted to well-managed and well-arranged urban areas while others prioritized what they viewed as natural, untouched green areas (interviews, 5 Dec 2016). These kinds of preferences need not be absolute though. Rabinowitz and Coughlin (1980) have shown that even though people report

preferring natural landscapes to treated landscapes, they are more likely to enjoy a managed, savanna-like, scenery to a natural one, if not beforehand informed of whether the landscape is manmade or not. But this does not change the fact that people remembering what the planned area looked like before development, might still experience the changes as negative.

It is also important to remember that Magelungens strand today is not natural area, such as an old growth forest, it is rather a product of land usage. The wide branched oaks are signs that the area was once quite likely used for grazing, but has been left to free development for some time. To create an environment more suitable for the oaks, and to ensure a view from the buildings, thinning of the trees has been proposed (Sjöberg, 2016, personal communication, 9 December). This will create a more open landscape within the planned area, compared to the present conditions with overgrowing forest and limited accessibility for pedestrians.

The impact on the landscape will not simply affect the planned area. The establishment of the new housing in Magelungens strand may affect the entire district of Farsta as well, since the purpose is to connect Farsta to Fagersjö and thereby to the rest of Stockholm. Building housing in the plan area can be seen as an expansion of the urban development of Farsta which increases the physical connectivity of the district. The urban landscape scene of Farsta may therefore be changed from a more distinct borough to a more connected denser city. The addition of higher houses outside the center of Farsta might risk to compete with the already existing higher houses in the borough (Stadsbyggnadskontoret, 2016b). However, according to the statement by C. Rivard working at the Farsta District Administration at least the current local politicians welcome tall rises (2016, personal communication, 7 December). Even though the area is supposed to stand separately from Farsta, it will be close enough to affect the landscape scene of the borough. In addition, development around the lake as a part of turning Farsta towards the lakes will change the urban landscape and might initiate additional development and business at the northern shore of Magelungen.

6.1.4.3 Conclusion

Overall the landscape scene in Magelungens strand will change notably. The green area and natural values will be reduced when the area is planned to be turned into an urban living area combining nature and people. Based on this the notion that people prefer natural looking landscapes to human made ones we conclude that it is *likely* that Alternative One *will* result in a minor negative impact.

6.1.5 Alternative Two - Impacts

6.1.5.1 Impacts During Construction Phase

The impacts on the landscape scenery from Alternative Two will still be very similar to Alternative One but in a somewhat smaller spatial scale than the impacts of Alternative One. The type of impacts is similar to the construction phase in Alternative One, including reducing the green area and disturbance from the construction. The negative impacts will mostly concern the area along the road Magelungsvägen even though it also may have an impact on how the entire plan area is experienced during the construction.

6.1.5.2 Impacts During Operational Phase

Like in Alternative One there will be both positive and negative impacts on the landscape from Alternative Two, and these impacts can be considered both positive and negative. Alternative Two implies building in a smaller scale to avoid building intrusion in the shore protection area, this might lead to

the visual impacts from Fågelviksbacken being lesser than in Alternative One. Regardless the new buildings will still occupy current green areas and therefore have a notable impact on the landscape scene, but how the impact is seen can vary among people.

Regarding the view from surrounding areas, Alternative Two entails a similar impact on the view towards the plan area compared to Alternative One. The visual impact for people living in areas surrounding the plan area will depend on the height of the future buildings. Putting in the proper mitigations to assure that the tall rises in the plan area do not clash with surrounding nature areas will still be a challenge in this area.

6.1.5.3 Conclusion

Overall the impact on the landscape scene will be similar to Alternative One when building new housing along Magelungsvägen. Therefore, the conclusion is that also Alternative Two is *likely* to result in minor negative impact on the landscape scene.

6.2 Cultural Heritage

In this chapter we will discuss the direct impacts on cultural heritage, relics and ancient monuments in the area and the accessibility to them.

6.2.1 Environmental Baseline

Generally, ancient monuments have a strong legal protection, and for exploitations that will infringe on the protection zones of the monuments, permit has to be given from the County Administrative Board (Stadsbyggnadskontoret, 2016). The City Museum of Stockholm has classified the southeastern part of the plan area as valuable cultural landscape. Further southeast, outside the plan area is Farsta Gård, residing there since at least 1384 (RAA, 2016). The planned project area has been used for agriculture and pasture until the late 20th century. Most parts of the area are 30 meters above sea levels which implies that this area has been above sea level since the Stone Age. The region has been inhabited since prehistoric time and there are some historical remains that may be affected by the development (Stadsbyggnadskontoret, 2016). The cultural heritage that is still present is in form of ancient (15th century and earlier) monuments, bunkers and settlements and 16th century bunkers and foundations. There are 8 types of cultural remains in the area. They are (listed from west to east, from first occurrence, see **Figure 3**): bunkers (1), petroglyphs (2) (see **Figure 4**), historic foundations (3) stone clearances (4), gravestone formations (5), settlement traces (6) and cairns (7).

6.2.2 Zero Alternative - Impacts

In the Zero Alternative there may be some minor negative impacts in the long run. Cultural remains *will* become overgrown and some *may* fall apart if not managed. However, no notable impacts are likely to be seen in 20 years. Regarding the experience value of the monuments, increased accessibility to the areas is important, which is currently relatively bad. In a period of 20 years, unmanaged natural areas will grow denser and the experience value of these monuments will be worsened because of decreased accessibility. In addition, the vegetational remnants of the agricultural landscape will disappear with the change of vegetation from oak to conifer-species and following extinction of meadow-species.

6.2.2.1 Conclusion

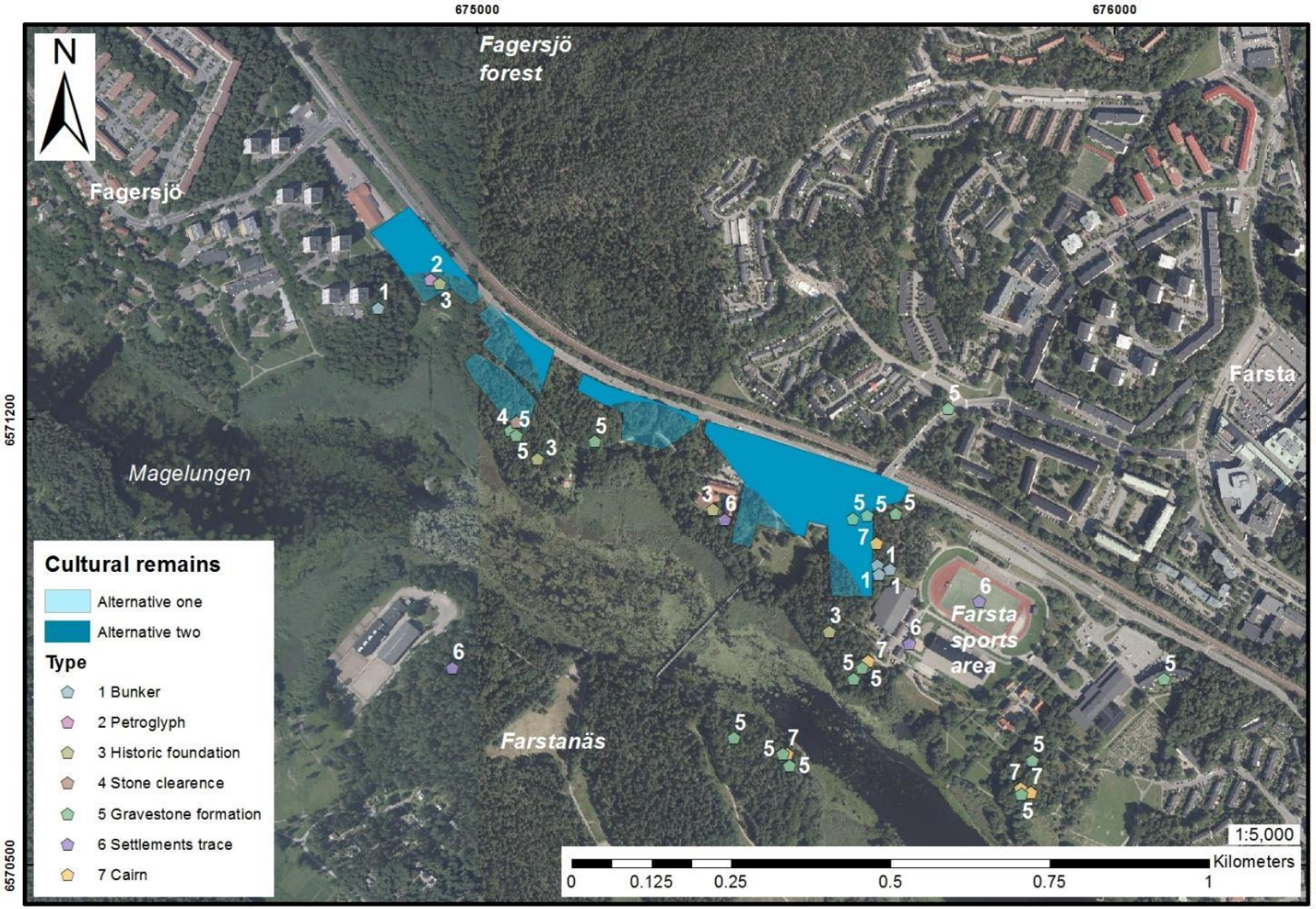
The accessibility to cultural monuments may decrease and cultural characteristics are likely to disappear. There *may* be a minor negative impact.

6.2.3 Zero Plus Alternative - Impacts

With increased management of oaks, a side effect will be a more open environment, with less vegetation. An oak-focused management would may result in more accessibility to the monuments, for people who are walking. As the oak forest is maintained and thinned, some meadow species might bloom, the cultural characteristics of the area *will* return and the experience value *will* increase. It might not be possible to return to a state of a previous agricultural landscape, but with reduced overgrowth the accessibility will increase and the established oak forest can be sustained better.

6.2.3.1 Conclusion

The accessibility may increase and cultural characteristics may return. There *may* be a minor positive impact.



GSD-Orthophoto, 0.25 m color. © Lantmäteriet (2009). Cultural heritage, shapefile. Swedish National Heritage Board Relic Information System (FMIS) (2016-12-01).

FIGURE 4. CULTURAL MONUMENTS IN THE PLANNING AREA WITH ALTERNATIVES ONE AND TWO

FIGURE 5. COLORED PETROGLYPHS (CUP MARKS) AT FLYHOW, VÄSTERGÖTLAND, SWEDEN. PHOTO BY GUNNAR CREUTZ.

6.2.4 Alternative One - Impacts

6.2.4.1 Impacts During Construction Phase

The methods used for construction are critical for whether an archeological excavation is needed or not. When constructing the houses much areas around them could be needed for example machinery, maneuvering and earthworks. In total, five monuments (including petroglyph, historic foundation, stone clearance and gravestone formations) are directly within and eight (further including bunker and cairn) are within ten meters of the planned building area (see **Figure 3**). The affected distance from a house wall can vary between building projects and it is unclear which objects actually will be affected. With great care, some of the stone formations could be preserved, perhaps moved and implemented into green structures of the area.

6.2.4.2 Impacts During Operational Phase

When the buildings are in place the accessibility to remaining monuments will probably increase, as the forest will be thinned out and new walkways will be constructed. They could be more frequently visited, both with increased accessibility but also with increased movement through the area from Fagersjö and new arrivals in Magelungens strand. Ancient monuments very close to the planned housing are at high risk of being damaged if not managed properly. To further increase knowledge and interest in these monuments, information signs could be put up, to draw attention and inform the public.

6.2.4.3 Conclusion

Overall the accessibility for pedestrians to the heritage sites will increase but the construction will cover and ruin some of the objects in the area. On these grounds the conclusion is that the impact is *likely* to have a minor negative impact.

6.2.5 Alternative Two - Impacts

6.2.5.1 Impacts During Construction Phase

Same circumstances apply for this alternative as for Alternative One. However, the amount of affected monuments is decreased, as the area for buildings is less. In total, two monuments (both gravestone formations) are directly within and four (further including bunker and cairn) are within ten meters of planned building area (see **Figure 4**). Also in this alternative, a mitigation measure could be to preserve stone formations, by moving and implementing them into green structures of the area.

6.2.5.2 Impacts During Operational Phase

Same circumstances apply as for Alternative One. However, since there will not be any new walkways constructed in the area, the accessibility to remaining monuments will not increase.

6.2.5.3 Conclusion

Some monuments will be affected, but there are many of the same type in the area. The accessibility may decrease, depending on management of the forest, that itself is a part of the cultural heritage. The conclusion is that there is *likely* to be a minor positive impact.

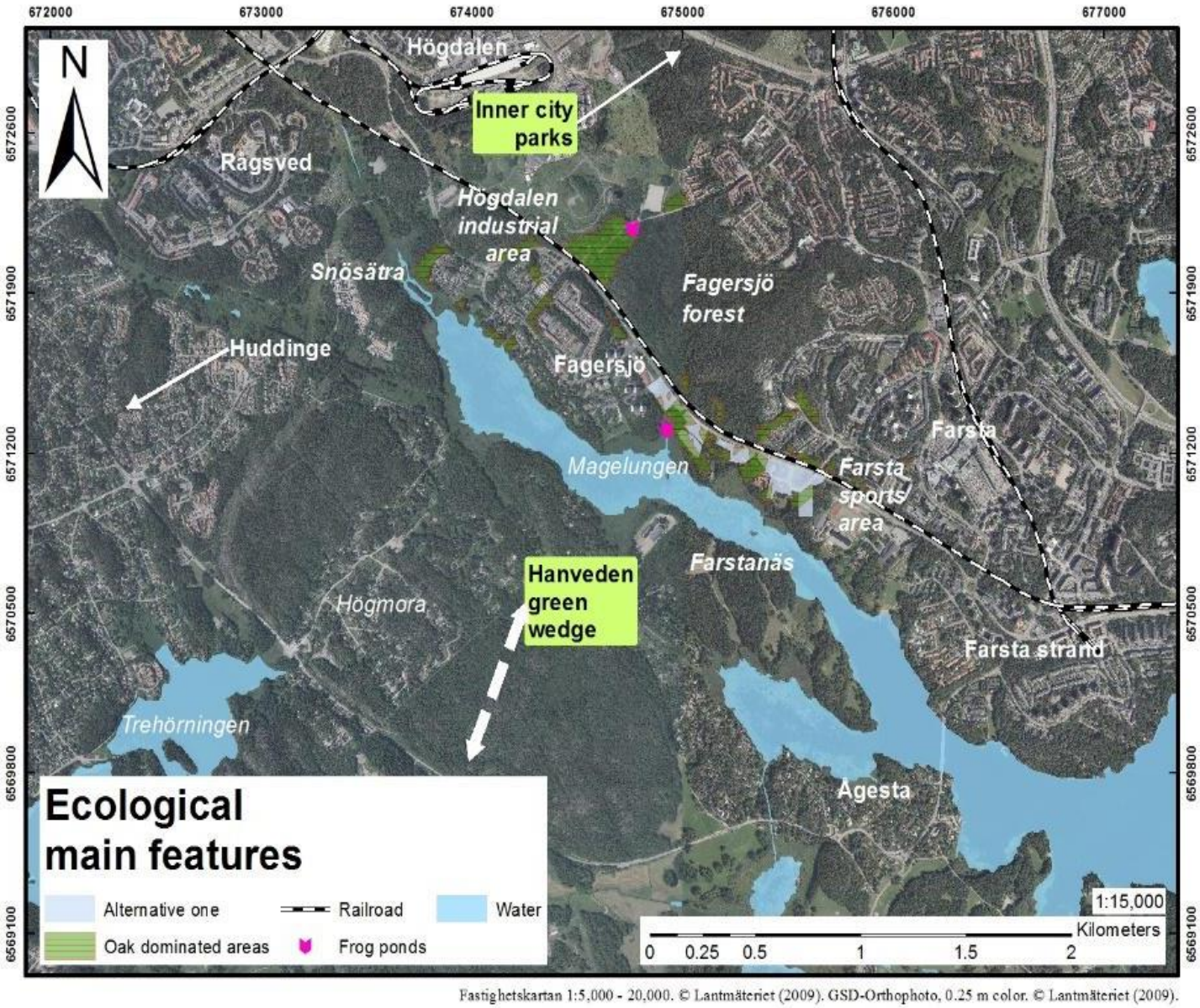
6.3 Ecology

This chapter will outline the impacts on the biodiversity, flora and fauna of the plan area. It also discusses what adding construction to the area might do for ecological connectivity.

6.3.1 Environmental Baseline

There is a broad biodiversity and many natural values for both flora and fauna in Magelungens strand (Exploateringskontoret, 2007; Pehrson, 2016, personal communication, 9 December). Most of the plan area is classified as an Ecologically Particularly Important Area (ESBO) (Miljöförvaltningen, 2014). These ESBO areas are considered to be very important to protect and strengthen biodiversity over time (Stadsbyggnadskontoret, 1995).

