



# Environmental Impact Assessment of the expansion of Stockholm Arlanda Airport

# 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 to develop Arlanda airport. Swedavia has produced a Draft Masterplan with a number of goals for the extension of Arlanda. The plan includes a vision to make Arlanda to the leading airport in Scandinavia. According to the plan the number of passengers travelling from and to Arlanda per year might increase from about 25 million to 70 million in a timespan of fifty years. This will cause a need for new runways, new terminal

buildings and an expansion of cargo- and logistic- capability. Another problem is how to handle the transport to and from the airport.

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 Håkan Berg, 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.

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## List of Actors Involved in the Projects

**Airport Coaches** - Flygbussarna Airport Coaches AB

**A-train AB** - Company operating Arlanda Express and owning the Arlanda train station.

**County Administrative Board** - Länsstyrelsen

**Sigtuna municipality** - Sigtuna kommun

**Stockholm public transport** - SL (Storstockholms lokaltrafik)

**Swedavia** - State owned company operating Arlanda airport.

**Swedish Transport Administration** – Trafikverket

**The States railways** - SJ (Statens järnvägar)

# Abbreviations

**As** - Arsenic

**Aviation authority** - Luftfartsverket

**AIRUSE** - Testing and development of air quality mitigation measures in Southern Europe

**Cd** - Cadmium

**CH<sub>4</sub>** - Methane

**CIA** - Cumulative impact assessment

**CLD** - Causal Loop Diagram

**CO** - Carbon monoxide

**CO<sub>2</sub>** - Carbon dioxide

**dB** - decibel

**dB(A)** - A-weighted decibels

**EU** - European union

**E4** - European route E4

**EIA** - Environmental Impact Assessment

**EIS** - Environmental Impact Statement

**EPA** - United States Environmental Protection Agency

**EQS** - Environmental Quality Standards

**ESS** - Ecosystem services

**FAME** - Fatty Acid Methyl Ester

**FOD** - Foreign object debris. Objects that do not belong on the runway, debris.

**GDP** - Gross Domestic Product

**GHG** - Greenhouse Gas

**GIS** - Geographic Information System

**Hg** - Mercury

**HKIA** - Hong Kong International Airport

**HVO** - Hydrogenated Vegetable Oils

**ICAO** - International Civil Aviation Organization's

**IPCC** - Intergovernmental Panel on Climate Change

**IUCN** - International Union for Conservation of Nature

**L<sub>den</sub>** - Day-evening-night level (noise)

**LEED**-certification - Environmental certification of buildings

**MPPA** - Millions Passengers Per Annum.

**N** – Nitrogen

**Ni** – Nickel

**NO<sub>x</sub>**- Nitrogen Oxide

**N<sub>2</sub>O** - Nitrous Oxide

**NO<sub>2</sub>**- Nitrogen Dioxide

**NRMN** - Non-Road Mobile Machinery. The diesel engines of heavy machinery used in construction

**O<sub>3</sub>**- Ozone

**P** - Phosphorus

**PAHs** - Polycyclic Aromatic Hydrocarbons

**Pb** – Lead

**PBA** - Planning and Building Act

**PBDE** - Polybrominated Diphenyl Ethers

**PFAS** - Perfluorooctanesulfonic Acid

**PFOS** - Perfluorooctane Sulfonate

**PM** - Particulate Matter

**RAA** - National Heritage Board

**RUFS** - Development Plan for the Stockholm region (Regional Utvecklingsplan för Stockholmsregionen)

**SCB** - Statistics Sweden (Statistiska Centralbyrån)

**SCR** - Selective Catalytic Reduction

**SEA** - Strategic Environmental Assessment

**SGI** - Swedish Geotechnical Institute

**SGU** - Geological Survey of Sweden

**SJ** - Swedish State Railways (Statens järnvägar)

**SL** - Stockholm Public Transport (Storstockholms lokaltrafik)

**SLB** - Stockholm Air and Noise Analysis (Stockholms Luft- och Bulleranalys)

**SO<sub>2</sub>**- Sulphur Dioxide

**SO<sub>x</sub>** - Sulphurous Oxide

**U** - Uranium

**UFP** - Ultrafine particle (particle smaller than 100 nm in diameter)

**UPA** - Developing Program Arlanda (Utvecklingsprogram Arlanda) An ongoing development (2014-2023) of Arlanda, and therefore not one of the visions of the Master Plan 2017. Though the Master Plan is to some degree based on the UPA.

