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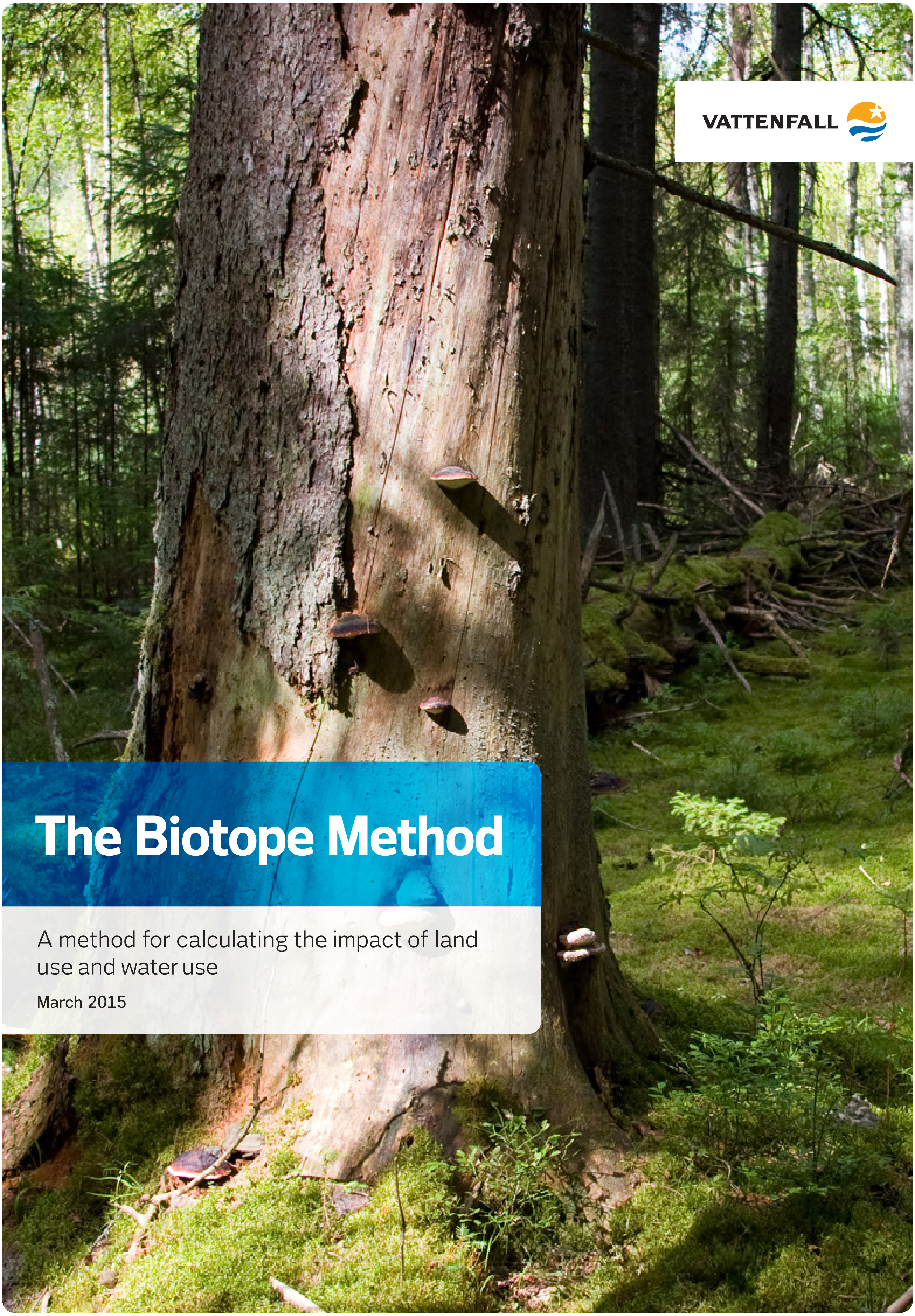


The Biotope Method

A method for calculating the impact of land use and water use

March 2015

Content

Preface

Vattenfall continuously work to improve our environmental performance. One crucial element in our work is to have a detailed understanding about the environmental impacts linked to the full value chain for our products. Vattenfall has for more than 20 years worked with life cycle assessments (LCA) and we have electricity generation certified according to Environmental Product Declaration (EPD) in accordance with ISO 14025. This means that we have information on use of resources, emissions, waste, recycling and land use for every kilowatt hour of electricity generated. This information we use proactively to reduce our impacts on environment and to be transparent towards our customers.

Protecting nature and species is one of Vattenfall's prioritised environmental topics. LCA standards today give us insufficient guidance in how to quantify and include impacts on biodiversity. As a result, Vattenfall decided to develop the Biotope Method in 1998-2000. The Biotope Method is a standardised way to compare the state of different biotopes before and after a development.

Now we have finished the update of the Biotope Method 2015 and the method has been significantly improved and takes new methods for assessing impacts on biodiversity into account, for example the new Swedish standards for biodiversity surveys. It also takes into account the increased access to digital information and additionally it includes more information on how to assess changes in the marine environment than the previous version.

With this update, Vattenfall has an even more robust tool for assessing environmental impacts from activities leading to a change in biotope composition. Vattenfall will use the method to guide us to further lower our impact on the biodiversity. The Biotope Method 2015 has been developed to be applicable in other areas than EPD, as well as beyond the energy sector. We see that the Biotope Method can be used with benefits in pilot studies and location studies, to assess the impact of planned operations. We hope that many others will find the method useful and we are always interested in getting input and ideas to improve the method even further.

We would like to thank Eva Grusell, Sweco, for her hard work with the revision. Also a special acknowledgement to the project group, and to the external reviewer Sofia Miliander, Sweco, for their efforts in improving the Biotope Method.

Helle Herk-Hansen,
Director Environment Vattenfall Norden
Stockholm, 2015-02-06

Summary

This report presents a review and update of the Biotope Method 2005.

The Biotope Method is based on the assumption that the losses and additions of biotopes resulting from exploitation mirror the resulting changes in biodiversity. These losses and additions can be quantified by measuring the areas affected, which enables comparisons between different types of exploitations. The use of the method entails assessing the changes in the distribution and quality of biotopes between 'before' and 'after' within a pre-defined area, i.e. the system boundary.

The Biotope Method is intended for use in connection with most types of land and water use. It is important to emphasise that the Biotope Method only reports the quantitative biotope changes (biotope losses and new additions) within the system boundary. Exploitation may also entail changes at the landscape level, i.e. outside the system boundary. These may include changes such as fragmentation, barrier effects and deterioration of habitats. When the Biotope Method is used, changes which take place beyond the system boundary are described only qualitatively.

The Biotope Method 2015 has been developed to be used also in areas of application other than EPD, as well as beyond the energy sector. The Biotope Method is also a tool which can be used in feasibility-studies and localisation studies, to assess the impact of planned operations.

Use of the Biotope Method obtains knowledge of the impact of planned or ongoing operations on biodiversity through the use of relatively limited measures and resources. Input data for the assessment is derived from available digital databases, aerial images and project-specific information. An inventory of biotopes is also carried out in the field. If the Biotope Method is used in a feasibility-study, the result can provide suggestions for modifications; if the method is used in a localisation study, it can generate suggestions for prioritisation. If the Biotope Method is applied to ongoing operations, the result can be used to identify suggestions for biotope improvements and compensation measures.

1 Background

Work with Life cycle assessment (LCA) has for many years been concerned with quantifying resource use and emissions. Effects of land and water exploitation on flora and fauna, on the other hand, have generally been described only in general terms, and are very rarely quantified.

In nature conservation biology, too, effects on biodiversity at biotope and species level have often been described only qualitatively. There are quantitative measures concerning area data for land and water which is protected by example national parks, Natura 2000 areas and nature reserves. There are also quantitative summaries of red-listed species at national level.

As part of the work of preparing documentation for environmental product declaration (EPD), the Biotope Method was developed in Vattenfall in order to quantify the effects on biodiversity (Blümer & Kyläkorpi 1998, 2001). This was a voluntary measure which resulted from the realisation that the alternative, a merely qualitative description, would be unsatisfactory. The method was initially developed primarily for Swedish hydro power, to deal with retrospective analyses. Between 1998 and 2005 the method was tested and further developed through applications in many other aspects of energy generation. Almost 10 years have passed since the Biotope Method 2005 was developed. With experience of the use of the Biotope Method 2005, modifications and new knowledge, it is now time for a review and update.

2 Purpose and objectives

The aim of this report is to describe a method for quantifying effects on biodiversity, which has been developed and tested in Vattenfall. The ambition is that the method will give a unified structure that allows descriptions, quantifications and the possibility of comparing different types of land use and the resulting effects on biodiversity. It is used to give standardised information concerning changes caused by different types of land use – primarily through biotope alteration, which are described quantitatively but also qualitatively. The advantage of this is that work on biotope improvements (nature conservation measures) can also be quantified.

The Biotope Method was initially developed as a tool to illustrate the environmental effect of electricity and heat generation.

The purpose of the Biotope Method 2015 is:

- that it should be usable for studies of changes in land and water use, both within and beyond the energy sector.
- that it should be usable as a tool in feasibility studies and location studies, in order to assess the impact of planned operations.