Parts of Magelungens strand are also important in a regional and national perspective (Stadsbyggnadskontoret, 2016b). Earlier district politicians have made a failed attempt to make the Fagersjö forest (see **Figure 6**) into a nature reserve because of existing natural and cultural values (Rivard, 2016, personal communication, 7 December).



Fastighetskartan 1:5,000 - 20,000. © Lantmäteriet (2009). GSD-Orthophoto, 0.25 m color. © Lantmäteriet (2009).

FIGURE 6. ECOLOGICAL MAIN FEATURES IN VICINITY OF FAGERSJÖ AND NORTH MAGELUNGEN

Shoreline
The shoreline is classified as ecologically particularly sensitive (ESKO). It is an unaffected shoreline which indicates a high biodiversity (Stadsbyggnadskontoret, 1995). According to the Swedish Environmental Code; "land and water areas that are particularly vulnerable from an ecological point of view shall, to the extent possible, be protected against measures that may damage the natural environment" (SFS 1998:808 Ch. 3 §3).

The shoreline zone of Magelungen is rich in bird life, including many species that nest in reedbeds. Sensitive and unaffected shorelines should be managed extensively. The shoreline also provides an ecosystem service in filtering stormwater runoff and trapping sediments from land. To function as a filter and significantly reduce the amount of nutrients ending up in the water, a well-developed vegetated protection zone of ten meters is needed (Stadsbyggnadskontoret, 1995). Even though the identification of ESBO and ESKO areas in Stockholms has been implemented some 20 years ago the classifications concerning Magelungens strand can still be seen as up-to-date as there has not been much development in the area since.

Oaks
Magelungens strand is dominated by oaks (*Quercus robur*) and other broad-leaved trees. It is one of the last remaining shoreline broad-leaved forests in Stockholm (Exploateringskontoret, 2007). This forest type is considered valuable and important for species diversity as it often harbors a rich flora and fauna (Stadsbyggnadskontoret, 1995). Since the area is facing south, it is expected to be valuable for biodiversity and as an oak environment (Nilsson, 2007). Old and well developed oaks with a stem circumference above 300 centimeters (about one meter in diameter) support rich biodiversity (Nilsson, 2007). In Magelungens strand there are four oaks today with this measure, and about as many upcoming candidates, measuring more than 280 centimeters. Today the area is unmanaged from an oak perspective, many oaks are overgrown or in the process of becoming so. Many oak-related species are dependent on flowering bushes (Nilsson, 2007). Based on field observation, these seems to be quite common in the area. Main oak forest areas are lining previous agricultural fields and meadows. It is therefore possible that the area has a reservoir of meadow species, residing in the oak forest or as slumbering seed banks.

Frogs
There are two artificially created frog ponds in the area. One frog pond is located along the shoreline and one directly north through Fagersjö forest, along Farstavägen by Hökarängens football field (see **Figure 6**). There are frog populations on both sides of the road Magelungsvägen (Pehrsson, 2016, personal communication, 9 December). The road does, however, act as a barrier between the populations, hindering connectivity (op. cit.).

Biodiversity
In Artportalen, a civil observational report database, there are no reported observations of red-listed species in the plan area or in Farstanäs, located south of the area, since 2010. There are however many observations of red-listed species reported north and west of Fagersjö by Snösätra and Högdalsberget, including three species of woodpeckers (*Picidae sp.*) and oak polypore (Ekticka/*Phellinus robustus*). Based solely on data from Artportalen, we can confirm that the area from Högmora through Snösätra to Högdalsberget seems to be ecologically important for some red-listed species. However, due to the nature of public

FIGURE 7. MACRO OF AN OAK STEM. PHOTO BY ANNE LOWE.

reported data, we cannot conclude that Magelungens strand is not important.

An inventory of bats was also made as a part of the environmental assessment done in the early planning stages of Magelungens strand (Pehrsson, 2016, personal communication, 9 December). This inventory concluded that there are bats in the area, and although all bats are protected under the EU Habitats Directive, the bats found here are not considered threatened in Sweden (op. cit).

Green wedges

Magelungens strand is a part of the Hanveden Wedge, which is one of the ten green wedges in Stockholm. Together the green wedges compose a star shaped, coherent green area with high natural values (TMR, 2012). They are important for the distribution of species, but also from a recreational and ecosystems perspective. Locally, green wedges provide ecosystem services by absorbing noise, filter air and by infiltrating stormwater. The wedges are located near and between urban areas, offering experience values that are not found in smaller, isolated green areas. Stockholms green wedges have many weak and sensitive connections acting as bottlenecks in the coherent green areas. Magelungens strand is classified as one of the weak connections in the Hanveden Wedge in the regional development plan for the Stockholm region (TMR, 2010). According to Stockholm County Board, weak connections should be treated carefully and strengthened, so that the function and value of the wedges remain (TMR 2012, 2010). Responsible developers in Stockholm should make an EIA concerning new establishments in green wedges, assessing impact for the entire wedge regarding changes in landscape over time (TMR, 2010). However, according to Stockholm's most recent comprehensive plan, there is no indication of weak connection marked in Magelungens strand (Stockholms stad, 2016a). It is instead classified as an area with certain possibilities for urban development. Looking at the immediate locations of oak forest habitats, Magelungens strand is a connector in a southwest-to-east direction, via park areas towards central Farsta and Farsta strand. Northwards the main connector consists of northern Fagersjö along Fagersjövägen, which is somewhat dislocated from Magelungens strand (see **Figure 6**).

Barriers and connectivity

Today there are ecological barriers in the area, mainly impeding ground bound movement. Magelungsvägen together with Nynäsbanan in the north and Lake Magelungen, south of the plan area, restricts animal ground bound movement to along the shoreline. Animals can cross these areas, although they have to move through railway fencing, enter unnatural (possibly perceived as hostile) environments and risk being killed by traffic. Lake Magelungen can be crossed by winter-active species

when ice has formed and by swimming and wading during the summer. These barriers primarily affect the distribution of amphibians, but they also restrict oaks, oak-dependent species and some bird species to some extent from moving between the plan area and Farstanäset and Fagersjö forest (Nilsson, 2007; Pehrsson, 2016, personal communication, 9 December). Two species are mainly responsible for spreading oak acorns, jays and squirrels (EOL 2016). Whilst jays are not necessarily impeded by these ecological barriers it is likely that squirrels are.

FIGURE 8. OAK FOREST. PHOTO BY ØYVIND HOLMSTAD

6.3.2 Zero Alternative - Impacts

The Zero Alternative implies continued usage and management as it is done today. The strategy in 2007 for managing the vegetation in Magelungens strand was to intensify management by the shoreline (Exploateringskontoret 2007). However, it is unclear if the management has been intensified, as many oaks are overgrown by other oaks and tree species. The future management in the rest of the plan area, that is the area between Magelungsvägen and Fågelviksbacken, is planned to remain extensive.

Shoreline

If management is continued as of today the shallow water, continued state of eutrophication and current establishment of reed beds indicates that the reeds will continue to increase coverage in Lake Magelungen. Birds will probably thrive in the reed environment as it will offer protection and a good access to insects hatching in water and in reeds. Within the 20-years-period sedimentation *may* build up and move the shoreline closer to the centre of the lake, creating more habitat for alder trees.

Oaks

In Sweden, oak seedlings need open environments to propagate and specially to develop high ecological values and esthetic values of thick stems, hedge-branched crowns and hollows from fall-off branches (Nilsson, 2007). Oak forests establish during open conditions and can mature even though open conditions ends, but cannot rejuvenate in confined conditions (Drakenberg, 2007; Sjörs 1971). As conditions are today oaks are not competitive against other tree-species in Sweden (op. cit.). Therefore, in order to keep established oaks, the environment need to be kept open, either by cutting, mowing or grazing (Nilsson 2007). Without any action, the oaks will be overgrown by competitive leaf- and conifer-species, such as beech and spruce, but the 20-years' timeframe set up for this EIS is not sufficient time for this to take place. Already today competition is visible in some parts of Magelungens strand, while in other parts the oak-dominance might suppress total transformation another 50 to 100 years (Drakenberg; 2007, Sjörs 1971; Eknert, 2016, personal communication 15 December).

*Frogs***.** As the frog pond already today is overgrown, there will be no additional effects on the frog population.

Biodiversity
Within the 20-years' timeframe no large scale effects can be expected, but increased shading could impede any residual meadow flowers and the fauna that depend on them. The present barrier effects which constrain the distribution of species are predicted to remain the same in the Zero Alternative. In a longer perspective a loss of oaks would lead to great losses of local biodiversity and the green wedge connectivity from Orlången to Högdalsberget would be hampered.

Green wedges, barriers and connectivity
The comparative value of Magelungens strand may increase as a result of exploitation in other areas in the Hanveden green wedge, for example the planned expansion of Rågsved southwards (Stadsbyggnadskontoret, 2011). As the area is transformed to a conifer forest in 50-100 years, the connectivity will be mainly for conifer-forest species. Connectivity for conifer trees will probably be good, as the pollen can spread by wind over barriers as lakes, roads and railway. There is also good establishment of conifer species in Fagersjö forest. Connectivity for remaining oaks and oak-related species in Farsta will be reduced, as connections will be reduced and restricted to oak pockets in Fagersjö forest, along the railway, to Fagersjö to the west and street-trees through Farsta northwards. Southwards they will be restricted to connect through Snösätra via Fagersjö. It will be worsened but, as long oak pockets remain in Fagersjö forest and are cared for, the connectivity may remain.

6.3.2.1 Conclusion
Overall, without any taken actions in the area, the ecological environment of the area will continue its natural development. Based on this, the conclusion is that the Zero Alternative is *likely* to result in no notable impact on the ecology within the 20-year timeframe.

6.3.3 Zero Plus Alternative - Impacts
*Shoreline***.** The water environment will be cared for so that the eutrophication is decreased. This will decrease nutrients for reed beds and in 20 years the reed domination may be somewhat decreased. The decrease of reed coverage will be slow to begin with, as nutrition for reeds will be reused from sediments and stored in roots. With decreased coverage of reeds, the sediment retention will be slowed in open areas. Along the shoreline, however, reeds may will still retain sediment and build on the shoreline, creating more habitable area for alder trees.

Oaks
One of the main characteristics of Magelungens strand is that the oak forest is so close to the lake. To refine existing natural ecological values in the area, the oaks and oak dependent species should be cared for through increased management in the area, with the aim of creating a good habitat for the oaks and oak related species. This can be accomplished by intensive management such as planting more flowering bushes, by thinning out the forest and by neglecting certain park care duties. Increasing the amount of certain bushes would increase the feed base for oak-dependent insects. Thinning out the trees, leaving a radius of five meters around larger oaks would increase the possibility for crown development of existing trees and rejuvenation. Holes from fall-off branches and fallen stems create certain habitats and increase natural values of the oaks and the area. Neglecting traditional park-duties such as removing near-to-fall branches and fallen stems and creating no-walk zones or putting up warning signs, *may* increase the natural values of oaks and the area. With this management the number of oaks would decrease, but the natural value of remaining oaks would increase, as base for the biodiversity get strengthened.

Frogs
As the frog pond is managed and cleared from reeds, it will become a better habitat for frogs. The frog tunnel will enable frogs to move to and from Fagersjö forest, enabling a higher genetic diversity.

Biodiversity
The valuable habitats for oak-related species will increase, as oaks can grow thicker and thrive in the thinned forest.

Green wedges, *barriers and connectivity*
The function of Magelungens strand as a part of the Hanveden green wedge will be secured and strengthened. The ecoduct from Magelungens strand to Fagersjö forest will increase connectivity for ground-moving animals such as amphibians, squirrels and wingless insects. It will also strengthen the connection between the two oak habitats and the frogtunnel will enable genetic exchanges between Magelungen strand and the wetlands in northern Fagersjö forest. It is also possible that this will enable further amphibian movement northwards through the green wedge towards Enskedefältet and Skogskyrkogården, depending on how the connections are in the northern parts of the Fagersjö forest.

6.3.3.1 Conclusion
Overall, the maintenance of the oaks and actions for improving the green connectivity and the lake water quality *will* contribute positively to the area's ecology. Based on this, the conclusion is that the Zero Alternative is *likely* to result in major positive impact on ecology.

6.3.4 Alternative One - Impacts

6.3.4.1 Impacts During Construction Phase
The scale of the impact during construction will be dependent on how much area is used for building barracks and machines. The building barracks will use approximately 500 sqm and one establishment can be used for several segments (Berglund, 2016, personal communication, 11 December). The need for machinery space is in turn dependent on machinery, building techniques and skills.

Shoreline
The shoreline will be affected by establishment of a walkway along the shoreline and through the reeds. The land walkway will in western parts go through wetland areas. This can have a negative impact on the movement of animals and is at risk of flooding. A possible mitigation measure would be to build an elevated walkway in wood. This would decrease impact on wetland species movement while also reducing risk of damage from flooding. By constructing it in wood it also be more aesthetically fitted to the environment and will not stand out as much. The shoreline will not be directly affected in any other way, but may be secondary or tertiary affected from changes in water environment. See the section Water Environment about this.

Oaks
During the building phase most trees within a certain radius of the planned buildings will need to be removed. This will decrease the habitable area for forest species. Additionally, some trees will be cut down to secure a maneuverable area. 140 of 279 oaks inventoried are today in areas that are intended to be built on (there is also an additional 188 oaks within a five meters' radius from the future buildings). There are 37 identified valuable oaks (class II) in the area today. Of these, 18 are in the

planned building areas. One of the four identified great oaks (more than 300 cm circumference) and two upcoming great oaks (more than 280 circumference) are situated in such a way that they risk being removed. About half (2.4 out of five hectares) of identified oak forest area in along Magelungens strand will be directly exploited and depending on where the different building machines and workers' modules will be placed, more trees might be affected. We recommend that the knowledge about valuable oaks is used when deciding which building techniques and what machinery is to be used in the area. We also recommend that identified valuable oaks are marked out in the field, so that they are not damaged by mistake during construction. Old oaks are important both from a local perspective and from a regional and national perspective so the reduction of oaks in the plan area will have a wider spatial impact.

Frogs
There will be no significant effects for frogs.

Biodiversity
According to the species-area relationship theory the number of species increase with habitable area (Arrhenius, 1921). As the plans greatly reduce habitable area we can expect a general reduction of biodiversity in the area (Stadsbyggnadskontoret, 1995). Additionally, there will be an increase in noise in the area from construction work and the construction of a wharf park will destroy bird habitats. This may disturb the fauna, such as nesting birds, force them to abandon the area completely or move within it.

Green wedges, barriers and connectivity
At three locations the planned buildings stretch far into shoreline protection, leaving just a thin strip of forested area between them and the water line. If the area is fenced off during construction, this will effectively impede connectivity eastwards during construction phase. Apart from this, the building phase per se will not affect the connectivity or the barriers in the area.

6.3.4.2 Impacts During Operational Phase

Shoreline
There will be a negative impact on the area's biodiversity and the ecological sensitivity. Since most of the plan area is classified as an Ecologically Particularly Important Area (ESBO) and the shoreline is classified as an Ecologically Particularly Sensitive Area (ESKO) the negative impact on the area's ecology can be estimated as significant. There are guidelines and goals for managing and protecting ecologically sensitive areas and exploiting this kind of areas should be avoided (Stadsbyggnadskontoret, 1995). The classification of ESKO in shore environments applies on land and water area within a minimum of five meters from the shoreline. The project plan includes building a wharf park by the shoreline in generous dimensions, with parts of it above elevated to easen be a bird watching (Exploateringskontoret, 2011). Building the wharf park will have a direct negative impact on the biodiversity due to loss of habitat, but also an indirect impact if the wharf park will attract more people that may disturb flora and fauna.

Oaks
Oaks will be thinned out to create a more open environment and to enhance the view towards Lake Magelungen (Sjöberg, 2016, personal communication). Increased use of the area through walking, running and playing in the area together with establishment of walkways will help to further thin out the oak forest. If this natural movement is restricted in such a way that the oaks don't get damaged and seedlings can develop, this will ultimately result in a better environment for oaks to develop.

Frogs
As long as the reeds are kept clear from the construction of a

wharf park, the habitat quality for frogs will remain good. The expected increased activity and movement in the area may also cause action to clear out and reinstate the artificial frogpond.

Biodiversity
The decrease of habitable area will affect biodiversity also in the operational phase. However, as the oak environment will be enhanced by thinning we can expect an increase in oak-related species. As good oak habitats are relatively species rich, the biodiversity in the area can ultimately be increased, if connectivity is good enough for species to migrate here. The construction of a wharf park will probably not decrease habitable area, or disturb nesting birds, substantially, as this is a small part of Magelungen strand. It may increase bird interest in the area, increase public reports to Artportalen and protect the area from other negative impacts, such as further exploitation or consequences from eutrophication.

