Norra Kymlinge
Environmental Impact Assessment (EIA)

Project assignment in the Master Course Environmental Impact Assessment

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Photographer: Johanna Lennartson

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
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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 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

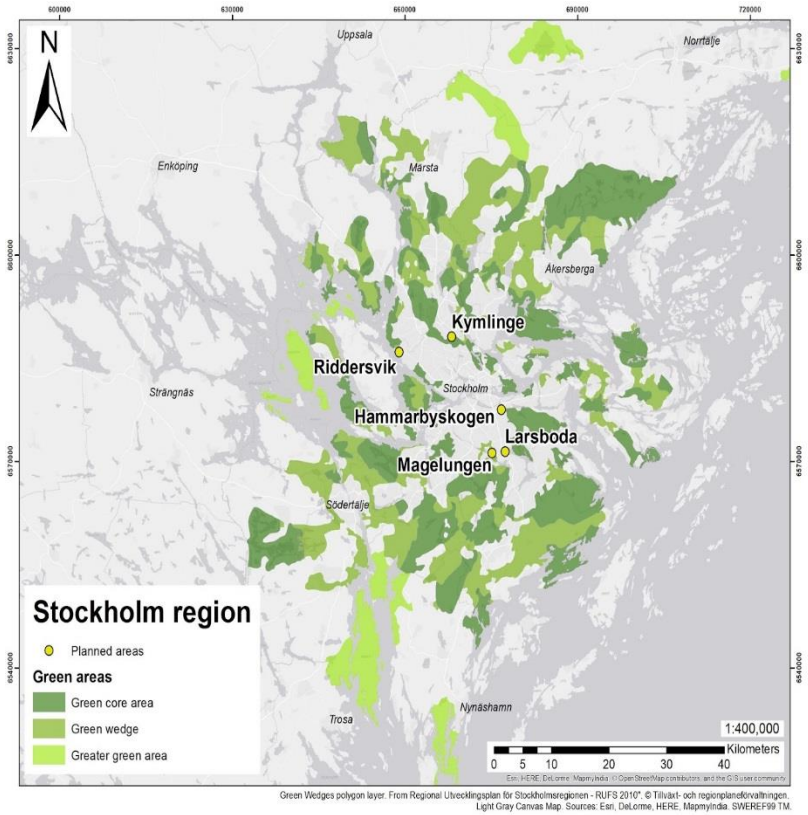
PBL (The Planning and Building Act) - Plan- och bygglag

SPO (Species Protection Ordinance) - Artskyddsförordningen

Table of Contents for 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.

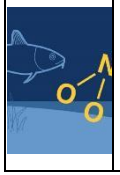
3. Environmental and Planning Objectives

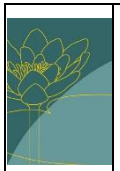
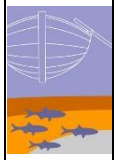
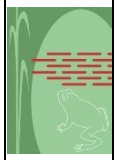
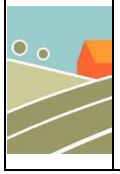
3.1. Environmental Objectives

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 are 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.

Norra Kymlinge

Non-technical summary in Swedish

Denna miljökonsekvensbeskrivning (MKB) har till syfte att beskriva konsekvenserna för miljön om byggplanerna för Norra Kymlinge skulle bli verklighet. Planer på att exploatera detta 55 ha stora område har funnits sedan 1960-talet, med planer på alltifrån statliga verk till studentbostäder. Det gick så långt att en tunnelbanestation byggdes i mitten av området, vilken fortfarande står mitt i skogen. Även om den är oöppnad och inte helt klar, så är den förberedd. Ingen bebyggelse har gjorts, och Kymlinge är idag ett grönområde, med det högexploaterade Kista som granne. Det gränsar till Igelbäckens naturreservat, men är inte skyddat. Marken ägs av företaget Vasakronan, som vill bygga, men alla planer har fått avslag av Sundbybergs kommun, som vill behålla Kymlinge som grönområde, trots att Länsstyrelsen tycker annorlunda. Det stora bostadsbehovet i Stockholmsregionen har gjort frågan om att exploatera Kymlinge aktuell på nytt, men det politiska intresset i kommunen är lågt.

Alternativen

Alternativet hög exploateringsgrad

Detta alternativ består av 4 000 lägenheter, 3 000 kontor och 2 000 studentlägenheter, vilket beräknas resultera i ett inflöde av 16 000 människor. Detta överskrider de 10 000 människor som SL kräver för att öppna tunnelbanestationen. Ungefär 80 % av området kommer att bebyggas, utan buffertzon mellan naturreservat och bebyggelse. På grund av detta kommer ekologin i området att förändras. En stor del av rekreations-områdena kommer att försvinna, men förbättringar kommer att genomföras i de återstående. Nya rekreations-möjligheter kommer att skapas genom att en idrottsarena byggs.

Alternativet låg exploateringsgrad

I alternativet beräknas 70 % av ytan att bebyggas. 2 500 lägenheter, 1 500 kontor och 1 000 studentlägenheter, vilket ger ett beräknat inflöde av 9 000 människor. Tunnelbane-stationen kommer att öppnas, då 1 000 människor från Kista förväntas använda den. Ekologiskt viktiga områden kommer att gynnas genom att skapa en buffertzon mellan naturreservatet och bebyggelsen. Trots detta kan ekologiska förändringar komma att ske och ett högre besökstryck på naturreservatet kommer ske då tillgängligheten blir högre. Delar av rekreationsområdena kommer att försvinna, men förbättringar kommer genomföras i de återstående.

Noll-alternativet

I detta alternativ förespråkas skötsel av området och förhållanden anses fortgå som idag. Utvecklingen i närliggande områden kan resultera i att besökstrycket ökar, då fler människor använder området för rekreation. Åtgärder som skräpplockning kommer heller inte att genomföras i högre grad än idag. Ekologiska förändringar kan uppstå.

Noll plus-alternativet

Detta alternativ utgår liksom noll-alternativet från att ingen exploatering sker, men skötseln förespråkas utöka och att Norra Kymlinge blir en del av Igelbäckens naturreservat. En separat skötselplan kommer att upprättas. Ett inrättande av bullerskydd kommer förbättra upplevelse- och naturvärdet i området. Reaktionsdelarna kommer också att underhållas

bättre, genom elljus längs spåren, skräpplockningen kommer att blir bättre och död ved kommer att plockas bort kring spåren. Liksom i tidigare alternativ kan ekologiska förändringar ske.

Slutsatser

Den sammanlagda bedömningen visar att det mest hållbara alternativet skulle vara noll plus-alternativet, eftersom det är det enda alternativet med mestadels positiv eller ingen påverkan. Båda exploateringsalternativen kommer att resultera i negativ påverkan, vilken är oundvikligt vid bebyggelse. Dock är ingenting inom MKB svart eller vitt. Om den politiska opinionen i Sundbyberg svänger och den nya kommunledningen bestämmer sig för att gå på länsstyrelsens linje och bygga, rekommenderas alternativet låg exploateringsgrad då det minimerar negativ påverkan, och mer av grönområdet, som är det som gör Kymlinge attraktivt idag, bevaras.

Non-technical summary

This Environmental Impact Assessment (EIA) is aiming to describe the impacts of possible future development plans in the area of Norra Kymlinge. There have been plans to exploit this 55 ha area since the 1960's, with plans reaching from government institutions to student apartments. It even went as far as building an underground station in the centre of the area, which still stands in the middle of the forest, unopened but prepared, although not fully finished. No exploitation has been done, and today Norra Kymlinge is a green area, close to the highly developed area of Kista. It borders to the nature reserve Igelbäcken. The land is owned by the company Vasakronan, who wants to build there, but all plans have been politically rejected by Sundbyberg municipality. The municipality wants to keep Norra Kymlinge in its current state, despite the County Administrative Board saying otherwise. The urgent need for housing in the Stockholm region has raised the question about exploiting Norra Kymlinge once more, however, the political interest is low.

Alternatives

The high exploitation alternative

The alternative consists of 4 000 apartments, 3 000 offices and 2 000 student apartments that would be built, resulting in an inflow of 16 000 people. Around 80 % of the area would be built, and there would be no buffer zone between the nature reserve and the exploited area. Due to this, the ecology in the area would change and a higher amount of visitors to the nature reserve would increase the wearing of the nature. Much of the recreational space would be lost, but the remaining parts would be improved upon. A sporting arena would be built, thus giving new recreational possibilities.

The low exploitation alternative

In this alternative, there would be exploitation on 70 % of the area. 2 500 apartments, 1 500 offices and 1 000 student apartments would be built, with a resulting inflow of 9 000 people. The underground station would open, since 1 000 people from Kista are expected to use it. By creating a buffer zone between the nature reserve and the housing area ecologically important areas would be saved. Changes in

ecology may occur despite of this and more visitors to the nature reserve would increase the wearing of the nature. The development of nearby areas would increase the pressure on the green areas. The recreational spaces will be partially lost, but the remaining ones will be improved upon.

The zero alternative

The management and area conditions remain as today. The development in nearby areas and municipalities would probably result in an increasing pressure from visitors, as more people use the area for recreation. There would not be any change in management from today, such as litter removal. Changes in ecology may occur.

The zero plus alternative

This considers the same options as the zero alternative, but with better management and Norra Kymlinge would also be included in the nature reserve, thus having it managed in a better way. A separate management plan would be created. Noise protection would be improved with screens along the motorway, and there would also be improved management of the recreational values, with lighting on the tracks, better litter removal and also removal of deadwood along the tracks. As mentioned in the previous alternatives, development outside of the project area would change the ecological connectivity and thus change the ecological conditions.

Baseline

The landscape of Kymlinge is an important part of Järvakilen, a large green area in the Stockholm region. It consists of hilly land and is mainly covered by coniferous forest, with some meadowlands in the south. There are many bird species in the area, like woodpeckers and crested tit, but the most remarkable species is the fish, the stone loach, which inhabits Igelbäcken. Despite its high natural values, Norra Kymlinge is located between the two motorways E4 and E18. Kymlinge and Järvafältet have a long story of human usage, which can be seen in remains, reaching from Bronze and Iron age features, to trenches and hand grenade courses from military activities in the 1900's. Today, it is a popular area for several physical activities, among others: horseback riding, orienteering and mountain bike cycling. Several people also use Norra Kymlinge for simply strolling or walking their dog.

Conclusion

The assessment shows that the most sustainable alternative would be the zero plus alternative, since it is the only alternative that has a mainly positive or no significant impact. Both exploitation alternatives will result in negative impacts, which is unavoidable when building. However, nothing in the EIA is black or white. If the political opinion in Sundbyberg changes, and the new municipality decides to go along with the County Administrative Board and build, we recommend a low exploitation rate as the negative impacts will be minor, and more of the green area, which makes Kymlinge attractive today, will be kept.

Table of Contents for EIS Norra Kymlinge

1. Introduction

1.1 Background and purpose

Stockholm region is growing and the population within the county is predicted to grow to 2.4 million people by the year 2020 (Sundbybergs stad, 2013). Sundbyberg has a central location in the Stockholm region where it borders to the municipalities of Stockholm, Solna, and Sollentuna. Norra Kymlinge in Sundbyberg municipality is situated in the northern part of the southeastern Järvafältet about 10 kilometres north of Stockholm city centre. Järvafältet is one of the green wedges (grönkil) of Stockholm and stretches from Sigtuna in the north to Brunnsviken in the south near the Stockholm city centre. The name of the area origins from the early 1900s when the area was state owned and used as a military training area. After the military relocated in the 1960s, most of the state owned land in Järvafältet was turned into municipal land, but about 55 hectare remained to be state owned, and the landowner today is Vasakronan, a company financed through public pension funds (Sundbybergs stad, 2004). Norra Kymlinge is framed by the motorways E4 to the east, E18 to the north/northwest and the nature reserve Igelbäcken in the south/southwest (Figure 1).

Norra Kymlinge is close to Kista, which is partly a residential area but also a centre for commerce, technology, communication, education, and businesses. The proposed new district would offer residential houses, offices, buildings for sport activities and other business activities, possibly a health center and a preschool. The new district would enhance the regional socio-economic values, enhance the connection from Kista to Igelbäckens nature reserve and serve as link between close by districts such as Ursvik and Solna (Vasakronan, 2000; Sundbybergs stad, 2013; Thiberg & Enander, 2016).

In the centre of Norra Kymlinge is an unopened but prepared - yet not fully finished - underground station where the blue line (Akalla - Kungsträdgården) passes. In the 1960s, Solna, Stockholm and Sundbyberg municipality agreed to divide the costs of expanding the underground in the region Tensta – Rinkeby to meet the needs of public transport. At the same time, a plan for a “Governmental city” with a concentration of governmental functions and institutions in Norra Kymlinge was presented. This plan was never realized since the National Board of Public Building (Byggnadsstyrelsen) advocated that a development of Norra Kymlinge should be more integrated in the rest of the municipality and in 1971 Norra Kymlinge was included in Sundbybergs municipality. At this time the municipality had the intention to exploit the area and so the underground station was built. Ever since, different plans for the area have been presented. The plans have been to build mostly residential houses and offices. However, an ice rink and a bio-fuel heating plant have been suggested, but politically rejected (Sundbybergs stad, 2010; Eriksson, 2016; Thiberg & Enander, 2016). Vasakronan and Sundbyberg municipality have done several initial planning projects accompanied by public participation processes, but for the time being the political majority is against exploiting Norra Kymlinge. Vasakronans vision is to create the world’s most sustainable and resilient city district (Vasakronan, no year), however no actual plans are ready. Together with consultants, Vasakronan is conducting investigations in Norra Kymlinge (such as site

analysis and nature inventories) and is hoping for a political change in the next election (2018), to get permission to build (Eriksson, 2016; Thiberg & Enander, 2016).

Despite the strong regional pressure to build and in contrast to the regional agreements, a political majority in Sundbyberg municipality have voted to keep Norra Kymlinge as a green area (Sundbybergs stad & Vasakronan, 2005). Nevertheless, the existing underground station is for many a reasons to exploit Norra Kymlinge. In an interview, the chairman of the Municipal Executive Board, Eriksson (2016) says, that the cost for opening the underground station is estimated to 300 million SEK, which is relatively little compared to opening a totally new station. Norra Kymlinge was marked as a developing area in Sundbybergs municipal comprehensive plan in 2010, but this was later changed and Norra Kymlinge became marked as a green area in the 2013 comprehensive plan. In the consultation process, the County Administrative Board, in agreement with the Swedish Transport Administration (Trafikverket) stated that Norra Kymlinge should be marked as a developing area to meet the development goals on a regional level (Sundbybergs stad, 2012).

1.1.1 Municipal development in a regional context

The municipality of Sundbyberg has a population prediction which can be found in the comprehensive plan and which is used for the detailed development plans. The prediction states that the municipality will go from having 47 000 inhabitants today (2016) to having 83 000 inhabitants by 2030. This makes Sundbyberg the fastest growing municipality in Sweden. Today, Sundbyberg has decided about a few different housing projects in the municipality. Among others, the property company Wallenstam has started a densification project named Umami Park in Hallonbergen. It will be finished by 2019 with 900 apartments. Along the road Enköpingsvägen, also in Hallonbergen, a housing project with 10 000 new apartments is planned. Another project, the so-called MILO-project, focuses to develop different types of businesses in an area that used to be in military use. The railroad in the city center will be reconstructed until 2025 so that 1500 new housings can be built. In Stora Ursvik, around 900 housings, a park and a preschool are planned in the area of Forskarparken. Construction for densification is planned in many places in the municipality until 2030, primarily on already hard surfaces.

Since 2010 there is a regional development plan for the Stockholm county (RUFS). A regional plan is a basis for strategic planning on a municipal level, with a vision for the county that extends until 2030. According to the regional plan, the strategy for the green wedges - to which Norra Kymlinge is adjacent to - is to “try to preserve, develop and to make them available” (SLL, 2010). At the same time there is a need for housings to meet the needs of migration to the Stockholm area. According to Sundbybergs comprehensive plan of 2013, the municipality will work for a regional perspective on the housing issue where the housing market is the same for many of the inhabitants of the municipalities in the county (Sundbybergs stad, 2013).

Sundbyberg city's current vision for the municipality extends until 2020. Due to the large population increase there is now a

new plan in preparation that extends to 2030, "Vision 2030" (Sundbybergs stad, 2016). Vision 2030 is based on interviews with the municipal group leaders and is compiled as a vision statement by the project managers for Sundbybergs new vision. The vision of the municipal group leaders for the future Sundbyberg is (Sundbybergs stad, 2016):

- The city is growing with quality
- Full barrier-free city
- Mixed and vibrant city
- Proximity and participation
- Diversity
- Municipal services with high and equivalent quality to all citizens (Sundbybergs stad, 2016).

When asked how they would like it *not* to be in the future Sundbyberg in 2030, they lifted up the following (Sundbybergs stad, 2016):

- Built decomposition or overexploited
- Exclusion
- Segregated

1.1.2 Purpose

The Planning and Building Act (SFS, 2010:900) states in chapter 3, section 10 and chapter 5, section 14, that the County Administrative Board shall, when assessing risks in comprehensive plans, act to ensure that development does not become unsuitable in regard to human health and safety or in regard to risk of accidents.

The purpose of this report is to assess the environmental impact of the proposed development of Norra Kymlinge. The assessment is of importance not only because of the planned areas adjacent to Igelbäckens nature reserve but also because of its importance as a recreational area, its cultural and archaeological values as well as the status of the current natural environment and ecological function.

1.2 Boundaries

1.2.1 Temporal boundaries

The planning area does not have a detailed development plan and permission to build has not been given, which makes the EIA a strategic document and has therefore no specific beginning or end. The assessment regards the near future, during construction and 10-20 years after a hypothetical construction.

1.2.2 Spatial boundaries

When carrying out environmental impact assessments, it is important to define the starting point. In this case, the starting point is to weigh the housing needs of the whole Stockholm region against the existing environmental values the area has, such as the access to green areas, ESS and biodiversity. To make a well-considered decision, boundaries are important, both geographically and from a physical planning perspective. The responsibility of providing housing does not lie on subareas but on the whole municipality. It therefore becomes necessary to analyze the housing issue beyond the boundaries of the project area (Norra Kymlinge). Because of that, present

and future housing projects have been included in the consideration and comparison of the different alternatives.

The spatial boundaries for the EIAs investigation area are Norra Kymlinge and Igelbäckens nature reserve (Figure 1). Igelbäckens nature reserve is adjacent to the planned area and it will therefore be affected by an eventual exploitation. Effects of impacts from the exploitation of Norra Kymlinge can have significant consequences for the nature reserve.

The different alternatives are based on the same area and are compared to the zero alternative. Since the EIA is a strategic document, both regional and municipal plans have also been included although, the prediction of impacts are only based on the boundaries for Norra Kymlinge and Igelbäckens nature reserve.

1.2.3 Significant impacts

The Swedish Environmental Code chapter 3, section 6 states that:

"Land and water areas, as well as the physical environment in general, that are important for reasons of public interest on account of their natural or cultural value or for outdoor recreation shall, to the extent possible, be protected against measures that damage the natural or cultural environment. Special consideration shall be given to the need for green spaces in and near urban areas" (SFS, 1998:808).

Therefore, any impact contributing to a negative consequence on significant natural or cultural environment could be considered to be a significant impact. It is important to note, that we did not make a statistical analysis for our assessment even though we use the word significant. The significance of impacts is based on the knowledge that we have had and that we gained through our studies.

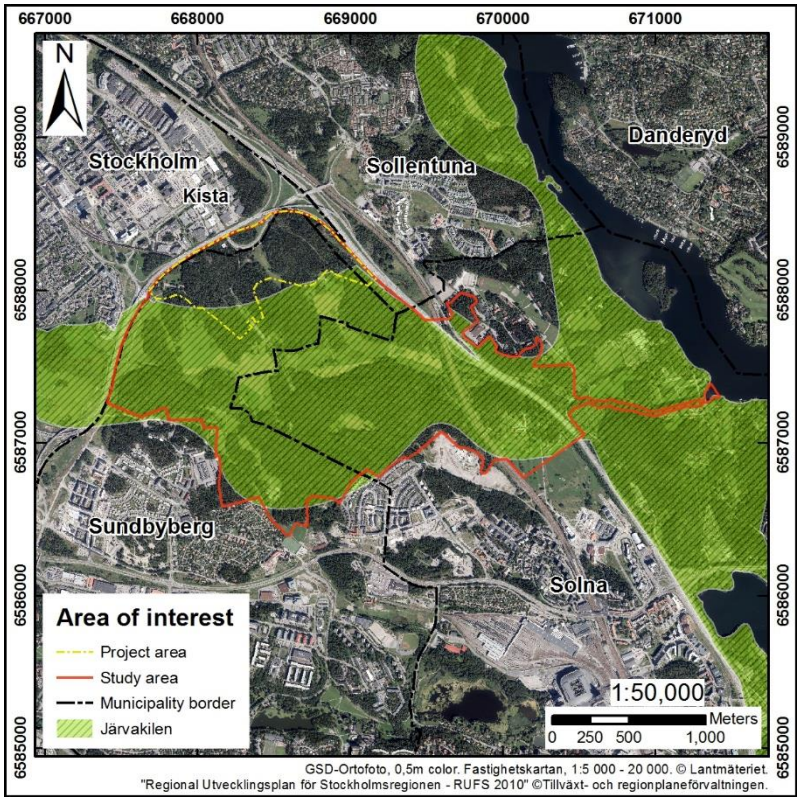


FIGURE 1. Green wedge in the project and study area.