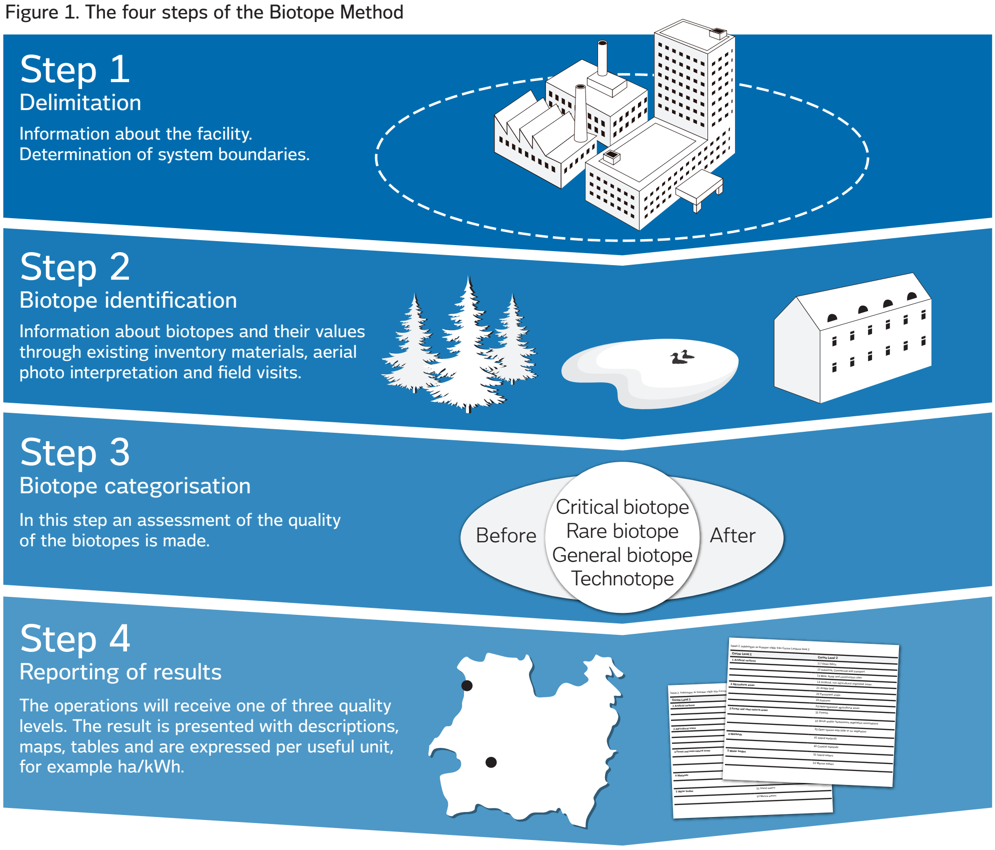
The method should be usable even in cases where time is limited, and with available data from databases, aerial photography, etc., together with a complementary site visit, when the delineated areas are described in summary and verified. The method is not intended to be an environmental impact assessment, to result in detailed and complete inventories of species or to give a full picture of the effects on flora and fauna. It is important to bear this in mind, since the method may entail simplifications of things which are difficult to describe quantitatively. A balance has to be struck between completeness and simplification.

3 Method

The Biotope Method is based on the assumption that the loss and addition of biotopes resulting from exploitation mirror the resulting changes in biodiversity. These losses and additions can be quantified by measuring the areas affected, which enables comparisons between different types of exploitations. The application of the method entails the assessment of changes in the distribution and quality of biotopes between situations 'before' and 'after' exploitation within a delimited area (the system boundary of the investigation).

The Biotope Method is intended for use in connection with most types of land and water use. It is important to emphasise that the Biotope Method only reports the quantitative biotope changes (biotope losses and any additions) within the system boundary. Exploitation may also cause changes at the landscape level, i.e. outside the system boundary. These may include changes such as fragmentation, barrier effects and degradation of habitats. When the Biotope Method is used, changes which take place beyond the system boundary are described only qualitatively. The Biotope Method is divided into four steps (see Figure 1).

Figure 1. The four steps of the Biotope Method



Depending on access to information about the exploitation and the knowledge base concerning the land and water areas affected, the results are assigned to one of three possible quality levels. The approach when using the Biotope Method is always to achieve as high a quality level as possible. If the operations under investigation are located on geographically separate sites, a combined quality level can be calculated from the total area used in relation to the quality level of the individual plants.

When biotopes are categorised, an assessment is made of their quality as habitats, e.g. naturalness, the existence of certain structures, as well as the occurrence of red-listed species or the diversity of species. National assessment criteria are used in the categorisation. An alternative approach can be used in the event of limited access to species inventories or other relevant information. The area in the 'before' and 'after' situations is in this case allocated in accordance with a categorisation key that is further described in chapter 6. The area of the technotope must however always be known in the 'before' and 'after' situations.

4 Step 1 – Delimitation

4.1 Introduction

The first step of the Biotope Method is to establish the system boundaries of the project in question. 'System boundary' is used here with the meaning it has in the context of LCA, i.e. the technical, geographical and temporal systems which are analysed in a life cycle assessment. The impact which takes place outside the system boundary should also be established.

In short, the purpose of the delimitation stage is to define what is to be included in the assessment and what is to be excluded, both temporally and spatially. The impact inside the system boundary includes losses and additions of biotopes, which should be quantified. The impact generally takes place over a larger area than the more technically-oriented system boundary. Impact beyond the system boundary includes impact from a landscape point of view, such as fragmentation, barrier effects and degradation of habitats, which should be described qualitatively.

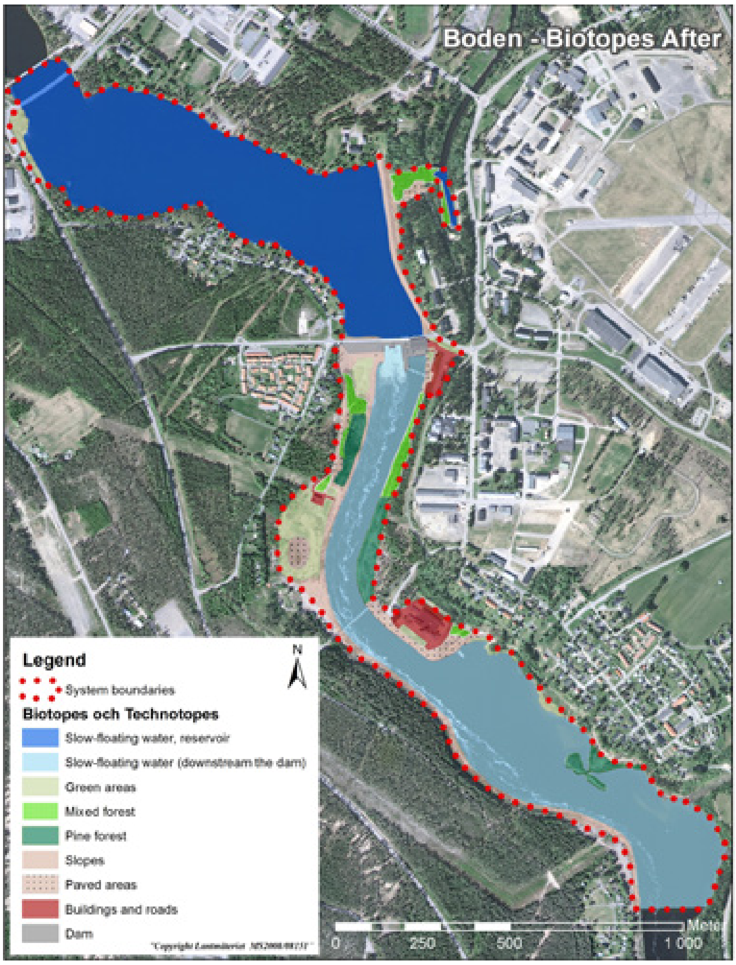


Figure 2. System boundary around a hydro power plant in the Lule River in Boden

In order for the Biotope Method to be applicable, it must be possible to determine the system boundary. There should be information concerning the area covered by the project and at least some information concerning the direct impact of the operations in order to achieve the lowest quality level. The extent and quality of information sources determine how the Biotope Method can be applied.

An important methodological limitation is that the method does not include a step for analysing potential compensation measures. On the other hand, the method makes it possible to take account of nature conservation measures in the reporting of results.

4.2 System boundaries

Temporal delimitations
The 'before' state is defined as the situation immediately before, or as close as possible to, the actual requisitioning/exploitation. The 'after' state is defined as a point in time after exploitation, which usually corresponds to the year in which the assessment is carried out.

The time of biotope identification and biotope categorisation in both the 'before' situation and the 'after' state is always given. In the preparation of an EPD, which is revised every three years, the 'after' situation is determined by the year in which the EPD is revised and by basing the calculations on an updated value of the functional unit. Biotope identification and biotope categorisation for the 'after' state do not need to be carried out in the same year as the EPD is prepared, but should not be carried out too long after the 'after' situation, as the biotopes might have changed by then. If the time of biotope identification and biotope categorisation is different from the 'after' situation (e.g. EPD revision), the time of biotope identification and biotope categorisation should be documented.

Since the method aims at analysing net effects, there is no requirement to define a 'natural state'. The Biotope Method includes only the impact of the project under investigation on the natural environment, with subsequent changes in flora and fauna; it does not include anything done in the area earlier. In the Biotope Method, only the effect of the individual project (i.e. the net effect) is to be taken into consideration.

Spatial delimitation
It is important to define the spatial delimitation of what is to be included in the study. The quantitative assessment in the Biotope Method focuses on land and water use which is directly connected with the project under investigation and:
- has a clear geographical delimitation.
- is primarily not shared with other projects/interests.

The quantitative step therefore includes only the direct impact which has arisen in the immediate vicinity of the exploitation project. A road, a storage area or a leisure area, for example, which is judged to have very little connection with the project, can be defined as beyond the system boundary. In practice, this means that decisions have to be made on a case to case basis regarding what should be included in the assessment and what should be excluded. Proportions may also be calculated in cases where land and water use is shared by a number of projects. Delimitations should always be justified and reported.

There are certain differences of approach between different types of land use. Below a number of examples concerning different types of energy sources are described.

The direct impact, i.e. within the system boundary, from land and water use of an onshore wind power project includes the requisition of land for works, roads and other related infrastructure. Wind energy typically entails some form of impact beyond the system boundary, such as the fragmentation of habitats, the creation of barrier effects or collision risk for birds.