Green wedges, barriers and connectivity
The proposed plan will impact not only the local green structure but also the regional green structure. Implementing the project will have a negative impact on the Hanveden green wedge in Magelungens strand, which is the green connection between Farstanäset in south, and Fagersjö forest in the north. Building along the road Magelungsvägen will contribute to the cumulative impact on the connectivity in the wedge by creating another barrier. Since Magelungens strand is classified as a weak connection in the wedge, which should be strengthened, the impact on the green wedge can be considered as significant. However, the barrier effect is planned to be mitigated by leaving two green distribution corridors in a north-south direction. As movement is spatially restricted there may be a possible decrease in connectivity for certain fauna for example low-flying birds and insects. Amphibians, squirrels and non-flying insects are unlikely to utilize the combined walking and cycling bridge, although isolated events of migrations could occur.

6.3.4.3 Conclusion
Overall the green surface and natural values of the area will be reduced which affects the biodiversity and the connectivity in the area. Building in the plan area will also affect the regional green connectivity and damage oaks which are of national importance. Based on this, the conclusion is that the Alternative One is *likely* to result in major negative impacts.

6.3.5 Alternative Two - Impacts
Compared to Alternative One major oak stands will be preserved, and rather than just a bridge for bicyclists and pedestrians across Magelungsvägen, an ecoduct will be built connecting oak habitats on either side.

6.3.5.1 Impacts During Construction Phase
As with Alternative One, the scale of the impact during construction will be dependent on how much area is used for building barracks and machines. Approximately the same area for building barracks is in this analysis.

Shoreline
The shoreline will not be directly affected by the building phase in this scenario. The development will be similar to the one in the Zero Plus Alternative, as long as mitigation measures are taken to protect the water environment.

Oaks
During the building phase, trees within the building site will be affected but to a lesser extent than in Alternative One. 46 out of 279 oaks identified are situated where buildings are planned in this alternative (and an additional 60 oaks within five meters' radius from the housing). There are 37 identified valuable oaks

(class II) in the area today. Of these, eight are situated where buildings are planned. One of the four identified great oaks (more than 300 cm circumference) and one upcoming great oak (more than 280 circumference) may need to be cut down. About one fifth (one out of five hectares) of identified oak forest area along Magelungens strand will be directly exploited and depending on where the barracks will be placed, more trees might be affected. Same mitigation techniques as for Alternative One are recommended; regarding marking of oaks, planning and execution of construction.

Frogs
No apparent effect on frogs from construction, as long as there is no major increase in pollution running into Lake Magelungen as a result of the construction phase.

Biodiversity
Effects on biodiversity will be the same as for Alternative one during the building phase.

Green wedges, barriers and connectivity
By honoring the shoreline protection, connectivity west to east along Magelungens strand is secured even during building. If the ecoduct is built first, it is also possible to strengthen connectivity north to south and into Farsta from an early stage of the construction phase. The earlier the ecoduct is in place, the sooner it will start to develop soil layers and flora and fauna can start establishing.

6.3.5.2 Impacts During Operational Phase

Shoreline
The development of the shoreline will be similar to the Zero Plus Alternative. With thinning out of forest there may be a short period of soil deportation from rain, until damaged ground vegetation is replaced. This can temporarily increase nutritional values and sediment retention along the shoreline.

Oaks and biodiversity. The impacts on oaks when buildings are in place will be similar to Alternative One. However, fewer trees will need to be removed. Leaving more trees of high ecological value and others that are on their way to become ecologically important.

Frogs
The same positive effects can be expected here as in Alternative Zero Plus, with the exception that having buildings with their associated lights and sounds could have an effect on the amphibians.

Green wedges, barriers and connectivity
Implementing the project will have both positive and negative impacts on the Hanveden green wedge. The buildings along the road will contribute to the cumulative negative impact on the connectivity of the wedge by creating another barrier. However, the mitigation of adding of an ecoduct will lead to an increased potential for connectivity, especially for ground bound animals. Since Magelungens strand is classified as a weak connection in the wedge, and this connection could be strengthened with the ecoduct. There it can be assessed that there will be significant positive impacts on the green wedge.

6.3.5.3 Conclusion

Overall the impact on ecology will be similar to Alternative One in exploited areas, but the magnitude of the impact will be smaller as a smaller area is exploited and the sensitive shoreline environments is protected from building. The connectivity will be strengthened in ways similar to the ones in the Zero Plus Alternative. Based on this, the conclusion is that the Alternative Two is *likely* to result in a major positive impact for ecology.

6.4 Water Environment

6.4.1 Environmental Baseline

Magelungens strand is located within the drainage basin of Lake Magelungen, the second biggest lake in Stockholm. It is situated on the border between the municipalities of Stockholm and Huddinge (Stockholms stad, 2016b). Its main inflow is from Ågestasjön in the south, the water then flows out via Forsån to Drevviken in the northeast. The lake is shallow, especially in the northern part, where the approximate depth is one meter. The lake is considered eutrophic and the state of the water quality is classified as unsatisfactory at this moment (VISS, 2009). The EU Water Directive has set an objective that the water quality of the lake should reach "good ecological status" by 2021 (Stockholms stad, 2016b).

At the time of writing investigations are being made to assess the main stresses to the lake (Virgin, 2016, personal communication, 9 December). The main issue of the lake today is eutrophication, nutrients is mainly added to the lake through the grey water from surrounding housing developments. Nutrients leaking in the lake during a long time period have also created conditions where the bottom sediments are so loaded with nutrients that the lake has entered self-feeding loop of eutrophication. the eutrophication in turn affects the flora and fauna in the lake and has created problems with algal blooms and areas of oxygen deprived lake beds (Virgin, 2016, personal communication, 9 December).

Apart from the levels of nutrients the chemical status of Lake Magelungen is considered good, except for levels of mercury, which will require monitoring (VISS, 2016). Major roads and industrial plots have been assessed to be the main contributors of pollution to the lake (Stadsbyggnadskontoret, 2011).

The vegetation in the lake is plentiful during summertime, which affects the possibilities of swimming and boating in the lake, especially in the Bay of Fagersjö. Whilst the vegetation is a hindrance to recreation, it is important as a birth chamber for fish in the lake offering protection from predators (Virgin, 2016, personal communication, 9 December).

At present, there are no specific mitigation measures proposed to improve the water quality of Lake Magelungen. But the Environmental Administration of Stockholm puts a lot of emphasis on new developments in the drainage basin needing to ensure local processing of grey water to mitigate nutrients and toxins reaching the lake (Pehrsson, 2016, personal communication, 9 December; Virgin, 2016, personal communication, 9 December).

The buildings currently within the planned area are neither built on unstable soil, nor of 50 year floods (SGU 2016). In case of flooding, areas likely to be affected are the walkway by the existing frog pond, the dog park in the same area and the northern land connection of the walking bridge between Farsta Strand and Farstanäset (see **Figure 9**).

6.4.2 Zero Alternative - Impacts

Without any change in land use the area of Magelungens strand is unlikely to itself be the cause of any changes to Lake Magelungen. But since Lake Magelungen is part of a network of lakes, outside of the scope of this EIA, construction in other areas may affect the state of Lake Magelungen. Self-eutrophication is likely to continue, meaning that it is of even more importance that any further influx of nutrients is limited.

6.4.2.1 Conclusion

There *will* be no notable impacts on the conditions of Lake Magelungen from the area being left as it is today, but developments outside of the plan area *may* still have some effect.

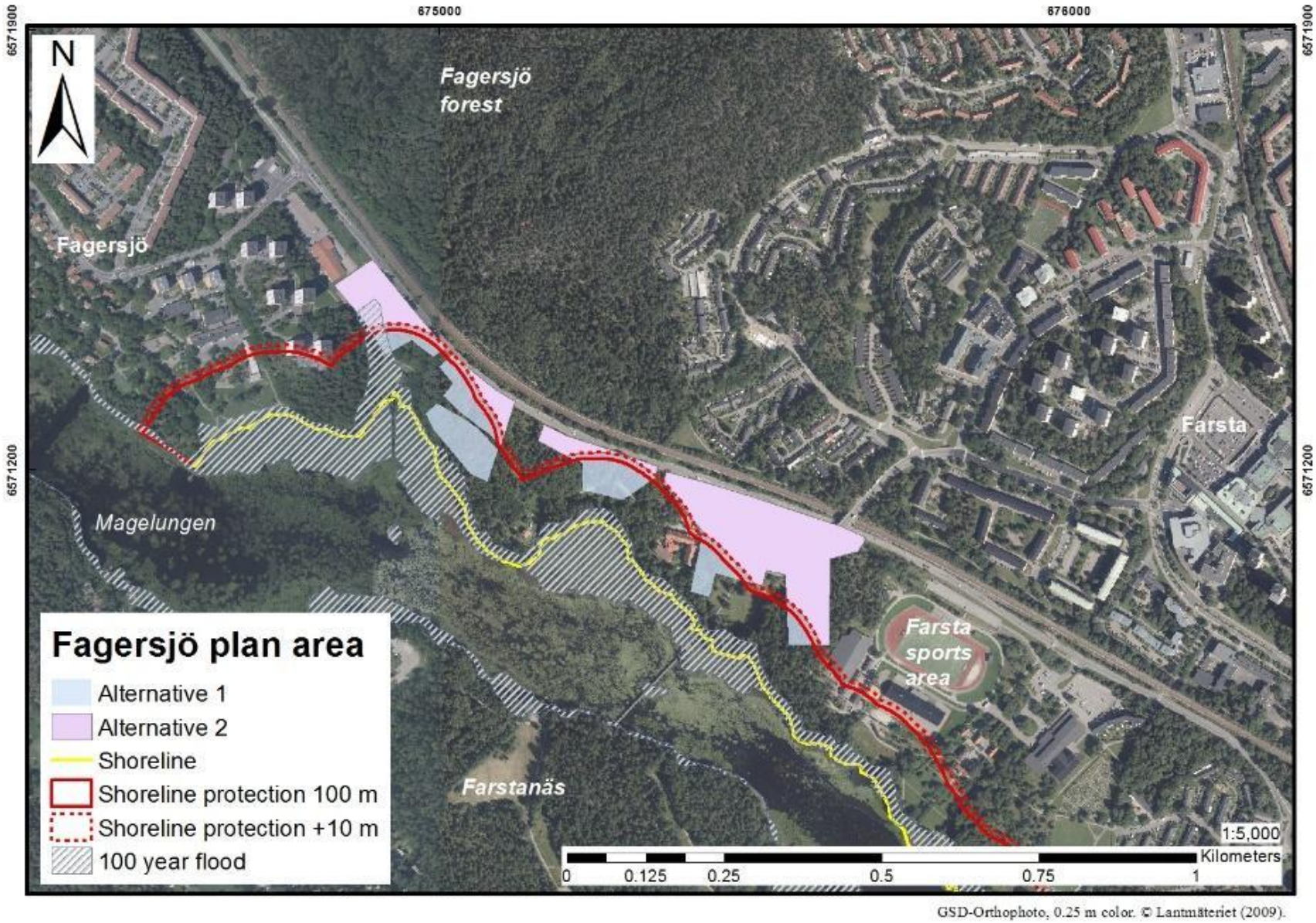


FIGURE 9. MAGELUNGENS STRAND WITH DELINEATED SHORELINE, PROTECTION ZONE AND FLOOD RISK.

6.4.3 Zero Plus Alternative - Impacts

As some vegetation will be will be cleared in this alternative, erosion may slightly increase in the short run, leading to more nutrients entering the lake. However, after the initial period the forest will reinstate its function of intercepting and infiltrating water. In the long term, the managed forest may decrease the nutrients to Lake Magelungen as interception increases with crown size and roots will absorb more water as the trees grow.

6.4.3.1 Conclusion

For the zero plus alternative the amount of nutrients is assessed to increase temporarily, but after a while decrease compared to the baseline. Therefore, the overall assessment of impacts from the Zero plus Alternative is that it *may* lead to minor positive effects.

6.4.4 Alternative One - Impacts

6.4.4.1 Impacts During Construction Phase

Removal of forest and ground vegetation will decrease evaporation and crown interception. During the construction phase, the road for heavy equipment will cause soil compaction, leading to a decrease in infiltration which in turn will lead to an increase in runoff. As the soil gets exposed by the removal of trees there is a risk that mercury and phosphorus becomes free to enter into the runoff water (VISS, 2016, ibid.; KSLA, 2009; Schindler, 1997). Runoff from construction sites may also have a significant impact on water quality. Sediment in runoff from construction sites are 1,000 to 2,000 times greater than those from forest lands. This type of sediment has been found to be one of the most common pollutant in lakes in the United States (EPA, 2005). Building materials, concrete washout, paint, fuel, wastewater, oil and solvents are substances that commonly enter runoff from construction and may end up in Lake Magelungen if mitigations are not made.

6.4.4.2 Impacts During Operational Phase

In the beginning of the operational phase the impacts will be the same as for the construction phase, but with time urban green areas will establish ground vegetation, and act as a filter for precipitation. However, urban green areas such as gardens, grass fields and bushes can also increase nutritional output, through the addition of fertilizers. This combined with increasing traffic in the area adding even more available phosphorous to the runoff could exacerbate the eutrophication in Lake Magelungen. The Stockholm Environmental Administration has already emphasized that should the project be implemented then the planning needs to include local treatment of storm water. A way of doing this is by implementing unfertilized green infiltration areas that the water passes through before entering the lake. Another possible issue that needs to be addressed is the capacity of the sewage system to which the new development will have to connect. Does it have the capacity to handle more sewage water and does it connect to storm water drains? If so when the capacity is breached during heavy rains, does the water get redirected into Lake Magelungen or somewhere else? In future where we can expect heavy rains to become more common, these are very important questions to answer in order to assess the future implications of developments around Lake Magelungen (SOU 2007:60).

Some of the buildings in the northwestern part of the planning area, close to Fagersjö will be placed within an area at risk of flooding within a 100-year recurrence interval (see **Figure 9**) (MSB, 2016). There is also a risk that the likelihood of flooding increases in the future. With climate change heavy rains will be more common, at the same time more surfaces around Lake Magelungen are likely to be made impervious as buildings and roads replace green areas, shortening the water transport route and causing an increase in peak flow.

6.4.4.3 Conclusion

Due to change in site conditions and an expected increase in heavy rains the flood risk, degree of runoff and eutrophication are all *likely* to be increased significantly. Therefore, Alternative One is *likely* to have major negative impact on the water environment.

6.4.4.4 Mitigation

As suggested by the Municipality of Stockholm storm water management should take a holistic approach (Exploateringskontoret, 2016). The municipality should investigate how greywater can be disposed of locally with delay measures for surface water such as green roofs and infiltration beds.

6.4.5 Alternative Two - Impacts

6.4.5.1 Impacts During Construction Phase

The same impacts will apply as for Alternative One. However, the area and amount of forest affected will be less, so the scale of impact will be smaller.

6.4.5.2 Impacts During Operational Phase

The same impacts will apply as for Alternative One. However, the area and amount of forest affected will be less, so the scale of impact will be smaller. The flood risk is also smaller since there are less buildings within the 100-year flooding area (see **Figure 9**).

6.4.5.3 Conclusion

Compared to Alternative One, the flood risk and the degree of runoff and eutrophication will be lower, and the quantity of pollutants drained into lake will be less. As a result, Alternative Two is *likely* to have minor negative impacts on the water environment.

6.4.5.4 Mitigation

Same as for Alternative One.

6.5 Noise

To be able to describe noise level dBA is often used, dB is not classified as an SI unit and will therefore be explained (CCU, 2004). dBA is a logarithmic scale which in this circumstance means that if the sound energy is doubled the unit increases three units. The index ”A” indicate that the frequency scale has been weighted to the human perception of the sound (VGU, 2004). In this project only dBA Leq 24 hours (average noise pollution over 24 hours) has been analyzed. There might be higher maximum noise levels in the area that we do not take into account. But based on the 24-hour data we can deduce that noise is a problem in the area.

For the assessment of noise, the following regulation and guidelines has been used;

Regulation (2015:216) of traffic noise by housing development 3-5 §§:

“3 § Noise from rail and roads should not exceed

1. 55 dBA equivalent sound level at a residential building façade,

2. 50 dBA equivalent sound level and 70 dBA maximum sound level at a patio if such be arranged adjacent to the building.

For an apartment of more than 35 square meters, is instead of what is stated in paragraph 1 that the noise should not exceed 60 dBA equivalent sound level in residential building facade.

4 § If the sound levels specified in § 3, first paragraph 1 nevertheless exceeded,

1. at least half of the living spaces in a dwelling be facing a side where 55 dBA equivalent sound level is not exceeded at the front, and

2. at least half of the residential rooms face towards a page where 70 dBA maximum sound level is not exceeded between the hours. 22:00 and 06:00 at the facade.

At such a modification of a building referred to in Chapter 9. § 2, first paragraph 3a Planning and Building Act (2010: 900) apply instead of what is stated in paragraph 1 to at least one habitable room in a dwelling should be turned towards a page where 55 dBA equivalent sound level is not exceeded at the facade.

5 § If the sound level of 70 dBA maximum sound level specified in § 3, first paragraph 2 is exceeded, the level should not be exceeded by more than 10 dBA maximum sound level five times per hour between the hours. 06:00 and 22:00."