Based on the proposed development plans, the working group's competence, the location of the area and consequential value, the most significant impacts have been, in no particular order, identified as the following:

- Landscape
- Biodiversity
- Cultural values
- Air pollution
- Barriers
- Water
- Noise
- Recreational values

2. Method

The EIA of the four alternatives is based on literature studies, interviews and fieldwork. The literature is among others taken from Sundbybergs municipality, the consulting firm Calluna (nature value inventory and ecosystem service inventory), GIS-data are taken from Idrottsförvaltningen (Stockholms stad), Lantmäteriet, Länsstyrelsen, Riksantikvarieämbetet, SLB-analys, tillväxt- och regionplaneförvaltningen and Trailforks. The Air quality maps were made with the help of screenshots taken of the air quality maps from SLB-analys (SLB-analys, 2017). These images were put into Esris's Arcmap 10.4.1 and georeferenced to fit into the area. They were then digitized by drawing different types of polygons to differentiate between the levels of particles in the air to visualize the air quality levels of NO2 and PM10.

2.1 Interviews

The interviews were made with the municipality, Vasakronan, Swedish Society for Nature Conservation and other interest groups. It was important to interview both Vasakronan since they are the landowner and Sundbyberg municipality since they have the planning monopoly and is in charge of the exploitation in the area. Swedish Society for Nature Conservation was contacted because they are an important environmental organisation in Sweden and are against building in Norra Kymlinge. Norra Kymlinge and Igelbäcken nature reserve is important for the recreational values such as cycling, jogging and horse riding etc.

2.2 Fieldwork

The field observation was made by a group of students from Stockholm university on 2016-12-06 with the aim to study the natural values in the area. An inventory list from Swedish Society for Nature Conservation (Naturskyddsföreningen, 2016) was used for the purpose, see appendix 1. Since the field observations were made in December, and snow covered the ground, many species could not be identified. The nature inventory was complemented by Callunas inventory from 2016 (Calluna, 2016a). The inventory made by Calluna contains uncertainties since it was made during the spring (April to May). Species that grow later in the summertime could therefore not be identified.

2.3 Alternatives

The planning process in Norra Kymlinge is non-existent and the area has therefore no detailed development plan. In this EIA, the high exploitation alternative is based on the latest plan from 2010 (Sundbybergs stad, 2013). Although, the district heating plant is no longer up-to-date, which resulted in Vasakronans vision to build 3-4000 more housings than the plan from 2010 anticipated (Thiberg & Enander, 2016). The low exploitation alternative is based on a less densely built area where the cultural values and archaeological features will be taken into consideration, and a buffer zone between the nature reserve and the exploited area will be included. For the high and low exploitation alternative an assumption has been made that the management of storm water will be made through a local disposal of storm water (LOD). This assumption is based on Sundbybergs comprehensive plan (Sundbybergs stad, 2013) where they state that storm water should, where possible, be handled locally and purification and delay of the storm water must be done at exploitation in Sundbyberg where the recipient is Bällstaån/Bällstaviken, Lötsjön, northern Råstabäcken and Igelbäcken (Sundbybergs stad, 2013). By using LOD the biodiversity in the area can increase and at the same time the load on the municipal sewage system be reduced (Naturvårdsverket, 2010). Vasakronan has also studied different natural and technical solutions for storm water management so that the water that reaches the recipient fulfills the requirements. The ambition for Vasakronan was also to manage the storm water locally in Kymlinge (Vasakronan, 2006).

No alternative location has been prepared for the EIA. The municipality has a construction plan to provide the municipality with housing for the expected population growth and plans to build on hard surfaces that are already built on. Furthermore, Sundbyberg is Stockholms smallest municipality and does not have many different locations to choose from.

There is a great uncertainty in how exploitation in the area would be designed. The alternatives are based on average statistics and are rough estimates, however, the alternatives are designed to be able to evaluate the potential impacts of exploiting the planned area. The area plans, the building density, the design, the height of the buildings and the relative use of the buildings, is likely to change significantly if the area is to be exploited. Nonetheless, the scenarios assist in making an assessment of the likelihood of different kinds of impact and the designed alternatives function as starting point to identify what, in terms of design and extent, may be important to consider if the plans would be further developed.

In Sundbyberg, the average living space is about 34 m^2 (SCB, 2012), which is about the same as in Stockholm. The average apartment in Stockholm is approximately 91 m^2 (SCB, 2013). Based on this, the average number of people per average apartment is 2,7 persons/apartment. There are different ways to calculate the size of an average office but based on a previous study from Vasakronan, the average office size is estimated to be 30 m^2 (Vasakronan *et al*., 2000). The average student apartment in stockholm is 27 m^2 (Studentbostadsföretagen, 2016), but to add space for common space, each student apartment is estimated to 35 m^2

(Vasakronan *et al.*, 2000). The data used in our estimates are listed in Table 1.

This report considers two different exploitation alternatives. The parts of the extent and the expected amount of population increase coupled with the two alternatives are summarized in Table 2.

The two alternatives are illustrated in Figure 4 and 5. The buildings are classified into two categories; office/student apartment/commercial buildings and apartment buildings. The first types of buildings are assumed to be higher and placed closest to the motorways.

TABLE 1. Estimates used to design the alternatives.

Average Living Space (Square Meter)	34
Average Apartment Size (Square Meter)	91
Average Apartment Household Size (People)	2,68
Average Student Apartment (Square Meter)	35
Average office space (Square Meter)	30

TABLE 2. Summary of the alternatives – Number of apartments, offices and student apartments and number of residents they estimate to bring to the area.

	Alternative 1 High exploitation		**Alternative 2 Low exploitation**	
	Planned	People	Planned	People
Apartments	4 000	10 706	2 500	6 691
Offices	3 000	3 000	1 500	1 500
Student Apartments	2 000	2 000	1 000	1 000
Total amount of people		15 706		9 191

To further estimate the impacts of the two alternatives, rough calculations were made to assess the amount of space that each alternative would effect in the area. Figure 4 and Figure 5 mark the area that will be affected by exploitation but only 40 % of the area is estimated to be actual buildings, 60 % of the area are assumed to be courtyard. This would correspond to the plans in Stora Ursvik. The use of the area is summarized in the table 3 below.

TABLE 3. Explaining the relative use of the planned area.

	Alternative 1 High exploitation		**Alternative 2 Low exploitation**	
	Area marked in Figure 4	Actual Building Area (60 % is courtyard)	Area marked in Figure 5	Actual Building Area (60 % is courtyard)
Total project area (ha)	54	54	54	54
Office/student apartment/ commercial space- ground area (ha)	8	3,2	5	2
Housing ground area (ha)	17	6,8	10,5	4,2
Green area (hectare)	8,5	8,5	16	16
Rest (roads, squares ect.) (ha)	20,5	20,5	22,5	22,5
Total built area (ha)	45,5	30,5	38	28,7
% Exploitation affected area	84		70	

Since the height of the buildings is of interest when assessing the impact of exploiting the area, estimates of the height of the buildings in each alternative is illustrated in Table 4.

The number of floors in the apartment buildings is an average estimate but based on that the exploitation alternatives assumes varying height, 3-7 floor buildings, of the apartment buildings in both alternatives.

TABLE 4. Estimates of the average amount of space and floors in the two alternatives for exploitation.

	Alternative 1 High exploitation	**Alternative 2 Low exploitation**
Office/student/apartment/ commercial space (m^2)	260 000	80 000
Available ground area for office/student apartment/ commercial space (m^2)	32 000	20 000
Average number of floors of the office/student apartment/ commercial space buildings	8	4
Apartment space (m^2)	364 000	227 500
Available ground area for apartment buildings	68 000	42 000
Average number of floors of the apartment buildings	5	5

2.4 Matrix

The assessment in the matrix is made in relation to the different Swedish environmental quality standards and the environmental goals. The matrix has five stages: major positive, minor (notable) positive, neutral, minor (notable) negative and major negative.

If an impact is assessed as notable (either minor positive or minor negative) it means that the impact is not significant but still worth mentioning. These types of impacts are not likely to significantly affect the environment, human health, regional and national environmental goals or exceed/decrease environmental quality standards parameters.

2.5 Assessment of probability

In the EIA the concept *impact* is interpreted as the physical impact due to an intervention. An *effect* is what the impact leads to, the effect of the changed environmental qualities, and a *consequence* refers to whom or what it affects.

Predictions of impact are connected to uncertainty and different degrees of probability. To be consistent and clear with the degree of uncertainty of the assessments, this report will use different terminology to describe the likelihood of an effect.

Effects of an impact that are highly probable (80-100 %) are describe as it *will* happen.
Effects of an impact that are likely (60-80 %) are described as *likely* to happen.
Effects of an impact that are uncertain (10-60 %) are described as they *may* happen.
Effects with a lower probability are referred to as *unlikely*.

3. Description of project area

There is currently no political support for exploiting Norra Kymlinge and there are no actual plans to consider. As a result, there are no actual architectural suggestions or concrete information about the size, extension, character and content of a planned building project.

3.1 General

The planned area of Norra Kymlinge is about 55 ha and is strategically located south of Kista which is the largest information and communication cluster in Europe and provides about 30 000 jobs (Kista, 2016). Besides the motorways E18 and E4, there is railway traffic in the east, with the commuter trains and the East Coast Line (Ostkustbanan) where around 25 to 30 trains pass per day (Sundbyberg Stad, 2010). A light rail (tvärbanan) from Bromma to Helenelund is planned with a construction start in 2017 (SLL, 2016), and will pass next to the western part of the nature reserve Igelbäcken. An underground station (Kymlinge) exists, located in the nature reserve, although it has never been opened and is partly unfinished. The area is currently not managed and litter is polluting the forest.

3.2 Potential risks

3.2.1 Soil

The soil in the area varies from postglacial clay, sandy moraine and bedrock (see appendix 2) (SGU, 2016) which consists of granite and gneiss. Where the bedrock is visible, traces of the last ice age are visible through glacial striations (Sundbybergs

stad, 2003). It is important to take soil samples to determine how exploitation should be managed. There is a risk for subsidence on buildings, i.e. clay soils, and therefore it is important to consider appropriate building techniques (SGI, n.d.).

From 1905 to 1960, Järvafältet had been a military exercise area. According to the database MIFO, a method for inventory and identifying contaminated areas; there are no indicators of contaminated soil in Norra Kymlinge due to the military activities (Sundbybergs stad, 2013). However, it is important to recognize the possibility of pollution in the area and take soil samples before building. During the exploitation in Stora Ursvik, close to Norra Kymlinge, there had been several soil investigations that resulted in findings of heavy metals as cadmium, lead, copper, mercury, zinc and arsenic and findings of oil, solvents and organic substances as PCB, aliphatic hydrocarbons and carcinogenic PAHs. All exceeded the levels of Naturvårdsverkets guidelines for "sensitive" (i.e. the choice of land-use shall not be limited by the soil quality) and "less sensitive" land-use (i.e. the soil quality limits the choice of land-use) (Adrup & Mörner, 2008).

Soils properties also matter if the area has been contaminated. How well the pollution is spread to surrounding areas and into groundwater is dependent on the soil property. Clay has a low permeability i.e. the time it takes for water to seep through the soil into the groundwater (Bovin *et al.*, 2015).

3.2.2 Litter

Norra Kymlinge is littered and in some parts of the area dumping of waste occurs (Figure 2. and Figure 3.). Littering might harm animals, humans and spread chemicals in the environment. Litter in the environment can also affect recreational values in an area (Naturvårdsverket, 2016a). If the area would be exploited, more people would reside there and the maintenance of the area is likely to improve. Dumping of litter may not be as extensive as today since the area will not be as secluded. On the other hand, more people will generate more waste and without a good waste management, there may be more littering in the area.

For the zero and zero plus alternative actions will have to be made to minimize the litter in the area. A greater maintenance is required: for example, to put up more wastebaskets around the recreation areas and in the nature reserve and CCTVs (surveillance cameras) to minimize the risk of illegal dumping of waste in certain areas.

FIGURE 2. Litter, photographer: Jennie Jalkner, 2016.

FIGURE 3. Litter, photographer: Jennie Jalkner, 2016.

3.2.3 Close-by transport of dangerous goods

Section 5 in the Act relative to the transportation of dangerous goods (SFS, 2006:263) in the Swedish Environmental Code, lists all characteristics of dangerous goods, which are essentially goods that comprise or contain substances that are harmful to humans and the environment (SFS, 2006:263). Section 20 second point 9 (SFS, 2006:263), states that:

"substances and items beyond section 5 is considered as dangerous goods if they during transport can lead to damage to life, health, environment or property or affect the performance of the transport".

Since the area is not populated today, the risk associated with transport of dangerous goods for human health is limited. The two motorways around Norra Kymlinge are both considered and recommended as primary roads for the transport of dangerous goods (Trafikverket, 2016b; Länsstyrelsen Stockholm, 2016a).

Considering the growing and densification of population as well as a possible exploitation of Norra Kymlinge, an increased population in the area would increase the risk of human health being affected in a possible accident involving transport of dangerous goods. Recommendations from the County Administrative Board state that the location of residential buildings is appropriate 75-150 meters from a road used for transport of dangerous goods while offices could be as close as 40-75 meters (Länsstyrelsen Stockholm, 2016c). Within these distances, there is no need for further investigations of possible risks, according to the County Administrative Board.

In some cases, the County Administrative Board can request that the municipality conducts a more detailed risk assessment. Building close to primary roads requires a safety distance of minimum 25 meters. Within 30 meters the following safety measures are to be ensured through planning. For usage including residents and offices, glass shall be of minimum fire technical standard class EW30, facades shall be made from non-combustible material, alternatively from minimum fire technical standard class EI30, fresh-air intake

shall point away from the road and evacuation away from road shall be possible in a safe way (Länsstyrelsen Stockholm, 2016c).

Based on the data from the Swedish Civil Contingencies Agency, the likelihood of serious accident is very small. During the last five years only one out of the total number of reported incidents on a national scale led to evacuation of residential area due to the risk of explosion (MSB, 2011; 2012; 2013; 2014 & 2015). The vehicles are robust and most accidents occur when transports are loading or unloading the goods (Skärdin, 2016). Nevertheless, because of the location of the planned area, exploiting Norra Kymlinge is connected to increased risk in this regard and mitigation measures should be regarded.

3.3 Nature preservation area

The nature reserve is located in the municipalities of Solna and Sundbyberg and is 127 hectares large. The name comes from the stream Igelbäcken that runs from Säbysjön to Edsviken. The stream has relatively low anthropogenic influence and is home to the red listed fish stone loach (grönlingen) and the spined loach (nissöga), which gives it a high value of protection (Stockholm Vatten, 2015).

The municipalities of Sundbyberg and Solna have restored the stream Igelbäcken between 2005 and 2007 with the purpose to increase the spawning grounds and the streaming flow quality as well as handling the overgrowing shoreline (Sundbyberg, 2016).

3.4 Ecosystem services

Nature contributes in many different ways to human wellbeing. Cities depend on ecosystems, their components and services to maintain long-term conditions for life and wellbeing. Urban ecological infrastructure does not only contribute to qualitative life for us inhabitants but also increase the resilience of cities. To build a sustainable city district, ESS must be addressed early in the planning process.

The following ESS have been identified in the area of Norra Kymlinge and the nature reserve (Calluna 2016c; Fieldwork 2016-12-05):

- Cultural benefits in form of recreational experiences (walking and mountain biking trails, skiing and bird watching, etc.) as well as some historical heritage in form of ancient remains from the Bronze Age and the Kymlinge gård.
- Regulating benefits are provided by the vegetation that absorbs pollutants, noise and regulates climate. Vegetation and soil cleans and drains the precipitation through evapotranspiration and filtering.
- Supporting benefits are given by primary production, nutrient cycling and pollination.
- Provisioning benefits are represented by the stream Igelbäcken in form of habitat and for the existence of other species around.

4. Alternatives

To make an assessment of a potential exploitation of the area, different alternatives have been designed based on the available information. The alternatives have been designed and assessed as hypothetical scenarios.

The report regards different alternative developments of the area and assesses the most significant environmental impacts of all the alternatives. The alternatives that will be considered is the zero alternative, the zero plus alternative, the high exploitation alternative and the low exploitation alternative explained more detailed below.

4.1 High exploitation alternative

Assumptions about the alternative are:

- A high degree of exploitation that would result in 4 000 apartments, 3 000 offices, and 2 000 student apartments resulting in an inflow of 16 000 people in the area.
- Opening of the underground station would be motivated if 10 000 people or more would live and work in close distance of the underground station (Vasakronan *et al*., 2000), though a 1 000 people are estimated to come from Kista, thus, the underground station will open.
- Building affecting on about 84 % of the planned area, no buffer zone between the planned area and the nature reserve.
- Increased pressure from more visitors in the area and the nature reserve. This is based not only on people living and working in the area but also on the

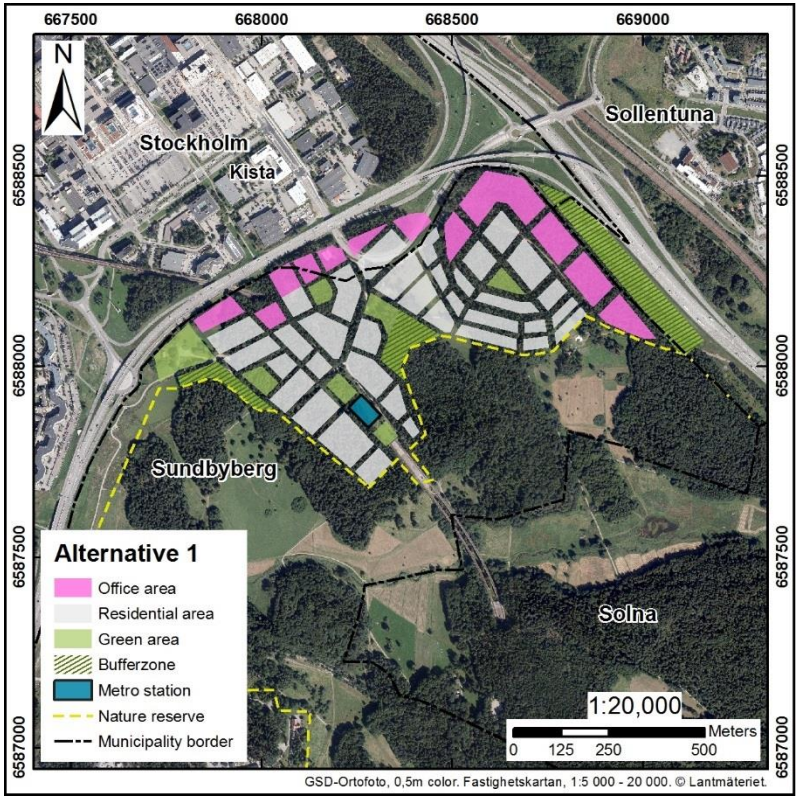


FIGURE 4. Alternative for a high exploitation in Norra Kymlinge.

assumption of population densification in the municipality and close by areas.

- More than 80 % of the area is exploited and much surface will be hardened. Therefore, it is assumed that storm water will be handled locally (LOD) in such way the report suggests in section 5.*6 Water quality*. Sundbybergs comprehensive plan describes that storm water should, where possible, be handled locally. Also, purification and delay of the storm water must be done when exploitation in Sundbyberg (Sundbybergs stad, 2013). The ambition for Vasakronan was also to manage the storm water locally in Kymlinge (Vasakronan, 2006).
- The ecological connectivity may be affected by development outside the boundaries of the project area and therefore change the current ecological conditions.
- The natural processes will continue but may be altered due to external factors such as increased air pollution and climate change.
- No preservation of archaeological features.
- Loss of recreational space in the planned area. Improvement of the recreational paths and the recreation areas that are left.

4.2 Low exploitation alternative

This alternative assumes development of apartments, offices and buildings for supporting functions but assumes that the planned area would not be exploited to the same extent as in the in the previous example. The assumptions for the low exploitation alternative are:

- Keeping more of the current ecologically valuable nature and as well as a buffer zone between the built area and the nature reserve.

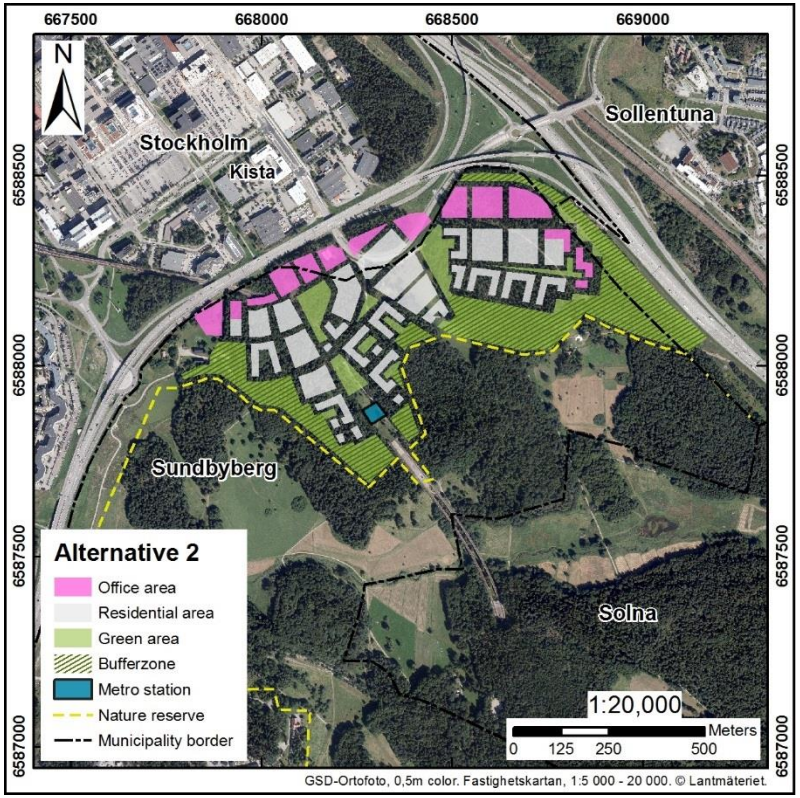


FIGURE 5. Alternative for a low exploitation in Norra Kymlinge.