The direct impact from land and water use of an offshore wind power project includes the requisition of areas for foundations, gravel beds etc., cables, substations and weather masts. The impacts beyond the system boundary take place both in and above the water. Examples of such impacts include reduced feeding areas for certain marine species, barrier effects and collision risk for birds.

The direct impact from land and water use of a hydro power plant can be complex. Along e.g. Sweden's major rivers, there are many hydro power plants. Regulation of one reservoir may be used by several different plants. The impact of a power plant upstream in the water system can lead to impacts downstream in the water system as well as in adjoining marine waters. Such impacts may include biotope loss or degradation of biotope quality, affecting fish breeding and reproduction. In the application of the Biotope Method on hydro power, the primary focus has been on the study of reservoirs, dams, spillways, dry water channels, switchgear, buildings and roads associated with operations, run-off channels, extraction sites, storage areas, fillings, embankments and affected beaches downstream. In the case of reservoirs, adjacent reservoirs are included within the system boundary.

The direct impact from land and water use of a nuclear power facility does not only concern the nuclear power plant where electricity is generated. The entire fuel chain is regarded as being within the system barrier - i.e. the uranium mines, conversion and enrichment plants, fuel production plants, the nuclear power plants and waste facilities. In the case of a nuclear power plant, the cooling water plume is also included within the system boundary.

In a corresponding manner as for nuclear power, the system boundary for coal power includes the entire fuel chain - i.e. the mines, transhipment harbours, power plants and waste management facilities.

5 Step 2 – Biotope identification

5.1 General application

The second step in the application of the Biotope Method is the identification of the biotopes which have been affected. The biotopes should be identified both in the 'before' and the 'after' situations, so that an assessment can be made of the changes related to the requisition of land and water areas. The focus is on collecting information on the area within the system boundary, where quantification takes place in accordance with the Biotope Method. Depending on the nature of the operations, i.e. whether there is also an impact beyond the system boundary, data should be collected in a larger area in order for the impact to be described qualitatively. The amount of detail in the description of qualitative impact beyond the system boundary depends on the purpose of applying the Biotope Method. The qualitative impact can be described in detail or summarised as a list of points.

The purpose of the identification is to produce as much knowledge as possible about the land and water areas within the area being studied. The step of biotope identification also includes identifying areas which lack preconditions for biological production. GIS data, existing inventories, aerial photographs, site visits etc. provide a basis for the identification of biotopes in the 'before' and 'after' situations. If a site visit in the 'after' state enables an impression to be formed of the 'before' situation, observations made during the site visit can be used as a basis for a description of the 'before' situation. The information collected for biotope identification determines the quality of the categorisation in step 3. There are alternative types of procedure, depending on accessibility and quality of information (see Table 9).

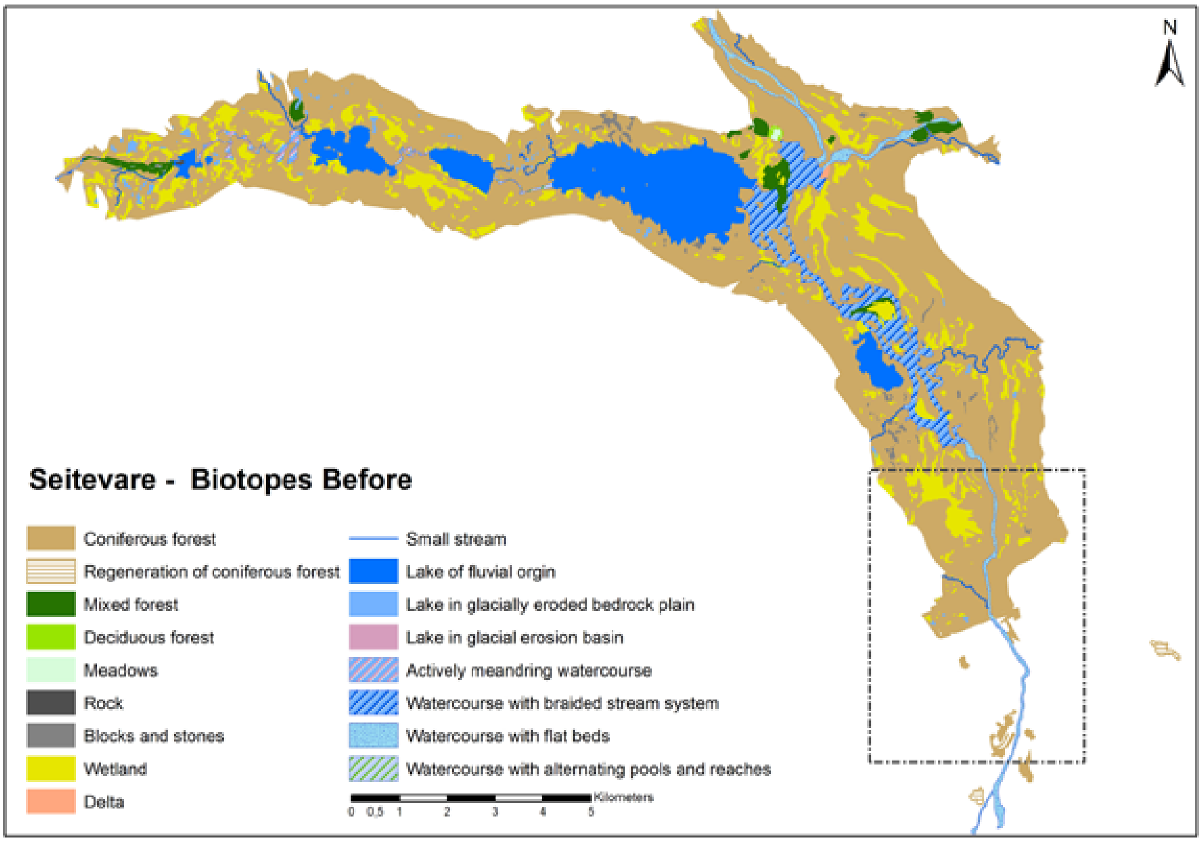


Figure 3. Seitevare hydro power plant in the Lule river, biotopes in the 'before' situation

Corine landuse (Bossard 2000) is used as the basis for the classification of biotopes. A national interpretation is made of level 2 (see Table 2). The classification is based on habitat types, vegetation types, hydro morphology/soil types or geomorphology/rock types, depending on national conditions (see Table 4 - Table 7). Biotopes are described on the basis of naturalness, structures and continuity etc. The description is complemented by the known incidence of species such as indicator species and 'conservation species', as well as diversity of species.

Collection of available information concerning known conditions:

- Information from available digital databases.
- Material from previously performed inventories.
- Information concerning the plant's land and water requirements, situation maps, environmental impact assessment, etc.
- Collect existing information and document the sources and the date.

Identification of biotopes:

- Interpretation of aerial photographs (if possible)
- Field visit (if possible).
- Descriptions on the basis of Corine landuse (see Table 2). The categorisation is based on national conditions and the biotopes are described on the basis of national practice.
- If there is also an impact beyond the system boundary, data is collected for a larger area.
- Calculation of areas.

Table 1. Information sources

Information sources	Commentary/description
Maps	Aerial photographs/orthophotos/IR
	Satellite images
	Topographic map
	Soil type map
Plant-specific information	Situation maps
	Environmental impact assessment
Knowledge base concerning known values	Digital info for GIS
	Inventory reports
Site visit	Surveying of conditions on site and verification of known information

Table 2. Categorisation of biotopes is based on Corine landuse level 2

Corine Level 1	Corine Level 2
1 Artificial surfaces	11 Urban fabric
	12 Industrial, commercial and transport
	13 Mine, dump and construction sites
	14 Artificial, non-agricultural vegetated areas
2 Agricultural areas	21 Arable land
	22 Permanent crops
	23 Pastures
	24 Heterogeneous agricultural areas
3 Forest and semi-natural areas	31 Forests
	32 Shrub and/or herbaceous vegetation associations
	33 Open spaces with little or no vegetation
4 Wetlands	41 Inland wetlands
	42 Coastal wetlands
5 Water bodies	51 Inland waters
	52 Marine waters

5.2 Application of the method in Sweden

Information concerning known conditions can be taken from digital databases supplied by authorities. This includes information on protected areas, woodlands, agricultural land, meadows and pastures, wetlands, red-listed species and other rare species, catchment areas, water protection areas, soil types and data from sampling and environmental monitoring. Digital map material can be obtained for ground maps, current and historic aerial photographs, satellite images and soil type maps, etc. (see Table 3).

The categorisation of biotope/habitat types to be found in nationwide inventories of terrestrial environments is also used in the Biotope Method. Categorisation of biotopes in lakes and watercourses is based on the hydro morphological conditions. Categorisation of marine biotopes is based on the type of seabed. If a Natura 2000 habitat appears, this is indicated and named as such.

Table 3. Information sources

Maps	**Collected/delivered from:**
Aerial photographs/orthophotos/IR	Land Survey
Satellite images	Land Survey
Map of soil types	Geological Survey of Sweden
Ground maps etc.	Land Survey etc.
Plant-specific information	
Situation maps	Operator
Environmental impact assessment	Operator, authorities
Knowledge base concerning known values	
Digital info for GIS	National, regional and local databases, e.g. Swedish Environmental Protection Agency (protected areas), Environmental data portal (Miljödataportalen), Geological Survey of Sweden (soil ets), Swedish Meteorological and Hydrological Institute (waterweb), Sweden´s five water agencies (VISS portalen), The Swedish Species Information Centre (Artportalen and Trädportalen) , Swedish Board of Agriculture (database about agriculture land and, TUVA - database of meadow and pasture inventories), Swedish Forest Agency (database about values in the forest), Swedish University of Agricultural Sciences ((Forest Map) and Swedish Environmental Protection Agency (System Aqua).
Inventory reports	A knowledge base can be derived from various inventories. These have national, regional or local distribution. The national and regional documents produced by authorities have been partly digitalised - see above. There are also various reports produced by experts.