**µm** – Micro meter

**µg** - Microgram

**VISS** - Water Information System Sweden (VattenInformationsSystem Sverige)

**VOC** - Volatile Organic Compound

**WWF** - World Wide Fund for Nature (Världsnaturfonden)

## Glossary

**Airside** - The area of an airport after security check, i.e. accessible only to staff and passengers holding a valid boarding card.

**Apron** - An area designated for aircraft during embarkation and disembarkation of passengers, loading and unloading of cargo, fuelling, parking and maintenance.

**ArcMap** - an application where you display and explore GIS datasets for the specific study area.

**Boverket** - National Board of Housing.

**Catchment area** - The number of people living within an area in which people have approximately two hours of transport by bus, car or train to an airport. The size of the catchment area is of great importance to an airline's choice of routes and thus of airports.

**Comprehensive plan** - Guiding document for the use of land and water in in a municipality.

**Connectivity** - In ecology, the degree to which the landscape facilitates or interferes with the movement of species among resource patches maintaining the biological processes necessary for its conservation, such as reproduction and feeding.

**Dispersal** - When species spread spatially.

**Drainage** - Natural or artificial removal of surface- or subsurface water from an area.

**Earthmoving processes** - The process of removal and adding construction material and/or materials like soil and rock.

**Ecological corridor** - A functional zone of passage between several natural zones that connects different populations and favours the spread and migration of species, as well as the re-colonisation of environments that have been disturbed.

**Ecosystem services** - The benefits that humans freely gain from the natural environment and from properly-functioning ecosystems.

**Environmental code** - The Swedish Parliament has adopted 16 environmental quality objectives, describing what state and quality of the country's environment are sustainable in the long term.

**Esker** - A Quaternary, Ice Age mineral soil formation. A residual from meltwater rivers below the ice cap, consisting mainly of sorted sand and gravel.

**Eutrophication** - High concentration of nutrients in a water body which leads to high algae and plant growth and after that oxygen depletion are a high possibility.

**Gate** - Area where passengers can stay immediately before their flight begins.

**Habitat** - An area of a suitable type of nature for one or several species, to exist or reproduce within.

**Habitat Fragmentation** - Process in which a large habitat expansion is transformed into a number of smaller patches that are isolated from each other by a matrix with properties different from the original habitat.

**Handling** - Handling of passengers, baggage and cargo, etc.

**Hav- och vattenmyndigheten** - National marine and water authority.

**Hydraulic conductivity** - Measure of how easily fluid can pass through soil or rock.

**Jet bridge** - The bridge connecting an aircraft to the gate so that passengers can embark and disembark without getting their feet wet.

**Landside** - The area of an airport where everybody is allowed, prior to security check, i.e. where the general public has unrestricted access.

**Light pollution** - The presence of anthropogenic light in the night environment.

**Natural corridor** - Corridors that exist naturally between isolated habitat patches where one or many species can move freely throughout the landscape.

**Naturvårdsverket** - Swedish environmental protection agency.

**Nocturnal** - Night active animals.

**Peak discharge** - Highest flow for a stream.

**Pier** - The halls leading from the airport transit area to the departure gates.

**Planning and Building Act** - Regulates the planning of land and water use, as well as construction.

**PM2.5, PM10** - Particulate matter; the mass concentration of all particles in air, with a (aerodynamic) diameter smaller than 2.5 and 10  $\mu\text{m}$  respectively.

**Remnant** - what is left of a part/quantity after the larger part has been used, removed or destroyed.

**Remote stand** - A stand (see Stand) that is not located immediately by the airport buildings.

**Runoff** - Overland flow that occurs when there is more water than the land can absorb.

**Runway** - A designated area used for aircraft take-offs and landings.

**Satellite terminal** - A building detached from other airport buildings, so that aircrafts can park around its entire circumference.