- A comparatively low degree of exploitation resulting in 2 500 apartments, 1 500 offices, and 1 000 student apartments resulting in an inflow of 9 000 people in the area.
- Opening of the underground station would be motivated if 10 000 people or more would live and work in close distance of the underground station (Vasakronan *et al*., 2000), but a 1 000 people are estimated to come from Kista thus the underground station could be opened.
- Increased pressure from more visitors in the area and the nature reserve. This is based not only on people living and working in the area but also on the assumption of population densification in the municipality and close by areas.
- 70 % of the area would be exploited and much surface will be hardened. Therefore, it is assumed that storm water will be handled locally (LOD) in such way the report suggests in section 5.*6 Water quality*. Sundbyberg comprehensive plan describes that storm water should, where possible, be handled locally. Also, purification and delay of the storm water must be done when exploit in Sundbyberg (Sundbybergs stad, 2013). The ambition for Vasakronan was also to manage the storm water locally in Kymlinge (Vasakronan, 2006).
- The ecological connectivity may be affected by development outside the boundaries of the project area and therefore change the current ecological conditions.
- The natural processes will continue but may be altered due to external factors such as increased air pollution and climate change.
- Integration of archaeological and cultural values into the built area.
- Partial loss of recreational space in the planned area. Improvement of the recreational paths and the recreation areas that are left.

4.3 Zero alternative

In the zero alternative the current management and area conditions will be the same. This does not mean that the area will be unaffected by surrounding development over time. The assumptions for the zero alternative are:

- The development in the surrounding areas is likely to increase the pressure from human use with more people using Norra Kymlinge and the nature reserve for recreational purposes.
- The ecological connectivity may be affected by development outside the boundaries of the project area and therefore change the current ecological conditions.
- The natural processes will continue but may be altered due to external factors such as increased air pollution and climate change.
- No management, such as litter removal etc.
- The current political opinion may change and the area may become marked as a developing area in the future comprehensive plan. This is uncertain and is difficult to assess but if this occurs, the high and low exploitation alternatives can be seen as potential possibilities.

4.4 Zero plus alternative

The zero plus alternative considers the same conditions in zero alternative but assumes improved management of the planned area. It also assumes an extension of the nature reserve to include Norra Kymlinge. This is based on a full majority decision from the Municipal Board in 2014, stating that proposal for extending the nature reserve area to the north, is to be formalized by the Technical Board and the Planning Office to the municipality board (Eriksson, 2016). Assumptions for the zero plus alternative:

- Norra Kymlinge will be integrated in the nature reserve where a separate management plan shall be established.
- Improved noise protection from the surrounding motorways by building noise screens.
- Water catchment improvements to enhance the flow and water level in Igelbäcken and other improvements to enhance the ecology in the area. Nature reserves require management plans, which means that Norra Kymlinge would be managed more than it is today.
- The ecological connectivity may be affected by development outside the boundaries of the project area and therefore change the current ecological conditions.
- The natural processes will continue but may be altered due to external factors such as increased air pollution and climate change.
- Improved management of the recreational values in the area with for example better litter management and lights on the recreational paths as well as removing some of the deadwood on activity trails.
- If the nature reserve is extended into the planned area, it is unlikely that the area will be exploited in the future.

5. Impact assessment

5.1 Landscape

Landscape

Environmental Objective: *A Good Built Environment*

Regional environmental goals:

The adopted regional planning document, RUFS (2010a) includes the goal: A region with good living environment. The goal implies i.e.:

- The range of culture must be large and of high quality
- Historical values must be available and be an important factor in social development.
- The region's inhabitants must have a high quality of life with access to clean air, clean water and a pleasant, safe, healthy and beautiful environment.
- Easily accessible and scenic areas with rich flora and fauna should provide good hiking possibilities.

Municipal environmental goals:

- Sundbybergs Municipality has a climate and sustainability Policy (adopted 2013) where one of the goals is to preserve biodiversity and the natural and cultural environment (Sundbybergs stad, 2014).
- According to the Green plan (Sundbybergs stad, 2011) an eventual exploitation in the project area should not affect the positive experiences when visiting the nature reserve.

Legislation

The Swedish Environmental Code (SFS, 1998:808), chapter 1 section 1 states:

"…The Environmental Code shall be applied in such a way as to ensure that:

1. *human health and the environment are protected against damage and detriment, whether caused by pollutants or other impacts;*
2. *valuable natural and cultural environments are protected and preserved…"* (SFS, 1998:808).

The Planning and Building Act, chapter 2, section 6 states:

"In planning, in matters concerning building permits, and measures regarding buildings that do not require permits in accordance with this Act, built environment and construction works must be designed and placed on the intended land in a manner that is suitable, with regard to:

1. *the townscape and landscape, natural and cultural values on the site, and in the interest of ensuring a favourable overall impression…"* (SFS, 2010:900).

Baseline

The meaning of landscape can be identified by a view over or into an area of land, or the area and landforms embedded by a view (Daniel, 2001). The landscape in Norra Kymlinge is hilly and characterized by a mixed forest with trails for outdoor activities. The forest is represented by old pine and spruce trees, old oaks and deadwood from ash and willow trees. There are also patches with open meadows where rosehip bushes and different herbs grow. The area lies within the Järvafältet

and ancient features date back to the Bronze Age. Norra Kymlinge and the rest of Järvafältet have been used as a military base and today there are still remnants from hand grenade courses and machine gun courses as well as pits and trenches. The Swedish working dog club have their localities at Kymlinge gård, which is owned by the municipality of Sundbyberg (Sundbybergs stad, 2013; Calluna, 2016a; Fieldwork, 2016-12-06).

Impact prediction

High exploitation alternative

A high exploitation will give the landscape a whole new character, which will affect the overall view of the area and the whole natural reserve. The proposed plan will change the landscape into an urban impression. Much depends on the design of the buildings. High buildings will transform the area tremendously but lower buildings and open spaces that blend into the current nature, the area will not transform as dramatically. Exploitation could also destroy the cultural and natural values in the area, which goes against the Environmental Objective *A Good Built Environment*, where it states that natural and cultural values shall be protected and developed. This type of exploitation lies in contrast with the Green plan of the municipality and would significantly affect the experiences in the nature reserve. The area in the nature reserve closest to the exploited area could become a crowded place that significantly affects the experiences of being there.

Low exploitation alternative

A lower exploitation will increase the opportunities to maintain the character of the landscape with fewer buildings and preserving green areas as well as the archaeological features. A buffer zone between the exploited area and the nature reserve would help to keep the recreational values of the nature reserve high. The nature would gradually extend into the built area and thereby prevent the exploitation to intrude on the experience of nature when being there.

Zero alternative

Natural and cultural values will likely be protected and developed according to the Environmental Objective *A Good Built Environment.* The old forest can keep growing and will likely develop. Cultural values will be preserved and the area will therefore keep its current value. However, no management of, for instance litter and bushwood removal, will affect the image of the landscape negatively.

Zero plus alternative

By including Norra Kymlinge in the nature reserve, recreational values will be improved and archaeological features will be preserved, which improves the landscape and scenery. This alternative would promote the Environmental Objective *A Good Built Environment*.

Mitigation measures

Nevertheless, which exploitation alternative is chosen, it is important that the new buildings and roads will blend into the existing landscape. It should be taken advantage of the natural

hilly landscape, and the existing vegetation, especially the old oak and pine trees, should be included in the building plans (Sundbybergs stad, 2013). Green walls and green roofs on the buildings could improve the feeling of "being surrounded by nature" and can help to mitigate the negative feeling that urbanization and densification can have on the landscape.

A landscape analysis of Norra Kymlinge could improve the understanding of the area, the base material and the project. It makes it possible to identify values that exist in the landscape today and identifies relevant criterion for a further deeper impact assessment (Raa, 2016b & Boverket, 2010).

Summary

The landscape of Norra Kymlinge is today hilly and most of the area is covered by forest. An exploitation of the area will change the character of the landscape, from natural land to a more urban impression. A high exploitation will affect the landscape through changing the natural and cultural values in the area, which will make it more difficult to reach the Environmental Objective *A Good Built Environment.* A low exploitation alternative can, on the other hand, preserve the values and promote reaching the environmental quality goal. The buffer zone toward the nature reserve helps to keep the scenery "natural". No management of the area can also affect the natural and cultural values negatively. With an extend of the natural reserve, including Norra Kymlinge, recreational values will be improved and archaeological features will be preserved, which improves the landscape and scenery.

5.2 Biodiversity

Biodiversity

Environmental Objectives: *Sustainable Forests and A Rich Diversity of Plant and Animal Life.*

Regional environmental goals:

- The biodiversity in the county will be perpetuated and habitats for wild animal and plant populations will be preserved or recreated within the county.
- The near urban green and water areas will be preserved, cared for and developed for natural, cultural environmental and recreational purposes.

RUFS states that biodiversity is not within their assessment basis, yet many of the commitments in RUFS (2010a) regard biodiversity, such as the conserving of green and water areas mentioned above.

Municipal environmental goals:

Preserving the biodiversity is one of the objectives in the climate and sustainability policy of Sundbyberg (Sundbybergs stad, 2014a). The municipality has also bound itself to follow the national Swedish environmental goals.

Legislation

The Swedish Environmental code, chapter 7, section 4:

"A land or water area may be declared a nature reserve by a county administrative board or a municipality for the purpose of preserving biological diversity, protecting and preserving valuable natural environments or satisfying the need of areas for outdoor recreation." (SFS, 1998:808).

EU species and habitats directive, annex 2 (European Commission, 2016):

Annex II species (about 900): core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the species.

Baseline

Flora

The majority of the area is covered by different types of forest. Common hardwood is found, as well as broad leaved and coniferous forest. The trees found are pine (*Pinus sylvestris*), spruce (*Picea abies*), birch (*Betula pendula*), maple (*Acer platanoides*), sallow (*Salix caprea*), aspen (*Populus tremula*), alder (*Alnus glutinosa*) along the ditches and streams, oak (*Quercus robur*) and some ashes (*Fraxinus excelsior*) can be found (Calluna, 2016a). Many of these trees are old and thick and constitute the reason why the area has a high natural value. The old pines also contribute with a providing ESS, such as genetic diversity, since they are not planted or cultivated (Calluna, 2016b). Several deciduous trees have tinder fungus (*Fomes fomentarius*) and birch polypore (*Piptoporis betulinus*) growing on them, which Calluna (2016a) stated in their nature value inventory and which the fieldwork confirmed (Fieldwork 2016-12-06). The excursion further confirmed the presence of edible berries, such as bilberry (*Vaccinium myrtillus*) and lingonberry (*Vaccinium vitis-idaea*), another providing ESS (Calluna, 2016c). The southern part also contains meadowlands, where the flora is grassy with some herbs.

Fauna

The project area is habitat to several different kinds of birds. Some of them are red listed and/or indicator species of high natural values, such as the green woodpecker (*Picus viridis*), the goldcrest (*Regulus regulus*) and the crested tit (*Lophophanes cristatus*). Since the crested tit is associated with structurally complex woodland habitats, its presence emphasizes the ecological importance of the project area. The types of birds in the area may not only be seen as a biological value, but also as a recreational one, as bird watching is considered an ESS (Calluna, 2016b). As previously mentioned, there is a great abundance of deadwood found in Norra Kymlinge. Deadwood is important from an ecological perspective as it provides food and habitat for different species, especially insects (Figure 6).

One of the more remarkable species in the nature reserve is the stone loach (*Barbulata barbulata*), a small fish found in the stream Igelbäcken. Since this is the most northern find of this species, it is an important reason why Igelbäcken is a nature reserve. Downstream in Igelbäcken (Figure 7), the spined loach

(*Cobitis taenia*) can be found. The EU habitats directive protects this fish.

FIGURE 6. Hatching holes from wood living insects in deadwood, photographer: Tina Koskela, 2016.

Impact prediction

High exploitation alternative

The local impacts are that 84 % of the current green area will be affected by exploitation. This means that habitats for flora and fauna will disappear. The future of the deadwood in the remaining forest is uncertain too, as proximity to the residential areas could change it. As an example, inhabitants may demand clearing of the deadwood, both fallen and standing, for safety reasons. A consequence will be that the national Environmental Objective *Sustainable Forests* (Andersson, 2016) will not be reached, since one of the goals in this objects is to increase the amount of deadwood, thus providing habitats for different species of insects and birds which demands it. Reaching the objective *Rich Diversity in Animals and Plants,* will be counteracted as well, due to the loss of local genetic diversity of old pines. Genetic diversity is important to make the forests more resilient to climate change and environmental changes. The resource of old pines, is only threatened locally, since there are other populations of old pines in the Stockholm county within 5-7 km distance (Calluna, 2016a). Bird wise, the crested tit population will remain, but the woodpeckers will decline, since they demand large areas for nesting. In the long run, they might stop nesting in the area (Calluna, 2016a), resulting in a decrease of the birds and value for birdwatchers who frequent the area. On the other hand, the exploitation may benefit species who prefer an urban environment, which will outcompete forest species. Light and noise pollution during construction as well as after can have negative effects on animals. Habitat loss of this size means that the ecological connectivity will be negatively affected. This impedes species' ability to respond to a changing climate through relocation (Auffret *et al.,* 2015). The biodiversity in the stream Igelbäcken could be threatened and harmed by a high exploitation. Many factors play a role and there are high uncertainties in how the species would be affected.

Low exploitation alternative

Similar kind of impacts as in the high exploitation alternative. The so-called buffer zone, where high natural values have been saved, might serve as refuge for different species. Still,

pursuing this alternative will be contradictive to the Environmental Objective *Sustainable Forests* and, if done without caution, also work against the objective *A Rich Diversity of Animals and Plants*. Ecological connectivity is better accounted for in this alternative, although it is uncertain how species will respond to the more urban landscape.

Zero alternative

The environment will be affected by noise and air pollution from the roads. The increasing human activity in the area might disturb some sensitive species. The lack of water in Igelbäcken in the summers may have an impact on the stone loach population. The species populations in the area may be affected by breaks in the connectivity in the area, which will be further discussed in cumulative effects.

Zero plus alternative

Since this alternative will add Norra Kymlinge to the nature reserve, it may help the biodiversity and work toward the national objective *Sustainable Forests* and *Rich Diversity in Animals and Plants*. The noise reducing action may have some positive effects, like mitigating the noise disturbance, and some negative, with invasive species like lupine taking over the ramparts. The maintenance for outdoor activities could have a negative impact on wood dependent species, like insects and woodpeckers, if deadwood is cleared away to make the forests more available. Clearing the area from litter will remove the risks for birds and mammals of hurting themselves or get poisoned.

FIGURE 7. Igelbäcken, photographer: Tina Koskela, 2016.

Mitigation measures

One thing that could be done in planning, is exploitation with regard for existing nature. For example, old pines might be saved in a courtyard, and provide both shade, pine cones for the children to play or craft with, an ecosystem service, and maintain biodiversity (Calluna, 2016c). In maintaining and creating tracks for sports activities, they can be led away from sensitive places i.e. nesting birds. Also, deadwood needs to be saved, even if it's not 100 % safe or aesthetically pleasing to

some, in order to provide suitable habitats. When deciding what areas that should have been built on or saved, the goal should be to maintain a complex wood structure. This has been done in our low exploitation alternative, where areas with high natural values have been saved as a buffer zone towards the nature preservation area.

Summary

The majority of Norra Kymlinge consists of forest, and thus much of the biodiversity of both flora and fauna is linked to forest habitats. Through the area flows Igelbäcken, which has two protected fish species, the stone loach and the spined loach. The high exploitation alternative will result into a negative impact, since 84 % of the forest habitat will disappear. Habitat loss will also occur in the low exploitation alternative, though the buffer zone will provide some mitigation. The zero and zero plus alternatives do not have any significant impacts.

5.3 Cultural values

Cultural values

Environmental quality objectives: *Sustainable Forests, A Varied Agricultural Landscape, A Good Built Environment*

Regional environmental goals:

The adopted regional planning document, RUFS (2010a) includes the environmental goals and according to the cultural values it states followed:

- The region's cultural heritage has to be accessible, protected and living
- The experience of history is an asset for both residents and visitors
- Historical values must be available and be an important factor in social development (RUFS, 2010a).

Municipal environmental goals:

According to the Comprehensive Plan (Sundbybergs stad, 2013) it is important to:

"...protect our heritage that can teach us about the city´s history and contribute to the understanding of the present...".

Legislation

Cultural Heritage Law chapter 1 section 1:

" ...it is a national *responsibility to preserve and protect the cultural environment..."* (SFS, 1988:950).

Swedish Environmental Code chapter 1 section 1:

" ...*law should be applied so that valuable cultural environments are protected and conserved...*" (SFS, 1998:808).

Baseline

Many features from the Iron Age and onwards indicate a continuity in the landscape around Igelbäcken valley. The district has been a permanent residence since the 400's, but the findings are from the Bronze Age (Andersson, 1998). The eastern part of the nature reserve has previously been dedicated to woodland and pastures. North of Igelbäcken are several graveyards. Most of Järvafältets existing farms are located around Igelbäcken, which had higher water levels, and are coated in writing from the early Middle Ages. At the end of the Middle Ages, the nobility had a strong position in Järva and during the 1600s, mastered some of the most distinguished families in Igelbäcken valley. One explanation could be that the ground was significant by its close location to Stockholm (Landell, 1997). Despite the 19th century agrarian reform no major villages were established in Järva. But a growing population utilized all arable land along the Igelbäcken and at the end of the century hundreds of crop fields were created in the valley. In 1905 Järvafältet began being used by the military (Andersson, 1998).

In the north-eastern part of the planned area there are at least two stone circles from prehistoric times. Southwest of them there are other cultural features such as military facilities and one stone circle located near each other (Figure 8).

At the western border, a graveyard from the iron age, is located. Altogether there are at least six cultural features in the area planned to be built upon (Riksantikvarieämbetet, 2016a). The features in the northeast was investigated in 2001 for the construction of the interchange, but is not fully investigated. Other features were examined 2010/2011 for planning the heating plant, although not fully investigated.

In the nature reserve outside the planned area other cultural features can be found. Several older farms, which the municipality of Sundbyberg identified as of special cultural interest, are located in the surrounding area (Andersson, 1998). The archaeological remains give the landscape a historical dimension where preserved and accessible features provide a unique opportunity for individuals to experience the history of their neighbourhood. Ancient features are often an essential part of the cultural values in the landscape and it is important that they be taken into account in the planning of different types of changes in the physical environment (Riksantikvarieämbetet, 2013a).

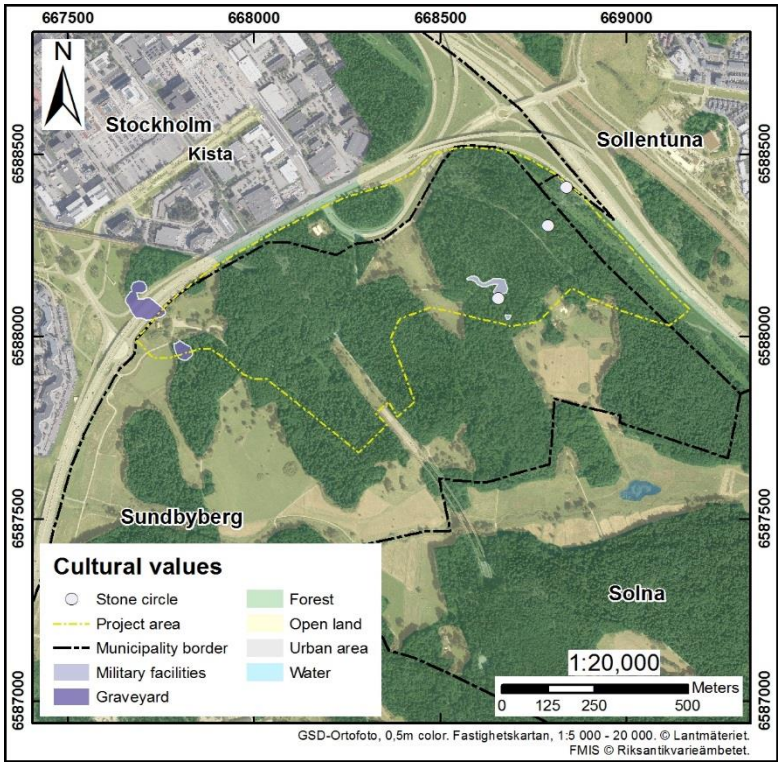


FIGURE 8. Location of cultural features in the planned area.

Impact prediction

High exploitation alternative

At a high exploitation of Norra Kymlinge the features will be destroyed during construction. Even if an excavation provides new knowledge, the opportunity to experience the history of the area is forever lost. The alternative goes against the Environmental Objectives: *A Good Built Environment,* *Sustainable Forests* and *A Rich Agricultural Landscape*, where it says that cultural values shall be protected and developed. According to Cultural Heritage Law chapter 2 section 6 it is prohibited without a license under this chapter, to remove, excavate, cover over or through buildings, planting or otherwise alter or damage an ancient monument (SFS, 1998:950).

Low exploitation alternative

At a low exploitation of the area with protection and integration of the historical features, the impact scale may be lower and the cultural values may be protected and developed. The features historical context in the landscape may be weakened. But accessibility is likely to increase and the possibility to experience the history in the area still in some extent remains.

Zero alternative

If nothing will be done in Norra Kymlinge, the cultural historic landscape will still be working as an ecosystem service and the features will remain protected. It will have no significant impacts.

Zero plus alternative

The accessibility to Norra Kymlinge is likely to increase but the alternative may have no significant impacts.

Mitigation measures

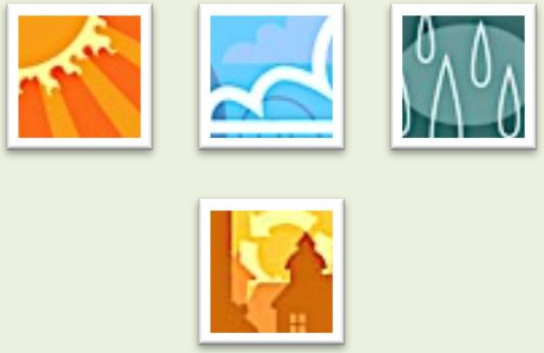
Integrating and highlighting the features in the surrounding landscape will make them accessible and at same time the cultural values can be protected and developed according to the Environmental Objectives. Archaeological features that remain adjacent to areas being constructed can be valuable for those who will use the site in the future (Riksantikvarieämbetet, 2013b).
It is of great value to preserve the cultural heritage when building new structures (Thiberg & Enander, 2016).