The artificial areas

The artificial areas are described on the basis of information from the operator and observations made during the site visit. If vegetation appears in association with roads, power lines, airports etc., the so-called green infrastructure, the biotope is described on the basis of their habitats they provide and the species they support.

Table 4 .The artificial areas

Corine level 2	**Level 3 - National interpretation: examples of biotopes or technotopes**
11 Urban fabric	Hard-made surfaces, buildings
12 Industrial, commercial and transport	Roads, turning areas, railways, switchgear
13 Mine, dump and construction sites	Slag heaps, storage areas, open-pit mines, quarries
14 Artificial, non-agricultural vegetated areas	Lawns, parks

Terrestrial biotopes

There are a number of nationwide biotope inventories of terrestrial environments, such as the key biotope inventory (forests with value), wetland inventory and meadow and pasture inventory. There is a relatively good knowledge of the most valuable biotopes, which are included in these national inventories. Protected areas are often well documented. For example, there are management plans available for nature reserves and habitats within Natura 2000 areas. The naming used in the national inventories and within protected areas can be used in the description of values. In appendix 1 there is a compilation of national and regional knowledge bases, which should always be taken into account. There is additional support for the naming of biotopes in the technical report (SIS-TR 199001:2014) associated with the Swedish Standard Institute (SIS) standard for Biodiversity survey - Implementation, assessment and reporting (SIS-SS 199000:2014).

The terrestrial biotopes are identified initially on the basis of an aerial orthophoto interpretation. Complementary information is taken from the digital databases and any available inventory reports. During the site visit, an inventory of biotopes is made and the biotopes are classified on the basis of the methodology in the national inventories referred to above.

Table 5. Terrestrial biotopes

Corine level 2	Level 3 - National interpretation: examples of biotopes
21 Arable land	Ploughable arable land
22 Permanent crops	Fruit and berry cultivation etc
23 Pastures	Different types of maintained meadow and pasture
24 Heterogeneous agricultural areas	Mixed cultivation, agroforestry etc
31 Forests	Different types of woodland such as coniferous forest, deciduous woodland, broad-leaved deciduous woodland, alder fen and marsh woodland, older solitary trees and groves
32 Shrub and/or herbaceous vegetation associations	Different types of bush areas such as willows, hazel groves and forests edges
33 Open spaces with little or no vegetation	Sandy environments, e.g. sand dunes and sandy moorlands
41 Inland wetlands	Different types of wetland and rich fen
42 Coastal wetlands	Different types of beach and water environments

Photo Eva Grusell

Inland water biotopes

Knowledge concerning biodiversity in lakes and watercourses is relatively good, but there is a lack of nationwide inventories. Also in the inland water environments, there are protected areas with associated documentation of their value, e.g. Natura 2000 habitats and nationally designated areas of nature protection. In recent years, a number of criteria for the assessment of natural value have been presented, including System Aqua and inland water key biotopes. During 2013, the Swedish Agency for Marine and Water Management produced regulations for the classification and environmental quality norms of inland water. These also include assessment criteria for hydromorphological quality factors in lakes and watercourses.

There is information concerning lakes and watercourses produced in connection with environmental monitoring. Information relating to water chemistry, phytoplankton, lake and river bed fauna, obstacles to migration and water vegetation are collected in the Environmental Data Portal and VISS portal databases. Other inventories have also been made - of sea birds, otters and mussels, for example. Overall, lakes and watercourses in southern and central Sweden are better mapped than those in northern Sweden.

The inland biotopes are initially identified (see Table 6) on the basis of an interpretation of aerial photography of the hydromorphological conditions, with complementary information concerning soil types. The biotopes are then classified according to hydromorphological types - see Appendix 2. The Swedish Agency for Marine and Water Management's assessment criteria for hydromorphological quality factors in lakes and watercourses (HVMFS 2013:19) are used for this classification. Complementary information concerning the area's status is taken from the digital databases, such as the VISS portal, and any inventory reports which may be available. During the site visit, a study is made of the degree of naturalness/impact in the inland water biotope and surrounding area.

Table 6 Inland water biotopes

Corine level 2	Level 3 - National interpretation: examples of biotopes
51 Inland waters	Steep watercourses in solid rock, Steep watercourses with stones and turbulent flow, Broad watercourses with regularly alternating reaches and pools, Watercourses with a number of parallel channels, Meandering watercourses, Over-deepened watercourses in fine-grained sediment, Watercourses in peat Lakes in tectonic basins, Lakes in glacial erosion basins, Glacial damming basins, Natural non-glacial lakes, Artificial lakes, Artificial waters

Photo Eva Grusell

Marine biotopes

Today's knowledge base for the marine environments is not all-encompassing. Threatened biotopes in the Baltic Sea are listed in HELCOM (HELCOM 1998, 2006) and a biotope classification of threatened and representative coastal biotopes was made in 'Kustbiotoper i Norden' ('Coastal biotopes in the Nordic region') (Nordic Council of Ministers 2001). The Swedish Environmental Protection Agency has produced a guide to the protection of marine environments. Otherwise there are only a number of inventories, samples and models of the distribution of species and biotopes. Some data on marine environments is available via the VISS portal. The Swedish Agency for Marine and Water Management has begun work to produce a national method of marine natural value assessment.

The marine biotopes (see Table 7) are described on the basis of information in the VISS portal and any available reports concerning on-site conditions. Appendix 3 contains a description of the marine habitats.

Table 7. Marine biotopes

Corine level 2	Level 3 – National interpretation: examples of biotopes
52 Marine waters	Shallow marine soft seabed, Shallow marine hard seabed, Deep marine soft seabed, Deep marine hard seabed, Biogenic reefs and bubble reefs, Anthropogenic marine seabed.

6 Step 3 – Categorisation of biotopes

6.1 General application

During the categorisation step, an assessment of the quality of the biotopes is made. Based on their ecological characteristics, the biotopes are divided into four different categories: critical biotopes, rare biotopes, general biotopes and technotopes. When applying the Biotope Method, national assessment criteria should be used as a basis. A biotope is assessed on the basis of its quality as a habitat, as well as the existence of certain structures and the incidence of red-listed species, signal species, 'conservation species', as well as diversity of species.

The Swedish SIS standard for Biodiversity survey - Implementation, assessment and reporting (SIS-SS 199000:2014) was used as the basis for constructing the hierarchy and formulating the general criteria. An important difference is that, while the Biotope Method uses species as a support for the assessment of biotopes, the SIS standard for Biodiversity survey - Implementation, assessment and reporting assesses species and biotopes separately.

Table 8 The biotopes are divided into four categories.

Category	Definition
Critical biotope	*Highest or high natural value:* an area categorised as a critical biotope is judged to have particular importance for the preservation of biodiversity on a global, national and regional level. The area has a much greater diversity of species than the surrounding landscape or other areas of the same biotope in the region or country. All Natura 2000 habitats are categorised as critical biotopes. There are red-listed species in the area.
Rare biotope	*Substantial natural value:* an area categorised as rare biotope need not have particular importance for the preservation of biodiversity at regional, national or global level. The area is judged to have particular importance for the maintenance or growth of the total extent of such areas, and for the maintenance or improvement of their ecological quality. A rare biotope may, in the long term or with restoration measures, reach critical biotope status. A rare biotope has a greater diversity of species than the landscape in general, and is of importance for landscape variation. Isolated red-listed species or key elements occur.
General biotope	*Minor natural value:* an area categorised as general biotope consists of commonly occurring habitats - the so-called everyday landscape. The general biotope also includes trivial areas where biological production occurs, e.g. planted green spaces in urban environments.
Technotope	Areas lacking preconditions for biological production.

The best categorisation results are obtained when there has been good access to information for biotope identification (step 2) for both the 'before' and 'after' situations. In this case all areas should be delineated, and every biotope described. In Table 11 there is a review of the quality levels of the Biotope method and requirements of the different levels for documentation.

If access to inventory material is limited, there is an alternative type of procedure which can be used. In the 'before' and 'after' states, the area is divided in accordance with categorisation keys (see Table 9). In these cases the areas are categorised directly, without prior identification. The technotope must be known in the 'before' or 'after' states. The purpose of the keys is to enable a standardised categorisation of the original and/or resulting areas, with a reasonable margin of error. The categorisation keys are produced with a high degree of conservatism. Their main purpose is that they should only be used in case of extremely limited access to information. The proportions between the categories in the categorisation keys are judged to be sufficiently well worked out that the disturbances caused by the use of the area are, by a wide margin, not underestimated. This means that the categorisation keys should always overestimate critical and rare biotopes in the 'before' situation, and always underestimate them in the 'after' situation. There should therefore be no risk of these keys being used to quickly reach a result which is more favourable for the operator.

Table 9. Categorisation with the aid of categorisation keys, where there is a lack of information for biotope identification in the 'before' or 'after' situation

Categorisation key [F] for 'before' situation	Categorisation key [E] for 'after' situation
The area T* is measured, and the remaining area is assumed to comprise 40 % critical biotope, 40 % rare biotope and 20 % general biotope.	The area T is measured, and the remaining area is assumed to consist of general biotope.

* If it is impossible to establish the area T, the value is assumed to be 100 % of the affected area in the 'after' situation, and 0 % in the 'before' situation.