**Side section of a road** - Commonly called shoulder, which is the emergency stopping lane by the verge of a road on the right side. The Swedish word is *vägren*.

**Stand** - An area on the apron (see Apron) where aircraft are parked.

**Sub-basin** - Smaller drainage area within the same watershed.

**Taxiways** - An airfield road for aircraft use.

**Terminal** - building at an airport where passengers transfer between ground transportation and the facilities that allow them to board and disembark from aircraft.

**Transit area** - The airside area where passengers stay before departing on their journey.

**Transit bus** - A free shuttle bus between the domestic terminal and the international terminals.

**Watershed** - An area of land where all the water that falls on it and drains of it goes to one common outlet.

**Wildlife Corridor** - A strip of natural habitat connecting populations of wildlife otherwise separated by cultivated land, roads, etc.

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# Chapter 1 Introduction

## 1.1 Background

### 1.1.1 Arlanda Airport Expansion

Stockholm Arlanda Airport is today the leading international airport in Sweden, and one of the most important transport nodes in connecting Sweden with the rest of the world. Travels made from the airport are currently growing rapidly and has been increasing in recent years (Swedavia, 2017a). At the same, the population in surrounding municipalities in Stockholm County is increasing. According to prognostics and plans for future development the growth will most likely continue (Sigtuna kommun, 2006). Thus, there is a need for an increased capacity at Stockholm Arlanda Airport.

The owner of Arlanda is Swedavia, a nationally owned company. To enable the airport growth, Swedavia has produced a Draft Masterplan. The Draft Masterplan is meant to work as a long-term strategic planning tool to guide the future sustainable development both for internal and external parties. It is supposed to enable cross-sectorial and functional coordination of activities and planning actions within different sub-areas and sub-functions at the airport. A massive increase of travellers will have economic, environmental and social effects on both local and regional scale.

Moreover, uncertainties regarding the development of Bromma City Airport might lead to even more increased travels for Arlanda. 2,5 million travellers that travel from Bromma today might after 2038 travel from Arlanda, if it is decided that the environmental permit for Bromma airport operation will not be extended (Sundström, 2016). The environmental permit for Arlanda was claimed in 2016. Arlanda airport

already today has environmental challenges with reduction of noise and carbon emissions. Therefore, the requirement for the permit was, that Swedavia's action plan should include lowering of carbon dioxide (CO<sub>2</sub>) emissions as well as introducing noise protection measures close to nearby housing areas (Swedavia, 2017b).

### 1.1.2. Swedavia goals

Swedavia has set a number of goals in the Draft Masterplan. The goals, which Swedavia (2017b) strive to achieve until 2025, are:

- to be an international role model in sustainability
- to offer a smooth and inspiring travel experience
- to have Scandinavia's most important meeting places
- to be a drive for the growth of Sweden

The Draft Masterplan also sets strategic visions for Arlanda airport. The main future vision is to have 70 million passengers per year. This is a tripling compared to the amount of passengers at the airport in 2016, which was 24.7 million (*ibid.*). Swedavia also envisions an increase in air traffic due to more airborne freight (*ibid.*). Contained within the vision of Arlanda airport, a number of development opportunities are proposed. This report focuses on five of those areas, which have to be expanded or developed in order to reach Arlanda airport's future visions. All five projects are based on assumptions proposed by the Draft Masterplan. Firstly, an expansion of the runway system would be necessary to cover the increase in airborne passengers. Furthermore, an expansion of the terminal area would also be necessary to meet the increased number of passengers. Thirdly, the airport would need an expansion of cargo- and logistics- capability in order to handle an increase in airfreight and host other services. Fourthly, expanding the current parking areas to meet the increased need for parking space would be necessary. The new parking