Summary

The development of the area will risk that cultural and historic values disappear. Settlements threaten archaeological features which, according to the Environmental Objectives and Cultural Heritage Law, should be preserved. But with mitigation measures that integrate the features in the development of Norra Kymlinge, the historical environment in some extent can provide citizens an experience of the cultural values in the landscape.

5.4 Air quality

Air quality



Environmental Objectives: *Reduced Climate Impact, Clean Air, Natural Acidification Only, and A Good Built Environment*

Regional environmental goals:

- Direct emissions of greenhouse gases should be less than 2.3 tons per capita. Current situation: 3 tons per capita
- The average trips per person per day by car should not be more than 6.5 kilometres. Current situation: 7.2 km (Intermediate goals for 2030) (RUFS, 2016).

Municipal environmental goals:

- Sundbyberg should be fossil fuel free by 2020.
- The energy usage should be reduced by at least 30 % by 2020.
- Carbon dioxide emissions must be reduced by at least 40 % by 2020.
- The inconveniences through traffic should be reduced (Sundbybergs stad, 2012).

Legislation

Environmental Quality Standards (EQS) aim to protect human health and the environment. The standards are mandatory national regulations that have been developed in conjunction with the Environmental Code. There are environmental quality standards for nitrogen dioxide, particulate matter (PM10 and PM2.5), benzene, carbon monoxide, sulphur dioxide, ozone, benzene, arsenic, cadmium, nickel and lead. In spatial planning, the environmental quality standards, as defined in the Air Quality Ordinance (2010: 477), must be take into account. According to The Planning and Building Act, spatial planning must not contribute to exceed the environmental quality standards. Additionally, it is important to ensure that people are exposed to air pollution levels as low as possible (Air quality regulation, 2010).

Baseline

Air pollution in the area derives largely from car traffic because of the close proximity to E18 and E4. According to the *Traffic plan* from 2012 (Sundbybergs stad, 2012), Sundbybergs municipality did not exceed the environmental quality standards for air, based on ten investigated sites in the municipality (Trafikplan, 2012). However, Norra Kymlinge was not included in the investigated sites. The amount of PM in Norra Kymlinge can be seen in Figure 9, where the values nearby E18 (Kymlingelänken) and E4 are higher than 50 µg/m^2, which exceed the environmental quality standards (Luftkvalitetsförordning, 2010). Further away from the motorways the measurements of PM10 values are lower and are therefore within the environmental quality standards.

TABLE 5. Environmental Quality Standards for Air (Naturvårdsverket, 2014).

Parameter	EQS (MG/M^2)	Comment
Nitrogen dioxide	40 µg/m^2(annual average) 60 µg/m^2 (daily average) 90 µg/m^2 (hourly)	Must not be exceeded Must not be exceeded more than 7 days per year Must not be exceeded more than 175 hours per year
Particulates, PM10	40 µg/m^2 (annual average) 50 µg/m^2 (daily average)	Must not be exceeded Must not be exceeded more than 35 days per year
Carbon monoxide	10 µg/m^2 (daily average)	Must not be exceeded
Benzene	5 µg/m^2 (annual average)	Must not be exceeded
Sulphur	100 µg/m^2 (daily average) 200 µg/m^2 (hourly)	
Lead	0.5 µg/m^2 (annual average)	

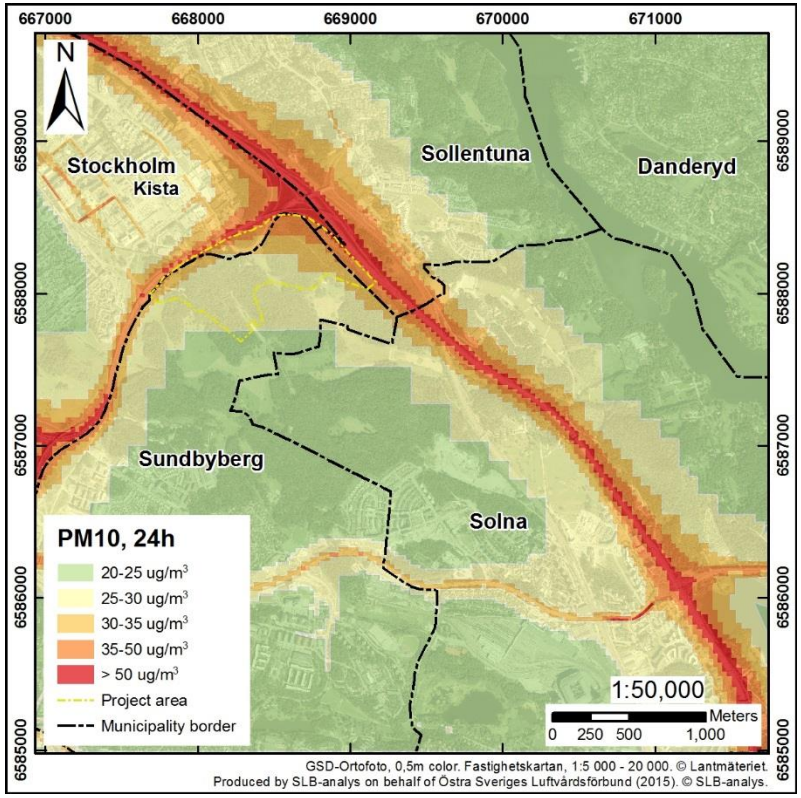


FIGURE 9. Estimated levels of particulate matter (PM10) for the 36th day of the current situation (in 2015) (from SLB-analys).

Figure 10 shows the amount of NO_2 in Norra Kymlinge, and the values nearby E18 (Kymlingelänken) and E4 is higher than 60 µg/m², which exceeds the environmental quality standards. Further away from the motorways the measurements of NO_2 values are lower and are therefore within the environmental quality standards.

The survey *Travel habits in Stockholm County 2015* presents transport distribution in the county's municipalities. Sundbybergs weekly average transport distribution is 33 % by car, 39 % collectively, 7 % by bike and 16 % by foot. 5 % have set different mode of transport (SLL, 2015). The results show thereby that a third of Sundbyberg´s citizens use the car as transport.

Urban vegetation provides a regulating ecosystem service by improving air quality through dry deposition of atmospheric pollutants such as NOx (NO and NO_2), SO_2, O_2, CO and particulate matter. Vegetation also sequesters carbon and contributes thereby to lower levels of atmospheric CO_2. Particulate matter (PM10/2.5) in the air can be responsible for human health problems. Particles that are smaller than 10 µm² or 2.5 µm² can enter deep into a person's lungs and cause lung diseases and heart diseases (Naturvårdsverket, 2016d).

Knowledge of the wind environment around buildings is useful to predict the dispersion of atmospheric pollutants. After the release of pollutants, those will be moving around by wind and turbulence. The wind speed determines both the distance of the tailwind transport and pollution dilution. The wind direction controls the general path of the pollution and its variation surrounds the extent of crosswind (Oke, 1988).

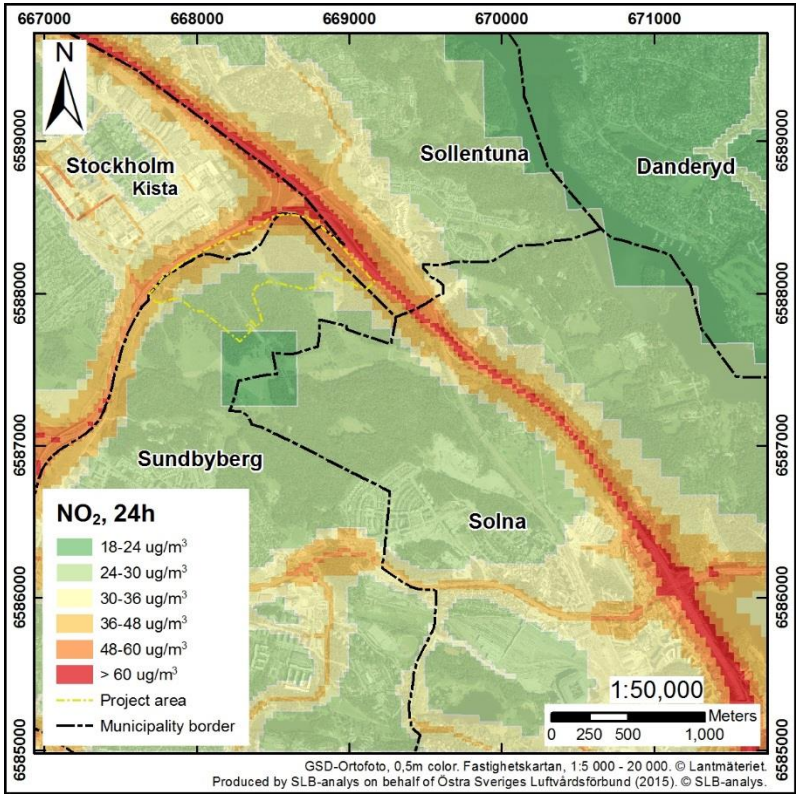


FIGURE 10. Estimated levels of nitrogen dioxide (NO2) for the 8th day of the current situation (in 2015) (From SLB-analys).

Impact prediction

High exploitation alternative

Emissions will increase during construction and may increase when the exploitation is completed.

Atmospheric concentrations of CO_2 may increase due to the loss of trees that store CO_2 and due to the use of machines etc., during construction (Nowak & Crane, 2002). Atmospheric air pollution (NO_2, SO_2, particulate matter) may increase due to the loss of trees that would otherwise take up pollutants. Hence, and a greater risk of air pollution related diseases (such as asthma) will be posed to the possible future residents of Norra Kymlinge. The traffic plan states that pollutants will most likely not exceed the standards in the future (Traffic plan, 2012). However, this statement is based on calculations outside Norra Kymlinge and in case of considering an exploitation in that area, investigations need to be conducted.

Buildings will be placed in zones where residents will most likely be exposed to amounts of up to 50 µg/m³ of PM10 per 24 h (see Figure 9). These levels are close to exceeding the EQS. Levels of NO_2 are estimated to be up to 60 µg/m³ per 24 h (see Figure 10), in those zones closest to the roads, where buildings would be placed. These levels are as well close to exceeding the EQS. The values can change if it comes to an exploitation.

The Environmental Objectives: *Reduced Climate Impact, Natural Acidification Only and Clean Air,* could be affected negatively by an exploitation and an increase of traffic. The Environmental Objective: *A Good Built Environment*, could also be affected negatively by worsening the conditions to provide a good and healthy living environment.

Uncertainties exist about the number and types of cars that would increase in the project area. This information depends on decisions that have not yet been made. Examples of such decisions would be if Norra Kymlinge would be a car-free district or if not, how many cars and parking lots would be planned for and expected.

Depending on how tall the construction of the buildings would be, it can affect the wind-flow conditions between the buildings. Tall buildings can create winds on pedestrian level three times stronger compared to the open or sheltered places. This would not only make it uncomfortable from a residents-point-of-view but also affect how atmospheric pollutants are distributed.

A positive impact can be seen in the buildings, as they act as a physical barrier where particles can be deposited and dispersion is inhibited (Bowker *et al.*, 2007).

Low exploitation alternative

Emissions may increase during construction and may when the exploitation is completed. Atmospheric concentrations of CO_2 may increase due to the loss of trees that store CO_2 and due to the use of machines etc., during construction (Nowak & Crane, 2002). Atmospheric air pollution (NO_2, SO_2, particulate matter) may increase due to the loss of trees that would otherwise take up pollutants. Hence, and a greater risk of air pollution related diseases (such as asthma) will be posed to the possible future residents of Norra Kymlinge. However, the severity of these impacts may not be as strong or large as in the high exploitation alternative.

The Environmental Objectives: *Reduced Climate Impact, Natural Acidification Only and Clean Air,* could be affected negatively by an exploitation and an increase of traffic. The Environmental Objective *A Good Built Environment*, could also be affected negatively by a worsening the conditions to provide a good and healthy living environment.

A positive impact can be seen in the buildings, as they act as a physical barrier where particles can be deposited and dispersion is inhibited (Bowker *et al.,* 2007). Viewer buildings would be placed in high PM10 and NO_2 zones but residents would still move around in those areas and be affected.

Zero alternative

The forest will most likely continue to be working as an ecosystem service regarding reducing air pollution and regulating temperature, thereby contributing to a reduction in some of direct and indirect adverse effects on human health as well as global warming. But the climate change and the development of the environment will result into not achieve the Environmental Objectives; *Reduced Climate Impact, Clean Air and A Good Built Environment,* according to the responsible authorities for each objective.

Zero plus alternative

If measures to improve recreation in the area will be done, the forest will most likely continue to be working as an ecosystem service for the environmental and human health as well as global warming. But the climate change and the development of the environment will result into not achieve the Environmental Objectives; *Reduced Climate Impact, Clean Air and A Good Built Environment,* according to the responsible authorities for each objective. However, different maintenance activities may increase CO_2 emissions (e.g. use of cars, chain saws, chippers etc.) (Nowak & Crane, 2002).

Mitigation measures

It is important to plan for pedestrian and bicycle paths and public transport to and from the project area to minimize the emissions from the exploitation. Construction needs to account for simple ways for residents to travel in the most sustainable way. Sweden's first car-free district could be introduced. The prepared underground station increases the choices for inhabitants to use public transport instead of cars.

Air pollution control should be of importance during the planning process. Several studies have investigated the effects of green roofs and green walls and the results show that those can effectively reduce urban air pollution (Rowe, 2010 and references therein). When planning for green roofs and green walls and other green areas, it must be considered which types of trees and plants should be planted. The filtration capacity of air pollutants by vegetation can be more and less effective with different species (Johnson, 2011) and trees are most effective as they have a larger leaf area compared to other vegetation (Rowe, 2013). Studies have shown that a green roof can reduce levels of sulfur dioxide and nitrous oxide with 37 % and 21 % respectively, and that 0.2 kg dust particles can be removed per year per m^2 of grass roof (Getter & Rowe, 2006, and references therein). This means that 10-hectare roof area, as it is the case in the high exploitation alternative, can remove 20 000 kg of dust particles per year.

According to researchers at the Building Research Establishment in Great Britain, buildings taller than 25 m (approximately 6 floors) or those that are twice the size of the buildings surrounding it, create wind speeds of 5 ms^{-1} and more (Oke, 1988). There are different construction techniques in how to mitigate such issues that also regard the dispersion of pollutants (Oke, 1988).

Measures of noise barriers can improve the environmental conditions, particularly when located on the upwind side or on both sides of a motorway (Brechler & Fuka, 2014).

Summary

Norra Kymlinge is located close to two motorways (E18 and E4) with high traffic and where a lot of air pollution is produced. Both exploitation alternatives would increase the amount of air pollution. Removing the forest, a great amount of trees that account for regulating ESS will be lost which will further increase air pollution, which in turn will negatively contribute to climate change. An exploitation also goes against the regional and municipal goals. If Vasakronan

gets a permission to build, construction plans need to account for a suitable substitution of the natural air pollution control from the present vegetation. Noise protection barriers and green roofs/walls can offset negative effects regarding air quality from building in such close proximity to busy motorways.

5.5 Barriers

Barriers


Environmental Objectives: *A rich diversity of plant and animal life and A good built Environment*

Regional environmental goals:

- Easy and accessible green areas with rich flora and fauna will provide good possibilities for outdoor activities (RUFS, 2010a).
- The Swedish Environmental code chapter 3 section 6 states that land and water areas that are important for public interests for outdoor activities and recreational shall be to the extent possible be protected from damaging measures. "*…Special consideration shall be given to the need for green spaces in and near urban areas*" (SFS 1998:808).

Municipal environmental goals:

- Sundbyberg Green plan (Grönplan) has the main goal to identify barriers for humans to reach the green areas (Sundbybergs stad, 2011).
- The Green plan also describes that the biodiversity shall be preserved and strengthened (Sundbybergs stad, 2011).
- When planning close to the nature reserve a great respect must be considered so that the access to it is not degraded, valuable links are not broken or the area's recreational values are affected (Sundbybergs stad, 2011).
- The municipality shall work for increased physical activity for the whole population. Green areas close to build environment increases the physical activities (Sundbyberg stad, 2011).

Baseline

Barriers have negative effects on biodiversity by limiting the passage for flora and fauna among green areas. It further prevents the possibility to develop a viable population (Naturvårdsverket, 2016c).

Barriers also affect the possibility for outdoor life for people in the area. If the physical environment is integrated with green areas, the physical activity might increase. Norra Kymlinge is today well used for different physical activities. Sundbybergs stad (2011) describes the importance of nature in urban areas and also stresses the vulnerability due to expansion of the city.

Impact prediction

High exploitation alternative

Nature-nature:
Since almost the whole area of Norra Kymlinge will be exploited, the buildings and roads in the area will act as a barrier for flora and fauna. A fragmentation will occur during the high exploitation alternative for flora and fauna when a large area of forest reduces in size (Calluna, 2016a). It further affects habitats that need a complex and varied forest as woodpecker and green woodpecker (Calluna, 2016 & Reitmann, 2016).

The Environmental Objective *A Rich Diversity of Plant and Animal Life* states that one of the challenges is the hard use of natural resources which is a threat against the biodiversity. Creating barriers through roads and buildings makes it even harder for flora and fauna to spread and survive (Naturvårdsverket, 2016e). One of the municipality's goal which they state in the Green plan (Sundbybergs stad, 2011) is that any exploitation close to the nature reserve shall take into account that the access to it is not degraded, valuable links are not broken or the area's recreational values are affected (Sundbybergs stad, 2011). The high exploitation alternative does not correspond to the municipal goal and the Environmental Objective *A Rich Diversity of Plant and Animal Life*.

Human-nature:
A significant impact will occur during the high exploitation alternative, both positive and negative. Positive effects can be seen in that more people will have access to the nature reserve since more people reside in the area and the underground station will be opened. This is positive in both a short and long term. Negative effects will arise for the people using Norra Kymlinge today for recreational purposes.

The access to the nature reserve will be greater for many people; the barrier will in a way be reduced by opening the underground station. Although, the area is today well used by many people and this should not be neglected.

According to the Environmental Objective *A Good Built Environment* the risk of densification of cities are that green areas often built on which in turn is affecting the possibility for outdoor activities for the inhabitants (Ripa, 2016). By building in Norra Kymlinge more people will get access to green areas,

but at the same time the people already using the area will be robbed of their possibility.

The Swedish Environmental Code chapter 3 section 6 states that an area which is of common interest of its natural values, cultural values or outdoor activities shall be protected and especially nature in urban areas (SFS 1998:808).

According to RUFS (2010) people shall have

"accessible areas with natural beauty and a rich animal and plant life should provide good recreational possibilities".

In the high exploitation alternative, the more people will have access to green areas, but uncertainties occur during the long-term impact if the nature reserve will continue having a rich biodiversity if the number of visitors and the wearing of the area is increasing.

Low exploitation alternative

Nature-nature:
This alternative exploits 70 % of Norra Kymlinge, which means that the impacts will not be as strong as for the high exploitation alternative. However, buildings and roads will pose barriers for flora and fauna. A buffer zone and green patches among the buildings mitigate the abrupt transition between nature reserve and exploited area and may serve as a buffer in case of negative impact. The buffer zone will absorb disturbance or negative impact from both side of the border between the built area and the nature reserve and thus reduce sensitivity to disturbance.

According to Sundbyberg municipality's goal (Sundbybergs stad, 2011) shall planning that might affect the nature reserve take into account that the access to it is not degraded, valuable links are broken or the area's recreational values are affected (Sundbybergs stad, 2011). The low exploitation alternative will not obstruct the municipal goals.

Human-nature:
The low exploitation alternative will have the same result as in the high exploitation alternative. It will result in both positive and negative effects. More people will gain access to the area since the underground station will open and more people will live in the area. The negative impacts are for Norra Kymlinge where the exploitation will occur. The current outdoor activities will have to be relocated. The municipality's goal that Sundbyberg shall work for increased physical activity for the whole population and green areas close to build environment would be promoted (Sundbybergs stad, 2011).

Zero alternative
Nature-nature:
No significant impact of the zero alternative but if current political opinion changes, the planned area may become exploited.

Human-nature:
No significant impact of the zero alternative but if current political opinion changes, the planned area may become exploited.

Zero plus alternative

Nature-nature:

The whole area would become a nature reserve and noise reducing measures would be build. In a long term this could result in a positive impact since the area will be protected and not be threatened by exploitation. However, noise barriers can make it difficult for species to travel.

Human-Nature:

The area is already today well visited and used for outdoor activities. The noise reducing measures could result in an increase in the number of visitors and increase the area's value. This corresponds to The Swedish Environmental Code chapter 3 section 6 (SFS 1998:808).

Mitigation measures

In case of an exploitation of Norra Kymlinge, it is important that the western link between Igelbäckens nature reserve and the green wedge, Järvakilen, is still intact and maintained. During the low exploitation alternative it would be preferable to leave the tracks for the recreational activities so that the people using the area would not have to move. It is important to support physical activity and outdoor activities. One way could be to give each activity 'an area of their own', to avoid collisions between for example horse riding and cycling (Kihl, 2016). If no exploitation will occur, it is still important to improve and increase the maintenance of the flora and fauna passage.

Summary

The high and low exploitation alternatives are, in comparison to the zero and zero plus alternative, in a higher risk of creating barriers, in terms of large forest areas that are decreasing in size and that would become fragmented. This will affect species that need large and varied forest areas. The exploitation alternatives are also creating barriers for the outdoor activities, the area is today well used by many people and by building houses and roads will result in a barrier for recreations. At the same time the exploitation is reducing the barriers for recreation due to the opening of the underground station and the exploitation. The municipal goal in the Green plan (Sundbybergs stad, 2011) describes that both the access to green areas shall be improved and also the biodiversity shall be protected.

In the zero alternative there will be no significant change. It might be exploited in the future, but this is uncertain. The zero plus alternative will result in a positive impact since Norra Kymlinge will become a part of the nature reserve and be protected from exploitation. Although, in both zero and zero plus alternative it is important that the connectivity to the west passage is maintained and protected since E18 is already acting as a barrier.