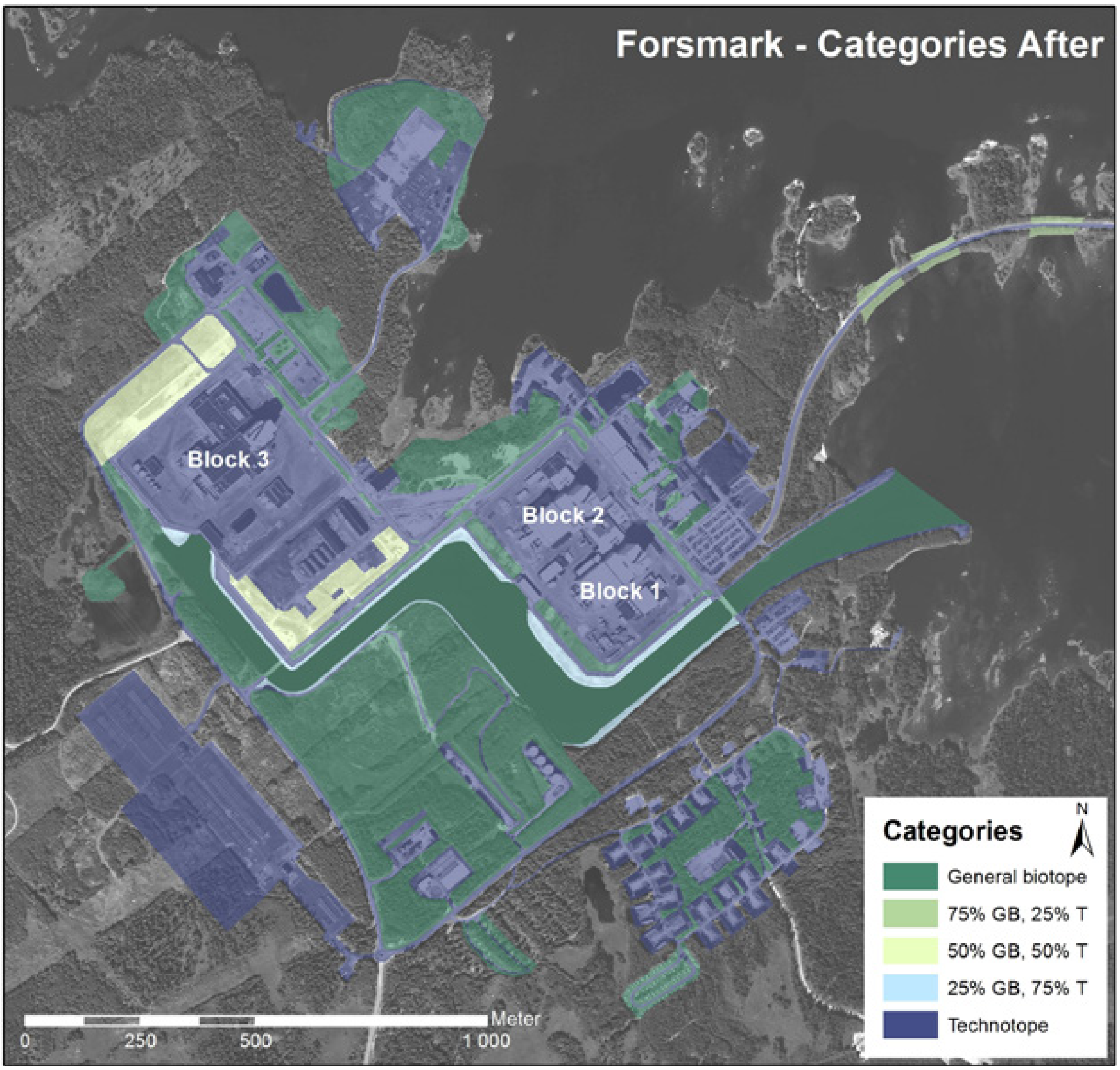


Figure 4. Forsmark nuclear power plant, categories in the 'after' state. GB = General Biotope, T = Technotope

6.2 Application of the method in Sweden

The categorisation of biotopes is based on the SIS standard for Biodiversity survey - Implementation, assessment and reporting (SIS-SS 199000:2014), but certain modifications have been made to adapt it to EPD, feasibility studies and localisation studies. Biotopes and species are not assessed separately in the Biotope Method; species are, rather, used as a support in assessing biotopes. In other respects, the terrestrial biotopes follow the SIS standard and the associated technical reports. Sweden does not have generally accepted assessment criteria for marine and inland water habitats, of the kind it has for terrestrial habitats. In comparison with the SIS standard for nature value inventory, a modification has been made for the inland water and marine environments in the Biotope Method. The reason for this is to adapt the method to the ongoing work on assessment criteria by the Swedish Agency for Marine and Water Management.

There are national assessment criteria for a number of **terrestrial environments** such as Natura 2000 habitats, wetlands, key biotopes for woodland, meadow and pasture land. In the SIS standard, the assessment criteria for the terrestrial environments are harmonised.

There are no national assessment criteria for **inland water environments**, but there are documents and criteria in the Natura 2000 habitats, 'System aqua' and 'Limniska nyckelbiotoper' ('Inland water key biotopes') as well as information in the VISS portal. Access to information for individual sites varies. The ecological status in the VISS portal can be used if there is no other information to use as a basis for categorisation. The Swedish Agency for Marine and Water Management is working to produce assessment criteria for inland water environments: for watercourses in autumn 2014 and for lakes in spring 2015.

There are no national assessment criteria for **marine environments**. Natura 2000 habitats, the HELCOM list of threatened biotopes in the Baltic Sea, 'Kustbiotoper i Norden' ('Coastal biotopes in the Nordic region') – biotope classification of threatened and representative coastal biotopes - and information in the VISS portal can be used to support assessment. Access to information for the individual sites varies, and is considerably more limited than for the inland water environments. The ecological status in the VISS portal can be used if there is no other information to use as a basis for categorisation. During 2015, the Swedish Agency for Marine and Water Management will initiate a more comprehensive work on assessment criteria for marine environments.

Table 10. The Biotope Method's categories, and how they correspond to the SIS standard and VISS portal

Category	Equivalent in SIS standard	Corresponds to current water status*
Critical biotope	Nature value class 1 and 2	High ecological status
Rare biotope	Nature value class 3	Good ecological status
General biotope	Nature value class 4 and all green spaces with biological production	Moderate ecological status
Technotope	Areas lacking preconditions for biological production	

* In the absence of information, ecological status can be used for categorisation

Table 11. Classification of biotopes into four categories and their definitions

Critical biotope (SIS class 1 och 2)

General criteria

An area categorised as *critical biotope* is judged to have particular importance for the preservation of biodiversity on a global, national and regional level. The area has a much greater diversity of species than the surrounding landscape or other areas of the same biotope in the region or country. All Natura 2000 habitats are categorised as critical biotopes. Aquatic environments judged to have a high ecological status. A number of protected species / isolated red-listed species occur.

Criteria in Sweden

The marine biotopes	Clarification
Shallow seabed	Species-rich and unaffected, or affected to some extent, by human intervention Examples of soft seabeds: • Shell gravel banks, lagoons, deltas and sea wrack meadows Examples of hard seabeds: • Blue mussel beds, caves, reefs, vertical surfaces and algae belts
Deep seabeds	Species-rich and unaffected, or affected to some extent, by human intervention Examples of soft seabeds: • Seabeds have not been bottom-trawled or damaged by lack of oxygen • Sea pens and scallops are species which may indicate higher value Examples of hard seabeds: • Fiords or other protected sites, vertical surfaces, caves and areas which are important for fish, benthic animals and corals
Biogenic reefs and bubble reefs	Seabeds can even be considerably affected by human intervention Example: • Coral reefs, blue mussel banks and oyster beds
Anthropogenic marine seabed	Seabeds should contribute towards variation in soft seabeds Example: • Establishment of man-made substrates with fouling of mussels, cnidarians and ascidians • Blue mussel beds and algae belts with distinct zoning
The inland water biotopes	**Clarification**
Lakes	Example: • Lakes with important reproduction areas and growth environments for fish, birds, etc • Lowland lakes with substantial aquatic vegetation and rich birdlife • Charophyceae lakes • Nutrient-poor clear water lakes with zoned underwater vegetation • Naturally dystrophic lakes and lakes with islands, bare rocks, beach cliffs, rocks, bird cliffs and reefs • Lakes with long turnover time, pelagic fish fauna and high plankton biodiversity • Large, variegated, deep lakes with good nutrition status, water quality and incidence of deep gravel lake beds which function as breeding grounds and growth areas for fish • Naturally clear and nutrition-poor lakes with ice-age relics
Small bodies of water	Example: • Naturally dystrophic small bodies of water, mire lakes • Clay pits • Small bodies of water with rich fen vegetation • Breeding waters for frogs and lesser water salamanders

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Watercourses	Example: • Block-rich unaffected reach • Unaffected ravine reaches with surrounding ravine woodland • Larger natural bifurcation areas • Gently-flowing reaches across extensive open water land with substantial incidence of well-grazed and/or open shores • Long meanders • Rapids, unaffected reach with waterfalls • Sandy erosion slopes • Outflow areas • Estuary areas and deltas
The terrestrial biotopes	**Clarification**
Woodland	Example: • Key biotopes • Deciduous woodland inventory class 1 and 2 • High-grade deciduous woodland inventory class 1 and 2
Wetlands	Example: • VMI class 1 and 2 • Rich fen inventory class 1, 2 and 3
Meadow and pasture land	Example: • The Swedish Board of Agriculture's meadow and pasture land - active sites (TUVA)
Trees	Example: • Trees worthy of protection, as in programme of measures

Rare biotope (SIS class 3)

General criteria

An area categorised as *rare biotope* need not have particular importance for the preservation of biodiversity at regional, national or global level. The area is judged to have particular importance for the maintenance or growth of the total extent of such areas, and for the maintenance or improvement of their ecological quality. A rare biotope may, in the long term or with restoration measures, reach critical biotope status. A rare biotope has a greater diversity of species than the landscape in general, and is of importance for landscape variation. For example, aquatic environments judged to have a good ecological status are included. Isolated protected species / red-listed species occur, or occurrence of key elements.