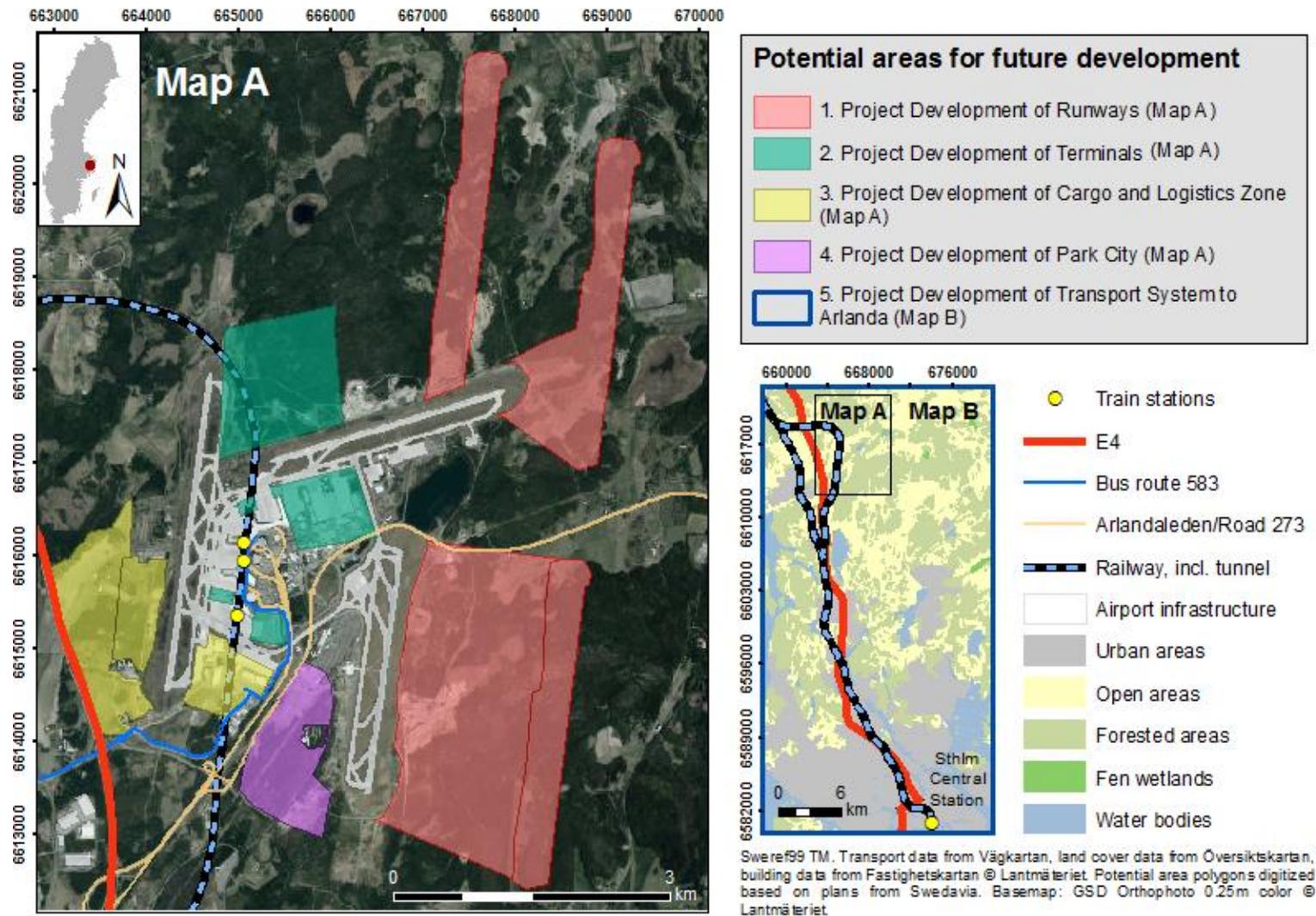
area could also include recreational green areas and hotels. Lastly, Arlanda airport would need to be connected to the regional roads and railway networks in order to enable passengers to travel to and from the airport.

### **1.1.3 Purpose of the projects**

Swedavia is not obligated to carry out an Environmental Impact Assessment (EIA) for a Draft Masterplan, since the masterplan is only a guiding document. However, according to 24 Chap. 3 § of the Swedish Environmental Assessment Ordinance (Miljöprövningsförförordningen, 2013: 251), civil airports with a runway exceeding 1200 meters, are covered by commission obligation. In addition, the project leaders for the Draft Masterplan stressed that one of the main reasons they wanted to make an EIA, is to get input about what effects a development of Arlanda airport might have on the environment at an early stage. They wish to take that input into account when working with the final version of the Masterplan as well as when developing future detail plans (Karelis *et al.*, 2017).