TABLE 3. GUIDELINES FOR MAXIMUM NOISE FROM CONSTRUCTION SITES, DEPENDING ON WEEKDAY, TIME OF DAY AND BUILDING TYPE. GUIDLINES FOR HOUSING IN LIGHT GREEN AND GUIDLINES FOR HOSPITALS IN DARK GREEN

	Monday- Friday		Saturday, Sunday and weekday		All days	
Time	Day 07 - 19	Night 19-22	Day 07 - 19	Night 19-22	Night 22-07	Night 07 - 20
Measurement	LAeq	LAeq	LAeq		LAeq	LAFMAX
Outside at facade	60 dBA	50 dBA	50 dBA	45 dBA	45 dBA	70 dBA
Inside	45 dBA	35 dBA	35 dBA	30 dBA	30 dBA	45 dBA
Outside at facade	60 dBA	50 dBA	50 dBA	45 dBA	45 dBA	X
Inside	45 dBA	35 dBA	35 dBA	30 dBA	30 dBA	45 dBA

Apart from the regulations, Swedish Environmental Protection Agency has set up guidelines that are applicable to the project area. A general recommendation for maximum noise at recreational areas is 55 dBA, but there are also specific regulation depending on house type, time of day and week (NSF 2004:15).

6.5.1 Environmental Baseline

Noise is defined in Environmental Impact Assessments as unwanted sounds. The main source of noise is due to traffic and transportation. The impact from noise differs depending on what time we are exposed, what we are doing when we are affected and the strength and frequency of the waves (Naturvårdsverket, 2016b). In Sweden more than 2 million people are affected by road noise in their homes and 25 percent experience that they are disturbed by noise at work. Health consequences from noise span from stress and exhaustion to cardiovascular diseases (Tideström, 2015). Urban noise has shown in studies that it has a strong negative effect on recreation in natural settings (Ulrich, 1986). Apart from human health, noise from roads have a negative effect on fauna that can act as an additive for habitat fragmentation (Parris & Schneider, 2008).

Background noise is present within the whole plan area (see **Figure 10**). Magelungens strand is located next to Magelungsvägen, a major road with a speed limit of 70 km/h that connects the southern outskirts of Stockholm. Parallel to the road is a railroad track for public transportation and transportation of goods. The cumulative effects of the two infrastructure systems generate a noisy environment within the plan area. Noise levels vary from 50 to 75 dBA Leq 24 hours in the project area which exceeds the set thresholds (Table 3). The highest values of noise are present in the north part, next to Magelungsvägen and successive get lower towards Lake

Magelungen. Noise levels exceed the threshold for recreational areas within the whole plan area (SLB, 2012).

Within the area there is temporary housing for newly arrived persons (asylum seekers that have received their residents permit) one private house and the psychiatric clinic Ytterö. At present, the clinic is heavily affected by noise levels at 50-65 dBA L_{eq}, exceeding regulations and guidelines for hospitals.

6.5.2 Zero Alternative - Impacts

In the Zero Alternative noise levels are expected to slightly increase from today's values. The City of Stockholm has the ambition to grow which is expected to lead to an increase in car traffic on public roads by year 2030 (Stockholms översiktsplan, 2010; Trafikverket, 2015). On the other hand, with improved technology, cars become quieter. Noise from road traffic is mainly created by motor, exhaust system, transmission and tires. Tire noise is the main noise source for all vehicles that exceed a speed of 50 km/h below that threshold transmission, engine and exhaust systems are the main contributors to noise pollution (Cowan, 1999).

The Swedish Government has a goal set for year 2030 that no vehicles will depend on fossil fuel (Regeringen, prop. 2008/09:162). Depending on what kind of approaches, laws and technical improvements that will be adapted and developed, new vehicles will be prone towards ether biofuel or electric cars. Electric engines emit a substantially lower noise than other kind of engines (Transportstyrelsen, 2013). But the main noise in the area comes from the tires, due to the fact that the speed limit of Magelungsvägen is 70 km/h. Therefore, car engine development will not decrease noise levels as long as surface, tires and speed stay the same.

6.5.2.1 Conclusion

Overall taking the increase in inhabitants into consideration, the expected increase in the number of cars in the municipality, and that the threshold of noise is already breached today, the Zero Alternative is likely to have a minor negative impact in the area.

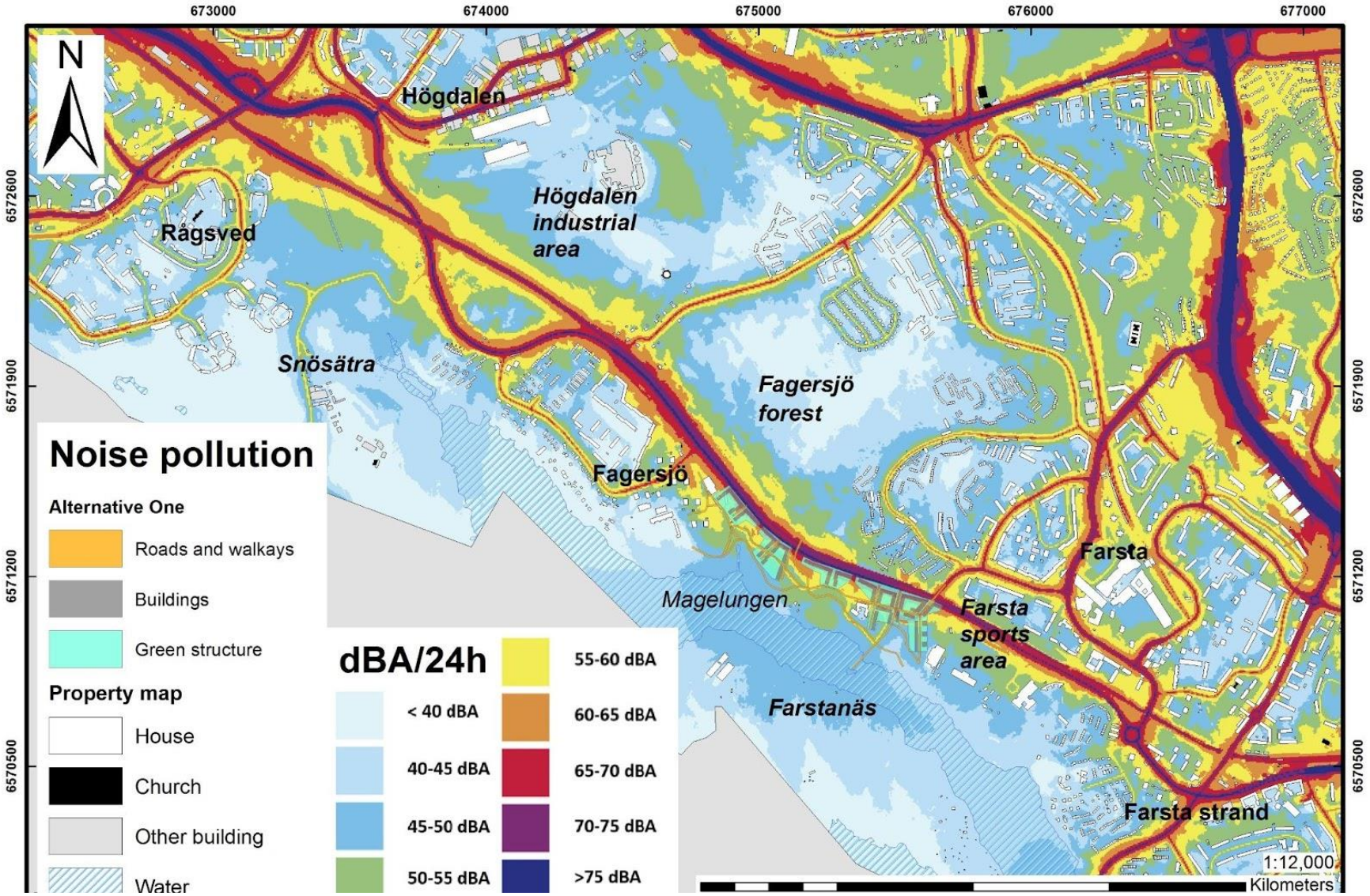


FIGURE 10. NOISE MAP FOR THE PLAN AREA CALCULATED FROM TRAFFIC FLOWS FROM ROADS AND TRAINS IN 2012. THE MAP SHOWS LEQ DBA FOR 24 HOURS,

6.5.3 Zero Plus Alternative - Impacts

The main difference between the Zero Plus and the Zero Alternative is the loss of noise reducing biomass when thinning the forest, as well as the plan to introduce a noise barrier towards the road and railway north of the plan area. Depending on how and where the noise barriers are built these will be able to improve and compensate for the increased noise that comes with thinning of biomass.

6.5.3.1 Conclusion

Overall taking the increase in inhabitants into consideration, the expected increase in the number of cars in the municipality, and the effect from thinning and construction of a noise barrier, the Zero Alternative is *likely* to have a minor positive impact in the area.

6.5.4 Alternative One - Impacts

6.5.4.1 Impacts During Construction Phase

During the building phase the noise in the area will increase. Although, we can only analyze a general building scenario as there is not yet a construction plan to explain what methods and equipment will be used at the different building stages. We can assume that the use of heavy machinery can easily generate high noise levels, which will make the area less attractive to visit. There is a high risk that the residential building and the psychiatric clinic will be heavily impacted by building noise during the construction. When meeting with A. Ericsson and N. Widell at the Ytterö clinic, noise during the construction phase was one of the issues raised when discussing the building project's impact on their operations (2016, personal communication, 21 December). As Ytterö is an emergency clinic for people with psychosis, they stressed that a calm environment is of high importance.

Outside of the plan area there is a residential area north of Magelungsvägen that might be affected by noise pollution. The residential area is partly shielded by the existing train track that runs on an embankment and by the noise barriers that are already installed north of Magelungsvägen. It is also partly shielded by trees when building the western parts of Magelungens strand. Depending on elevation, the noise sources, and the strength of the noise, the residential areas might be less impacted.

6.5.4.2 Impacts During Operational Phase

The proposed residential area is situated right next to Magelungsvägen where the noise already is a problem. The noise levels today are already too high for the new buildings to be legal. The proposed design of the houses uses the facade as a barrier towards the road to reduce the noise between the road and the shoreline in Magelungens strand. Courtyards will be developed on the shielded southern side. The facade facing Magelungsvägen will breach the recommendation for maximal equivalent noise limitation for housing. In order to make the project viable, the apartments should be planned in a way in which the majority of the rooms, especially those used for sleeping, except for kitchens and bathrooms should be situated towards the quiet side. Apart from that, noise protecting windows should be installed.

The Development Administration has the aim to change the speed limit at Magelungsvägen to 40 km/h, which is a municipal road just outside the plan area (Sjöberg, 2016, personal communication, 12 December). The new speed limit will majorly decrease the noise level since the noise from tires is much lower at speeds below 50 km/h. In addition, the developing car technology with quieter cars will contribute to the decrease in the noise level.

Today it is not decided how the moving-in process will be handled (Sjöberg, 2016, personal communication, 12 December). If the new housing is built in phases and the new inhabitants move in in stages during construction there *will* be an impact on the new inhabitants in the area as well. If that is the case then temporal noise measures will need to be taken within the area, not only adjacent to Magelungsvägen, to ensure a habitable environment.

6.5.4.3 Conclusion

Overall taking into consideration the change of speed limit from 70 to 40 km/h the alternative will *likely* have a major positive impact.

6.5.5 Alternative Two - Impacts

6.5.5.1 Impacts During Construction Phase

During the building phase in Alternative Two the impact of noise is estimated to be the same as in Alternative One.

6.5.5.2 Impacts During Operational Phase

The major difference between Alternative One and Alternative Two from a noise perspective is the design of the major part of the houses. In Alternative Two the construction is based on towers that would not have the same shielding effect on road noise compared to the high buildings that stretches along the road. There will still be houses along the road, but with greater distance between them, that will allow more noise into the area. To compensate for this, the alternative includes an establishment of noise barriers. Compared to Alternative One the newly developed buildings will be further away from Magelungsvägen and will therefore experience less noise.

6.5.5.3 Conclusion

Overall taking into consideration the change of speed limit from 70 to 40 km/h and the installation of noise barriers the alternative *may* have a major positive impact.

6.5.5.4 Mitigation

Depending on the final design of the area, different mitigation measures may be developed. The following are general solutions that can be applied on all alternatives:

- Noise barriers between the road and the residential area would decrease the strong noise that is expected by the future building facades, as well as lower the noise in the whole area. Depending on the surrounding ground a noise barrier can lower the noise by 6-10 dB units (VGU, 2004)
- Lower speed limit at Magelungsvägen would eliminate much of the tire noise, no matter what kind of technical engine inventions that are expected within the next 20 years.
- Quiet asphalt can be used at local streets as well at Magelungsvägen in order to further decrease the noise levels in the area. (VGU, 2004)
- Traffic planning, by cooperating between different contractors the amount of heavy trucks for transportation can decrease.
- Increased and more effective public transportation
- Bicycle roads: by increasing the stretch and quality of bicycle roads the car traffic can be somewhat decreased.

6.6 Air quality

The regulation 2010:477 on Environmental Quality Standards for air quality is issued with support from the Swedish Environmental Code. (SFS 2010:477; MB 1998:808) The regulation defines thresholds for sulfur oxides, nitrogen oxides, particles and lead, carbon monoxide, benzene and ozone (Trafikverket 2016). For the assessment of noise the following regulation and guidelines have been used, based on Regulation (2010:477) about air quality.

"**10 §** In order to protect health, nitrogen oxide may not exceed the following thresholds in outside air

1. In average 90 microgram per cubic meter in air during an hour (hourly average),

2. In average 60 microgram per cubic meter in air during a day (daily average),

3. In average 40 microgram per cubic meter in air during a year (yearly average).

18 § In order to protect health, particles (PM10) oxide may not exceed the following thresholds in outside air

1. In average 50 microgram per cubic meter in air during a day (daily average),

2. In average 40 microgram per cubic meter in air during a year (yearly average)"

Area-specific air quality data has been collected from SLB (Stockholm air and noise- analysis) which is a unit at Stockholm Environment Administration (SLB, 2016). The data present the daily average for PM10 and NO2 two meters above the ground.

6.6.1 Environmental Baseline

The main source of air quality pollutants in Magelungens strand today is the traffic at Magelungsvägen, which is the road parallel to the plan area. Particles from roads stems primarily from tear on the road, tires, brakes and from exhausts (Stockholms Stad, 2016c). PM10 are particles that are smaller than 1/10000 of a millimeter. Within the municipality, roads are the major contributor of particles and contributes with 86 percent of the total particle pollution. The impact on human health from particles varies, some of the health issues being irritation on the respiratory system, cardiovascular diseases and lung cancer. The major particle components are sulfates, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water and the components are often a mix of organic and inorganic material (Stockholms Stad 2016e; WHO, 2016).

Nitrogen dioxide arises from incineration within the plan area, cars at Magelungsvägen are the main contributors to pollution (Stockholms stad, 2016d). Today the air quality is well beneath the thresholds (Environmental Quality Standards) in the plan area. Particles (PM 10) are calculated to be 20-25 micrograms/m^3 in the whole area except for direct parallel to the road where the levels peak at 30 micrograms/m^3 (see **Figure 11**). Nitrogen dioxide (NO2) is calculated to 18-24 micrograms/m^3 in the major part of the plan area except for parallel to the road where it peaks to 30 micrograms/m^3 (**Figure 12**; SLB Analys, 2012).

6.6.2 Zero Alternative

In the Zero Alternative the overall air quality will not change notably. The traffic is likely to increase in the region due to increased population, but with the development of more fuel efficient and electrical cars, the nitrogen oxide levels is likely to decrease. Particle levels are likely to increase slightly with the Zero Alternative because of an increase in traffic.

6.6.2.1 Conclusion

The overall impact of the Zero Alternative is *likely* no notable change.

6.6.3 Zero Plus Alternative - Impacts

The main difference between the Zero Plus and the Zero Alternative from an air pollution perspective is the establishment of noise barriers in the area. Noise barriers can be used to reduce local air pollution from roads. Given that the noise barrier has the right dimensions, up to seventy-five percent of the local air pollution can be isolated from the plan area (Fuka, 2014).