Criteria in Sweden

The marine biotopes	**Clarification**
Shallow seabed	All hard and soft shallow seabeds, but not completely impoverished
Deep seabeds	Soft seabeds are affected to some extent by human intervention Hard seabeds may even be affected by trawling
Biogenic reefs and bubble reefs	Seabeds may even by heavily affected by human intervention, but still with occurrence of reef-forming species
Anthropogenic marine seabed	Anthropogenic seabed, as it can contribute to creating variation in soft seabeds without identified red-listed species
The inland water biotopes	**Clarification**
Lakes and small bodies of water	More or less natural lakes and small bodies of water which have been subject to minor or moderate human intervention Artificial and regulated lakes and small bodies of water, with a degree of naturalness and with importance for the preservation of biodiversity
Watercourses	Example: • Block-rich, partly affected reach • Smaller bifurcation area, partly affected • Meandering watercourse, shorter stretch • Rapids, partly affected stretch with waterfalls
The terrestrial biotopes	**Clarification**
Woodland	Example: • National Board of Forestry sites with natural value or equivalent value
Wetlands	Example: • VMI (Wetland Inventory) class 3 with value concentrations or equivalent value
Meadow and pasture land	Example: • The Swedish Board of Agriculture's 'restorable meadow and pasture land' or equivalent value
Trees	Trees with potential protection value

General biotope (SIS class 4 + preconditions for biological production)

General criteria

An area categorised as *general biotope* consists of commonly occurring habitats, the so-called everyday landscape. The general biotope also includes trivial areas where biological production occurs, for example planted green spaces in urban environments. Aquatic environments judged to have a moderate ecological status.

Criteria in Sweden

The marine biotopes	**Clarification**
All	Certain values and/or trivial marine habitats with biological production
The inland water biotopes	**Clarification**
All	Certain values and/or trivial inland water habitats with biological production
De terrestra naturtyperna	**Clarification**
All	Certain values and/or trivial green areas with biological production

Technotope

General criteria

Areas lacking preconditions for biological production.

Criteria in Sweden

Technotopes	**Clarifications**
	E.g. buildings, roads, car parks, aquatic environments with no biological life

Figure 5. Examples of biotopes divided into categories
Photo Eva Grusell

7 Step 4 – Reporting of results

7.1 Quality level

The quality of the result depends on the extent to which input data is available, and on the efforts and resources the operator is prepared to invest in the study. The results can be reported according to various quality levels. In short, it may be said that the more information is available and the more time is devoted to data collection and analysis, the higher the quality level it is possible to achieve. In Table 12 details are given of the requirements concerning inventory material for the different quality levels.

A project in a geographical situation
Quality level A is achieved when satisfactory inventory material is available for both 'before' and 'after' situations. This result in identified biotopes and categorised areas, classified into the Biotope Method's four categories: critical, rare and general biotopes, and technotopes. Quality level B is achieved if inventory material is lacking either 'before' or 'after': B1 if there is inventory material for the 'before' state and B2 if there is inventory material for the 'after' state. If inventory material is lacking for both the 'before' and 'after' states, quality level C is achieved.

Table 12. Quality levels and requirements for inventory material for the 'before' and 'after' states

Quality level	Before	After
A	• Inventories in the field or • Satisfactory inventory material or • Aerial photography interpretation, incl. verification of red-listed species and values	• Site visit (though exceptions are possible) and • Inventories in the field or • Satisfactory inventory material or • Aerial photography interpretation, incl. verification of red-listed species and values
B1	• Inventories in the field or • Satisfactory inventory material or • Aerial photography interpretation, incl. verification of red-listed species and values	• Categorisation key
B2	• Categorisation key	• Site visit (though exceptions are possible) and • Inventories in the field or • Satisfactory inventory material or • Aerial photography interpretation, incl. verification of red-listed species and values
C	• Categorisation key	• Categorisation key

Several projects with geographical spread
Whether quality level A, B or C is achieved depends on the combined quality of the inventory material for the plants included. The precision of the figures is also reflected in the combined quality level. In Table 13 details are given of how the quality level is calculated.

Table 13. Calculation of quality levels if several plants with geographical spread are included in a study

Quality level Weighted	Explanation
A	≥75 % of the total area has been carried out as in A
B	≥75 % of the total area has been carried out as in A or B (A+B≥75 %)
C	Other cases

7.2 Functional unit

The term 'functional unit' is taken from the methodology of life cycle assessment (LCA). It means the unit of produced good which is used as a measure of comparison or efficiency. If the biotope impact measured by the Biotope Method is to be used to compare the efficiency of two ways of producing the same good, it has to be related to such a functional unit.

In the case of electrical energy, for which the Biotope Method was originally developed, this unit is the kWh. Other units, such as MWh or GJ, can of course also be used, but the important thing is to be consistent in reporting all impact in relation to the same unit.

Example of calculation: $$\frac{\textit{Impacted Area } (m^2 \textit{ or ha})}{\textit{Life span } (y) \times \textit{Functional Unit (e.g. kWh)}} = \textit{Area per Functional Unit (e.g. } m^2/kWh)$$

7.3 The concept of life span

The biodiversity will be affected for at least as long as the operations continue on the specific site. The degree of impact is determined by the situation in the chosen 'after' state. The longer the life span used in calculating the result, the smaller will be the impact per unit of usefulness, since the biotope impact is assumed to be constant during the entire life span. If the study of operations forms part of an environmental product declaration (EPD) which is revised every three years, for example, there is a possibility of updating the biotope impact. The quality of a biotope may, in time, improve as well as deteriorate.

In the context of life cycle assessments, the life cycle of a plant is considered, from the cradle to the grave, and the length of the life cycle is determined by the life span of the components included. A plant may of course be modernised or even replaced entirely, and thus acquire a longer life span than the technical components included. It is likely, for example, that wind power turbines will stand in a favourable location for longer than 25 years, and that hydropower dams can exist for much longer than 100 years. When the Biotope Method is applied in connection with a life cycle assessment (LCA) or in an environmental product declaration (EPD), however, the same temporal system boundary is used as in the LCA.

7.4 Reporting of results

Data generated in a life cycle assessment and other methods of environmental analysis must be presented in a standardised manner. It is important that reporting of relevant information, input data, assessments conducted and final results is done in a transparent fashion.

Table 14. Reporting of results

Quality level	Descriptions with rationale concerning	Maps Identification	Maps categorisation	Tables	Significant figures
A	System boundary Identification Categorisation	Before and After	Before and After	Before and After	3
B1		Before	Before	Before and After	2
B2		After	After	Before and After	2
C	Systemgräns	-		Before and After	1

Example of calculation for an operation with three plants with 100 years' technical life span

The areas in each biotope category related to electricity generation in each plant are shown in Table 15. Electricity generation in all plants is assumed to be 40 TWh over 100 years.

Table 15. Example of calculation of change of surface area per unit of usefulness (m²/kWh) for three plants with different quality levels (The values in the table have been rounded off, since they are here used for the purpose of illustration.)

Plant with quality level	Category	Area 'before' (ha)	Area 'after' (ha)	Biotope change (ha)	Change per kWh of electricity (m²/kWh electricity)
A	Critical biotope	400	0	-400	$-10{,}0 \times 10^{-6}$
	Rare biotope	400	0	-400	$-10{,}0 \times 10^{-6}$
	General biotope	200	500	300	$7{,}5 \times 10^{-6}$
	Technotope	0	500	500	$12{,}5 \times 10^{-6}$
B	Critical biotope	1 000	200	-800	$-20{,}0 \times 10^{-6}$
	Rare biotope	600	300	-300	$-7{,}5 \times 10^{-6}$
	General biotope	300	500	200	$5{,}0 \times 10^{-6}$
	Technotope	100	1 000	900	$22{,}5 \times 10^{-6}$
C	Critical biotope	40	10	-30	$-0{,}75 \times 10^{-6}$
	Rare biotope	40	20	-20	$-0{,}5 \times 10^{-6}$
	General biotope	20	20	0	0
	Technotope	0	50	50	$1{,}25 \times 10^{-6}$

The application of the Biotope Method to the plants achieves the combined quality level B, since more than 75 % of the total area has been carried out in accordance with either A or B - see Table 16. The result is thus reported with two significant figures.

Table 16. Total area requisitioned, divided into quality levels

Quality level	Areal (ha)	%
A	1,000	32
B	2,000	65
C	100	3
Total	3,100	100

Table 17 is a summary of biotope changes for the three plants related to net electricity generated (120 TWh over 100 years' normal generating).

The combined biotope changes for the plants in the table below represent a considerable simplification. But the table does give a rough estimate of the direct biotope changes caused by the operations. The results should be interpreted on the basis of the whole report.

Table 17. Combined change of area per unit of usefulness

Category	Biotope change (ha)*	Change per kWh of electricity (m^2/kWh electricity)
Critical biotope	-1,200	-10×10^{-6}
Rare biotope	-720	$-6{,}2 \times 10^{-6}$
General biotope	500	$4{,}2 \times 10^{-6}$
Technotope	1,400	12×10^{-6}

* Rounding off to two significant figures sometimes entails, as in this example, that the sum of biotope changes is not zero.

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H

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M

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N

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S

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T

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Vattenfall AB

2015, March

Appendix 1 Guide to terrestrial biotopes

In Sweden, information concerning known nature values can be taken from digital databases supplied by authorities. This includes information on protected nature, woodlands, meadows and pastures, wetlands and red-listed species. There are national assessment criteria for the majority of terrestrial environments. In the SIS standard for nature value inventories, the assessment criteria for the terrestrial environments are harmonised. In the technical report associated with the SIS standard there are summaries of the knowledge base which can be used.