5.6 Water quality

Water quality



Environmental Objectives: *Natural acidification only, A non-toxic environment, Flourishing lakes and streams, and Good-Quality Groundwater*

Regional environmental goals:

- Good quality on drinking water.
- Sustainable ecosystems and ecosystem services (RUFS Water Strategy – comprehensive goals) (RUFS, 2013).

Municipal environmental goals:

- To inhibiting the development of storm water and maintain the groundwater balance, the proportion of hard surfaces is minimized.
- Storm water should where possible be handled locally (LOD – lokalt omhändertagande av dagvatten). LOD means that the management of storm water shall imitate the natural disposal of storm water with evaporation, delays and infiltration into the soil. What type of management technique is dependent on the recipient's sensitivity and the pollution in the water.
- Purification and delay of the storm water must be done at exploitation in Sundbyberg.
- Materials that may release hazardous substances into surface water should always be avoided.

Legislation

Environmental quality standards for water content include that all water bodies should achieve good ecological and good chemical status to the next established planning cycle in water management (stated in 2009). Water authorities have the responsibility to achieve the EU Water Framework Directive, to coordinate efforts to preserve and improve the quality of Swedish water. Water authorities and County Administrative Boards have developed a common system, VISS, where they present information about larger lakes, rivers, coastal water, groundwater and other water bodies status (Vattenmyndigheterna, 2016).

Baseline

Water resources in Norra Kymlinge include the stream Igelbäcken with its catchment area, surface water, storm water and water in the ground. Igelbäcken constitute habitats for organisms, while surface and storm water conditions affect the habitat on land. Our drinking water supply in Sweden is based on the availability of ground water and fresh water of good quality (with support from HaV, 2016).

The stream Igelbäcken

Igelbäcken is one of the most valuable streams in the Stockholm area. In the stream lives the unique fish stone loach. Igelbäcken catchment area is sensitive to actions that affect water quality and quantity (Sundbybergs stad, 2003). Thereby it is important to continuously monitor the quality of Igelbäcken and its catchment areas.

Igelbäckens catchment area extends outside the green area, which puts high demands on the exploitation so that the stream's water quality and flow does not change (Sundbybergs stad, 2003). The tables below show the present status of Igelbäcken and the environmental problems within the stream. The classification of the status is an assessment of how the water flows. The examination process mainly comprises a starting point with a survey of what humans have done and does that can impact the water negatively, and then examine the status of the water (VISS, 2016).

The table of the present status of Igelbäcken shows that the ecological status is good, which means that the quality presence of flora and fauna is good. However, the chemical status failing to achieve good status and it states that the amount of certain pollutants is exceeded. This depends on the amount of mercury contained in the stream. Chemical status by excluding mercury is estimated to be "Good status" (VISS, 2016).

TABLE 6. Status of Igelbäcken, (VISS, 2016).

Present status of Igelbäcken	
Ecological status	Good
Chemical status	Failing to achieve good
Chemical status but everywhere overrun subjects	Good

The table of the environmental problems shows that there is no problem with eutrophication and oxygen deficient conditions or acidification within the stream. However, there is problems with environmental toxins which is included by the amount of mercury (VISS, 2016).

TABLE 7. Environmental problems (VISS, 2016).

Environmental problems	
Eutrophication and oxygen deficient conditions	No
Environmental toxins	Yes
Acidification	No
Changed habitats through physical impact	not rated

Surface water and storm water

The program area is within Igelbäcken catchment area, which in turn is part of Edsvikens catchment area. Edsviken is classified as a body of water according to the EU Water with insufficient ecological status and poor chemical status (Sundbybergs stad, 2013). Figure 11 shows the catchment area with runoff water within Norra Kymlinge.

Storm water, e.g. traffic storm, water may contain high levels of pollutants, especially heavy metals, that are discharged into rivers and lakes, soil and groundwater and can lead to destruction of living places for animals and plants, the

elimination of sensitive species and accumulate in living organisms and sediments (Structor, 2012).

The table below shows the difference between natural land and town surface. The evapotranspiration will be 100 mm less for town surface than natural land and the runoff will be 335 mm more for town surface than natural land. The catchment area will according to this, receive a water supply of 235 mm.

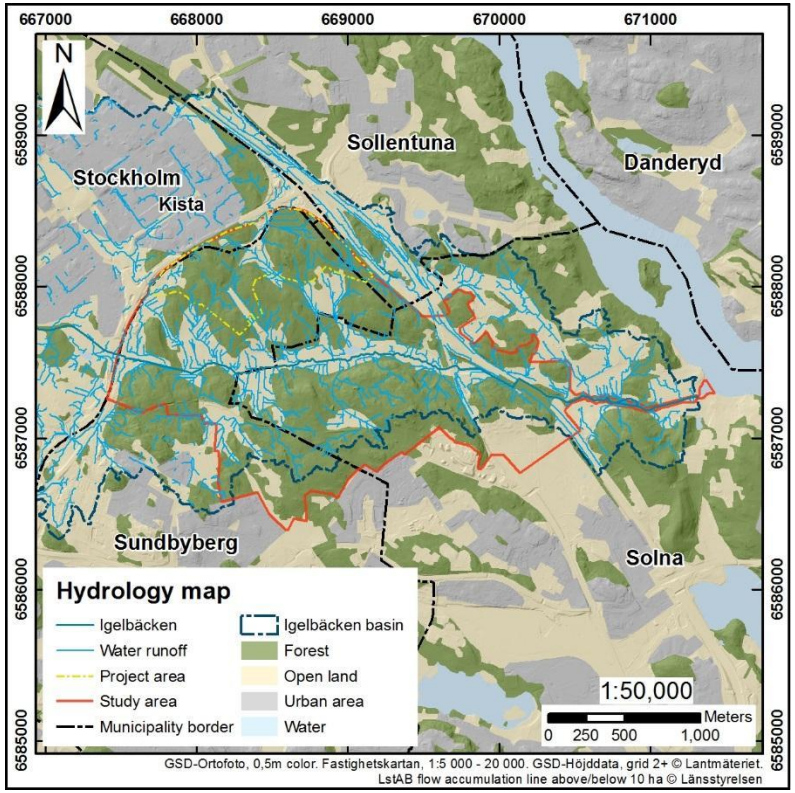


FIGURE 11. Water catchment area for Norra Kymlinge.

TABLE 8. Runoff conditions of natural land respective town (Länsstyrelsen Skånes län, 2009 after Gottschalk, 1980).

	Precipitation	Evapo-transpiration	Runoff	Water supply
Natural land	700 mm	450 mm	250 mm	
Town	700 mm	350 mm	585 mm	235 mm

Evapotranspiration is about transpiration, when plants take water from the ground through their roots and emit it through their leaves and evaporation, the conversion of water from a liquid to a gas through tree surfaces or surrounding soil (Oke, 1988).

Groundwater

Sundbyberg get their drinking water from Norrvatten and the raw water comes from Lake Mälaren. If the entire eastern Lake Mälaren would be polluted, reserve water would need to be used from groundwater (Sundbybergs stad, 2013).

Impact prediction

High exploitation alternatives

The exploitation in Norra Kymlinge is planned within the catchment area of Igelbäcken (Figure 11), which is one of the most valuable streams in Stockholm county.

For the high exploitation alternative an assumption has been made that the management of storm water will be made through a local disposal of storm water (LOD). Today Sundbyberg municipality has resolved the quality of the runoff water to Igelbäcken by sedimentation and fresh water, this shall continue even during exploitation in order not to degrade the quality of the stream. In association with a land-use change, where green areas are transformed into hard surfaces, the quality of storm water could deteriorate. More hard surfaces will result in a surplus water supply. This exploitation alternative obstructs the municipal and regional goals as well as the Environmental Objectives. Atmospheric pollutants and sodium chloride (from salting roads in winter) that are washed off into the groundwater and Igelbäcken can acidify the water and affect its quality, thereby negatively contributing to the Environmental Objectives A *Good-Quality Groundwater* and *Natural Acidification Only* as well as *Flourishing Lakes and Streams* and *A Non-Toxic Environment.*

However, a good management of the surplus runoff water could result in a better and richer catchment to the stream of Igelbäcken, which today has some problems with dehydration.

Low exploitation alternative

The exploitation in Norra Kymlinge is planned within the catchment area of Igelbäcken (Figure 11), which can affect the stream Igelbäcken and the water body Edsviken. For the low exploitation alternative an assumption has been made that the management of storm water will be made through a local disposal of storm water (LOD). A transformation of natural land to hard surfaces will change the conditions for runoff water. Together with preserving some of the natural area as buffer zone and a good management of the runoff water, exploitation may result in better water flow of the stream Igelbäcken. Saving a green buffer zone between the motorways (E4, E18) and the buildings will help to absorb runoff water with particles from the traffic and avoid them to be transported to the catchment area of the stream of Igelbäcken. The buffer zone would mitigate the transport of pollutants to the ground water and Igelbäcken, however it is uncertain how effective the buffer zone would be.

Zero alternative

With higher future uncertainty of precipitation and more extreme weather events, the stream Igelbäcken could suffer during dry periods. However, the uncertainty of the amount of precipitation makes it difficult to predict the impact. The mentioned Environmental Objectives will mostly likely not be reached.

Zero plus alternative

With higher future uncertainty of precipitation and more extreme weather events, the stream Igelbäcken could suffer during dry periods. However, the

uncertainty of the amount of precipitation makes it difficult to predict the impact. The mentioned Environmental Objectives will mostly likely not be reached.

Mitigation measures

Minimizing the proportion of hard surfaces shall prevent admission of storm water. Measures should be taken so that the resulting storm water as far as possible be taken care of locally (LOD), within the program area, by infiltration and delay. Cleaning the water locally with a dam before it reaches the recipient could ensure the quality of the storm water.

According to Adrup & Mörner (2008) Igelbäcken is a sensitive stream. By calculating the generated level of pollution from the planned area it is helpful to increase the knowledge and to know what kind of mitigation measures needed. If a parking lot is built, an oil separator will be needed to be installed before the dam. Also, water samples from Igelbäcken should be made to ensure that the water quality does not exceed the pollution levels (Adrup & Mörner, 2008).

By reducing the level of contamination at the source lower levels reaches recipient benefiting the aquatic environment.

According to the municipal goals shall storm water be handled locally (LOD) (Sundbybergs stad, 2013). If LOD is applied, it is important to clarify that the care is the property owner´s responsibility. It must then be placed to implement LOD within the property as e.g. the risk of water near the house foundation can cause moisture problems (Boverket, 2010). The most common solution for LOD is infiltration but for larger properties and activities can also equalization in the form of magazines and ditches be managed. In LOD, is not storm water management led away directly from the stovepipes. In order not to damage the building by the water, stovepipes should therefore be fitted with ejectors. With help from vegetation and green roofs, evapotranspiration can reduce the amount of storm water that is formed. Even if the reduction of storm water runoff from each plot is not so great at LOD, is the aggregate effect of consistently using LOD essential (Länsstyrelsen Skånes län, 2009).

In the area Augustenborg in Malmö, in south Sweden they have installed a storm water system to make the area ecologically sustainable. The storm water is partly taken up by plants on the roofs of the buildings, and then the water leads to a canal where the vegetation is contributing to a natural purification of the water. The water is then transported to bigger canals and dams (Naturvårdsverket, 2010).

There are various measures for the water management, to correct the amount of runoff water and supply water:

- *Delay at source:* via infiltration, which can take place in private or public land, but also on complete impervious surfaces such as parking spaces. By choosing paving stones that give good permeability and green roofs, these surfaces contribute to delay the storm water.
- *Slow diversion*: can be achieved by surface water that is led slowly over grassland towards a given goal.

- *Delay magazines:* in the form of ponds and wetlands required when infiltration and slow diversion does not provide adequate smoothing of the storm water. From a nature conservation point of view is it desirable with shallow ponds with a large surface and shallow shore zones (Länsstyrelsen Skånes län, 2009).

Green roofs and walls can effectively delay excessive storm water runoff and increase the quality of water that reaches Igelbäcken as well as prevent risks of overflowing sewage systems (Getter & Rowe, 2006).

The streets, parks and gardens in Norra Kymlinge shall be designed for local disposal of storm water. Green roofs, open canals and ponds shall be constructed and will beautify urban spaces. An increased influx of sedimentation and purified storm water to Igelbäcken is an environmental benefit today, to prevent drying, during dry periods adds fresh water to the stream and the management shall be continued (Sundbybergs stad, 2013).

Summary

An exploitation of the area will affect the catchment area to the stream of Igelbäcken. A transformation from natural land to hard surfaces will add more runoff water. The runoff water will contain particles and pollutants that can affect the stream of Igelbäcken negatively. A good management of the surplus runoff water, with sedimentation and freshwater, can may be result in a better and richer catchment to the stream of Igelbäcken, which today has some problems with dehydration. If the green areas will be kept, the vegetation can still absorb the water but it is important that the measures to manage the runoff water will continue and be developed, either with infiltration, slow diversion or delayed magazines. Green roofs would be necessary to mitigate storm water runoff and filter pollutants from reaching the groundwater and Igelbäcken.

5.7 Noise

Noise

Environmental Objective: *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" (Environmental Objectives, 2016c).

This definition, set by the Swedish parliament, sets out some of the challenges the growing urban population in Sweden faces. As cities spread further out, services and shopping centres follow, creating a need for transport which in turn increase the problem of transport noise. At the same time city centres are becoming denser, decreasing the demand for transport but still causing a noise problem. Noise is an issue to be considered and mitigated in order to reach the Environmental Objective of *A Good Build Environment*.

Noise is measured in equivalent noise levels that which refer to a daily average and maximum noise level that refers to a maximum occurring level from a single source, for example one car.

Legislation

Regulation (2015:216) on traffic noise on residential buildings section 3 in the Swedish Environmental Code (SFS, 1998:808) provides guidelines for noise and states that noise from rail and road traffic should not exceed:
1. 55 dB(A) equivalent noise level on a residential building facade, and
2. 50 dB(A) equivalent noise level and 70 dB(A) maximum noise level on a patio if it is to be provided in connection to the building.

For a house no larger than 35 m^2 an equivalent noise level of 60 dB(A) should not be exceeded on the residential building facade. Section 4 in the same regulation states that should the equivalent level mentioned in section 3 point 1 be exceeded then,

1. minimum half of the dwellings in a resident should face a side where 55 dB(A) equivalent noise level is not exceeded on the facade and,
2. minimum half of the dwellings in a resident should face a side where 70 dB(A) maximum noise level is not exceeded between hours 22.00-06.00 on the facade.

Section 5, same regulation, states that should the maximum levels in section 3 point 2 be exceeded, the level should not be exceeded by more than 10 dB(A) maximum noise level more than 5 times per hour between hours 06.00-22.00.

For recreation areas there are no regulations, however the Swedish EPA suggests 45 dB(A) for recreation areas where

80 % of the visitors should experience noise as non-disturbing (Naturvårdsverket, 2007).

Chapter 2 section 6a in The Planning and Building Act (SFS, 2010:900) states:

" *In planning and in matters concerning building permit in accordance with this Act, dwellings must be: 1. located to land that is suited for the purpose with regard to the possibility of preventing public health nuisance with regard to environmental noise; and 2. designed and placed on the intended land in a way that is suitable with regard to the possibility of preventing public health nuisance with regard to environmental noise. Public health nuisance encompasses a disturbance that, according to medical or hygienic assessment, could detrimentally affect people's health and that is neither insignificant nor completely temporary...*" (SFS, 2014:902).

As of January 2nd 2015, according to section 33 in The Planning and Building Act:

"*If a detailed development plan relates to one or more dwellings, the planning description – if with regard to the noise situation it cannot be considered unnecessary – must contain a report of the calculated values for environmental noise:*
1. by the façade of the dwelling; and
2. by an outdoor space, if one is to be arranged adjacent to the building act" (SFS, 2014:902).
This means that noise calculations most probably must be made for Norra Kymlinge when creating a detailed development plan since noise is considered an issue today. This also means that a supervisory authority must emanate from the calculated values during supervision.

Baseline

Norra Kymlinge is located in connection to two motorways, E18 and E4, making the area highly affected by traffic noise. The E18, situated north/northwest of the area, has a speed limit of 80 km/h and an annual mean traffic flow of around 47 000 vehicles per day (Trafikverket, 2016a) while the E4, situated east of the area, has a similar speed limit and an annual mean traffic flow of around 118 000 vehicles/day (Trafikverket, 2016a). Trees in the area absorb noise as an important regulating ecosystem service for the local inhabitants using the area for recreational purposes. This is important because noise is considered to be an important factor for quality of life and has great effect on human health, some being stress, sleeping impairment and concentration difficulties (Naturvårdsverket, 2016b). The effect is different on different people, determined by what we regard as noise and in what situation it occurs (Naturvårdsverket, 2016b).

The studies performed in year 2000 (Vasakronan), showed that the highest measured noise levels, 65 dB(A), are closest to the two motorways. This level is likely to have increased since then due to increased traffic flow. The inner part of the area displayed levels around 50-55 dB(A) and the relationship between outer and inner part of the area is not expected to have changed since then.

In a study performed between 2009-2013, a number of inquiries regarding noise were made to residents of newly built housings during the period. One residential area, Förtjusningen, located in west part of Stockholm city, is situated in just west to Sweden's most trafficked road Essingeleden with a traffic flow of 145 000 vehicles/day. Other surrounding roads are Nordenflychtsvägen (2500 vehicles/day) and Hornsbergs Strand (3000 vehicles/day). The equivalent noise recorded on the traffic side is 71-75 dB(A) and on opposite side is 51-55 dB(A) where the patio is situated. This is above the guidelines in regulation (2015:216) and therefore special measures were taken by not placing windows on the traffic side. The results of the surveys show that relatively few are disturbed by noise caused by road traffic (Hallin *et al.,* 2016).

According to an investigation made in Ursvik in 2012, close to Norra Kymlinge, where motorway E18 Enköpingsvägen with an annual average of 40 000 vehicles/day passes, the closest facades with 3-5 floors around 50 m from the center of the road record an equivalent sound level of 69 dB(A) (Ramböll, 2012). This exceeds the guidelines in regulation (2015:216) however the opposite sides of the buildings are below the maximum noise levels and residential buildings further in are below the guidelines (Ramböll, 2012). This is due to the buildings acting as noise screens along the motorway.

A survey made by the Swedish Transport Administration in 2011 showed that the E4 passing Norra Kymlinge records equivalent noise levels of 65 dB(A) by the proximity of the road and equivalent noise levels of 55 dB(A) some hundreds of meters into the area (Trafikverket, 2012). According to a general calculation on noise levels on residential buildings between 1-5 levels from the National board of Housing, Building and Planning, a road with 80 km/h speed limit and average traffic flow of around 118 000 vehicles/day, like the E4 passing Norra Kymlinge, could produce an equivalent noise level of 80 dB(A) 20 m from the center of the road and 68 dB(A) 100 m from the center of the road. A road with 80 km/h speed limit and average traffic flow of around 47 000 vehicles/day, like the E18 passing Norra Kymlinge, could produce an equivalent noise level of 75 dB(A) 20 m from the center of road and 64 dB(A) 100 m from the center of the road (Boverket, 2016).

Impact prediction

High exploitation alternative

In this alternative noise will increase during building phase with increased traffic and heavy machinery in area. Population growth will lead to an increased number of cars on the roads (Trafikverket, 2015). This will affect both the E4 and E18 passing Norra Kymlinge. One uncertainty is technological advancements in cars, for example the increased usage of silent electric cars may decrease traffic noise however, traffic noise is still unlikely to decrease significantly.

The noise is post-exploitation likely reduced due to 8-floor buildings closest to the roads blocking the noise to the residential buildings within. Some uncertainty lies with how close the buildings by the road are built

together. Other uncertainties include local noise events from cars in parking lots, if such are built, and from the sports ground that may increase noise in the nature reserve on occasion. Because regulation (2015:216) on traffic noise on residential buildings states that a house up to 35 m^2 is allowed to experience 60 dB(A) on the building facade, the student apartments that are in junction with the office buildings may satisfy this guideline. Compared to zero alternative, noise will be reduced and positively affect the chances of reaching the Environmental Objective of *A Good Built Environment.*

Low exploitation alternative

In this alternative the noise is similarly to the high exploitation alternative increased during building phase. Population growth will lead to an increased number of cars on the roads (Trafikverket, 2015) and noise from traffic is similar to the high exploitation alternative unlikely to decrease. Post-exploitation noise may be reduced to a lesser extent compared to higher exploitation alternative due to 5 floor buildings and more space between the buildings. Noise is likely to be reduced in the nature reserve due to the buffer zone between buildings and the nature reserve however, local noise event from cars in parking lots, if such are built, and sports ground may increase noise in nature reserve on occasion. The green area between the E4 motorway and nature reserve may act as a buffer zone for noise with uncertainty due to increased traffic noise. Compared to the zero alternative, noise will be reduced and positively affect the chances of reaching the Environmental Objective of *A Good Built Environment*.

Zero alternative

In this alternative noise will continue to be an issue in the area. Increased population growth will lead to increased traffic (Trafikverket, 2015) and given some uncertainty over technological advancements in cars, noise is still unlikely to decrease over time, affecting the existing local recreational groups as well as new visitors. Population growth may lead to more visitors that may cause local noise events in the nature reserve. Since a residential area is not built, this does not affect the possibilities of reaching the Environmental Objective of *A Good Built Environment.*

Zero plus alternative

In this alternative increased population growth will lead to increased traffic (Trafikverket, 2015) and noise is unlikely to decrease over time however, noise is likely to be reduced by noise screens set up along the two motorways. Uncertainties lies in the design of the noise screen, which needs to be high enough to break the line of sight of source and receiver, have proper thickness and density (Trafikverket, 2004). More visitors to the area may contribute to local noise events in the nature reserve. Compared to the zero alternative noise will be reduced however, since a residential area is not built it will not affect the possibilities of reaching

the Environmental Objective of *A Good Built Environment.*

Mitigation measures

Noise measurements should be made in the area to more precisely determine the existing levels and how harmful it is for people visiting the area. Building with noise reducing material should be done when exploitation takes place according to the high exploitation alternative as well as the low exploitation alternative. Building noise screens along the motorways will reduce noise according to the zero plus alternative while not exploiting leaves noise as a continuous issue in the area.