### **1.1.4 Study area**

Arlanda airport is located in Sigtuna municipality north of Stockholm. According to the environmental code (MB 1998:808), the airport and its surrounding infrastructure is a national interest for communication. Thereby, Arlanda airport should be protected against measures that obstruct or interfere with airport activity or transport to airport. The construction of Arlanda started in 1952 and its capacity has expanded throughout the years. Today there are four terminals, three runways, parking spaces, a logistic city and cargo city in the Arlanda area. To easily access Arlanda airport several railway operators like Arlanda express, regional trains and commuter trains run on Arlandabanan to Arlanda airport. In addition, it is also possible to go there by car and bus. Figure 1.1 show the study area and the all alternative locations proposed by the five projects.



**Figure 1.1.** The study area of Arlanda airport and the proposed location for the different alternatives for the respective projects.

## 1.2. Legislation

### 1.2.1 EIA and EU legislations

EIA is a key environmental policy tool in the European Union (EU). EIA is a process to assess effects of specific public and private development projects on the environment and has been required for all EU Member States since 1985 under the European Union Directives (85/337/EEC) as amended by Directives (97/11/EC, 2003/35/EC), and (2009/31/EC). Currently, the EIA is governed by the European Union Directive (2011/92/EU) as amended by Directive (2014/52/EU).

Screening is the first step in the process Directive (2014/52/EU) to determine whether an EIA is required or not for a particular project. The directive requires all projects likely to cause significant environmental effects to be subjected to an EIA. Projects are divided up and listed into two categories, Annex I and Annex II. Projects listed in the Annex I of the directive are always subjected to an EIA, whereas projects listed in Annex II are assessed for an EIA requirement under the EU member states' legislation. A further screening of a project can be done through a case-by-case examination or by thresholds and/or criteria that have been set by member states. The thresholds and/or criteria set by member states must incorporate the selection criteria under the Annex III of the Directive. Also, some member states have expanded their lists for project types that require EIAs and are not included in Annex I or II (EC, 2017).

If the five projects of the report, were to be implemented in reality, they would fall, depending on their type, into either Annex I or II of the EIA Directive. According to Annex I, an EIA is mandatory for "(a) construction of lines for long-distance railway traffic and of airports with a basic runway length of 2 100 m or more and (b) construction of motorways and express roads" (2014/52/EU). According to Annex II the

need for an EIA is determined by the Member State regulations for "infrastructure projects of (a) Industrial estate development projects; (b) Urban development projects, including the construction of shopping centres and car parks; (c) Construction of railways and intermodal transshipment facilities, and of intermodal terminals (projects not included in Annex I)" (*ibid.*).

### 1.2.2 The Planning and Building Act

The Planning and Building Act is a Swedish law, regulating the planning of land and water use, as well as construction (Regeringskansliet, 2010). The purpose of the act is to promote development of society with equal and proper societal progress and a sustainable habitat for people living today and for future generations (*ibid.*).

The expansion plans for the five projects in this report would need to be in accordance with the Planning and Building Act. However, it is the municipality, not Swedavia, who has the responsibility to keep the planning in accordance with the act. According to the Planning and Building Act 3 Chap. 5 § (Plan- och bygglag, 2010:900), national interests such as Arlanda airport must be taken into account by relevant municipalities when comprehensive plans are being formed (*ibid.*). A description of how the municipality will safeguard the national interest, while also abiding by the Environmental Quality Standards, must be compiled in the plan. Even though Swedavia is not responsible for constructing comprehensive or detail plans for the projects, it is in their interest to incorporate the Planning and Building Act in their plans.

### 1.2.3 Swedish Environmental Code

#### 1.2.3.1 Objectives and area of application of the Environmental Code

The purpose of the Swedish Environmental Code is to ensure a healthy and sound environment for present and future in a sustainable development way. The Environmental Code (MB 1998:808) shall be

applied on the Arlanda expansion projects to protect the human health as well as valuable natural and cultural environments, biodiversity, land, water and the physical environment.