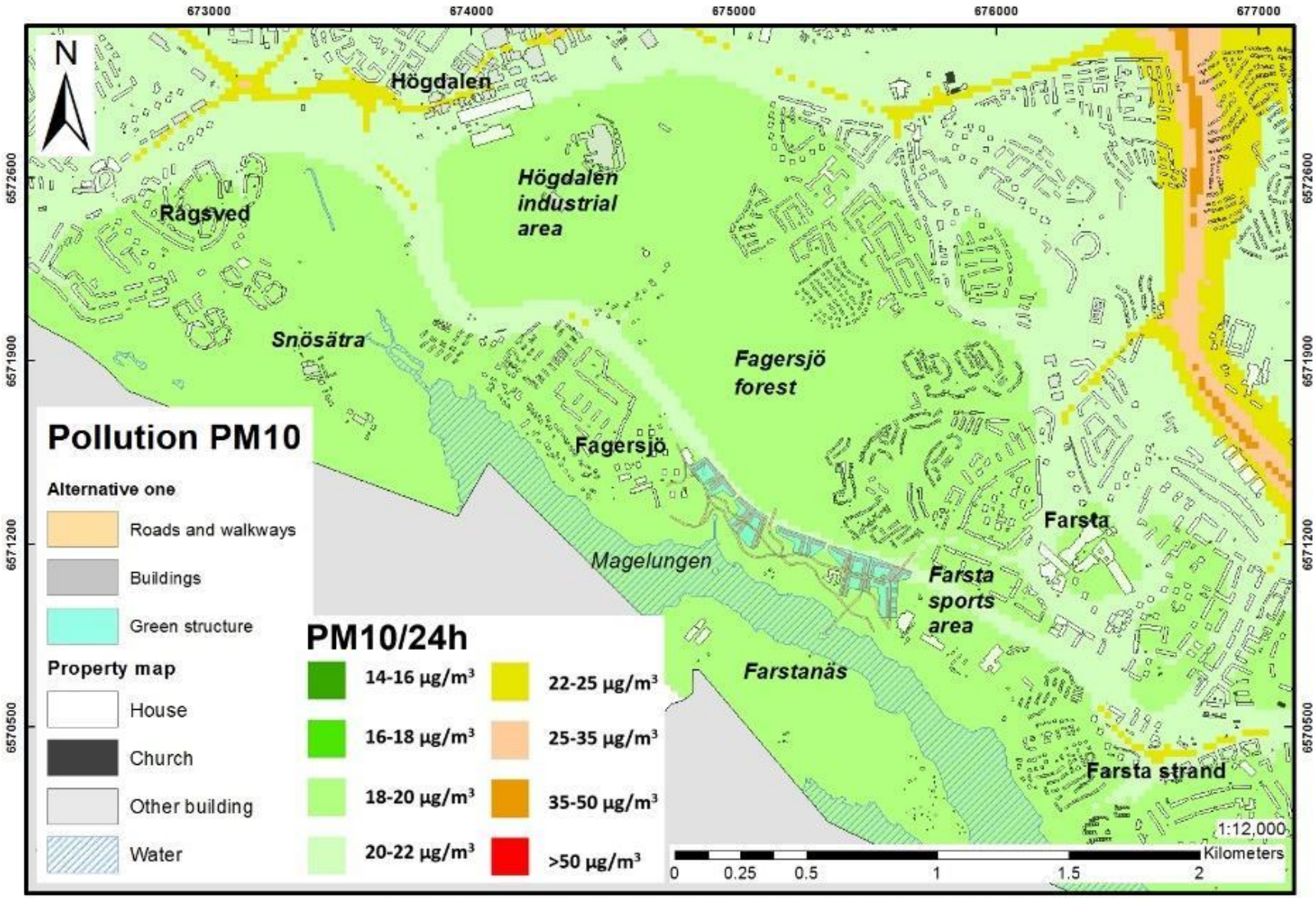
6.6.3.1 Conclusion

The overall impact of the Zero Alternative due to introduction of noise barriers is *likely* minor positive impact.

6.6.4 Alternative One - Impacts

6.6.4.1 Impacts During Construction Phase

Since there is not yet a construction plan developed for this project explaining what methods will be used and what equipment different building stages will be using, we can only analyze a general building scenario. Generally during the building process heavy machinery is used and from the air quality perspective the main problems are dust (particles), engine emissions and VOC (Volatile Organic Compounds) from welding, brazing and soldering and other building related processes (Stäubli & Kropf, 2004). Dust from building sites is commonly not spread further than 100 meters so the only people that are expected to be affected are the ones who live, work and spend time within the plan area (Stäubli & Kropf, 2004). Special considerations should be taken to the clinic and the residential house within the plan area. During the most pollutant stages of construction evacuation is a viable option. No air pollutants from the construction phase are considered to have a permanent effect in the area so the mitigation measures only have to be temporary.



PM10 map, all sources. © Stockholm municipality environmental administration (2010). Fastighetskartan 1:5,000 - 20,000 © Lantmäteriet (2009).

FIGURE 11. AVERAGE PM10 POLLUTION OVER 24H IN VICINITY OF FAGERSJÖ.

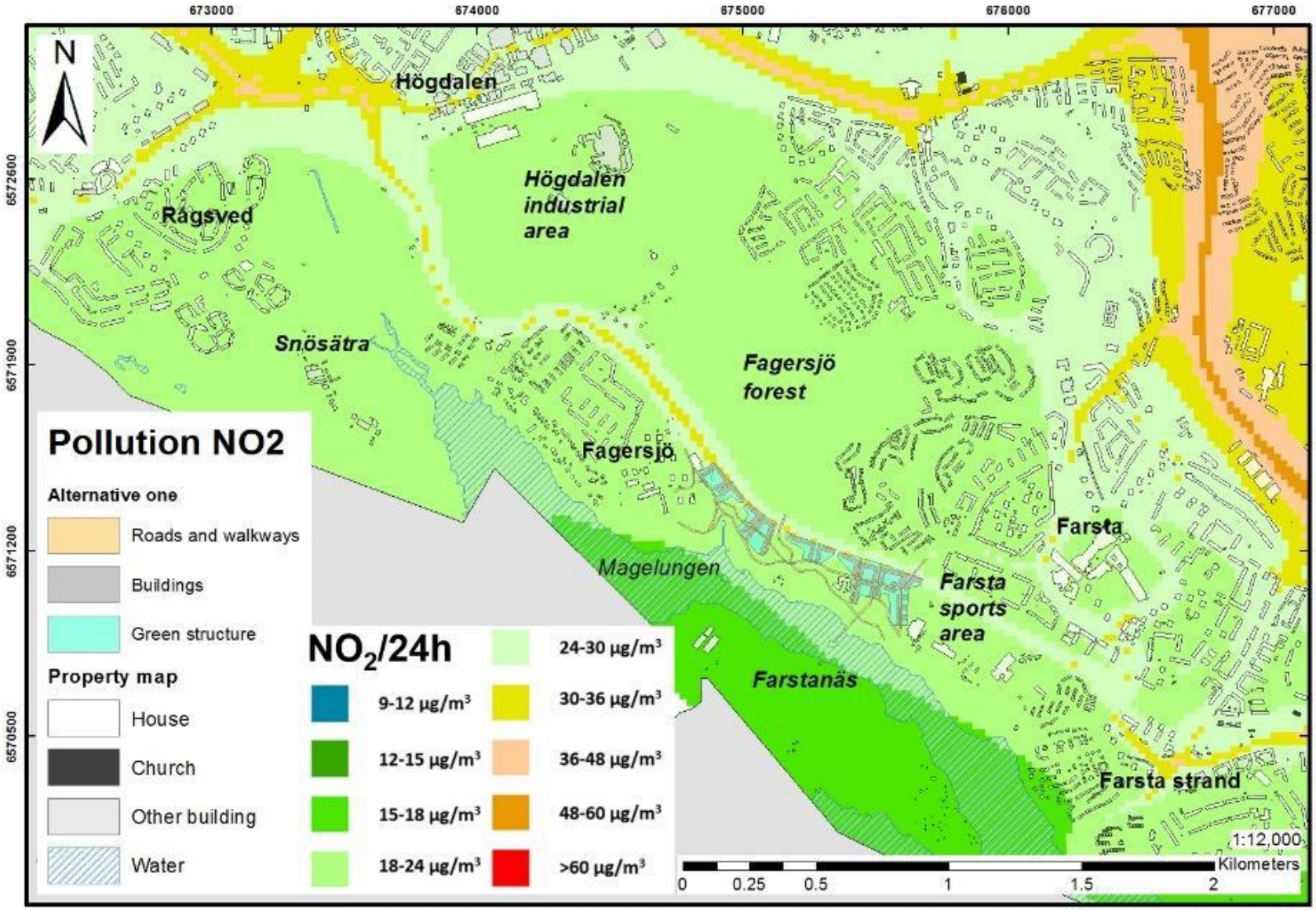


FIGURE 12. AVERAGE NO2 POLLUTION OVER 24 H IN VICINITY OF FAGERSJÖ.

As mentioned earlier the order of construction is yet to be decided. If the buildings are created in phases and the new inhabitants move in in stages during construction, there will be an impact on the new inhabitants in the area as well. If that is the case, then a control program and measurements are recommended to ensure that the maximum values for air pollutants do not breach the thresholds.

6.6.4.2 Impacts During Operational Phase

In Alternative One, which is the proposed plan, the overall air quality from Magelungsvägen is likely to not change notably within the plan area. An increase in traffic is expected (Trafikverket, 2015a), but more fuel efficient cars will decrease the pollution rate. Apart from this, the design of houses will act as a barrier between the road and the plan area, contributing to the dispersal effects (Fuka, 2014). More cars will generally move within the plan area, the public transportation will need to be developed further and become more effective within the region in order to ensure the ability for residents to live without a car. A speed limit change at Magelungsvägen from 70 to 40 km/h lower the amount of particles that each car emits into the air (EAA, 2011).

6.6.4.3 Conclusion

Overall, taking into account the increase of cars both at Magelungsvägen and in the plan area versus the mitigation effects implemented and development of technologies. The assessment for this alternative is that it *may* have no notable impact.

6.6.5 Alternative Two - Impacts

6.6.5.1 Impacts During Construction Phase

The impact on air quality during the building phase in Alternative Two is estimated to be the same as in Alternative One.

6.6.5.2 Impacts During Operational Phase

The impact on air quality in the operational phase is estimated to be the same as in Alternative One.

6.6.5.3 Conclusion

The conclusion for air quality is estimated to be the same as in Alternative One. *May* have no notable impact

6.6.5.4 Mitigation

Depending on the final design of the area, different mitigation measures may be developed. The following are general solutions that can be applied on all alternatives:

- Noise barriers can be used to reduce local air pollution from roads. Given that the noise barrier has the right dimension, up to 75 percent of gaseous pollutants can be isolated (Fuka, 2014).
- Housekeeping of site - for building phase, a continuous removal of debris and masses decreases the dust pollution, so constant cleaning of building sites will contribute to a better air quality.
- Traffic planning, by cooperating between different contractors the amount of heavy trucks for transportation can decrease.
- Introducing public transportation within the area

6.7 Services

This section will look at the current public and private services available to the people of Fagersjö and assess how services will be affected by the alternative scenarios.

6.7.1 Baseline

At the moment, as the area mainly consists of forested land, there are no primary services such as preschools, schools, health care centers or shops within the plan area. Currently there are four buildings here. In the centre of the area there is a private residence by the shoreline in which a home care service company called Din Hemtjänst is registered (Din Hemtjänst, 2016). Closer to Farsta Strand is a building that is owned by LOCUM and houses a county council run psychiatric emergency care clinic called Ytterö, where the patients sometimes use the nearby tennis court (Ericsson & Widell, 2016, personal communication, 21 December). Close to Fagersjö there are also two sets of temporarily situated modules with single housing for adult, newly arrived persons (Mölgård, 2016, personal communication, 19 December).

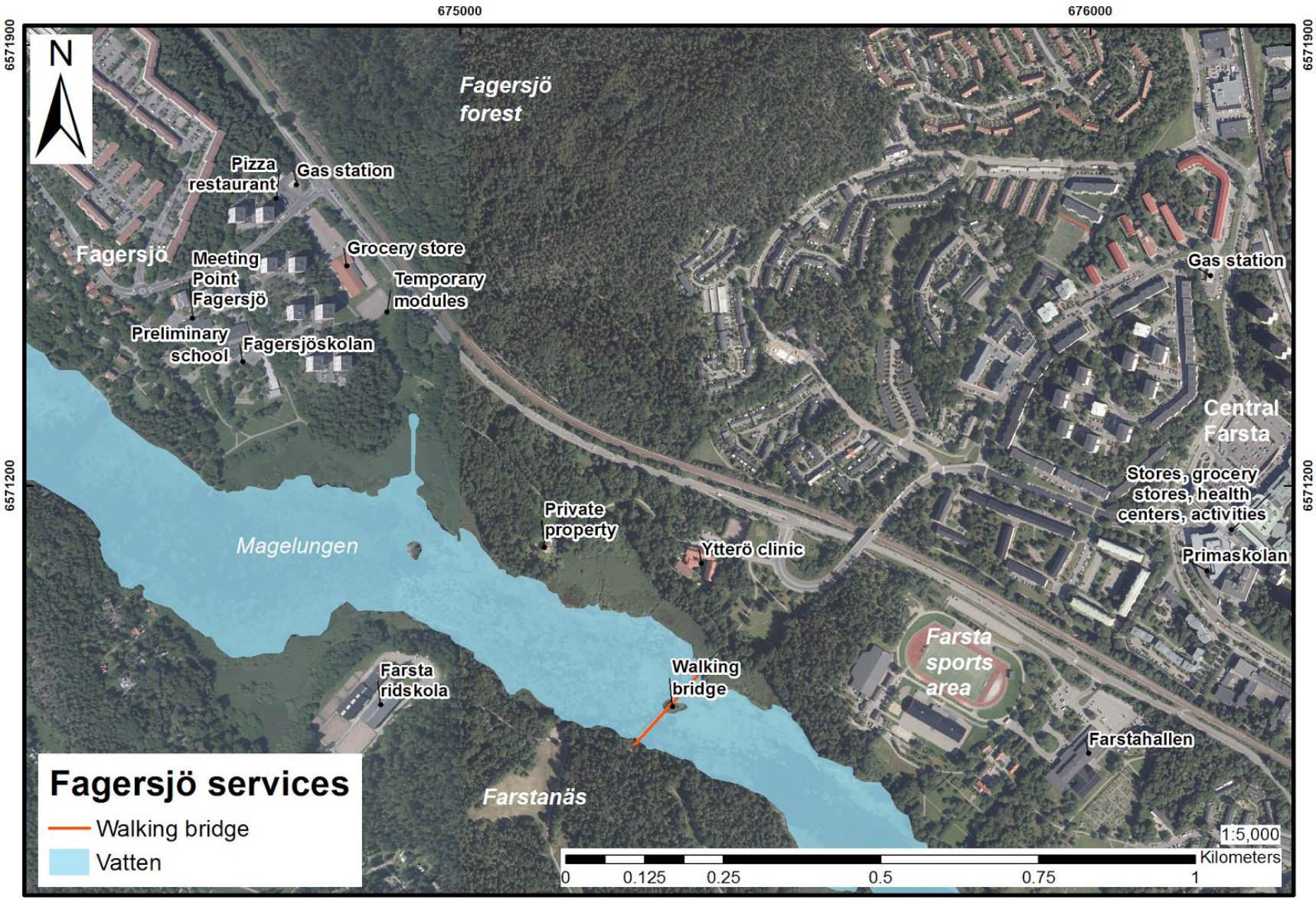
In Fagersjö today the available conveniences are located in the south east, by the southern side of Magelungsvägen, where there is a food store, a gas station and a pizzeria (see **Figure 13**). There is also a community meeting place called Meeting Point Fagersjö (swe. *Mötesplats Fagersjö*). Within Fagersjö the youth have expressed the need for more services and entertainment and there are also media reports of a general discontentment with the access to services. (Järnlo, 2015; Lindgren, 2010a; Tottmar, 2016).

At the moment the closest schools in the area are the municipal schools Fagersjöskolan (years F-6), Magelungsskolan (years F-6) and Farsta grundskola (years F-9) which consist of three separate schools spread out in Farsta, and the privately run Primaskolan (years 6-9). Today, the children of Fagersjö mainly attend Fagersjöskolan and Magelungsskolan, but earlier many parents have chosen to put their children in Hökarängsskolan (Averstedt, 2016, personal communication, 14 December). The right for the parents to choose school for their children, means a child might study in a different geographical area but at the same time the municipality must be able to offer a school nearby the address where the child is registered. (op. cit.; Skolverket, 2016).

Within Fagersjö there are four preschools; Äppelgården, Vildanden, Havsörnen and Ejdern. North of Magelungsvägen, to the west of Farsta Centrum there is also Karamellen and south east of Farsta Gård there is Guldgruvan. The closest general practitioners' offices are in Central Farsta, they are Curera Farsta (Karlandaplan 6) and Capio Vårdcentral (Munkforsplan 33). There is also a clinic specializing in children and youth aged zero to 18 years. Farsta district administration recently added more elderly housing to the area, and assess that there is currently no further need for more housing of this kind (Rivard, 2016, personal communication, 9 December).

Although the train (Nynäsbanan) runs close to Fagersjö there is no station and only busses offering public transport to and from the area, bus 165 that runs between Liljeholmen and Farsta Centrum, and bus 167 that runs between Älvsjö station and Farsta Centrum. There is a perceived lack of public transport to the area. It is also reported that it is not uncommon for buses not to make it into central Fagersjö when the slope leading there is slippery winter time (Ericsson & Wedell, 2016, personal communication, 21 December; Tottmar, 2016).