Summary

Considering that noise has a negative impact on human health, it is important to address the issue of reducing noise for quality of life but also to reach the Environmental Objective of a good built environment set by the government. If exploitation is done noise will increase at first but reduce post-exploitation however, noise reduction is also possible in zero plus alternative, this in contrast to the zero alternative where noise continues to be an issue in the area.

5.8 Recreational values

Recreational values

Environmental Objectives: *Sustainable forests*

This objective does not specifically mention recreation, but since deadwood is a vital part of it, and deadwood will be affected by recreational plans, we have chosen to include it.

Regional environmental goals: RUFS 2010

- Valuable cultural, natural and recreational environments are cared for and evolved.
- People in the region have access to high quality near urban nature.
- The outdoor environment of the region is healthy safe and simulating.

Municipal environmental goals:

- Increased public health (Sundbybergs Stad, 2013).

Baseline

The area of Kymlinge is used for many kinds of recreation and outdoor activities (Figure 12 and Figure 13). There are no official statistics on how many people are using this area, nearby sport clubs are counting between 200 000-500 000 visits/year in the Ursvik recreation area, which Kymlinge is part of. This is based on visits in similar recreation areas in the Stockholm region (Sundbybergs stad, 2014b). The municipality estimates 500 visitors/day in Kymlinge (Hamrin *et al.*, 2016). The Solna-Sundbyberg working dog club have their clubhouse and training grounds there, and Stockholms stigcyklister (the Stockholm MTB cyclists), approximately 880 members, have made a cycling track in the woods, which they maintain themselves (Figure 13).

The track is very popular, and is the only mtb-track in the northern parts of the Stockholm region (Pehrson, 2016). The municipality of Sundbyberg is maintaining the skiing tracks. The woods are also used for orienteering by Sundbybergs IK, with 528 orienteering members of all ages, with competitions of 130-140 participants that are held 12 times a year (Kihl, 2016, written communication). There are also riding tracks in the area, used by the local horse riding societies, and the walking track "Akallastråket" goes through Kymlinge (Stockholms stad, 2016b). The area also provides valuable ESS for the local inhabitant, both nutritional like berries and edible mushrooms and cultural services. The area is frequently used for strolling, which can be found to be distressing for the modern human, living in mostly urban environments (Calluna, 2016b).

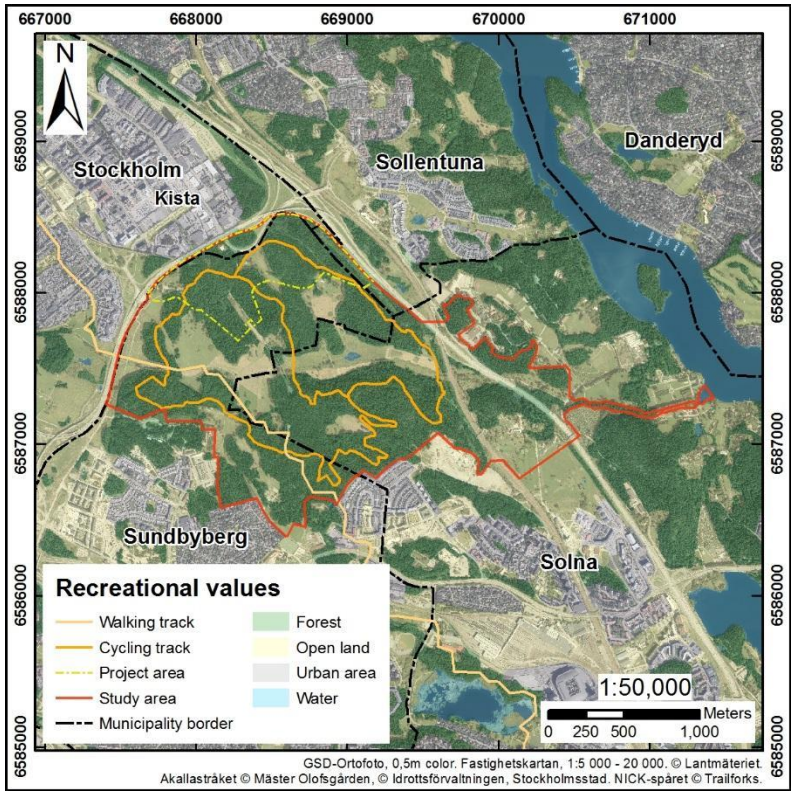


FIGURE 12. Walking track and cycling track in Norra Kymlinge and the nature reserve of Igelbäcken.

Impact prediction

High exploitation alternative

The impacts on recreation in the alternative are both positive and negative. One positive impact is that the opening of the underground station will make the nature reserve and the remaining green area in Kymlinge more accessible to people in the entire region. Today, it is mostly accessible to people who own a car. 25 % of the cycling tracks will be lost, which will also increase the wear on the remaining tracks, and there will also be a competition between different kinds of users (Pehrson, 2016). The orienteering will have to move out of the area, for example to Järvafältet or Jakobsberg, because the remaining green area will be too small for their needs. The majority of the people orienteering are children and adolescents, which is contradicting to *good health* being one of the five main aims in the municipal plan. (Structor, 2009). The increased numbers of visitors will mean more people on a smaller surface.

Today, the area receives 182 500 visits a year and if this alternative is pushed through, there will be 5 million visits a year, and the area space will be 25 % smaller (nature reserve excluded). ESS such as berries, mushrooms, distressing and strolling will also decrease or be lost (Calluna, 2016c). One positive impact might be that the noise will decrease since the buildings will work as noise protection (Eriksson, 2016). The sport grounds open up for organized sports, but may affect the strolling and relaxing negatively. To sum it up, nature will be accessible to more people, but the clubs active in the area today will be forced to move/decrease their activity.

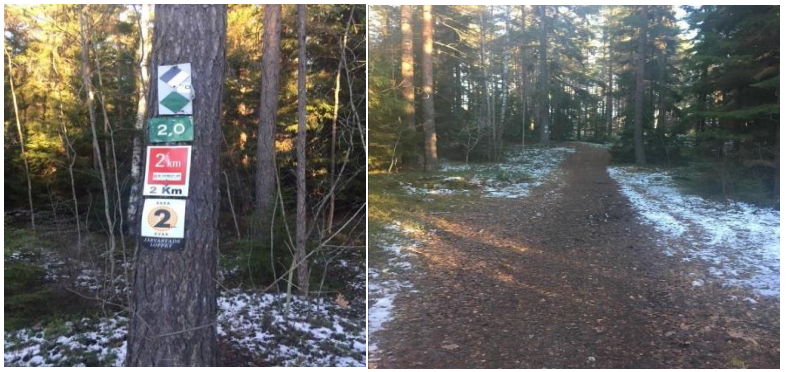


FIGURE 13. A recreational track in Kymlinge. photographer: Tina Koskela, 2016.

Low exploitation alternative

The increasing pressure and wear described in the high exploitation alternative will probably take place in the low exploitation alternative. Although, the scale might be slightly smaller. The cycle track will be shortened, which according to Pehrson (2016) will result in fewer people using the track, since it will be shorter and less challenging. The positive impact of noise reduction due to buildings working as noise protection may occur in this alternative, but it depends on the construction and placement. Another positive impact is the underground station, which will make the area more accessible for people, whether they have a car or not. The impacts will be positive for those who get easier access to the area, but the people using it today will be affected negatively, by losing space for their activities.

Zero alternative

The interviews with Kihl (2016) and Pehrson (2016) stress the current wear happening to the area. As the surrounding municipalities are exploiting the neighbouring areas, the pressure on the area will rise as the number of visitors and their frequency increases. The visitors may also contribute to more littering in the area, and the area around the working dog club might be especially exposed to wearing, since an increasing number of visitors arrive by car. The increasing use of the area may decrease the ecosystem service of a de-stressing environment that the area provides today (Calluna, 2016c). The Committee for Culture and Recreation in the Municipality of Sundbyberg are currently working on improving the availability and the quality of the tracks in the area.

Zero plus alternative

Kihl (2016), Pehrson (2016) and Eriksson (2016) agree on the fact that the quality of the tracks in the area needs improving. As stated in the zero alternative, that work is already being done. The orienteering club is doing some delittering work today, and have applied for economical funds from the municipality to do so. Vasakronan also drives around on their lands today and pick up the litter being dumped in the area. The cycling activity could be affected negatively. When the track was created, negotiations were done with the municipality to make sure that ecologically sensitive areas were not affected by the cyclists (Pehrson, 2016).

Mitigation measures

As stated in the description of impacts, one thing that needs to be dealt with is the noise from the high-traffic roads E18 and E4. If exploitation is to be done, some noise reduction could be achieved by planning the housing areas in such a way that the houses themselves protect the green areas from noise. Sound absorbing materials can also be used. If no exploitation is to be done, putting up noise reducing ramparts could help making the nature experience more pleasant, thus both being a regulative ESS, and increasing the value of the cultural ESS.

The wear of the nature reserve and other green areas can be dealt with by strengthening the tracks without turning them into gravel roads. Pehrson (2016) suggests lengthening the cycling tracks to handle the growing number of cyclists (Pehrson, 2016). During next year, Sundbyberg municipality is looking at increasing availability in the area, and also make the conditions for horse riding better (Eriksson, 2016). Kihl (2016) also suggests maintaining the tracks, and improving the signs in the area. He also mentions making sure each activity has their own space, and also some forest management in removing, for example wind-felled trees (Kihl, 2016). This must however be done with keeping the biodiversity in consideration.

Summary

Norra Kymlinge is frequently used for recreational activities. The impacts, if any of the exploitation alternatives are chosen, can be described as “some win, some lose” since the underground will provide access to nature for many people, the sport club active today will lose their space and will be

forced to move. The zero plus alternative will provide a significant positive impact, since the area will be included in the nature reserve and the management plan will focus on recreation. Regardless of alternative, management of the area will need to address the noise from surrounding roads and the wear from public use.

5.9 Cumulative effects

Cumulative effects are the result of individually small impacts that over time act together and form significant large impacts. In addition to the impacts described in this EIA, cumulative effects are described in the following, taken into account the development that happens outside the project area.

Norra Kymlinge is located in a developing district, with exploitation of houses and motorways, which can affect the environment in Norra Kymlinge and also the nature reserve of Igelbäcken. Ongoing projects around the area:

- *In Sundbyberg:* Exploitation of a new light rail and bike paths along with E18, exploitation of the MILO-area and Stora Ursvik (Sundbybergs stad, 2013).
- *In Sollentuna:* Exploitation of Silverdal (Sollentuna kommun, 2012).
- *In Stockholm:* Proposed supplementary development of Kista and strengthening the strategic important relationship between Kista and nearby areas (Stockholms stad, 2016).
- *In Solna:* Development and exploitation of Nya Ulriksdal and Järvastaden (Solna stad, 2016).

By emphasizing nearby projects and examining the environmental impacts of those, the understanding of cumulative effects of Norra Kymlinge will be easier. The projects may affect:

- *The landscape* in Norra Kymlinge and in the nature reserve, by transforming the character of the whole district.
- *Biodiversity* in Norra Kymlinge, through changing and removing habitat conditions for flora and fauna.
- *Air quality* in Norra Kymlinge, by increase the amount of emissions and particles in the whole district. A development of housing areas can likely result in more cars on the roads in the district.
- More *barriers*, especially when it comes to the implementation of the light rail, because it will develop a barrier both for humans and the biodiversity.
- *Water quality* in Norra Kymlinge, by impacts of the catchment area to Igelbäcken with more runoff water (more hard surfaces = more runoff water) containing pollutants (especially traffic pollutants and from construction) that can negatively affect the quality of the stream Igelbäcken.
- *Noise level* in Norra Kymlinge and the nature reserve Igelbäcken. Construction noise and increased traffic flow rises the noise, which in turn affect biodiversity, recreation and health of the inhabitants.
- The *natural and cultural values* can be affected by a higher amount and frequency of visitors of the nature reserve and Norra Kymlinge. An overcrowded green area may result in degradation of the nature and

increased littering which decreases the recreational values and affect biodiversity.

Implementing the light rail can both result in positive and negative impacts, not only for the nearest area, but also for the area of Norra Kymlinge and the nature reserve of Igelbäcken. Negative impacts will be the following, according to the EIA of the light rail (WSP, 2016):

- Small impacts on the noise level.
- Small to moderate impacts on the landscape and barriers.
- Moderate impacts on the nature environment.

Positive impacts will be the following, according to the EIA of the light rail (WSP, 2016):

- Small to moderate positive impacts on recreation, in terms of that the area will be more accessible and included within the municipality of Sundbyberg as well as for the whole region.
- Small to moderate positive impacts on climate change, because the light rail can contribute to reduce car dependency.
- Small to moderate positive impacts on health and housing environment, because an exploration will contribute to achieve the Environmental Objective *A good built environment* (WSP, 2016).

Norra Kymlinge is a part of Järvafältet (the green wedge). If an exploitation of Norra Kymlinge is implemented, a part of the green wedge will be lost, which can affect Järvafältet in the long run. Removing this green space will break connections within the green wedge that are important for biodiversity and other natural values. Climate is changing and species may need to resettle in order to survive. Fragmenting green spaces in cities impedes the possibility for species to move around which can lead to species extinction (Krosby *et al.*, 2010; Auffret *et al.*, 2015). Including Norra Kymlinge in the nature reserve means strengthening and protecting the ecological functions of the green wedge and supporting them by a management plan.

One thing that must be considered as a long term consequence is the risk of the recreational and the nature values in the nature preservation area that could be decreasing as a result of an increasing wear of the area if the high or low exploitation alternative becomes reality. By opening the underground station, it will give access for people from all over the region. This, combined with the thousands of people moving into the newly built housing area, will multiply the visits. An exploitation of Norra Kymlinge will affect biodiversity negatively in the area and in the nature reserve. Research indicate that high biodiversity increase the human wellbeing and reduces stress, and without rich biodiversity there will be a risk of more sick and stressed people (Carrus *et al*., 2014). From this perspective, it would be a statement to keep as much green areas as possible. In another perspective, an exploitation of Norra Kymlinge will result in an addition of housing areas and will have a positive effect, according to the housing shortage in the whole region (Boverket, 2012). The Intergovernmental Panel on Climate Change (IPCC) have predict a global warming with an increase temperature of 0,7 degrees Celsius the last 100 years. The temperature will rise

more in Sweden and precipitation will increase in larger parts of Sweden during fall, winter and spring. It will result in an increase of runoff water and it is important to include predictions about the climate change to be prepared of a changed climate (SOU, 2007). Climate change contributes to more precipitation and thereof more storm water, which can lead to damage on buildings and on the environment (SMHI, 2016). It is therefore important to take climate change into account and mitigation measures when planning for storm water management.

Cumulative effects are a non-linear process, with individually small impacts that collectively will be significant, over different timescales and space boundaries. It is difficult to predict cumulative effects, but by knowing about other projects around the surveyed area, it invites to collaborate with other stakeholders and municipalities and be averse of other impacts than just within the surveyed area to thus avoid getting surprises from outside (Glasson *et al*., 2005).

6. Summary of environmental impact assessment

To summarize and visualize the impact assessment, the results are presented in a matrix. Table 9 is a legend, explaining the impact categories. Table 10 is a matrix summary of the environmental impacts of the four different alternatives.

TABLE 9. Legend explaining the impact categories.

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 10. Matrix of the environmental impacts of the four different alternatives.

Environmental impact	High exploitation alternative	Low exploitation alternative	Zero alternative	Zero plus alternative
Landscape	Will change the character of the landscape, from a natural to a more urban impression.	Will change the character of the landscape, but will increase the opportunities to maintain some of the character that the landscape has today.	No significant impact, natural and cultural values will likely be protected.	By including Norra Kymlinge in the nature reserve, the landscape will be improved.
Biodiversity	75 % of forest area will be lost, leading to destroying important habitats.	Loss of forest area and habitats, through buffer zone provides mitigation by saving areas of high value.	No significant impacts. Affected by noise and pollution from the roads and wear from people using the area	No significant impacts. Positive to include the area in the nature reserve, but removing of deadwood affects negatively.
Cultural values	A significant impact at a high exploitation of Norra Kymlinge. The features will be destroyed during construction.	With integrating of features in development the historical context may be weakened, but the accessibility is likely to increase. May result in both positive and negative impacts.	No significant impact.	No significant impact.
Air	Emission will increase during construction and may be when the exploitation is completed.	No significant impact, some increasing of emissions but not significantly.	No significant impact. The forest will most likely continue to be working as an ecosystem service and stabilize the air quality.	The forest will most likely continue to be working as an ecosystem service and together with the noise reducing measures the air quality will be improved.

Environmental impact	High exploitation alternative	Low exploitation alternative	Zero alternative	Zero plus alternative
Barriers *Nature-nature*	Since almost the whole area of Norra Kymlinge will be exploited, the buildings and roads in the area will act as a barrier for flora and fauna.	This alternative exploits 70% of Norra Kymlinge, which will result in a barrier but the impacts will not be as severe as in the high exploitation alternative.	No significant impact.	Positive impact in a long term, since the area will be protected and not be threatened by exploitation which could create barriers.
Barriers *Nature-human*	A significant impact will occur since the people using Norra Kymlinge for recreation will greatly be affected. A significant impact will occur since more people will get access to the nature reserve.	The people using the area today will greatly be affected by an exploitation. More people will get access to the nature reserve.	No significant impact.	The noise reducing measures could result in an increase in the number of visitors and increase the area's value.
Water	With management of the surplus runoff water, it may result in a better and richer catchment to the stream Igelbäcken.	Together with some saving of green areas and management of the runoff water, it may result in a better treatment of the stream Igelbäcken.	May not be a significant impact.	May not be a significant impact.

Environmental impact	High exploitation alternative	Low exploitation alternative	Zero alternative	Zero plus alternative
Noise	Buildings act as noise screens along the two motorways and noise will reduce as a result.	Buildings act as noise screens in lesser extent but buffer zone reduces noise in nature reserve.	Noise continues to be an issue due to increased traffic noise and more visitors in the area.	Screens will reduce noise in the area and nature reserve with possibly more visitors as result.
Recreational values	Current users will be forced to move. More people in a smaller space. More people will have access to nature due to the opening of the underground station. Noise may be reduced by buildings.	Current users losing space for their activities. More people will have access to nature due to opening of the underground station. Noise may be reduced by buildings.	Exposed to noise and pollution from the surrounding roads. Increased pressure from the nearby housing areas. More visitors may mean more littering but essentially unchanged.	Norra Kymlinge becomes part of the nature reserve. Which will increase the maintenance on the tracks.

6.1 Overall impact assessment

The result in the matrix shows a varied outcome from the different alternatives. The alternatives can result in both positive and negative impacts of the environment within some substances, depending on the point of view, detailed statements and the cumulative effects. Some of the environmental impacts have a more noticeable effect than others. Most impacts will be on biodiversity, air, water, recreation and noise in the area. It is because of the location (e.g. nearby three motorways) and the landscape (natural hilly land with old forest) of the area Norra Kymlinge.
An overall impact assessment of the different alternatives:

- *High exploitation alternative:* Will mainly get a **major negative impact**, except within noise and water, where the alternative can result in a positive impact. Within recreational values and barriers can a high exploration result with both positive and negative impacts.
- *Low exploitation alternative:* Will mainly get a **minor negative impact**, except within noise and water, where the alternative can result in a positive impact. Within recreational values and barriers can a high exploration result in both positive and negative impacts.
- *Zero alternative:* Will mainly result in **no significant impact**, except of noise that will get a minor negative impact.
- *Zero plus alternative:* Will mainly get a **positive impact** or **no significant impact** of the environment.

Exploiting a green area always carries environmental impacts. These impacts can be of different kind depending on the construction and implementation of the project. An exploitation of Norra Kymlinge entails several environmental impacts which have been assessed in this report, as far as possible. However, many of these impacts and their severity depend on decisions that have not yet been made. Will Norra Kymlinge be a car-free district? Will the buildings have green roofs? Will cultural features and old trees be preserved? Etc. A more accessible green area which will be the case under three of the alternatives (high and low exploitation as well as zero plus alternative) means generally positive consequences for humans but negative consequences for biodiversity or individual recreational groups. Some of the current outdoor activities will be significantly negatively affected. The orienteers will have to move because the area will be too small and too non varied to suit its current purpose, also the mountain bikers will suffer from the same loss of space. According to the result of the matrix the zero plus is the most environmentally sustainable alternative for the area but it is also important to include the cumulative effects and the impact on a larger scale. From a regional point of view, the underground line is a rational reason for exploiting Norra Kymlinge. It will be beneficial on a regional perspective in terms of housing, enhanced socioeconomic connectivity to Kista and better regional accessibility to Igelbäckens nature reserve. On a municipal level, however, parts of a highly appreciated and important green area will be lost. Even if Vasakronans plans would increase the population and thereby taxpayers in the municipality, the City of Sundbyberg has already planned to increase population through densifying

other places in the municipality. The current political opinion further claims that there are no benefits in exploiting an area that is as disconnected from the rest of the municipality as it is the case with Norra Kymlinge. Even if the area remains unexploited, the pressure of the area is likely to increase due to densification and population increase in the surroundings. The construction of the light rail may have significant impacts on the ecological connectivity depending on how it is constructed and what is built around it. In the end it is all about interpretation and weighing the positives and negatives, to make a decision that works both in the short and long run, both in small and big scales. What will happen to the area in the future is highly dependent on the political opinion, despite regional pressure from the County Administrative Board and the Swedish Transport Agency, the current municipal board is unanimous in its opinion not to mark Norra Kymlinge as a developing area in the comprehensive plan. There are also ongoing discussions about extending the nature reserve to include Norra Kymlinge. In this case, the zero plus alternative would be the most likely development, which also is the most environmentally friendly option, according to this report. Preserving the green area with its biodiversity and cultural values, its various ESS would contribute to the local, regional and national environmental goals. If the regional need for housing will take precedence over keeping the area as a green space, the low exploitation alternative is more in line with the Environmental Objectives since the values in the area is protected to a higher extent. Not only will more of the old trees, deadwood and current nature be preserved and incorporated into the built-up area, the cultural values will be kept and made more accessible. A buffer zone will help protecting the nature reserve, serve as a visual and noise buffer between the nature reserve and the built area and would also help to preserve the green connectivity in a regional perspective.