### 1.2.3.2 Environmental impact statement

According to the 6 Chap. 3 § the Swedish Environmental Code (MB 1998:808), the purpose of an EIA is to establish and describe the direct and indirect impact of the planned activity or measure on people, animals, plants, land, water, air, climate, landscape and cultural environment. An EIA should also examine management of land, water and the physical environment in general, and other management of materials, raw materials and energy.

According to 6 Chap. 7 § of the code (MB 1998:808) the contents of an environmental impact statement shall include the following information:

1. A description of the project activities including location, screening and scoping.
2. The evaluation of the adverse impacts and mitigation measurements to ensure the environmental quality standard.
3. The assessment impact on human health, and the environment and management of land, water and other resources.
4. A description of non-action and different alternatives including the reasons of alternatives and the consequences of each alternative.
5. A non-technical summary in points 1-4.

### 1.2.3.3 Nature reserves

The 7 Chap. of the Swedish Environmental code (MB 1998:808) relates to nature reserves, activities relating to alteration of the nature reserve must not conflict with detailed development plans or area regulations adopted pursuant to Planning and Building Act (PBL 1987:10). Two nature reserves could be affected by the expansion of Arlanda. These are the nature reserve Laggatorp located 2 km north of Arlanda airport,

which is an area of old natural forest (Länsstyrelsen Stockholm, 2017) and the nature reserve Fysingen along the E4.

### 1.2.3.4 Special provisions concerning certain activities

According to 9 chap. 1 § the Environmental Code (MB 1998:808) environmentally hazardous activities are defined as follows:

1. The discharge of wastewater, solid matter or gas from land, buildings or structures on to land or into water area or groundwater.
2. Any use of land, buildings or structures that have a risk of detriment to human health or the environment due to discharges or emissions.
3. Any use of land, buildings or structures that may cause a detriment to the surroundings due to noise, vibration, light, ionizing or non-ionizing radiation or similar impact.

According to the Swedish Environmental Code, an EIA shall include assessments of hazardous activities. Thus, potential hazardous activities must be considered in the projects for the Arlanda expansion.

## 1.2.4 Regional planning

The plan for the future development of the Stockholm region is stated in the current regional plan for Stockholm County, RUFS 2010. The overall vision for the Stockholm region is to be the most attractive metropolitan region in Europe. This vision should be achieved by four goals: The region should be open and available for everyone; being the leading expanding region, promoting innovation and inspiring people; have a good living environment with clean air and water as well as a safe and beautiful environment; being a resource efficient region, where construction, public transportation, education and technical support should make it possible to use the resources in an efficient way as well as having small emissions of greenhouse gases and other pollutants (RUFS, 2010). With an increasing population in the region, the regional plan aims to expand the transport system to increase the connection between the municipalities in the region as well as to the surrounding

counties. New connections to airports and docks in the region, as well as to green areas are necessary. The water in the region is important for the drinking water supply as well as Stockholm's identity and its attractiveness. The natural and cultural landscape close to water should be protected, by constructing buildings in already exploited areas (*ibid.*).

Stockholm aims to be a small but leading region where the safety for the citizens is increased and the impact on the climate is reduced at the same time as the region's growth is benefitted. There should also be an increase in the capacity for public transportation, housing and education as well as reduce the segregation in the region (*ibid.*).

### 1.2.5 Comprehensive plan

Arlanda airport is located in Sigtuna municipality and the current comprehensive plan for the municipality was accepted in 2014 and is valid until 2030. The comprehensive plan for a municipality is a guiding document regarding the use of water and land areas and how to develop and preserve buildings, natural and cultural areas. The comprehensive plan is used for decision-making and the future vision for the municipality, though it is not legally binding. According to the comprehensive plan, Sigtuna shall be developed to a sustainable municipality that caters for today's as well as the future generation's needs. The development should be performed so that the social, economic and ecological aspects are balanced. Sigtuna municipality have defined eight strategies to achieve a sustainable development and to achieve their vision by 2030. These strategies are overarching for the work towards a sustainable society (Sigtuna, 2014):

1. Plan for ecological endurance by ensuring the connectivity for green areas as well as the closeness to green areas and parks for recreation, biodiversity as well as ecosystem services when densifying areas. The plan should also ensure water bodies with a good ecological quality as well as drinking water of good quality.