People in the area have expressed a hope that a train stop could get established by Fagersjö to increase accessibility. In 2011 Greater Stockholm Public Transport (SL) investigated the social economic gains from establishing a train station in the area. In



GSD-Orthophoto, 0.25 m color. © Lantmäteriet (2009). Fastighetskartan 1:5,000 - 1:20,000. © Lantmäteriet (2009).

FIGURE 13. SERVICES AND ITEMS OF INTEREST AROUND MAGELUNGEN STRAND.

in Magelungens strand. SL concluded that the disadvantage of adding another stop and thereby lengthening the journey for the people already using the train, would outweigh the benefits gained for the people that could take advantage of the new station (Sandberg, 2011).

6.7.2 Zero Alternative - Impacts

As no new people will be moving into the plan area the need for services will not increase within Magelungens strand, but Fagersjö is predicted to increase by about 100 individuals (Sweco Society, 2016; Saarinen, 2016, personal communication, 14 December). There will also be a change within the demographic distribution in Fagersjö, the most notable increase is predicted to happen within the demographic group aged 65-79 years (Sweco Society, 2016; Saarinen, personal communication, 14 December). This age group will increase by over a 100 individuals, which means that there might be an increased need for health services and home care service. The current housing within the plan area should remain unaffected. Though whether the temporary housing for newly arrived persons remain depend on a lot of factors. The modules get granted temporary building permits of five years at a time, the need for them to remain is mainly based on whether there is an acute need for housing (Mölgård, 2016, personal communication, 19 December). The groups using the modules might also change as the need for housing increases in some groups and decreases in others (op. cit).

The Ytterö clinic is today gained by their location. Being apart from other buildings bring peace and to some extent anonymity to the people residing here, this is especially important as approximately half of the patients are forcefully committed. Having access to areas both indoors and outside help deter incidents. Patients take daily walks, especially during the summer time, in the area.

South of the building there is also a garden where the patients can work the soil, which in turn has shown to have therapeutic effects (Ericsson & Wedell, 2016, personal communication, 21 December). In the zero alternative there should not be any major nor minor impacts or effects on the Ytterö clinic.

One reason behind why the modules nearby Fagersjö could get their temporary permit was because Magelungens strand is today a so called “planning area” (Mölgård, 2016, personal communication, 19 December). There is therefore a possibility that whether these modules can stay at this site is dependent on the status of the area. The need for this type of housing will increase next year as more persons of refugee status will have received resident permits and will need move into this type of transit housing.

6.7.2.1 Conclusion

The Zero Alternative is *unlikely* to lead to any larger scale noticeable impacts on the need for services. But that is not to say that current service needs within the area are currently met, nor that they will be met in the future. Neither *will* this alternative inherently have any negative impacts on the module housing nor on the Ytterö clinic.

6.7.3 Zero Plus Alternative - Impacts

Assuming that the Zero Plus Alternative does not affect the demographics in Fagersjö, by perhaps making the area more attractive to move to, the impact on services will be the same as in the zero alternative (for a discussion on demographics, see chapter 6.9 on Population).

There is a possibility though that this alternative will lead to more foot traffic in the area. This combined with a clearing of trees may increase the visibility into the private grounds of the Ytterö clinic from the path running between their complex and

the shoreline. Should foot traffic increase representatives of the clinic have expressed that there some sort of screen would be raised; to block view and to ensure the privacy of the grounds (Ericsson & Wedell, 2016, personal communication, 21 December).

6.7.3.1 Conclusion

Any large scale noticeable impacts on the need or availability of services is *unlikely* to occur. But that is not to say that the current need for services is or will be met. Should foot traffic increase in the eastern parts mitigations *may* need to be put into place to assure the privacy for the patients at the Ytterö clinic.

6.7.4 Alternative One - Impacts

6.7.4.1 Impacts During Construction Phase

Depending on what order the area is built the early impacts on the need for services will differ. Should they decide to build the whole planned area at one time the need for services *will* instantaneously increase at the moment the buildings are ready for occupation. This might put a high pressure on services in the area to expand rapidly.

People with children in preschool (or of age to enter preschool at the time of moving) that move within the municipality of Stockholm have to queue for a space in a preschool in the area they are moving to. By doing so before moving to the new address the guaranteed admission stays intact, this means that the child will keep their placement in the old preschool until a new one is offered in the new borough (Stockholms stad, 2016f). But the guaranteed admission does also mean that children older than one years should be guaranteed a placement within three calendar months from the time of application or within the month stated in the application, should the space not be required straight away (Stockholms stad, 2016h). This means that preschool places must be made available within a month after the apartments are ready for occupants. The best availability of places within preschool is in the month of August when many children move on to school (Stockholms stad, 2016h). This combined with the notion that moving schools within duration of the school year can negatively impact their education implies that seeking to finalize the buildings during the summer months would could be a possible mitigation to both these issues.

There is an awareness within the City District Administration of Farsta that due to Farsta planning a lot of new housing developments, there will be a need to create more places in the school system (Averstedt, 2016, personal communication, 14 December). More schools are being planned but there is no available information on the implications of the plans on the future inhabitants of Magelungens strand (op. cit.). But it is *likely* that a sudden influx of students will put a lot of pressure on the schools in the area.

From looking at the websites of the general practitioners' offices in the area they seem able to accept new patients. We cannot say if they can handle the influx of new patients that 750-1000 new apartments would create, and that is without counting potential new patients from the new developments in Larsboda and Teliaområdet.

Another option is that they build the area in phases, in which case there will *likely* be a continuous increase in the need for services. Here issues might arise concerning private enterprises. If there is not enough people in the area to sustain a business, important private services such as food stores might choose to delay opening in the area. For the people living by Magelungsvägen in the area between the Ytterö clinic and Farsta sports hall this would mean a distance of either about 800 meters (as the crow flies) to the food store in Fagersjö (Lidl,

Havsörnsvägen 3), or about 700 meters to the closest food store in Farsta Centrum (Ica Kvantum, Storöplan).

When it comes to other services such as preschools, schools and general practitioners building in phases might make it easier to expand these services with increasing demand. One difficulty will remain though. It is fairly safe to assume that parents will put their children in preschool close to their homes, but the ability to choose what school one's child should go to makes it harder to assess how many children of school age that will actually need schooling in the vicinity of Magelungens strand.

As formerly mentioned in the section on Noise, A. Ericsson and N. Widell at the Ytterö clinic has expressed a concern with noise during the construction phase (2016, personal communication, 21 December). As the clinic handles patients with psychosis a calm environment is of high importance. In the run up to a recent refurbishment the option of moving sites during the construction phase was investigated. The conclusion was that temporarily moving the premises to avoid a period of construction would be hard to achieve. Another aspect is that many of the patients are recurrent visitors of the clinic and recognizing the site adds a sense of security to these persons. It is therefore *likely* that the construction will have negative impacts on the clinics operations.

The clinic receives daily deliveries and emergency vehicles often arrive at the premises (Ericsson & Widell, 2016, personal communication, 21 December). Ensuring accessibility for these vehicles during the construction process is of high importance. Currently 68 people work at the clinic, but the operations are expanding into a wing of the building that is currently unused taking the patients from 28 to 40. This will result in a total workforce of about 100 people. According to A. Ericsson and N. Widell, access to parking space is a factor in whether persons choose to work at the Ytterö clinic or not. This is especially important as the clinic is staffed at all hours and for some members of staff using night time public transport might be an unfavorable option. Thus it also necessary that access to parking is secured during the construction process.

An initiation of Alternative One would in the end lead to the temporary housing by Fagersjö having to move. When the houses are moved would have to depending on the order of building. Starting in the eastern parts could mean that the housing could remain a while longer until construction reaches the western area. Currently there are 44 people living in these houses, but these will be 88 once one of the modules have been restored from a recent fire. To assure a new space for the modules, applications for five new potential sites are awaiting approval (Mölgård, 2016, personal communication, 9 December). But finding space in Stockholm is difficult, therefore there is no guarantee that application approval for a new site for the modules will happen in time. These might therefore be a minor negative impact on access to temporary housing for newly arrived persons in the County of Stockholm.

6.7.4.2 Impacts During Operational Phase

As the project planning is in an early state, information concerning future services is thin. The general guidelines within the Stockholm region with regard to assuring access to education in newly developed areas is that 25 places should be made available at preschools and an additional 50 at comprehensive schools per 100 dwellings built (Klingwall, 2016, personal communication, 7 December). This would mean that there is a need of up to an additional 250 preschool placements and 500 placements at comprehensive schools. It is within the local council's responsibility to assure access to nursery schools, and plans have been made for at least one to be included in the development (Rivard, 2016, personal communication, 7 December). In these plans the preschool was meant to be placed

in an area with risk of flooding, in light of the changes to the placement of the buildings the current preschool plans might be affected.

It is hard at this stage to assess whether there will be positive or negative impacts on services in the area because the available planning material is incomplete. But should all needs be met then Alternative One is *likely* to have a major positive impact on access to services, especially for the people of Fagersjö.

Judging from the plans that have so far been shown to the Ytterö Clinic there *will* be major negative impacts on the clinic. Housing is planned on what is today their parking lot, meaning they risk losing parking space and there is also a risk that access for vehicles to their premises might be impeded. Some of the housing placed on their parking lot will result in apartments having a view straight into the bedrooms of patients which can be considered an intrusion on their privacy. As up to half the patients are forcefully committed there can be an extra perceived need of privacy and sense of anonymity for some individuals. More people living in the area *will* also mean more movement in the area. To assure the privacy of the grounds of the clinic A. Ericsson and N. Widell mean that there would be a need to section off the grounds by adding some sort of fencing, preferably in the shape of bushes.

The temporary housing for newly arrived persons will have disappeared from Magelungens strand by the operational state. This need not have a negative impact on the specific individuals living here as this housing is only meant to be used temporarily by people who have just received their resident permit and are looking for a more permanent living situation. But since finding a space for this type of housing in Stockholm is difficult, this space ceasing to house newly arrived persons *may* have a major negative impact on housing availability for this group in Stockholm as a whole, depending on the future number of persons in this group.

6.7.4.3 Conclusion

There is a high uncertainty on what the results from this alternative will be. Assuming that the increased needs for services are met and there is an influx of conventional services as a result from the development, the end result *will* be a major positive impact on access to services for the people of Fagersjö. But it is important to be sensitive to where to start to build and at what time of the year the apartments are ready for occupation. On the other hand, there could also be major negative impacts on the Ytterö clinic as their conditions change. The loss of temporary housing for newly arrived persons *may* also have a major negative impacts on availability of temporary housing for this group.

6.7.5 Alternative Two - Impacts

6.7.5.1 Impacts During Construction Phase

The issues that will need to be considered during the construction phase in Alternative Two are the same as in Alternative One.

6.7.5.2 Impacts During Operational Phase

As the plan is to build as many apartments in Alternative Two as in Alternative One the impacts will be the same as in Alternative One, with the difference that the majority of the apartments will be located in the eastern part of the plan area. With this might follow that there *likely* will be a concentration of services in this part of the plan area, something that might be negative for Fagersjö. It is therefore possible to assume that it is *likely* that there will only be minor positive impacts to the people of Fagersjö with regards to access to services.

6.7.5.3 Conclusion

Due to the concentration of apartments to the area closest to Farsta Strand, and subsequent *likely* concentration of services in this area. It is *likely* that this alternative will only lead to minor positive impacts on access to services for the people of Fagersjö.

6.8 Recreation

6.8.1 Environmental Baseline

Within the current park plan of Farsta district, the plan area in Magelungens strand is classified as a natural park referred to as Fagersjöstranden (Exploateringskontoret, 2007). In this plan Magelungens strand count as a green connection to other surrounding recreational areas. According to the City Planning Office (2007) the main recreational values that the site provides is contact with water, a place to walk, unexploited nature and a landscape scenery. Walking and jogging were the most popular activities listed to do in the area by the people that we spoke to during our interviews in Farsta (interviews, 5 Dec 2016). Other activities mentioned by the respondents, included by selection; swimming, fishing, boating, picking mushrooms and berries, biking and skating on the lake in winter. 42 people were interviewed in total, seven out of the 26 persons interviewed that knew of the area did not use it in any way. Most people that spend time in the area do it between one to five days per month.

When speaking to people at the City District Administration we also found out that Magelungens strand is perceived as eerie, causing people to avoid walking there (Ekholm, 2016, personal communication, 7 December; Rivard, 2016, personal communication, 7 December). The notion of the area being unpleasant is also voiced by youth interviewed in Farsta in 2010 as a preparation for the Farsta-Högdalen programme (Lindgren, 2010a). In our interviews we did not ask what time of the day people preferred to spend their time in Magelungens strand, but judging from the listed activities it is possible to theorize that daylight may be a factor in people's tendency to spend time in the area. Many of these activities require daylight, and perhaps people do not spend time in the area to the same extent after dark, especially seeing as absence of daylight can often create feelings of insecurity (Lindgren, 2010b).

The area is today quite inaccessible to people with problems of mobility. Magelungsvägen does not have many steep slopes, but Fågelviksbacken, the road that one would walk on to get access to the natural values in the areas, is too steep in parts when assessed against the National Board of Housing, Building and Planning's criteria for accessibility for walking surfaces (BFS 2011:5 ALM 2). Getting close to the shoreline in the current state of the area is impossible in a wheelchair apart from by going across Farstanäsbron. There is also a lack of benches which is an issue for people that struggle to walk long distances at a time. The fact that Fågelviksbacken is a shared traffic space can be an issue for people with orientation difficulties, this group includes persons with low vision and persons with cognitive deficiencies, including children (Klerby Blomqvist, 2016). But this should not be a large issue since the road is hardly used. When it comes to orientation the road should be easy to follow, as it is clearly laid out with no apparent obstacles. Furthermore, the contrast between the gravel and green surfaces acts as a tactile path for people using a white cane.

6.8.2 Zero Alternative - Impacts

The Zero Alternative is unlikely to have a notable impact on the recreational value of the area since the area's characteristics will remain similar within the 20-year-time-frame. Even though the characteristics of the forest is likely to change to some extent with time if no management procedures are put into effect. The recreational value of the lake can change depending on the actions taken for improving the water quality. Since there is a

goal for improving water quality in the lake, it can be assumed that this alternative is likely to have a positive impact on the recreational value on the lake and its surroundings. Though, if no actions are taken, the lake will get more eutrophic. This would in turn likely affect some recreational activities in the area negatively such as swimming, boating and fishing. Another thing to consider is that it is people living outside the area that come here for recreational activities. With an increase in population in Farsta borough there is a chance that there will be more people willing to spend their time here.

The impact on the accessibility of area is likely to be of minor significance. The accessibility and orientability, especially to the shoreline, is likely to remain the same if the area is left undeveloped. However, the idea of making the shoreline more accessible would not necessarily disappear just because the housing development does not get built. The Development Administration has expressed an interest in creating a promenade along the shoreline at an earlier stage (Exploateringskontoret, 2007). A more accessible shoreline could increase the number of people using the area for recreational activities. This could potentially also make the shoreline more accessible for persons with disabilities, but that depends on how they plan to mitigate the inclination between the lake and Magelungsvägen, in the area on the verge between the Magelungens strand and Fagersjö.

6.8.3 Conclusion

Overall the characteristics of the area is estimated to remain somewhat similar and so are the possibilities for recreation. Based on this, the conclusion is that the Zero Alternative is *likely* to result in no notable impact on recreation.

6.8.3 Zero Plus Alternative - Impacts

The Zero Plus Alternative is likely to have a positive impact on the recreation in the area since it includes improving the natural and recreational qualities such as a species rich oak forest and walkways. A more intensive maintenance of oaks will result in less overgrown and thinned forest which can increase the accessibility to areas outside Fågelviksbacken for pedestrians and therefore possibly enhancing the possibilities for recreational activities in these areas for those individuals.

Improving and making walkways more clear will also positively affect the possibilities of walking and jogging. Because Fågelviksbacken is considered culturally significant making abrupt changes to it might be hard to do whilst maintaining the same appearance. There would therefore be a need to balance visible changes against opportunities to enhance the accessibility for people with disabilities, such as clearly separating bicycles from pedestrians and potentially even more extreme changes, such as evening out inclinations,

Today, the traffic on Magelungsvägen cause a lot of noise in Magelungens strand and contributes negatively to the experience value of the area. Some research has found that silence and calmness are some of the most important characteristics that people look for when visiting green spaces in urban areas (Peschardt & Stigsdotter, 2013; Stigsdotter & Grahn, 2011). Therefore, the establishment of a noise barrier along Magelungsvägen is likely to have a notable positive impact on the recreational value of the plan area.

Grahn and Stigsdotter (2003) have found in their research that one important obstacle hindering people from visiting green outdoor areas environments in urban areas is the feeling of unsafety, even more so during evenings. Woodlands with lower tree density have been found in some research to be considered safer than those with higher tree density (Jorgensen et al., 2002;

Kuo et al., 1998). Thus a thinning of the trees is therefore likely have a minor positive impact on people's feelings of security in the area. If combined with better lighting along Fågelviksbacken it is even likely that there would be a major positive impact to the sense of safety, this would in turn also increase orientability for people with impaired vision. The thinning would also add a further sense of depth. Considering Ulrich's (1986) list of attributes that increase preference for unspectacular natural scenes this is very likely to make the area more preferable, in turn increasing the chances of more people wanting to spend time here.