Even if exploitation may improve noise levels and to some extent nature-human accessibility as well as the flow of water in Igelbäcken, the high exploitation is likely to have negative impacts not only on landscape character, cultural values, recreational values but also on biodiversity, air and climate since vegetation and habitats will be lost and flora and fauna living space increasingly fragmented.

Uncertainties and insufficient data made a deep impact assessment impossible. To fully assess the impacts of an exploitation of Norra Kymlinge more data need to be collected regarding noise levels, soil contamination and connectivity.

6.2 Follow up/monitoring

According to the Swedish Environmental Code, chapter 6 section 12, are requirements of monitoring in an EIA. In the section it stated that:

" ...*an account of the measures planned for follow-up and monitoring of the significant environmental effects of implementing the plan or program..."* (SFS, 1998:8080).

Monitoring can provide information of environmental impacts that in an earlier stage have not been identified. Measures can be taken to prevent and mitigate adverse environmental impacts. If need be, already mitigation measures will be

strengthened or new mitigation measures be taken to avoid or reduce considerable negative environmental impacts identified in the EIA.

- Monitoring of water management should be done to examine if proposed measures are implemented as planned. It is important to examine how the management and handling of the runoff water in the catchment area will affect the stream Igelbäcken. An adversely effect on human health or the conditions for biological diversity is against the Environmental Objectives, why a monitoring is needed for the possibility to reaching the environmental and legal goals.
- Regarding noise and air quality, a follow-up need to be carried out to check that the measures included in the plan is implemented. Noise measurements should be carried out to investigate the noise barriers and buildings' impact on air quality and noise, in order to reach the Environmental Objectives.
- A follow up how ESS are affected by an exploitation is needed and monitoring of how natural and cultural values should be protected and developed; how the different alternatives affect biodiversity and historical and recreational values should be monitored. In an extension of nature reserve into Norra Kymlinge, a management plan should be monitored and evaluated.

6.3 Conclusion

In this EIA, we have presented four alternatives for the future of Norra Kymlinge. Two of them regarded an exploitation with different degrees (high and low exploitation) while the other two predicted a future under current circumstances (zero alternative) or if the area becomes included in the nature reserve (zero plus alternative).

As mentioned before, the impacts of an exploitation of Norra Kymlinge depend on construction and implementation methods that have not yet been decided on. The EIA shows that depending on the alternative and the assessed impact, consequences can be positive for one impact and at the same time negative for another (e.g. air quality and noise - building dense or not). The most significantly affected impacts were on air and water quality, noise, biodiversity and recreation.

To conclude this EIA, it can be stated that the zero plus alternative is the most environmentally friendly option for Norra Kymlinge that also reconciles best with the local, regional and Environmental Objectives. In the case of exploiting Norra Kymlinge, the results of this EIA shows that the low exploitation alternative should be considered together with the best available techniques and construction methods to develop a sustainable green city district.

An exploitation of Norra Kymlinge, together with the construction of the light rail and other projects around the nature reserve, will entail cumulative effects, many of which we cannot account for at this stage. Because of the uncertainties and the lack of data, consequences could look different and because impacts have positive and negative consequences at the same time for different respondents, no impact can exclusively be ruled out as positive or adverse.

7. Common reflections on the EIA process

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 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 EISs in this paper have been major negative, another sign of the municipalities avoiding to make EIAs 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.
- 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.
- A lack of relevant information has limited the work with these EIAs. For most of the projects described in this report, a detailed development plan has not been available but only 'starting PMs', 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.

8. References for common introduction

Laws and regulations:

EU Directive 85/337/EEC.

SFS 2015:852. *Kulturmiljölag*. Stockholm: Kulturdepartementet.

SFS 2010:900. *Plan- och Bygglag*. Stockholm: Näringsdepartementet.

SFS 1998:808. *Miljöbalk.* Stockholm: Miljö och Energidepartementet.

Other sources:

Boverket. (2016a). *Roller och ansvar*. http://www.boverket.se/sv/PBL-kunskapsbanken/detaljplan/roller-och-ansvar/ (Accessed 2016-12-15).

Boverket. (2016b). *Översiktsplanering - För en långsiktigt bra helhet.* http://www.boverket.se/sv/samhallsplanering/kommunal-planering/oversiktsplanering/ (Accessed 2016-12-14).

Boverket. (2016c). *Riksintressen*. http://www.boverket.se/sv/samhallsplanering/sa-planeras-sverige/riksintressen-ar-betydelsefulla-omraden/ (Accessed 2016-12-19).

Byggherrarna. (2016). *Vad är en byggherre?* http://www.byggherre.se/om-oss/vad-aer-en-byggherre/ (Accessed 2016-12-14).

Stockholms stad. (2010). *Promenadstaden - Översiktsplan för Stockholm*. Approved 2015.03.15 by the Municipal Council.

Edvardsson, K. (2004). Using goals in environmental management: the Swedish system of environmental objectives. *Environmental management*, *34*(2), 170-180.

Glasson, J., Therivel, R., & Chadwick, A. (2013). *Introduction to environmental impact assessment*. Routledge.

Iverlund, A., Ultenius, C. (2008). *Vem gör vad i planprocessen? Arbetsfördelning mellan kommun och byggherre.* Institutionen för Fastighetsvetenskap, KTH: Stockholm.

Miljömål.se. (2012). *Enskilda miljökvalitetsmål*. http://www.miljomal.se/sv/Publikationer-och-bilder/Logotyper-och-bilder/Enskilda-miljokvalitetsmal/ (Accessed 2016-12-12).

Naturvårdsverket. (2016a). *Sweden's Environmental Objectives - An Introduction.* Arkitektkopia AB: Bromma.

Naturvårdsverket. (2016b). *Miljömålen - Årlig Uppföljning av Sveriges Miljökvalitetsmål och Etappmål 2016.*

Nyström, J. (1999). *Planeringens grunder. En översikt*. 1st edition. Studentlitteratur: Lund.

Nyström, J., Tonell, L. (2012). *Planeringens grunder. En översikt*. 3rd edition. Studentlitteratur: Lund.

Länsstyrelsen. (2016). *Läget i länet - Bostadsmarknaden i Stockholms län 2016*. Rapport 2016:18.

RUFS - Stockholms läns landsting - Tillväxt- och regionplaneförvaltningen (2010). *Regional utvecklingsplan för Stockholmsregionen 2010 – Så blir vi Europas mest attraktiva storstadsregion.* R2010:5. Accepted by Landstingsfullmäktige in May 2010.

Stockholms läns landsting - Tillväxt- och Regionplaneförvaltningen (2016). *About RUFS.* http://www.rufs.se/in-english/ (Accessed 2016-12-13).

9. References for Norra Kymlinge

Adrup, P., Mörner, E. (2008). *Detaljplan för Stora Ursvik, Etapp 2D, Sundbyberg Stad Beskrivning av inverkan på miljön*. Structor Miljöbyrån. Stockholm.

Andersson, C. (2016). *12. Sustainable forests.* Skogsstyrelsen. [online] Available at: http://www.miljomal.se/sv/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/12-Sustainable-Forests/ [Accessed: 2016-12-20].

Andersson, U. (1998). *Dragkamp om storstadsmark, markanvändning och planering i Kymlinge.* Examensarbete. Stockholms universitet.

Auffret, A. G., Plue, J., Cousins, S. A. O. (2015). The spatial and temporal components of functional connectivity in fragmented landscapes. *Ambio.* 44(1), 51–59.

Boberg, P. (2016a) *1. Reduced climate impact.* Naturvårdsverket. [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/1-Reduced-Climate-Impact/ [Accessed: 2016-12-14].

Boberg, P. (2016b). *2. Clean Air.* Naturvårdsverket. [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/2-Clean-Air/ [Accessed: 2016-12-14].

Boverket. (2010). *Mångfunktionella ytor Klimatanpassning av befintlig bebyggd miljö i städer och tätorter genom grönstruktur.* [pdf] Available at: http://www.boverket.se/globalassets/publikationer/dokument/2010/mangfunktionella_ytor.pdf [Accessed: 2016-12-21].

Boverket. (2012). *Bostadsbristen ur ett marknadsperspektiv.* [online] Available at: http://www.boverket.se/globalassets/publikationer/dokument/2012/bostadsbristen-ur-ett-marknadsperspektiv.pdf [Accessed: 2016-12-20].

Boverket. (2016). *Hur mycket bullrar vägtrafiken?* Boverket januari 2016, Edition 1. ISBN: 978-91-7563-330-5.

Bovin, K., Vikberg, E. & Morén, I. (2015) *Tätande jordlager – en kunskapssammanställning.* SGU-rapport 2015:32.

Bowker, G. E., Baldauf, R., Isakov, V., Khlystov, A., Petersen, W. (2007). The effects of roadside structures on the transport and dispersion of ultrafine particles from highways. *Atmospheric Environment.* 41(37), 8128-8139.

Calluna. (2016a). *Ekologisk utredning av Norra Kymlinge 2016 – Naturvärdesinventering (NVI) och nulägesanalys av ekologiska landskapssamband.* Calluna AB. Linköping.

Calluna. (2016b). *Naturvärdesobjekt – Bilaga 2 till " Ekologisk utredning av Norra Kymlinge 2016 — Naturvärdesinventering.* Calluna AB. Linköping.

Calluna. (2016c). *PM-Bred analys av ekosystemtjänster i Norra Kymlinge*. Calluna AB, Linköping.

Daniel, T.C. (2001). Whither scenic beauty? Visual landscape quality assessment in the 21st century. *Landscape Urban Plan.* 54(1-4), 267–281.

European Commission. (2016) *The Habitats Directive.* [online] Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm [Accessed: 2016-12-15].

Getter, K. L., & Rowe, D. B. (2006). The role of extensive green roofs in sustainable development. *HortScience.* 41(5), 1276-1285.

Hallin, A., Halling, C., Lindqvist, M., Åkerlöf, L. (2016). *Trafikbuller och Planering V*. Järfälla.

HaV, Havs- och Vattenmyndigheten. (2016). *Vägledningar.* [online] Available at: https://www.havochvatten.se/hav/vagledning--lagar/vagledningar.html [Accessed: 2016-12-21].

Johansson, E. (2016). *7. Zero eutrophication.* Havs- och vattenmyndigheten. [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/7-Zero-Eutrophication/ [Accessed: 2016-12-14].

Johnson, H. (2011). *Vegetation som luftfilter i urban miljö*. Självständigt arbete vid LTJ-fakulteten, SLU.

Krosby, M., Tewksbury, J., Haddad, N. M., Hoekstra, J. (2010). Ecological connectivity for a changing climate. *Conservation Biology*. 24(6), 1686-1689.

Landell, N-E. (1997). Bearbetat utdrag ur grönlingens marker. *Skiss till dispositionsplan för sydöstra Järvafältet.* Vasakronan.

Lång, L-O. (2016). *9. Good-Quality Groundwater. Sveriges geologiska undersökning.* [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/9-Good-Quality-Groundwater/ [Accessed: 2016-12-14].

Länsstyrelsen Skånes län. (2009). *PlanPM Dagvatten.* [online] Available at: http://www.lansstyrelsen.se/skane/SiteCollectionDocuments/sv/publikationer/pluskatalogen/PM_dagvattenwebb.pdf [Accessed: 2016-12-12].

Länsstyrelsen Stockholm. (2016a). *Länsstyrelsen i Stockholms läns kungörelse om sammanställning av rekommenderade vägar och lokala trafikföreskrifter för transport av farligt gods i Stockholms län.* [online] Available at: http://www.lansstyrelsen.se/stockholm/SiteCollectionDocuments/Sv/nyheter/2016/01FS%202016%2010%20inkl%20bilagor.pdf [Accessed: 2016-12-21].

Länsstyrelsen Stockholm. (2016b). *Transport av farligt gods.* [online] Available at: http://www.lansstyrelsen.se/Stockholm/Sv/manniska-och-

samhalle/krisberedskap/risker-i-lanet/transport-av-farligt-gods/Pages/default.aspx [Accessed: 2016-12-11].

Länsstyrelsen Stockholm. (2016c). *Riktlinjer för planläggning intill vägar och järnvägar där det transporteras farligt gods*. [online]. Available at: http://www.lansstyrelsen.se/stockholm/SiteCollectionDocuments/Sv/publikationer/2016/fakta-2016-4.pdf [Accessed: 2016-04-11].

MSB, Myndigheten för samhällsskydd och beredskap. (2011). *Inrapporterade händelser farligt gods 2011.* https://www.msb.se/Upload/Kunskapsbank/Olycksundersokningar_ovrigt/Inrapporterade%20h%C3%A4ndelser%20farligt%20gods%202011.pdf [Accessed: 2016-12-12].

MSB, Myndigheten för samhällsskydd och beredskap. (2012). *Inrapporterade händelser farligt gods 2012.* [online] Available at: https://www.msb.se/Upload/Kunskapsbank/Olycksundersokningar_ovrigt/Inrapporterade%20h%C3%A4ndelser%20farligt%20gods%202012.pdf) [Accessed: 2016-12-12].

MSB, Myndigheten för samhällsskydd och beredskap. (2013). *Inrapporterade händelser farligt gods 2013.* [online] Available at: https://www.msb.se/Upload/Kunskapsbank/Olycksundersokningar_ovrigt/Inrapporterade%20h%C3%A4ndelser%20farligt%20gods%202013.pdf [Accessed: 2016-12-12].

MSB, Myndigheten för samhällsskydd och beredskap. (2014). *Inrapporterade händelser farligt gods 2014.* [online] Available at: https://www.msb.se/Upload/Kunskapsbank/Olycksundersokningar_ovrigt/Inrapporterade_handelser_farligt_gods_2014.pdf [Accessed: 2016-12-12].

MSB, Myndigheten för samhällsskydd och beredskap. (2015). *Inrapporterade händelser farligt gods 2015.* [online] Available at: https://www.msb.se/Upload/Kunskapsbank/Olycksundersokningar_ovrigt/LFG%20olyckor%202015.pdf [Accessed: 2016-12-12].

Naturvårdsverket. (2007). *God ljudmiljö...mer än bara frihet från buller*. [online] Available at: https://www.naturvardsverket.se/Documents/publikationer/620-5709-X.pdf [Accessed: 2016-12-21]

Naturvårdsverket. (2009). *Riktvärden för förorenad mark - Modellbeskrivning och vägledning.* [online] Available at: https://www.naturvardsverket.se/Documents/publikationer/978-91-620-5976-7.pdf [Accessed: 2016-12-13].

Naturvårdsverket. (2010) *Innovativt dagvattensystem i Malmö.* [online] http://www.naturvardsverket.se/Documents/publikationer/978-91-620-8464-6.pdf [Accessed: 2016-12-21].

Naturvårdsverket. (2014). *Luftguiden - Handbok om miljökvalitetsnormer för utomhusluft.* [online] Available at:

https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-0178-0.pdf?pid=13069 [Accessed: 2016-12-21].

Naturvårdsverket. (2016a). *Arbete för att minska nedskräpningen.* http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Avfall/Nedskrapning/ [Accessed: 2016-12-12].

Naturvårdsverket. (2016b). *Buller ger ohälsa.* [online] Available at: http://www.naturvardsverket.se/Sa-mar-miljon/Manniska/Buller/ [Accessed: 2016-12-06].

Naturvårdsverket. (2016c). *Vägtrafikens miljöpåverkan.* [online] Available at: http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Transporter-och-trafik/Vagtrafik/Vagtrafikens-miljopav [Accessed: 2016-12-12]

Naturvårdsverket. (2016d). *Fakta om partiklar i luft.* [online] Available at: http://www.naturvardsverket.se/Sa-mar-miljon/Klimat-och-luft/Luftfororeningar/Partiklar/ [Accessed: 2016-12-19].

Naturskyddsföreningen. (2016). *Inventeringsmall för skog.* [online] Available at: https://ostgotaskogsgrupp.wordpress.com/bakgrundsinformation/inventeringsmall-for-skog/ [Accessed: 2016-06-12].

Nowak, D.J. & Crane, D.E. (2002). Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution*. 116(3), 381-389.

Oke, T.R. (1988). *Boundary layer climates.* 2 ed. Routledge.

Pilestål Jungstedt, E. (2012). *Samrådsredogörelse om ändring i översiktsplanen.* Sundbybergs stad.

Ramböll. (2012). *Trafikbullerutredning, Ursvik*. [online] Available at: http://www.sundbyberg.se/download/18.6956188d13ce65c80faf9f/1366115824421/bullerutredning-samrd-ursvik-et3-2012.pdf [Accessed: 2016-12-14].

Riksantikvarieämbetet. (2013a). *Fornlämningar i översiktsplaneringen.* [online] Available at: http://www.raa.se/kulturarvet/arkeologi-fornlamningar-och-fynd/fornlamningar-i-planering-och-byggande/fornlamningar-i-oversiktsplaneringen/ [Accessed: 2016-12-20].

Riksantikvarieämbetet. (2013b). *Fornlämningar i planering och byggande*. [online] Available at: http://www.raa.se/kulturarvet/arkeologi-fornlamningar-och-fynd/fornlamningar-i-planering-och-byggande/ [Accessed: 2016-12-20].

Riksantikvarieämbetet. (2016a). *Fornsök.* [online] Available at: http://www.fmis.raa.se/cocoon/fornsok/search.html [Accessed: 2016-12-20].

Riksantikvarieämbetet. (2016b). *Landskapsanalys.* [online] Available at: http://www.raa.se/kulturarvet/samhallsplanering/miljokonsekvensbeskrivningar/landskapsanalys/ [Accessed: 2016-12-20].

Ripa, I. (2016). *15. A Good Built Environment.* Boverket. [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/15-A-Good-Built-Environment/ [Accessed: 2016-12-14].

Rowe, D. B. (2011). Green roofs as a means of pollution abatement. *Environmental Pollution.* 159(8-9), 2100-2110.

RUFS, Regional utvecklingsplan för Stockholmsregionen. (2010a). *Regional utvecklingsplan för Stockholmsregionen.* [online] Available at: http://www.rufs.se/globalassets/d.-rufs-2010/rufs-2010-planen/rufs10_hela.pdf [Accessed: 2016-12-16].

RUFS, Regional utvecklingsplan för Stockholmsregionen. (2010b). *Översiktsplan för Stockholmsregionen önskvärd framtid.* [online] Available at: https://www.google.com/url?q=http://www.rufs.se/RUFS-2010/antagna-planen/miljokonsekvensbeskrivning/5.-miljopaverkan-pa-varden-och-kvaliteter/5.2-onskvard-framtid/&sa=D&ust=1481787662096000&usg=AFQjCNE9AyJP9WHRmB_bU4DoDg3kyjUlWQ [Accessed: 2016-12-21].

RUFS, Regional utvecklingsplan för Stockholmsregionen. (2013). *Regional miljöstrategi för vatten.* [online] Available at: http://rufs.se/globalassets/h.-publikationer/vattenstrategi_web.pdf [Accessed: 2016-12-16].

RUFS, Regional utvecklingsplan för Stockholmsregionen. (2016). *Regional utvecklingsplan för Stockholmsregionen (Samråd) - Mål 4: En resurseffektiv och resilient region, delmål till år 2030.* [online] Available at: http://www.rufs.se/rufs-2050/vision-och-mal/delmal/mal-4/ [Accessed: 2016-12-16].

SCB, Statistiska centralbyrån. (2012). *Storstadsborna bor trängst.* [online] Available at: http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Hushallens-ekonomi/Inkomster-och-inkomstfordelning/Inkomster-och-skatter/Aktuell-pong/302201/Behallare-for-Press/368569/ [Accessed: 2016-12-14].

SCB, Statistiska centralbyrån. (2013). *Genomsnittlig bostadsarea per bostad (HEK) efter region, upplåtelseform och lägenhetstyp. Urvalsundersökning, se fotnoter. År 2006 - 2013.* [online] Available at: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__HE__HE0103__HE0103D/BostadBoarea/table/tableViewLayout1/?rxid=c115f82d-ab98-4aaa-b879-1a49f27040a2 [Accessed: 2016-12-14].

SFS 2015:216. *Förordning om trafikbuller vid bostadsbyggnader.* Stockholm: Näringsdepartementet

SFS 2010:900. *Plan- och bygglag.* Stockholm: Näringsdepartementet

SFS 2010:477. *Luftkvalitetsförordning.* Stockholm: Miljö- och energidepartementet

SFS 2006:263. *Förordning om transport av farligt gods*. Stockholm: Justitiedepartementet

SFS 1998:808. *Miljöbalk.* Stockholm: Miljö och Energidepartementet

SFS 1988:950. *Kulturmiljölag.* Stockholm: Kulturdepartementet.

SGI, Statens geotekniska institut. (nd). *Sättningar i småhus*. [online] Available at: http://www.omboende.se/Global/Bygga/Dokument/sattningar_i_smahus.pdf [Accessed: 2016-12-21].

SGU, Sveriges Geologiska Undersökning. (2016). *Jordartskarta*. Downloaded 2016-12-07.

SLB-analys (2016). Stockholms luft- och buller. Luftföroreningskartor [online] Available at: http://slb.nu/slbanalys/luftfororeningskartor [Accessed: 2017-01-09]

SLL, Stockholms läns landsting. (2015). *Resvanor i Stockholms län 2015* [online] Available at: http://www.sll.se/Global/Verksamhet/Kollektivtrafik/Kollektivtrafiken%20växer%20med%20Stockholm/SU/Resvaneundersökningen/resvanor-i-stockholms-lan-2015.pdf [Accessed: 2016-12-16].