2. Sustainable construction by promoting environmental friendly solutions, by being economical with resources like land, material and energy as well as not using harmful material in constructions. Sustainability as well as long-term solutions should be developed for the location, configuration, choice of material, waste water system and storm water system.
3. An attractive and social sustainable environment where the citizens feel like a part of the community, feel safe and have good health. Recreational areas like parks and natural areas should be available as they are promoting health for citizens.
4. New housing and operation areas should be located to areas with good infrastructure. Densifying should preferably be made in already existing housing areas where the capacity for already existing infrastructure can expand and be further developed.
5. Developing the countryside and prevent scattered housing. The countryside of Sigtuna is important. It should be a clear difference between the rural areas and the urban areas. The rural areas should be developed in areas where the infrastructure is good. The natural and cultural areas are important for future generations as well as production of food, and the agricultural land should be protected and preserved.
6. Create a more available, more sufficient and more sustainable transportation system. The road system and the public transportation system capacity should be increased as the city is growing. The amount of public transportation travellers should be doubled and transportation by bike or foot should be promoted by connecting the different parts of the municipality. The capacity for Ostkustbanan, Märsta traveller centre as well as the track-bound traffic between Märsta and Arlanda airport should expand.

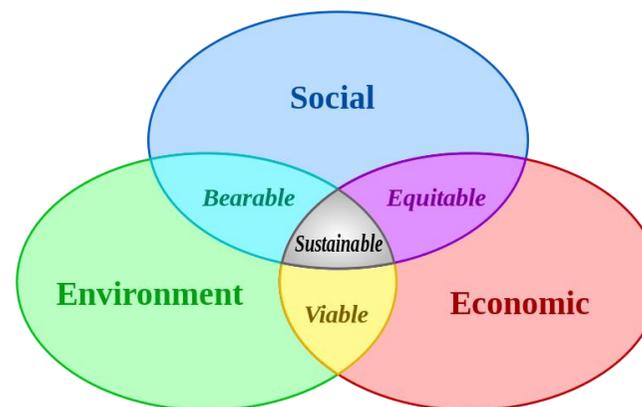
7. Develop Arlanda – Märsta to a regional city centre and strengthen the city centre, creating nodes for public transport. Arlanda –Märsta is close both to Uppsala and Stockholm, increasing the prerequisite to be a centre for a good enterprise, communications, education as well as an attractive place to live. The development of the Arlanda - Märsta centre should be in accordance with the development of the new Airport City Stockholm. Securing the public transport communications between Arlanda and Märsta.
8. A strong and diversified enterprise and opportunities to occupation and education. The enterprise in Sigtuna is closely related to Arlanda airport and dominated by logistic activities and tourism. A more diversified selection of workplaces as well as small business owner should be promoted (*ibid.*).

### 1.3. Environmental Objectives

#### 1.3.1 Sustainability

Sustainability is a socio-ecological process characterized by the pursuit of a common ideal (Parker, 2017). The term ‘sustainability’ could be viewed as the balance between human target goals and the planet environment. The original definition of sustainable development is usually considered to be ‘Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ (WCED, 1992).

Sustainability includes three dimensions which are economy, society and environment. The 2005 World Summit on Social Development identified sustainable development goals, such as economic development, social development and environmental protection (United Nations, 2005). The three pillars are interdependent and in long term none can exist without the others. The relationship between the pillars is shown in figure 1.2.



**Figure 1.2.** Venn diagram showing the relationship between the three pillars of sustainable development (Parker, 2017).