6.8.3.1 Conclusion

Overall there will be some improvements from a recreational perspective such as maintaining the forest, improving the walkways and establishing a noise barrier. Based on this, the conclusion is that the Zero Plus Alternative is *likely* to result in minor positive impact on the recreational value of the area.

6.8.4 Alternative One - Impacts

6.8.4.1 Impacts During Construction Phase

The building phase of the planned project will have a major negative impact on the recreational value of the area. Increased noise will likely lead to people choosing to spend time in other areas, seeing as calmness is a trait sought after in nature areas. It is also very likely that the visual impact from construction will decrease the amount of people choosing to spend time in the area.

The construction may also have a negative impact on recreation in other close by areas such as Fagersjö Forest, depending on the noise level. There is also a possibility that the accessibility to Magelungens strand gets impeded at times during the construction phase. Especially in the areas closest to Fagersjö, where there is a risk that access to Fågelviksbacken could be impeded as buildings are planned to lie very close to this road and there might be a need to do works in the vicinity of the buildings.

6.8.4.2 Impacts During Operational Phase

Since the final plan of the project is not finished, the impacts of this phase are somewhat uncertain. Alternative One means turning parts of this nature area into an urban living area. This can entail both a positive and a negative impact on the area's recreational value, depending on visitors' preferences. Judging from our interviews the planned area is mostly used for walking and jogging, and it is certain that the possibilities for these activities will remain. The preference to doing these activities in Magelungens strand might even increase with the establishment of the promenade and wharf park. This could in turn have positive effects on human health. The increased access to the shoreline is also likely to have a positive impact on water activities in the lake such as swimming, boating and fishing. However, the possibilities for the water activities are also dependent on the water quality. Should the wharf park negatively affect the water quality, then this is very likely to have a negative impact on the level of water-bound recreation.

The social aspect is also an important factor which influences the use of green areas (Schipperijn et al., 2010). As the project plan includes creating meeting places between the houses and along the shoreline, it is likely to entail a positive impact on the recreational value of the area. The planned promenade around Lake Magelungen together with the wharf park along the shoreline increases accessibility for pedestrians in the area. These may also draw more visitors to the area and make them spend more time doing recreational activities.

If the developers responsible for public spaces follow the recommendations in the law concerning accessibility and orientability ALM 2 and the guidelines set out in the handbook "Stockholms - en stad för alla: Handbok för utformning av en tillgänglig och användbar miljö" by Klasson et al (2008), then at least the built areas near the housing developments should good for people with disabilities. Though to ensure that this happens limited research in this field has implied that accessibility consultants need to be involved at an early stage of working with the detailed plan before fundamental decisions are made (Klerby Blomqvist, 2016).

Building a bridge for bicycles and pedestrians over Nynäsbanan and Magelungsvägen between Magelungens strand and Fagersjö forest will increase accessibility to the area from central Farsta. Whether it will increase accessibility and orientability for people with disabilities depends on the final design and also on the usability of the paths that the bridge connects to. An increase in public transport following the increase of inhabitants in the area also increases the likelihood of people coming to the area to spend time. A support for this claim is that youth in Högdalen claim that they would spend more time in Fagersjö and Farsta if public transport between there and Högdalen was improved (Lindgren, 2010a).

Reducing green surfaces and natural values was mentioned by the public as the main possible negative outcome of this project (interviews, 5 Dec 2016). According to WHO (2016), green areas are important for mental health and physical activities in natural environments can remedy stress and mild depression. Studies have shown that the three most popular reasons why people visit green areas are to enjoy the weather, exercise and reduce stress/relax (Schipperijn et al., 2010; Stigsdotter et al., 2010). In the plan area, experiences related to natural characteristics of the landscape will be decreased, as the area will be turned into an urban neighborhood and the amount of people will increase remarkably. This is likely to cause a major negative impact on the amount of people visiting green areas in order to relax since they usually seek for calm, wild and untouched natural environments (Peschardt & Stigsdotter, 2013). However, the relaxing value of the area is already affected negatively today, by the noise from the road Magelungsvägen.
New dwellings mean more people and activity in the area, which can have a positive impact on the people's feeling of safety and therefore the recreational value of the area (Lindgren, 2010b). Important to consider though is that a study in Stockholm of multi-family housing areas showed that social knowledge, that is; knowing whether someone belongs to your neighborhood or not, is an important issue when it comes to the feeling of security (ibid.). This means that even though people passing through the area might experience a heightened sense of security, there is a minor risk that the people that live here will experience a feeling of insecurity due to strangers passing by. This might be mitigated by the trees creating a barrier between Fågelviksbacken and the housing complexes, thus giving the impression that strangers are at least not walking around in the adjacent green spaces connected to the houses.

One group in Farsta that potentially could increase their time spent in the area in an Alternative One-scenario is the youth. Eight individuals aged 15-19 interviewed at Farsta Youth Café in preparation for the Högdalen-Farsta programme expressed a dislike of the area surrounding Fagersjö as it is today, but without being able to explain the reason behind their sentiments (Lindgren, 2010a). What most of them did explain in response to a different question was that they perceive the forest as scary. In light of this, the Alternative One type of development where there is a mix of natural and urban areas, might create an environment where youth of this sentiment can approach nature in a setting where they might feel more comfortable. Thus it is

likely that Alternative One may have a major positive impact on time spent in green areas by youth.

Making the area more active with more people and services may also increase the feeling of safety in the plan area. An increased feeling of safety is likely to enable people to relax more easily which is one of the important reasons why people visit green spaces, as mentioned above. The planned project implicates more people in Magelungens strand and people gathering together which may result in increased littering and therefore affect the recreational value of the area negatively. Litter affects how an environment is experienced and can increase the feeling of insecurity and decrease the attractiveness of a place (HSR, 2016; Lindgren, 2016b). However, littering can be prevented by well-placed trash bins for example.

6.8.4.3 Conclusion

Overall the possibilities for recreational activities is *likely* to slightly increase when new walkways, social green areas and the wharf park is built. The accessibility of the area and between other recreational areas *will* improve as well. Though, reducing the green area and the natural values is *likely* to affect some recreational values adversely. Based on this, the conclusion is that the Alternative One is *likely* to result in a minor positive impact.

6.8.5 Alternative Two - Impacts

6.8.5.1 Impacts During Construction Phase

Alternative Two, which means avoiding building in the shore protection area, is estimated to have similar impacts as Alternative One, though in a somewhat smaller spatial scale. The negative impacts on recreational activities during the building phase will be similar to Alternative One, mainly concerning issues of visual and noise pollution. The main identifiable difference during the operational phase is that the minor negative impact of the possible temporarily impeded access to Fågelviksbacken is more unlikely to be an issue in this alternative as the buildings in this area will not come as close to this road.

6.8.5.2 Impacts During Operational Phase

Building in a smaller scale along the road Magelungsvägen will have both positive and negative impacts on the recreational value of the plan area. The impacts in the operational phase are similar in both Alternative One and Alternative Two. The difference to Alternative One, the proposed plan, is that in Alternative Two a bigger part of the green area will be protected which can be considered as positive from a recreational perspective. Since Alternative Two means avoiding establishments along the shoreline such as walkways, there will not be the same positive impact with increased access to the shoreline as in Alternative One which would mean that it is very likely there will be no increase in foot traffic due to accessibility of the shoreline.

6.8.5.3 Conclusion

Overall the possibilities for recreational activities is *likely* to remain the same even if new housing was built along Magelungsvägen. The accessibility of the area *will* not change notably since the shore protection zone will be protected from establishments. Reducing the green area and the natural values may affect the recreational value adversely. Based on this, the conclusion is that the Alternative One is *likely* to result minor negative impact.

6.9 Population

6.9.1 Baseline

One of the main issues raised in the programmes leading up to the Magelungens strand project is that the neighborhood Fagersjö is both physically and socially segregated from the rest of Farsta to the east, and from Högdalen to the northwest. Therefore, aside from creating new housing, one main aim of the project at Magelungens strand is to connect Fagersjö to Farsta Centrum and Farsta Strand.

"The study of segregation is, at one level, the study of variance in neighborhood characteristics. That is to say, the amount by which the population in one place varies compared to the expected mean level" (van Ham & Manley, 2014, 248)

The notion that Fagersjö is segregated in comparison with the surrounding areas is confirmed by regional statistics. Compared to the whole district of Farsta and to Greater Stockholm, Fagersjö have a slightly higher percentage of inhabitants aged 1-19 years, and a slightly lower percentage of the population aged 65 years and above (Stockholm stad, 2016i). In Fagersjö the unemployment is more prevalent in the ages for the ages 25-54 (8.1 percent of the population) than in Farsta district (3.9 percent) and in Greater Stockholm (3.2 percent) (Stockholm stad, 2016i).

In population statistics for 2016 the people of Fagersjö are likely to have a lower income compared to Farsta district as a whole and Greater Stockholm (Sweco Society, 2016). 75.4 percent of the population make 310 900 SEK a year or less, whilst the equivalent income group in Farsta district make up 66.8 percent of the population and 58.5 percent of the population in Greater Stockholm fit into this income bracket (ibid.). The people of Fagersjö generally also has a lower degree of education. In Fagersjö 30.3 percent of the population has attended university, whilst 39.6 percent has done so in Farsta District and 51.8 percent of the population of Greater Stockholm (op. cit.).

Looking at this kind of statistics it is important to keep in mind that it has been highly criticized as a measure for segregation. Östh et al. (2014) have argued that there are two major shortcomings in existing measures of segregation. Firstly, the existing methods do not measure segregation as a phenomenon that affects individuals, it rather describes information about an abstract spatial structure. Secondly, pre-defined statistical areas within urban areas in Sweden have differences in residential patterns, this issue of difference in scale between statistical aggregates mean that some statistical comparisons may produce the faulty results. Since Fagersjö is a residential area framed by virtually uninhabited areas the issue of administrative units is not likely to be an issue when assessing the statistics of Fagersjö. Though when investigating segregation of visual minorities, Öst et al. (2014) also identified an issue of residential sorting; especially when looking at Stockholm the researchers found the issue that residential segregation of visible minorities exists even at the very lowest levels of the urban hierarchy.

Residential sorting appears to be an issue in Fagersjö. One borough official, Jan Ekholm (2016, personal communication, 7 December) described Ejdersvägen and Vildandsvägen in the neighborhood as "two different worlds", indicating that there might be a concentration of vulnerable groups within Fagersjö as well. The main population growth in Fagersjö at the moment is happening through births, but since 2012 there has been a small pattern of more people moving away from the area than there are moving in. The prognosis of population development until 2025 estimates the population of Fagersjö to increase by 117 people, this prognosis takes into consideration that the Magelungens strand area is built and that all the apartments are

inhabited (Sweco Society, 2016; Saarinen, 2016, personal communication, 14 December). This means that the expected population growth is likely to take place within the current housing stock in Fagersjö, since the population growth would be larger if Magelungens strand counted as part of Fagersjö.

The vast majority of the people that received a rental apartment in Fagersjö in 2015, had queued for eight to ten years (Bostadsförmedlingen, 2016). In Farsta Strand people queued for at least eight to ten years, but half of the people receiving housing had queued from ten to 16 years. For central Farsta the eight to ten year bracket of people queuing was the most voluminous one, followed by ten to twelve and going all the way up to 20 years, but with a few apartments actually being occupied after only two to eight years of queuing (ibid.).

6.9.2 Zero Alternative - Impacts

Should no measures be done in the project area there is a risk that the imbalance of people moving to and from Fagersjö might persist. Should that be the case then the there is a risk of the segregation being further emphasized, resulting in that there may be a major negative impact to the area. Studies show that a key determinant of choice in the residential housing market is finance (van Ham & Manley, 2014). Van Ham and Manley (2014, 253) claim that "housing and neighborhood outcomes are the result of an interplay between preferences, opportunities and restrictions on the one hand, and housing stock availability and allocation mechanisms on the other".

In the Stockholm housing market, where earning the right to an apartment through the housing queue system can take many years, the people who are most likely to move are those that can afford to buy an apartment or people who have been established for a long time in Sweden and thus been able to queue. The long queues to acquire a rental apartment can also specifically be more of an issue here as it is an area where most of the population growth is due to births, assuming that the people growing up here, would also like to continue living in this neighborhood.

6.9.2.1 Conclusion

Overall, due to the risk of increasing segregation in the area the Zero Alternative is assessed as *likely* to have a minor negative impact on population.

6.9.3 Zero Plus Alternative - Impacts

In the Zero Plus Alternative the planned housing is not built, but some maintenance is done to preserve natural values in the area. The impacts on population will very much remain the same if the area stays as it is today. Although there is a chance that a better maintained forest could increase the attractiveness of Fagersjö, causing more people to be interested in moving here. But that is merely speculation.

6.9.3.1 Conclusion

Overall, due to the risk of segregation increasing in the area the Zero Alternative is assessed as *likely* to have a minor negative impact on population.

6.9.4 Alternative One - Impacts

6.9.4.1 Impacts During Construction Phase

During the building phase there is a risk that the population in Fagersjö becomes even more segregated from Farsta than they are today. Redesigning Magelungsvägen may impede traffic, making it hard for the people of Fagersjö to get to Farsta by bus or car. Depending on the order of building, any positive effects might take time to manifest. As it looks in the promemorium for Magelungens strand, the area has been split up in three sections. If construction should start in the east (which is referred to as

section one) any possible benefits to Fagersjö, like an increase in public transport, are likely to be delayed until the north-western areas are finalized and thus new needs created.

6.9.4.2 Impacts During Operational Phase

Adding between 750 and a 1000 new dwellings, out of which 60 percent are condominiums is likely to affect the demographics in the area. Average income is likely to go up in the area Fagersjö-Magelungens strand, and assuming that education leads to higher wages it can be assumed that people in Magelungens strand will be more likely to study at university. People living in Fagersjö today feel like they do not have sufficient access to different services (Lindgren, 2010a). There is potential for access to services to be somewhat mitigated through the establishment of stores, café and restaurants in buildings in Magelungens strand. But that depends on whether they offer the specific services that the people of Fagersjö actually need, and whether they perhaps will also be able to offer job opportunities to the unemployed in Fagersjö.

There are reasons to believe that building this kind of area might actually have some positive impacts on segregation. Lilja (2008) studied four suburbs in Stockholm and came to the conclusion that the built environments can create opportunities for meetings. By becoming a space of interaction these places can act as an invisible counter force to segregation. The wharf park has the potential of becoming this kind of counter force, as can places like cafés.

Lilja also emphasizes that there is a need to have a perspective from within the suburbs to come up with the positive impacts to counteract segregation and this is something that Farsta district seems to have attempted to do. The programme Högdalen-Farsta have had two hearings during its production, which we have been able to access. One involves organizations from quite a wide area, where Fagersjö is represented by the association Fagersjö Trädgårdsstad, and to some possible extent by Magelungens Vänner (Eng. Friends of Magelungen), an organization that works for the improvement of Lake Magelungen (see Göransson, 2010). It is possible that the negative responses to the idea of housing development in Magelungens strand from this hearing was due to the specific natures of the associations represented. The second hearing was with youth in different youth cafés in Rågsved, Högdalen, Fagersjö and central Farsta (see Lindgren, 2010a). Judging by their responses they were mostly positive to the idea of building residential housing with different services in Magelungens strand. According to Cecilia Rivard (2016, personal communication, 7 December) at Farsta district there was another public hearing that went on for three days in Fagersjö, in which the locals were able to state their opinions, and the responses to building in Magelungens strand were mostly positive. But we have been unable to get hold of the notes from this occasion.

6.9.4.3 Conclusion

Overall, the project counteracts segregation by building attractive housing and spaces for interactions within the vicinity of Fagersjö and is assessed as *likely* to have a major positive impact on population

6.9.5 Alternative Two - Impacts

6.9.5.1 Impacts During Construction Phase

The possible impacts are the same as in Alternative One.

6.9.5.2 Impacts During Operational Phase

The possible impacts are the same as in Alternative One with a few exceptions. By not building the wharf park along the shoreline the opportunity of this space becoming a counter force

to segregation is lost. A decrease in apartments close to Fagersjö, and an emphasis on apartments close to Farsta Strand, could mean that the connection of Fagersjö to the rest of Farsta does not get as strong. Depending on the amount of apartments that will be built, this might also affect the basis for establishing services in this part of the planned area.

6.9.5.3 Conclusion

Overall, the project counteracts segregation by building attractive housing and is still assessed to be *likely* to have a minor positive impact on the population of Fagersjö.

7. Summary of the Environmental Impact Assessment: Conclusion and Comparison of Alternatives

7.1 Summary of Impact Assessments

7.1.1.1 Zero Alternative

An overall assessment of the Zero Alternative shows that the impacts of "no action" are likely to be either insignificant or minor (see **Table 4**). The aspects which are likely to be slightly affected are noise and population. The aspects, which are estimated to not be notably impacted, since the conditions remain the same, include landscape scene, cultural heritage, ecology, air quality, services and recreation. The level of noise, that is already an issue in the area, is expected to further increase as the number of cars and traffic are expected to increase in the municipality of Stockholm. Regarding the population in Fagersjö, there is a risk for a further segregation if no measures are taken in order to prevent the current development.