Table 18. SIS assessment criteria were used as the basis for the Biotope Method categories

Biotope Method categories	Biotope Method categories
Critical biotope	Nature value class 1 and 2
Rare biotope	Nature value class 3
General biotope	Naturel value class 4 and all green spaces with biological production
Technotope	Areas lacking preconditions for biological production

Below follows a summary of known knowledge which should be taken into account in a study:

Protected areas with associated information:	• National parks • Natura 2000 • Nature reserves • Biotope protection
Nationwide biotope inventories with classifications:	• Meadow and pasture inventory • Wetland inventory • Key biotope inventory • Marsh woodland inventory
Information concerning species:	• Red-listed species
Further regional information:	• Rich fen • Other available biotope or species information

Appendix 2 Guide to inland water and marine biotopes

Inland water biotopes
In Sweden, knowledge concerning biodiversity in lakes and watercourses is relatively good, but there is a lack of nationwide inventories. There is information produced in connection with environmental monitoring, etc. Information relating to water chemistry, phytoplankton, lake and river bed fauna, obstacles to migration and water vegetation are collected in the Environmental Data Portal and VISS portal databases. Furthermore, a number of species inventories have also been carried out. In the technical report associated with the SIS standard for nature value inventories there are summaries of the knowledge base for different inland water habitats.

There are no national assessment criteria for inland water environments. In recent years, a number of criteria for the assessment of nature value have been presented, including System Aqua and inland water key biotopes. The Swedish Agency for Marine and Water Management is working to produce assessment criteria for inland water environments: for watercourses in autumn 2014 and for lakes in spring 2015.

In the Biotope Method, the inland water biotopes are initially identified (see Table 20 and Table 21) on the basis of an aerial photography interpretation of the hydro morphological conditions and the incidence of soil types. The Swedish Agency for Marine and Water Management's assessment criteria for hydro morphological quality factors in lakes and watercourses (HVMFS 2013:19) are used for classification of hydro morphological type. Complementary information concerning the area's status is taken from the digital databases, such as the VISS portal, and any inventory reports which may be available. Where a basis for the assessment of the inland water environment is lacking, the ecological status in the VISS portal is used as a guide. During the site visit, a study is made of the degree of naturalness/impact in the inland water biotope and surrounding area.

Marine biotopes
In Sweden, knowledge concerning the marine environments is not all-encompassing. Access to data for the marine environments is considerably more limited than for the inland water environments. There are only a number of inventories, samples and models of the distribution of species and biotopes. There is a limited amount of data on the marine environments available in the VISS portal. In the technical report associated with the SIS standard for nature value inventories there are summaries of the knowledge base for the different marine habitats.

There are no national assessment criteria for marine environments. Natura 2000 environments, HELCOM, a list of threatened biotopes in the Baltic Sea, and 'Coastal biotopes in the Nordic region', a biotope classification of threatened and representative coastal biotopes, can be used to support the assessment. During 2015, the Swedish Agency for Marine and Water Management will initiate a more comprehensive work on assessment criteria for marine environments.

In the application of the Biotope Method to operations which affect the marine environment, the marine biotopes are described (see Table 22) on the basis of available information in the VISS portal and any inventory reports on conditions at the site. Where a basis for the assessment of the marine environment is lacking, the ecological status in the VISS portal is used as a guide.

Table 19. Ecological status in the VISS portal can be used for assessments of aquatic environments if there is a lack of documentation

Category	Corresponds to current water status
Critical biotope	High ecological status
Rare biotope	Good ecological status
General biotope	Moderate ecological status

Table 20. Hydro morphological types in watercourses (HVMFS 2013:19)

Hydro morphological type	Morphological sub-type	Typical soil type
Steep watercourses in solid rock	• Gradient over 10 % • Gradient under 10 %	• bare rock • bare rock
Steep watercourse, stone and turbulent flow	• Cascade watercourse • Watercourse with stepped profile • Watercourse with flat bed	• moraine and glacial meltwater sediment • moraine and glacial meltwater sediment • moraine and glacial meltwater sediment
Broad watercourse with regularly alternating reaches and pools	• Watercourse with transverse riffle pool system • Watercourse with alternating pools and reaches	• moraine and glacial meltwater sediment • glacial meltwater sediment and moraine
Watercourse with several parallel channels	• Watercourse with bifurcation system • Watercourse with braided stream system	• glacial meltwater sediment to moraine • glacial meltwater sediment
Meandering watercourse	• Weakly meandering watercourse • Actively meandering watercourse • Passively meandering watercourse with ravine • Passively meandering watercourse	• sandy soil types • flood sediment, glacial meltwater material • silt • mud-silt, flood sediment
Over-deepened watercourse in fine-grained sediment	• Over-deepened watercourse in fine-grained sediment	• sand, mud-silt, flood sediment
Watercourse in peat	• Watercourse in peat	• peat

Table 21. Hydro morphological types in lakes (HVMFS 2013:19)

Hydro morphological type	Morphological sub-type	Characteristic
Lakes in tectonic basins	Rift lake	Lakes formed in rift valleys which, in turn, are formed by tectonic movements in the earth's crust and which have subsequently, through weathering and glacial erosion, formed a lake basin. Owing to rift systems in different directions, the lake can be highly laciniated. One of the most common lake types. The substrate of the shallow water area is often stony, but can be fine-grained in inlets as a result of delta formation. A considerable part of the shoreline often consists of solid rock.
	Lake in rift	Lakes formed in a downfaulted zone in the earth's crust as a result of tectonic movements. Their shape is often long and narrow, with steep sides, while the lake bed can be relatively flat.
Lakes in glacial erosion basins	Lake in corrie	Lakes occurring in the bottom of corries. Often small drainage basins in the upper part of drainage basins, exclusively in northern Sweden. Their shape varies from almost circular to oval, and they can be very deep in proportion to their size. This means that the shallow water area is often small and dominated by bedrock, stones and pebbles. Occur most often in mountain chains, at a high altitude.
	Lake in glacial erosion basin	Long, narrow lakes with relatively straight shores without laciniation, occurring in a valley formed by mechanical erosion of a valley glacier or meltwater erosion, so that the valley has steep sides. The drainage area is often relatively large. The substrate in the shallow area is most often stone or pebbles. The cross-section through the lake is often parabolic.
	Lake in glacially eroded bedrock plain	Lakes formed in bedrock plain by glacial erosion. The soil cover round the lakes is often thin or completely absent. The lakes are often small, with small drainage areas. The shape of the lakes is determined by the bedrock and rift pattern, so that the shoreline is determined to a large extent by the line of the bedrock, and less by moraine or peat. This means that the shape of the shoreline, but also the depth of water along the shoreline, varies considerably in the same lake. The lakes are often long and narrow, following the direction of glaciation. The drainage network to the lake is often chaotic. A considerable part of the shoreline often consists of solid rock.

Continued table next page

Continued table 21

Glacial dam basin	Kettles	Lakes formed in stratified drift, from melting ice blocks from ice sheet. The lakes are relatively small, often with steep edges. Can be deep in proportion to their size. The substrate in the shallow water area is most commonly sand and pebbles, with some stone and boulders.
	Dam lakes in moraine or stratified drift	Lakes formed in depressions or as a result of various types of ridges in moraines or in stratified drift. The shallow water area consists most commonly of a mixture of boulders, pebbles and sand. The shape of the lake is often determined by the direction of glaciation, either parallel or at right angles to the ice front.
Natural non-glacial lakes	Wetland lakes	Relatively small lakes formed primarily in peat. The shoreline may be uneven. The shore edge can be steep or even overhanging.
	Lakes of fluvial origin	Lakes such as lagoons and pools formed by erosion and deposition of flowing water. The lakes are relatively shallow, with sand or finer substrate in the shallow water area.
	Plain lakes	Shallow lakes, most commonly with rounded shorelines, formed from depressions in sand or mud. The transition to the surrounding area can be blurred, owing to the broad, flat area.
	Lakes formed as a result of the damming of wind-transported material.	Onshore lakes formed by the damming of sand dunes which protect surface water from the direct ingress of seawater. These lakes are often shallow, with heterogeneous substrate consisting of pebbles and sand.
	Lakes formed by wind erosion	Onshore lakes formed by wind erosion, most commonly between or behind sand dunes. The lakes are long and narrow. The lake bed substrate is most commonly sandy.
	Lakes formed by chemical weathering	Lakes formed primarily by chemical weathering in chalk. In many cases the lakes are shallow, but they may be deep if they have formed in dolines.
	Coastal lagoons	Onshore lakes formed by the truncation of part of the coastline as a result of large-scale transport of sediment along the coast or the formation of sediment banks by waves.
Artificial lakes Artificial bodies of water	Dammed areas in watercourses	Artificial lakes formed by the damming of watercourses by artificial structures.
	Water-filled quarries	Quarries which have been filled with water.
	Water-filled gravel, sand or peat extraction sites	Gravel or peat extraction sites where a lake has formed after extraction has finished.
	Lake formed by damming with banks	Lake formed by damming of water with banks.

Table 22. Classification of marine environments in accordance with SIS-SS 199000:2014

Designation	Meaning	Clarification
Shallow marine soft seabed	Marine environment which is principally characterised by soft bottom substrate within the photic zone*	The soft bottom substrate consists of sand, clay, mud, organic material from residential and industrial areas, and other similar material that is flushed out or actively released into the sea via rivers, runoff from land or via other processes, as well as remains of marine organisms and other organic material that is produced in the sea or in rivers which flow out into the sea.
Shallow marine hard seabed	Marine environment which is principally characterised by hard bottom substrate within the photic zone*	Hard bottom substrate refers to rock, boulders and stone.
Deep marine soft seabed	Marine environment which is principally characterised by soft bottom substrate below the photic zone*	The soft bottom substrate consists of sand, clay, mud, organic material from residential and industrial areas, and other similar material that is flushed or actively released into the sea via rivers, runoff from land or via other processes, as well as remains of marine organisms and other organic material which is produced in the sea or in rivers which flow out into the sea.
Deep marine hard seabed	Marine environment which is principally characterised by hard bottom substrate below the photic zone*	Hard bottom substrate refers to rock, boulders and stone.
Biogenic reefs and bubble reefs	Marine environment which is principally characterised by reef formations which are made up either of fixed structure-forming species or leaking gases	The most common biogenic reefs are comprised of mussel beds and oyster beds, but there are also reefs made of deepwater white coral. The keel worm also forms reefs, but not much is known about its distribution. Maerl seabed can also be regarded as a biogenic reef structure which occurs within sandbanks.
Anthropogenic marine environment	Marine environment which is principally characterised by buildings or construction	This includes concrete foundations, breakwaters, piers, docks, harbour areas, wrecks and anthropogenic reefs.
NOTE. In marine habitats, objects with a natural value with different demarcations can be identified at different depths. This is because the natural value which is associated with the seabed can be of a character other than the natural value associated with the body of water or the surface of the water.		