#### 1.3.2 Environmental Quality Standards

Environmental quality standards (EQS) are legally binding and are decided and based on scientific knowledge of levels not harmful to humans and the environment. An EQS can apply for a geographical area, municipality, country, water body or a sea area. The majority of the EQS in Sweden have been implemented due to EU directives. EQS can either be:

- threshold standards, where contamination or disturbance levels that cannot be exceeded or undershot after a certain time or for a certain period
- targeting norms, where the level of contaminants or disturbance that should not be exceeded or undershot
- indicative norms, which specifies the highest or lowest amount of an organism in the surface water or groundwater to contribute with guidance for the environmental status

- other norms with demands on quality in the environment due to that Sweden is a member of EU Sweden has EQS regarding marine environments, surface water, noise and outside air quality (Havs och Vattenmyndigheten (HaV), 2017)

Authorities and municipalities are responsible for the EQS to be followed and municipalities are obliged to consider the EQS during the comprehensive and detailed planning. EQS must be considered in the permit application for activities with a significant environmental impact, and the EIA should state how they are not exceeded. In Sweden the marine and water authority are responsible for the EQS regarding marine environment and surface water (*ibid.*).

The Swedish EQS regarding air quality aims to protect human and the environment as well as fulfilling the requirement in the EU directives 2008/50/EG and 2004/107/EG. There are threshold standards and targeting norms regarding the outside air quality for NO<sub>2</sub>, SO<sub>2</sub>, CO, benzene, particles, benzopyrene, As, Cd, Ni, Pb and O<sub>3</sub>. The municipality is responsible for the EQS regarding air quality. There are also EQS to protect vegetation regarding the following compounds: NO<sub>x</sub>, SO<sub>2</sub> and O<sub>3</sub> (Naturvårdsverket, 2017a). EQS regarding noise aims to protect humans from harmful effects due to noise. Activities like roads, railways, aviation and docks that requires permits are covered by these EQS and therefore has to consider their noise level (Naturvårdsverket, 2017b).

### 1.3.3 Environmental Objectives

Sweden has sixteen environmental objectives, with the aim to solve the major environmental problems our generation is struggling with by 2020 (Naturvårdsverket, 2012). The purpose of the objectives is to leave an environment to future generations, without such problems (*ibid.*). The sixteen environmental objectives were approved by the Swedish parliament in 1999 (Naturvårdsverket, 2017c). Achieving the objectives will ensure an environment with clean air, healthy living environments, and opportunities to enjoy nature. Furthermore, this should be

accomplished without increasing environmental and health problems in other countries (Naturvårdsverket, 2012). The environmental objectives are very ambitious and whether or not they achieved depends largely on domestic and foreign politics (*ibid.*). A definition of the generation goal and the sixteen environmental objectives can be found in table 2 in appendix 1.

Stockholm Arlanda Airport aims to handle environmental issues in a long-term perspective. The target is to have zero emissions of carbon dioxide from the airports own operations by 2020 (Swedavia, 2017c). It is important to note that Swedavia's operations do not include the air traffic. The target of Arlanda airport accords with reduced climate impact and clean air objectives in Swedish Environmental Objectives. On other aspects such as water, noise and energy, Arlanda airport has taken some mitigation measurements to reduce the adverse impacts on the environment, which supports the environmental quality objectives.

### 1.3.4 Regional Objectives

Stockholm County prioritizes six of the national environmental objectives. These are: reduced climate impact, clean air, a non-toxic environment, zero eutrophication, a rich diversity of plant and animal life and a good built environment (Naturvårdsverket, 2017d). They are defined in the same manner as the national environmental objectives but are evaluated at a regional level (see appendix 9.1). The County Administrative Board is responsible for the evaluation of and work to achieve the regional objectives (*ibid.*). The work is carried out in close dialogue with Trafikverket, the county's municipalities and Stockholm county council as well as climate networks (Naturvårdsverket, 2017e).

To plan for a society where a growing population constitutes a need for new residential areas, expanded waste and sewer management and investment in infrastructure when at the same time striving to achieve the regional objective is a challenge for the county (Naturvårdsverket, 2017d). Political incentives as well as the pace of mitigations measures

must increase if the county shall be able to achieve the regional objectives (*ibid.*).

In the process of the Arlanda expansion, both construction and operation phases should reference to the Swedish Environmental Objectives, both national and regional, in order to reduce the adverse environmental impacts.

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