7.1.1.2 Zero Plus Alternative

The Zero Plus Alternative includes improving conditions for flora and fauna, existing walkways and reducing noise by establishing a noise barrier. This alternative will have the comparatively largest positive impact on ecology; strengthening the ecological environment by maintaining oaks and improving the ground-bound movement by building an ecoduct and frog tunnel. Managing the forest is likely to reduce the runoff in the long run, which will contribute positively to the water quality in the lake. There will also be minor positive impacts on the landscape scene, cultural heritage, recreation, noise and air quality, but the increase in foot traffic may lead to mitigations being needed to assure the privacy of the psychiatric clinic Ytterö.

Maintaining the oaks and the forest is likely to have a positive impact on the landscape scene but also on the cultural heritage, which in turn is also impacted positively by an increased access to the cultural heritage sites when the forest is thinned. By enhancing the natural values, improving the walkways and reducing the noise, the areas recreational value is likely to increase. The noise barrier is also estimated to improve the air quality in the area.

7.1.1.3 Alternative One

Alternative One is the alternative presented by the Exploitations Office in the promemoria and intend to help fill the need for housing in Stockholm whilst connecting Fagersjö to central Farsta. The development will be concentrated adjacent to Magelungsvägen. The main negative environmental impact from this alternative would be on the landscape scene, cultural heritage, the ecology and the water environment while impacts on social and health aspects vary between not notable to positive.

On one hand, if no sufficient mitigations are put into place, there is a high probability that Lake Magelungen becomes more polluted due to an increase in gray water. There will also be a negative impact on the oak forest and biodiversity due to a decrease in habitat. On the other hand, the accessibility to services for the people of Fagersjö is likely to increase and with the introduction of new buildings and spaces of interaction nearby there is a chance that the segregation of Fagersjö will decrease. Noise levels within the plan area will likely decrease due to the design of the buildings which may result in positive impacts on both recreation and animal life. As some people may choose not to spend time in the area as it changes from a natural environment into a more urban one, others, such as adolescents, may feel more comfortable in this new urban green space. If planned accordingly, the site and especially the shoreline may also become more accessible for people with disabilities.

It is important that assurances are made to secure the operations at the Ytterö clinic both during the construction process and at the operational stage. Emergency vehicles' access must be assured as well and the privacy of the patients maintained as foot traffic in the area increases.

7.1.1.4 Alternative Two

Alternative Two includes the construction of three high-rises in the area the project takes the following factors into consideration; keeping buildings out of the shoreline protection zone, conservation of valuable areas of oak forest and avoiding to build in areas in risk of flooding. This alternative also includes the construction of an ecoduct and noise barriers.

This construction alternative is assessed to have major positive impacts on the ecology due the efforts made to conserve oak habitats and the construction of ecoducts. The landscape scene, cultural heritage qualities and water quality is likely to be impacted somewhat similar to Alternative One. Regarding the social aspects this alternative is expected to have a minor positive impact on population and services while recreation is assessed to suffer some minor negative impacts. Accessibility for people with disabilities to the green areas may not increase as much in this alternative. With the introduction of noise barriers and a change of speed limit there will be a major decrease in noise within the area.

Just like in Alternative One care and consideration will need to be shown to the Ytterö clinic to assure that their needs of privacy and accessibility for emergency vehicles are assured.

7.2 Discussion - Comparison of Alternatives

We have chosen to compare the alternatives using an impact chart (**Table 4**). The impact chart shows magnitude and type of impact but does not include the probability of the impact. The probability of the impacts can be read from the conclusion part for each alternative in each aspect.

From an ecological sustainability perspective, the Zero Plus Alternative is considered the most positive since it is likely to result in several positive impacts on the environmental aspects. Though, the purpose of the project is to build new housing in Stockholm and to connect the isolated neighborhood of Fagersjö to the core of Farsta. This is something that the Zero Plus Alternative will not be able to achieve. The Alternative One can be considered to be the least ecologically sustainable since it is likely to have both major and minor negative impacts on several aspects, the biggest negative impact on ecology. The impact on

ecology is not only troublesome on a local scale, but also on a national, as this type of oak habitat is very rare in all of Sweden.

The negative impacts of the Alternative One are compensated to some extent by major positive impacts on several other aspects. One of the important issues in Alternative One is also the need of partially suspending the shore protection. The Alternative Two was formed, especially to avoid the need of repealing the shore protection. In Alternative Two the sensitive shore environment is left untouched while still building along the road Magelungsvägen. The main difference between Alternative One and Alternative Two is how the new housing areas are spread out. The housing in Alternative One will be more evenly spread out over the entire plan area, possibly affecting a larger area for a longer time. The housing in Alternative Two will be concentrated to the eastern part, possibly affecting this particular area for a longer time. The Alternative Two still fulfills the project's purpose, providing new housing and creating a physical connection between central Farsta and Fagersjö, but the necessary increase in services and spaces of interaction might not be as notable in this alternative.

Major positive impact	*Major positive impact on national, regional or municipal interests and objects. Alternatively improvement of currently exceeded environmental quality standards, national guidelines or environmental thresholds.*
Minor positive impact	*A positive impact that does not constitute a Major positive impact.*
No impact	*No notable impact*
Minor negative impact	*A negative impact that does not constitute a Major negative impact.*
Major negative impact	*Major negative impact on national, regional or municipal interests and objects. Alternatively exceeding environmental quality standards, national guidelines or environmental thresholds; or clearly worsen currently exceeded environmental quality standards, national guidelines or environmental thresholds.*

FIGURE 14. FIVE STAGE SCALE TO ASSESS IMPACT.

	Zero Alternative	Zero Plus Alternative	Alternative One	Alternative two
Landscape scene	No notable impact	Minor positive impact	Minor negative impact	Minor negative impact
Cultural heritage	Minor negative impact	Minor positive impact	Minor negative impact	Minor negative impact
Ecology	Minor negative impact	**Major positive impact**	**Major negative impact**	**Major positive impact**
Water environment	No notable impact	Minor positive impact	Minor negative impact	Minor negative impact
Noise	Minor negative impact	Minor positive impact	**Major positive impact**	**Major positive impact**
Air quality	No notable impact	Minor positive impact	No notable impact	No notable impact
Services	No notable impact	Minor negative impact	Minor positive impact	Minor positive impact
Recreation	No notable impact	Minor positive impact	Minor positive impact	Minor negative impact
Population	Minor negative impact	Minor negative impact	**Major positive impact**	Minor positive impact

FIGURE 15. WEIGHTED PREDICTED IMPACT PER ALTERNATIVE AND IMPACT TYPE. COLORS CORRESPOND TO THE SCALE OF IMPACT

7.3 Follow Up and Monitoring

Depending on which alternative is pursued, there will be different aspects that are important to monitor.

7.3.1 Zero Alternative

If no action is taken, the municipality should still follow up the idea of socially connecting Fagersjö towards Farsta. This may be done through other building projects or by other projects. The municipality should also look into how to make the walk along Fågelviksbacken to feel more secure. The predicted turnover from oak-dominated broadleaf forest towards spruce-dominated forest should be monitored regarding biodiversity values within the area and connectivity to surrounding areas.

7.3.2 Zero Plus Alternative

If this alternative is realized, the municipality should still follow up the idea of socially connecting Fagersjö towards Farsta. This may be done through other building projects or by other projects. The impacts from constructing an ecoduct is of national interest, since the implementation of such in a city environment is quite rare. How connectivity is affected by the ecoduct should therefore be monitored. Frog usage of the frog tunnel should be monitored, in order to assess the usage and importance of the tunnel.

7.3.3. Alternative One

If this alternative is realized, the main goals of the project will have to be monitored. The effect of the new area on segregation is an aspect that would be important to follow up on, to identify factors that are important when building away segregation and if there is experience that can be brought into similar projects.

The amount of noise will have to be monitored, especially during the building phase and at the facade, especially if it takes time to implement the new speed limits at Magelungsvägen. Noise monitoring would be needed during construction phase at the hospital and by new build apartments, if construction is going on while people are moving into the new areas. Air quality would be important to monitor during the construction process to ensure that no health thresholds are breached. The water quality has to be monitored, for further eutrophication and leaching of heavy metals into runoff water. The impact on remaining oak forest should be monitored in order to see if the management is adequate and if the remaining oak population is viable.

7.3.4 Alternative Two

The same monitoring as for Alternative One and for Zero Plus Alternative should be performed.

7.4 Conclusion

The purpose of an Environmental Impact Statement is to make it possible to compare the risks and benefits of different alternatives. During our assessment we have found that the end goal for the municipality is unclear. Many documents will speak of the value of nature, the green wedges and the importance of protecting and preserving valuable green areas. At the same time the comprehensive plan for Stockholm, which is currently on display for consultation, identifies the green wedges as areas for possible development.

The main problem in an assessment like this one is weighing the issue of Stockholm needing more housing against the loss of rare and valuable natural areas. By introducing Alternative Two we have tried to achieve the smallest possible impact on ecology whilst still contributing to the need of housing. But finding a one-size-fits-all solution to this area is proving harder than we first anticipated. Many of the possible benefits such as combating segregation and improving access to services for the people of

Fagersjö would not be as strong in Alternative Two. Weighing human day-to-day well-being against what some would consider the inherent value of natural areas is not an easy task to do.

If the issues that are outlined in this statement are adhered to and proper mitigations are put into place, we believe that there are good reasons why exploitation of Magelungens Strand should occur. For this to happen there is still an issue that needs to be resolved: in order for exploitation to take place, the city of Stockholm should clarify what should be prioritized above the other - rare natural areas or the need for housing.

Final reflections

The work of writing an EIS has given rise to a number of issues regarding the work of creating an EIA for projects in the Stockholm region. These are the final reflections from all five groups that have been doing EIAs of five different areas during this course. The areas were Hammarbyskogen, Kymlinge, Larsboda, Magelungen and Riddersvik.

- The municipalities have sometimes decided to split a larger project into several smaller ones. This can be a sign of them trying to avoid having to make an EIA.
- Most of the municipalities have estimated that an EIA is not needed for the projects. Since some of the impacts in the EIS:s in this paper have been major negative, another sign of the municipalities avoiding to make EIA:s can be said to be found. Together with the municipalities splitting projects into smaller ones, one can say that there is a tendency that the municipalities are showing an "avoidance syndrome" concerning the EIA process.
- Overall, coordination between the regional plans and the local plans is needed. The regional planning is concerning infrastructure while the municipalities themselves are to decide if and where to contribute with new housing units. This have given rise to gaps between goals when state authorities and regional plans count on the municipalities to do their part, while the municipalities have other plans. With this, the regional plan becomes subordinated the local plans, especially since the municipalities have planning monopoly in Sweden and there are no sanctions for not building more housing units or not following the regional plan. There is also a need for infrastructure planning to go well with future housing planning in order to create better conditions for the future.
- Goals to preserve natural values can sometimes stand in conflict with goals of developing infrastructure and the housing situation in Stockholm. Often, the most attractive places are also the most vulnerable.
- There could also be a better collaboration between the municipalities to create better relations and to make sure they are all contributing to reach the regional goals.
- To create better conditions for the EIA process, there should be certain standards and data for the municipalities to provide and keep track of, for example noise level maps.
- Overall, a lack of relevant information have limited the work with these EIA:s. For most of the projects described in this report, a detail development plan has not been available but only "starting PM":s giving an overview of the planned projects. For some, the plans have even changed during the working process, which have caused problems and confusion.
- If an EIA is not carried out, major negative, or positive impacts from a project risks not being found or highlighted. With this report, some major impacts have been found that can help decision makers when developing the proposed new residential areas.

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Photos

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Appendices

Appendix 1

Data collection variables

The following values were collected during oak inventory.

Position in SWEREF99 TM.

Circumference at 150 cm height, in cm.

Crown-formation as thin-crowned/in between/hedge crowned.

Hollows present/not present.

Threats present of buildings or ant hills within 10 meters, notable wear from humans or overgrowth. Buildings were recorded as houses, roads or prepared walkways. Notable wear was recorded as e.g. broken branches, signs of climbing, nailed items or walkways within 5 meters. Overgrowth was recorded as the need of thinning out, if the crown was surrounded by other trees in southerly direction, as high or higher, within 5 meters.

Classification

Values from data-collection were quantified using a reduced classification system (based on Nilsson, 2007). Values not quantified was used for qualitative analysis.

Size at 150 cm height (circumference converted to diameter)

<1,3 m = 1

1,30-2,0 m = 2

>2,0 = 3

Hollows

Present = 2

Other = 0

Crown form

Hedge-branched = 1

Other = 0

Classification table

Sum of 1-2 = class III (corresponding to class II or III using full classification[1])

Sum of 3-5 = class II (corresponding to class I, II or III using full classification[1])

Appendix 2

Magelungen frågeformulär, swedish version

Hur gammal är du?

Ditt svar

Vilken könsidentitet identifierar du dig med?

Man

Kvinna

Övrigt:

Bor du i Farsta kommun?

Ja

Nej

Arbetar du i Farsta kommun?

Ja

Nej

All (1)

Känner du till Magelungens strand? [Visa området på karta]

Ja

Nej

Känner till Magelungens strand

Hur använder du Magelungens strand idag? (Följdfråga: något mer?)

Ditt svar

Hur många dagar i månaden gör du något i Magelungens strand-området?

Ditt svar

Vet du om några andra områden i närheten som du skulle kunna göra samma saker i? Var? (Följdfråga: Något mer?)

Ditt svar

All (2)

Det finns planer på att bygga mellan 750-1000 nya lägenheter och butiker i området, från Fagersjö till Farsta idrottsplats. Man planerar även att bygga en gångbro över järnvägen och att förbättra möjligheten att gå ner till vattnet.

Vad tänker du kan vara positivt med planerna? (Följdfråga: Något mer?)

Ditt svar

Vad tänker du kan vara negativt med planerna? (Följdfråga: Något mer?)

Ditt svar

Tror du att Fagersjö skulle bli mer sammankopplat med resten av Farsta genom att bebygga området?

Mer

Mindre

Övrigt:

Om projektet genomförs, tror du att du skulle spendera mer eller mindre tid i området, jämfört med idag?

Mer

Mindre

Övrigt:

Bor du i Fagersjö?

Ja

Nej

Bor i Fagersjö

For people who live in Fagersjö

Tycker du att Fagersjö är en isolerad plats?

Ja

Nej

Skulle du åka kollektivt (t.ex. buss eller tunnelbana) mer om Magelungens strand bebyggdes?

Ja

Nej

Magelungens strand har potential att bli ett mindre centrum med caféer och butiker och en gångbro över järnvägen. Tror du att du skulle vara mer i området om det bebyggdes?

Ja

Nej

Avslut

Delar av planområdet ligger inom strandskyddet. Det innehåller gamla ekar och är en del av Stockholms Gröna kilar, som sammankopplar yttre skogar med stadens parker. Samtidigt har vi bostadsbrist i Stockholm. Vad tänker du om att bygga i områden som Malungens strand?

Magelungen questionnaire, english version

How old are you?

Ditt svar

What sex do you identify yourself with? Male/female, for example?

Ditt svar

Do you live in Farsta borough?

Yes

No

Do you work in Farsta borough?

Yes

No

All (1)

Do you know about the area Magelungens strand? [Show area on map]

Yes

No

Know about Magelungens strand

How would you say that you use the Magelungens strand area today? (Follow-up: Any more?)

Ditt svar

How many days of the month would you say that you use the area Magelungens strand?

Ditt svar

Are there other areas close enough to you, that you know of, that you could use for these activities instead? Where? (Follow-up: Any more?)

All (2)

There are plans to build 750-1000 new apartments and shops in this area, from Fagersjö to .Farsta idrottsplats. There will be a walking bridge over the railway and there will be a new trail close to the water.

What do you think could be positive outcomes from this project? (Follow-up: Any more?)

Ditt svar

What do you think could be negative outcomes of this project? (Follow-up: Any more?)

Ditt svar

Do you think that Fagersjö will be more included with the rest of Farsta through this project?

More

Less

Övrigt:

If the plan is realised do you think that you would spend more or less time in Magelungens strand than you are doing today?

More

Less

Övrigt:

Do you live in Fagersjö?

Yes

No

Live in Fagersjö

For people who live in Fagersjö

Do you feel that Fagersjö is an isolated place?

Yes

No

Would you use public transport (e.g. subway/commuter train) more if this area was built?

Yes

No

This area has a potential to become a small business district with be new shops, restaurants and a bridge over the railway. Do you think you will use this area more if this is built?

Yes

No

Ending

Parts of the planned building area is within shore protection area. It contains old oaks and is a part of Stockholms Gröna kilar, connecting outer forests with inner parks. We also have housing deficiency in Stockholm. What do you think about building in environments like these?

Ditt svar