* Photic zone refers to the part of the water environment where the light is sufficient for photosynthesis to occur. In practice the depth is equivalent to twice the visual depth. In the North Sea the photic zone reaches down to a depth of about 30 m and in the Baltic Sea about 20 m. In coastal areas that are affected by runoff from the land with soil-rich water, the zone's lower limit can however be considerably higher up.

Appendix 3 Application of the method in Namibia and Australia

Uranium mine Rio Tinto/Rössing in Namibia (Burke 2005, 2007)
The biotopes were described on the basis of aerial photographs, topographical maps, geological map material and botanical inventories. A combination of geomorphology, distribution of characteristic species and rock types forms the basis for biotope identification.

The incidence of red-listed species and endemic species formed the basis of biotope categorisation. Species lists were compiled for each biotope. A summary species list for Rössing includes around 200 plant species, of which 37 species were used as indicator species (red-listed or endemic). Endemism was, however, chosen as the main criterion in the biotope categorisation.

The species were evaluated on a three-point scale on the basis of red-listing and endemism. Three points are assigned to species which are endemic to Central Namibia. Two points are assigned to species which are endemic to Central Namibia and one other region. One point is assigned to species which are endemic to Central Namibia and several other regions in Namibia. Then, biodiversity is assigned to one of three levels: low (1-13 points), moderate (14-17 points) and high (18-21 points). 'Low' corresponds to general biotope, 'moderate' corresponds to rare biotope, and 'high' corresponds to critical biotope as defined in the Biotope Method.

Uranium mine Rio Tinto/Ranger in Australia (Gardener 2007)
In the EWL sciences report (Gardener 2007) the ERA's (Energy Resources of Australia) mining areas were divided into four major habitat types with the aid of GIS and 18 detailed vegetation types developed by Schodde et al. (1987). The four biotope types identified are: woodland, sandstone, lowland riparian and rainforest and floodplain.

Species which may possibly occur in the mine area and the four habitats were determined by EWL Sciences, by overlapping site data from the Northern Territory Government Database with the mine areas and a 30 km-wide buffer zone. This initial list was then reduced with the aid of expert knowledge. The species in the database are only potentially present in the area and, according to EWL Sciences, detailed investigations are under way to determine the actual distributions. In order to divide the habitats into biotope classes, a quantitative tool was used. This tool ranks habitats numerically by, for example, endangered species, conservation status, the habitat's capacity for recovery after disturbance and habitat distribution.

Olympic Dam mine in Australia (WMC 1997b, 2000)
The Olympic Dam mine is located in the interior of the territory of South Australia. Biotope identification is based on vegetation inventories carried out in connection with producing a description of Olympic Dam's environmental consequences. It was found that the area consists almost exclusively of two types of land form: dune fields and stony tableland. The vegetation follows this pattern and broadly speaking, therefore, only two different biotopes occur.

The above-named biotopes also occur frequently beyond the mine area and, according to the inventories, do not include any red-listed species or regionally significant flora or fauna. Thus, no critical or rare biotopes were identified in the actual area of the operations.

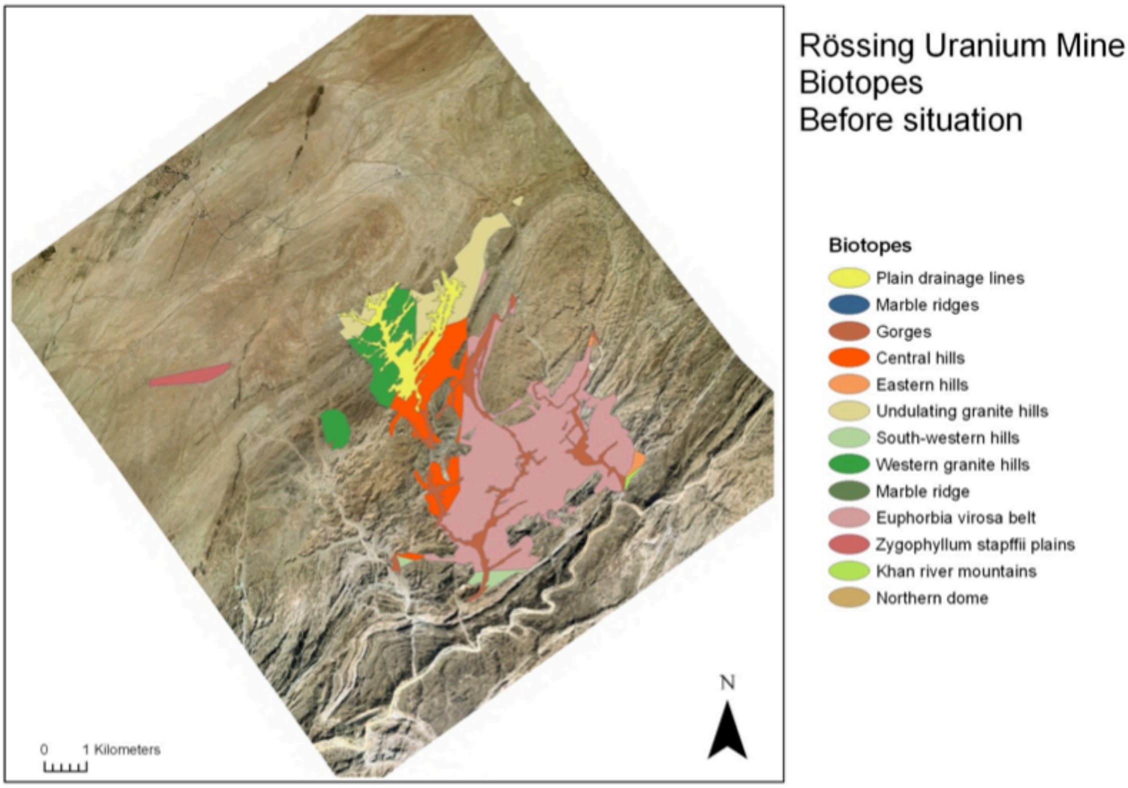

Figure 6. Uranium mine in Rössing, biotopes in the 'before' state

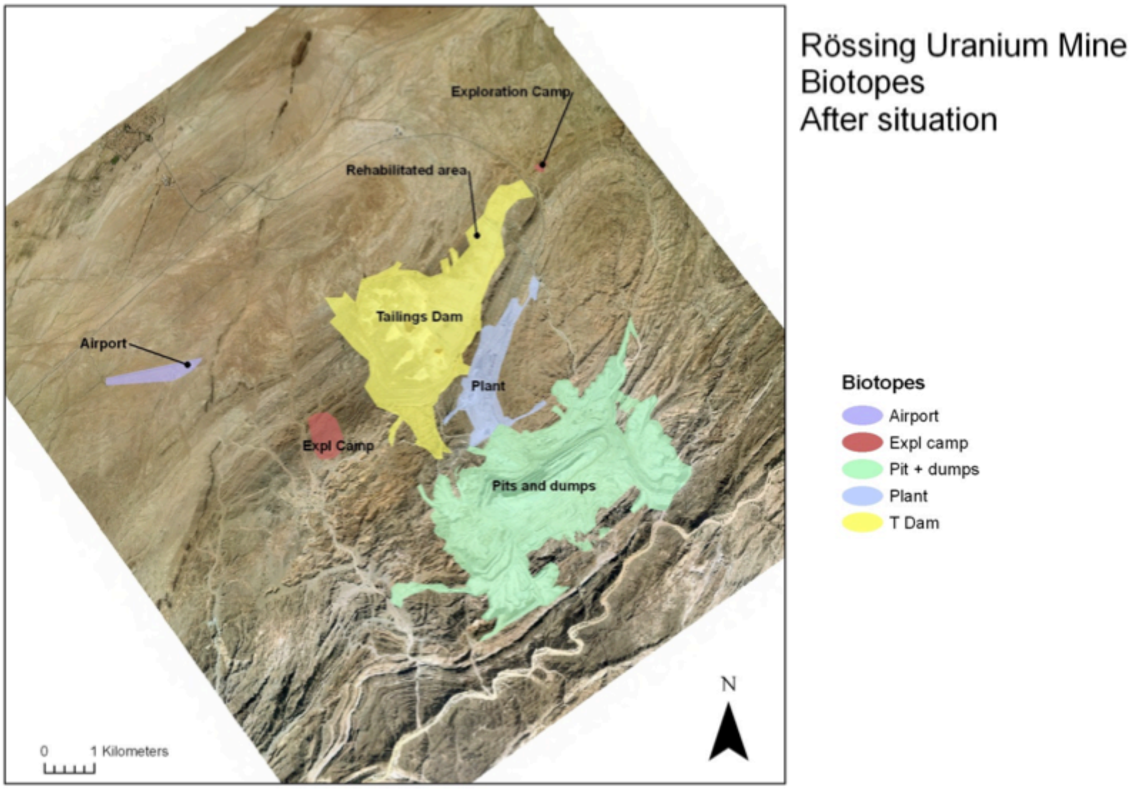

Figure 7. Uranium mine in Rössing, biotopes in the 'after' state

Appendix 4 Review of The Biotope method 2015

As reviewer of the Biotope Method 2015 I find the proposed method to provide a comprehensive material to evaluate changes in biotopes from operations in land- and water environments. The report is well supported with references to national as well as international methods for biodiversity inventory, and the method is in line with sustainable thinking as it provides useful and comparable results including not only the consequences for affected biotopes but also considers the achieved value of the plant. For increased use outside the energy sector additional guidance and examples be useful regarding for example possible functional units.

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2014-12-19