SMHI. (2015). *Klimatförändringarna märks redan idag.* [online] Available at: http://www.smhi.se/kunskapsbanken/klimat/klimatforandringarna-marks-redan-idag-1.1510 [Accessed: 2016-12-12].

Sollentuna kommun. (2012). *Översiktsplan.* [online] Available at: https://www.sollentuna.se/globalassets/trafik--stadsplanering/stadsplanering/op2010/uppdaterade-pdfer/oversiktsplan-sollentuna_sid-22-39.pdf [Accessed: 2016-12-19].

Solna stad. (2016). *Översiktsplan 2030.* [online] Available at: https://www.solna.se/Global/Stadsbyggnad%20och%20trafik/ÖP%202030/Solna_ÖP_februari%202016%20-%20slutversion%20-%20webb%202016-04-08.pdf [Accessed: 2016-12-19].

SOU. (2007). *Klimatutredning - Till statsrådet och chefen för Miljödepartementet.* [online] Available at: http://www.regeringen.se/contentassets/94b5ab7c66604cd0b8842fd6510b42c9/sverige-infor-klimatforandringarna---hot-och-mojligheter-missiv-kapitel-1-3-sou-200760 [Accessed: 2016-12-20].

Staaf, H. (2016). 3. *Natural acidification only.* Naturvårdsverket. [online] Available at:

http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/3-Natural-Acidification-Only/ (Accessed: 2016-12-14].

Stockholms stad (2016a). *Översiktsplan (samråd)* [online] Available at: http://vaxer.stockholm.se/globalassets/tema/oversiktsplanen/uppdatering-av-op/karta_stadsutvecklingsmojligheter_a3.pdf [Accessed: 2016-12-19].

Stockholms stad. (2016b). *Gångstråk Stockholm.* [online] Available at: http://www.stockholm.se/gangstrak [Accessed: 2016-12-20].

Structor. (2009). *Sundbybergs stad - Miljökonsekvensbeskrivning för översiktsplan*. [online] Available at: https://www.sundbyberg.se/download/18.71bab0661393481211c1b56/1366115714948/miljosekvensbeskrivning-for.oversiktsplan-2012-08-10.pdf [Accessed: 2016-12-02].

Studentbostadsföretagen. (2016). *Framtidens studentbostäder.* [online] Available at: http://studentbostadsforetagen.se/wp-content/uploads/2016/05/framtidens-studentbostader-minskad-filstorlek.pdf [Accessed: 2016-12-14].

Sundbybergs stad. (2003). *Föreskrifter om Igelbäckens naturreservat*. [online] Available at: http://www.sundbyberg.se/download/18.711e8fd414b689dd4dcbe11f/1423668055921/foreskrifter-for-igelbackens-naturreservat-okt-2003.pdf [Accessed: 2016-12-21].

Sundbybergs stad & Vasakronan. (2005). *Nästa Kymlinge, en utställning och diskussion om Kymlinges framtid, Rapport från visionsarbete 2005*.

Sundbybergs stad. (2010). *Samrådsförslag 2010. Program för norra Kymlinge.*

Sundbybergs stad. (2010). *Klimat- och hållbarhetspolicy.* [online] Available at: http://www.sundbyberg.se/download/18.32da1d2c1483e9972af151d1/1409821306538/klimat-och-hallbarhetspolicy-sbg-2014.pdf [Accessed: 2016-12-21].

Sundbybergs stad. (2011). *Grönplan Sundbyberg.* [online] Available at: https://www.sundbyberg.se/download/18.71bab0661393481211ca85/1366115716224/gronplan-Sundbyberg-2011.pdf [Accessed: 2016-12-21].

Sundbybergs stad. (2012). *Trafikplan.* [online] Available at: https://www.sundbyberg.se/download/18.71bab0661393481211c3ec/1366115833374/trafikplan-2012.pdf [Accessed: 2016-12-21].

Sundbybergs stad. (2013). *Sundbybergs stads översiktsplan*. [online] Available at: https://www.sundbyberg.se/download/18.5e27835413e64c486452d/1367491907005/%C3%96versikt_antagen+2013.pdf [Accessed: 2016-12-21].

Sundbybergs stad. (2014a). *Klimat- och hållbarhetspolicy.* [online] Available at: http://www.sundbyberg.se/download/18.32da1d2c1483e9972af151d1/1409821306538/klimat-och-hallbarhetspolicy-sbg-2014.pdf [Accessed: 2016-12-21].

Sundbybergs stad. (2014b). *Förslag till utvecklingsplan för Ursviks friluftsområde, 2014 Friluftsområde*

Sundbybergs stad. (2016). *Vision 2030 - Sundbyberg växer med dig!* [online] Available at: http://www.sundbyberg.se/om-sundbyberg/om-sundbybergs-stad/vision-2030.html [Accessed: 2016-12-21].

Sveaskog. (nd). [online] Available at: http://www.sveaskog.se/om-sveaskog/var-verksamhet/klimatarbete-och-koldioxidavtryck/?acceptCookies=true [Accessed: 2016-12-21].

Svensson, M. (2016). 8. *Flourishing lakes and streams.* Havs- och vattenmyndigheten. [online] Available at: http://www.miljomal.se/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/8-Flourishing-Lakes-and-Streams/ [Accessed: 2016-12-14].

Svärd, L. (2016). 16. *A Rich diversity of plant and animal life.* [online] Available at: http://www.miljomal.se/sv/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/16-A-Rich-Diversity-of-Plant-and-Animal-Life/ [Accessed: 2016-12-20]

Trafikverket. (2004). *Väg- och gatuutrustning, 7 Bullerskydd*. VV publikation 2004:80. [online] Available at: http://www.trafikverket.se/TrvSeFiler/Foretag/Bygga_och_underhalla/Vag/Vagutformning/Dokument_vag_och_gatuutformning/Vagar_och_gators_utformning/Vag_och_gatuutrustning/07_bullerskydd_gatuutrustning.pdf [Accessed: 2016-12-14].

Trafikverket. (2012). *Bullerkartor - väg, järnväg och flyg*. *Bullerkartering_vag_kommuner_2012_sundbyberg*. [online] Available at: http://www.trafikverket.se/om-oss/var-verksamhet/sa-har-jobbar-vi-med/Miljo-och-halsa/Halsa/Buller-och-vibrationer/kartlaggning-och-atgardsprogram-for-bullerenligt-eu-direktiv/bullerkartor---vag-jarnvag-och-flyg/ [Accessed: 2012-12-11].

Trafikverket. (2015). *Prognos för personresor 2030*. Trafikverkets basprognos 2015. Rapport 2015:059. ISBN: 978-91-7467-715-7

Trafikverket. (2016a). *Trafikverkets nationella vägdatabas (NVDB)*. Dataslag: Alla + ÅDT totaltrafik. [online] Available at: https://nvdb2012.trafikverket.se/SeTransportnatverket [Accessed: 2016-12-11].

Trafikverket. (2016b). *Trafikverkets nationella vägdatabas (NVDB)*. Dataslag: Administrativa vägdata, Rekom. väg farligt gods. [online] Available at: https://nvdb2012.trafikverket.se/SeTransportnatverket [Accessed: 2016-12-11].

Vasakronan, FFNS Arkitekter, Ingemanssons technology (2000). *Kymlinge: Delstudie- buller, exploatering, bebyggelsetyper.*

Vasakronan. (2006). *Plattform kymlinge. Förslag till utveckling av stad och natur i Kymlinge.*

Vattenmyndigheterna. (2016). *Välkommen till Sveriges fem vattenmyndigheter!* [online] Available at: http://www.vattenmyndigheterna.se/Sv/om-vattenmyndigheterna/Pages/default.aspx [Accessed: 2016-12-21].

VISS, Vatteninformationssystem Sverige. (2016a). *Slutklassning.* [online] Available at: http://extra.lansstyrelsen.se/viss/Sv/detta-beskrivs-i-viss/statusklassning/Pages/default.aspx?keyword=status [Accessed: 2016-12-21]

VISS, Vatteninformationssystem Sverige. (2016b). *Igelbäcken.* [online] Available at: https://viss.lansstyrelsen.se/Waters.aspx?waterEUID=SE658818-162065 [Accessed: 2016-12-21].

Wallander, J. (2016). *13. A varied agricultural landscape.* Jordbruksverket. [online] Available at: http://www.miljomal.se/sv/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/13-A-Varied-Agricultural-Landscape/ [Accessed: 2016-12-20].

WSP. (2016). *Miljökonskvensbeskrivning - tillhörande skelettplanen för tvärbana genom Ursvik, del av Sundbyberg 2:26 m.fl. fastigheter i Rissne och Ursvik.* [online] Available at: http://www.sundbyberg.se/download/18.3f876aea15506c7ad9f3e529/1464852358894/MKB.pdf [Accessed: 2016-12-19].

Interviews:

Eriksson, Mikael; Ordförande i kommunfullmäktige Sundbybergs stad. 2016. Interview 6 December.

Hamrin, Martin & Grönvik, Mats; Verksamhetsansvarig idrott, Landskapsingenjör, Sundbybergs stad, 2016. Written communication 13 December.

Kihl, Jan; Idrottsalliansen Sundbyberg. 2016. Interview 7 December.

Pehrson, Karin; Stockholms Stigcyklister. 2016. Email conversation 7 December.

Reitmann, Florian; Ordförande för Naturskyddsföreningen Solna/Sundbyberg. 2016. Interview 1 December.

Skärdin, Brita; Handläggare, MSB. 2016. Phone Interview 13 December.

Thiberg, Per & Enander, Mats; Chef affärsutveckling & Property developer, Vasakronan. 2016. Interview 6 December.

Other references:

Fieldwork. (2016-12-06). Norra Kymlinge.
Jennie Jalkner. (2016-12-06). Photograph.
Tina Koskela. (2016-12-06). Photograph.

Appendix 1

Inventeringsmall för identifiering av skyddsvärda skogar

Kommun: Närmsta ort: Koordinater (om du har):			Datum: Namn: Telefonnummer/mailadress:			
Hur stort är skogsområdet?			Stort	Mellan	Litet	Uppskattat:
Ange dominerande träd:	Gran	Tall	Ek	Björk	Annat:	

Finns följande?	Nej	Enstaka	Många	Kommentar
Gamla grova träd				
Stående döda träd				
Liggande döda träd				
Sågade stubbar				
Naturliga stubbar				
Höga stubbar (över 2 meter)				
Höga myrstackar (högre än 70 cm)				
Träd med spår av hackspett				
Träd med större håligheter				
Träd med tickor				
Träd med hänglavar				
Träd med bävergnag				
Stora stenblock med mossor				

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Finns följande?	Ja	Nej	Kommentar
Rinnande naturlig bäck			
Grävt dike			
Öppen sankmark			
Tecken av brand			
Träd av olika ålder/grovlek			
Sumpskog			
Bäverdamm			
Körskador			
Gläntor i skogen			
Gran vars nedre grenar är grova (3-5 cm)			

Förklaringar för dig som undrar varför vi valt just dessa frågor:

- **Gamla/grova levande träd** är livsnödvändiga för många insekter, svampar och mossor. Många fåglar bygger bo i hål i träd. I moderna skogar är det svår bostadsbrist för sådana fåglar.
- **Stående döda träd/höga stubbar** är livsnödvändiga för många sorters djur, svampar och växter.
- **Sågade stubbar, grävda diken och körskador** är tecken på mänsklig påverkan. Många av skogens organismer överlever bara där det varit skog kontinuerligt under många sekler.
- **Höga myrstackar** tyder på en viss kontinuitet, då myrorna har fått tid på sig att bygga upp en stor stack. En övervuxen myrstack ökar sannolikheten att skogen varit orörd länge.

Bilaga till inventeringsmall för identifering av skyddsvärd skog

Det här är en bilaga till inventeringsmallen för att identifiera skyddsvärd skog. Syftet är att göra mallen mer lättanvändlig och öka kunskapen om naturen och hur man läser av dess ekologiska värden. Alla bilder är tagna av Rebecka Le Moine.

Gamla och/eller grova träd är en brist i dagens svenska skogar. Träden hinner inte bli så gamla som de blev förut, innan de avverkas och ersätts. Eftersom att detta är en relativt ny brist, finns det väldigt många organismer som är anpassadeefter grova och/eller gamla träd, som idag istället hotas att försvinna.

Stående döda träd och/eller höga stubbar är i dagens skogsbruk också en brist. Eftersom dessa strukturer finns i naturliga skogar har det funnits en konstant tillgång till stående döda träd som många organismer har anpassat sig till.

Höga myrstackar tyder på en viss kontinuitet, då myrorna kräver en viss tid på sig att bygga upp en stor stack. Det tar också tar tid för mossa och andra växter att att växa över en myrstack.

Liggande döda träd är en brist i dagens brukade skogar. I en naturlig skog får de döda träden ligga kvar och brytas ner. Många insekter, lavar och mossor är beroende av död liggande ved för att fotplanta sig och överleva.

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En naturlig rinnande bäck är ett väldigt viktigt inslag i skogen för många organismer. Många insekter lever som larver i rinnande vatten, och utvecklas sedan till olika flygande insekter. Även många musslor och fiskar är beroende av naturliga bäckar med rinnande vatten. Man kan ofta se om en bäck är naturlig genom att kolla om den rinner helt rakt eller om bäcken slingrar sig. Finns det stenar i bäcken är det också troligt att den är naturlig.

Grävda diken är en tydlig mänsklig påverkan, och förändrar ofta den naturliga förhållanden fort genom att blöta områden blir torrare under en kort tid. Det visar också att området inte är orört. Om diket misstänks vara mycket gammalt behöver det inte innebära något negativt för naturen idag.

Tickor på träd behöver inte ha så stor betydelse för hur naturvärdet i området är, men om det många tickor på många träd kan det indikera att vedsvamparna ha fått tid och möjlighet på sig att spridas och tillväxa. En del tickor är ovanliga och kräsna i sen reproduktion och kräver att andra tickor redan har etaberat sig för att mjuka upp veden åt dem.

Fuktiga områden kan ta många olika former. Ibland kan det ha ett trädskikt, ibland inte. Det är vitkigt för många organismer att ha ett fuktigt mikroklimat då det gör att träden blir mjukare och murknar snabbare.

Hänglavar på träd kan, liksom tickor, indikera att lavarna i området har fått tid och möjlighet att sprida sig och växa. Lavar växer mycket långsamt, så hittar man långa hänglavar (mer än 30 cm) kan området ha fått stå orört under en längre tid.

Större ihåligheter i träd är ett mycket vitkigt inslag för många insekter, vilka i sin tur kan spela stor roll i ekosystemet som föda för andra djur. Bara det att trädet har utvecklat en hålighet indikerar en hög ålder. Olika trädslag åldras dock olika fort. När håligheter har utvecklas finns det chans att det ovanliga och mycket viktiga substratet "mulm" bildas i trädet, vilket många ovanliga arter är knutna till.

Mulm är det som bildas i gamla träd när olika insektekslarver har ätit och bajsat ut trädets mjuka ved. Många insekter är beroende av mulm för att kunna lägga sina ägg och för att äggen ska lyckas utvecklas och klara sig som larver. Mulm är vanligare i gamla håliga lövträd.

Spår av brand är ganska ovanligt men viktigt att notera, då många allt fler ovanliga arter kräver att det har brunnit för att kunna fotplanta sig. Skogsbränder var vanligare förr, och spår efter brand betyder att en viktig naturlig funktion har fått äga rum i skogen.

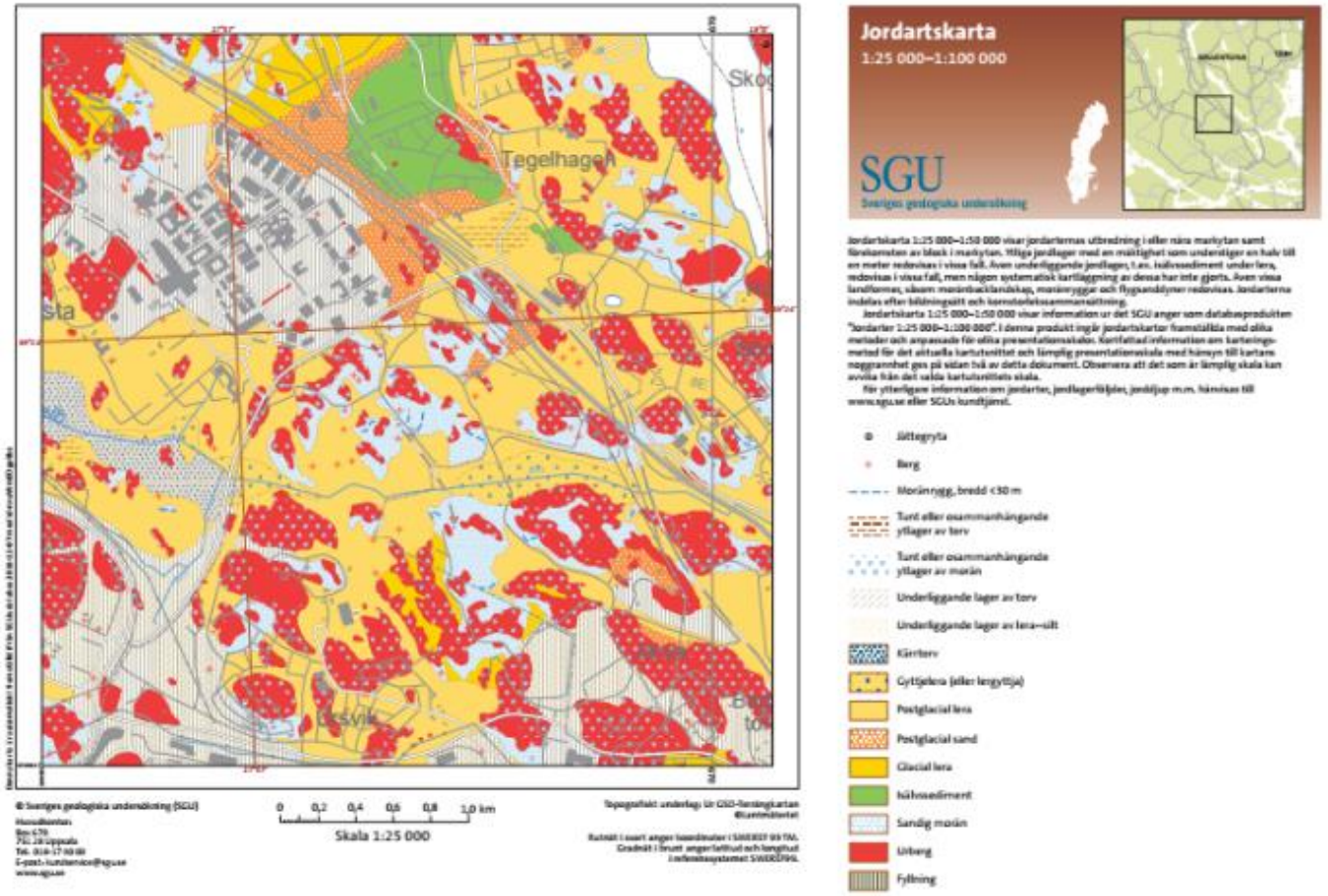
Spår av hackspett, i form av födosökning eller bohål är tydliga tecken på att det finns gott om föda i området. Hackspettar äter insekter i träd, och för detta krävs något äldre mjukare träd med rikt insektsliv. Vid observation av hackspett kan man förvänta sig en skog med inslag av lövträd eller gamla döda träd.

Spår av bäver är lätt att känna igen och spelar en stor roll i ekosystemet. Bävrarna dämmer upp vattendrag för att bygga sina bon, vilket leder till att skogsområden svämmas över. Detta leder i sin tur till att det bildas fler döda träd, både som offer av uppdämningen och av trädfällningen, vilket gör att fler ovanliga arter knutna till död ved får livsutrymme.

Naturliga stigar som bildas av djur kan indikera att området har lämnats orört en längre tid, då det tar ett tag innan stigarna blir så pass markerade. Det visar också att området har betydelse för många däggdjur som antingen passerar genom området mellan två punkter, eller lever i området.

Stenblock med mosstäcke ger en viss variation och kan tyda på en viss kontinuitet. Blockighet ger upphov till ett varierat mikroklimat vilket gör att många olika organismer, främst mossor, kan trivas.

Appendix 2


Tegelhagen
Skala 1:25 000
0 0,2 0,4 0,6 0,8 1,0 km
Jordartskarta
1:25 000–1:100 000
SGU
Sveriges geologiska undersökning
Jordartskarta 1:25 000–1:50 000 visar jordlagrens utbredning i eller nära markytan samt förekomsten av block i markytan. Yttäcka jordlager med en mäktighet som understiger en halv till en meter redovisas i vissa fall. Även underliggande jordlager, t.ex. isälvssediment under lera, redovisas i vissa fall, men någon systematisk kartläggning av dessa har inte gjorts. Även vissa landformer, såsom moränbacklandskap, moränrygg ar och flygsanddyner redovisas. Jordarterna indelas efter bildningssätt och kornstorleksammansättning.
Jordartskarta 1:25 000–1:50 000 visar information ur det SGU anger som databasprodukten "Jordarter 1:25 000–1:100 000". I denna produkt ingår jordartskartor framställda med olika metoder och anpassade för olika presentationsskalor. Kortfattad information om karteringsmetod för det aktuella kartutsnittet och lämplig presentationsskala med hänsyn till kartans noggrannhet ges på sidan två av detta dokument. Observera att det som är lämplig skala kan avvika från det valda kartutsnittets skala.
För ytterligare information om jordarter, jordlagerföljder, jorddjup m.m. hänvisas till www.sgu.se eller SGUs kundtjänst.
Jättegryta
Berg
Moränrygg, bredd <50 m
Tunt eller osammanhängande ytlager av torv
Tunt eller osammanhängande ytlager av morän
Underliggande lager av torv
Underliggande lager av lera–silt
Kärrtorv
Gyttjelera (äller lergyttja)
Postglacial lera
Postglacial sand
Glacial lera
Isälvssediment
Sandig morän
Urberg
Fyllning