
BIOTOPE SE in English

The methodology and biotope database in brief

Database template DBM220630

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1. Introduction and background

The purpose of this summary is to give an overview of what a BIOTOPE SE biotope database is and how it can be used in its various stages of construction. The goal of BIOTOP SE is to be a regionally comprehensive cost-effective knowledge base, and collaboration platform for community planning and nature conservation. It can be used for analyses of nature, ecosystem services and green infrastructure. The work began in 2012 when the County Administrative Board of Stockholm, together with the county's municipalities, the County Council, the Swedish Transport Administration and Stockholm University, investigated the interest in a county-wide biotope database to meet the need for detailed and comprehensive knowledge of the county's nature and biotopes. Since 2014, the pilot municipalities of Sollentuna, Ekerö, Södertälje, Solna, Stockholm, Botkyrka and Skellefteå have contributed to the development work with wishes, experiences and funding. This collaboration guarantees to ensure the usability of the method. The final method has been developed by Stockholm University.

1.1. A multi-step approach

BIOTOPE SE is both a methodology and a biotope database that shows nature's properties and land use. Unlike previous biotope mapping methods, BIOTOPE SE is based on a multi-stage hybrid method (Figure 1). Step 1 includes initial automatic and semiautomatic classifications from air photo-based remote sensing in smart integration with selected existing national data from e.g., the land survey's property map, the Swedish Board of Agriculture's block database and the Swedish Environmental Protection Agency's national land cover data, NMD. The purpose of Step 1 is to create as detailed an initial biotope database as possible over a selected landscape section to enable landscape analyses directly or facilitate the air photo interpretation-based work in the method's Step 2 (Figure 1).

Step 2 includes visual air photo interpretation of the Step1 database in infrared color air photos in digital photogrammetric 3D environment with seamless connection to a GIS. Step2 primarily contributes information that is not obtained in the national data used and that cannot be calculated with sufficient certainty, or not at all, via automated methods at present. The purpose of Step 2 is to improve the Step1 database with respect to parts that do not receive sufficient accuracy in Step 1. This applies in particular to open land, shrubland and urban green structure outside low-rise settlements, as well as automatically calculated forest phase and land use in forests and other areas that often lack support for land use in the input data used.

The need for a detailed, high-quality Step1 database cannot be underestimated. Only when one exists is it possible for the client / performer to calculate what the cost of a finished Step2 database lands on. The Step1 database also enables priorities in the work, which is an integral part of the BIOTOPE SE concept itself, i.e. that you can already from day 1 use the

Step1 database in certain analyzes and then the client can make their own geographical and thematic priorities for the continued work (Submanual C).

1.2. The method is documented in a number of sub-manuals

BIOTOPE SE is presented in several reports, tutorials, training packages and information material. These documents are not currently why this document has been produced to facilitate an initial review by the municipality's ecologists and GIS managers.

The purpose of this document is to provide a quick overview of the method while waiting for the other documents to be finally completed. The main document manual part A gives a brief background to the method and reference to which manual to use when. Submanual B is the most important metadata of the method where the classification system is described in detail. The other manuals for the method, in turn, refer to manualpart B where the database classification system is addressed.

- A. **BIOTOPE SE - overview.** For everyone interested (Skånes & Tullback Rosenström).
- B. **BIOTOPE SE – Metadata.** For clients, performers and users who read at different levels (Skånes).
- C. **BIOTOPE SE - Guidance to procurement.** For clients and performers. (Skånes)
- D. **BIOTOPE SE – Technical manual for Step 1.** For performers and technical users (Skånes & Wennbom).
- E. **BIOTOPE SE - Manual for air photo interpretation in Step 2.** For performers, air photo interpreters (Skånes).

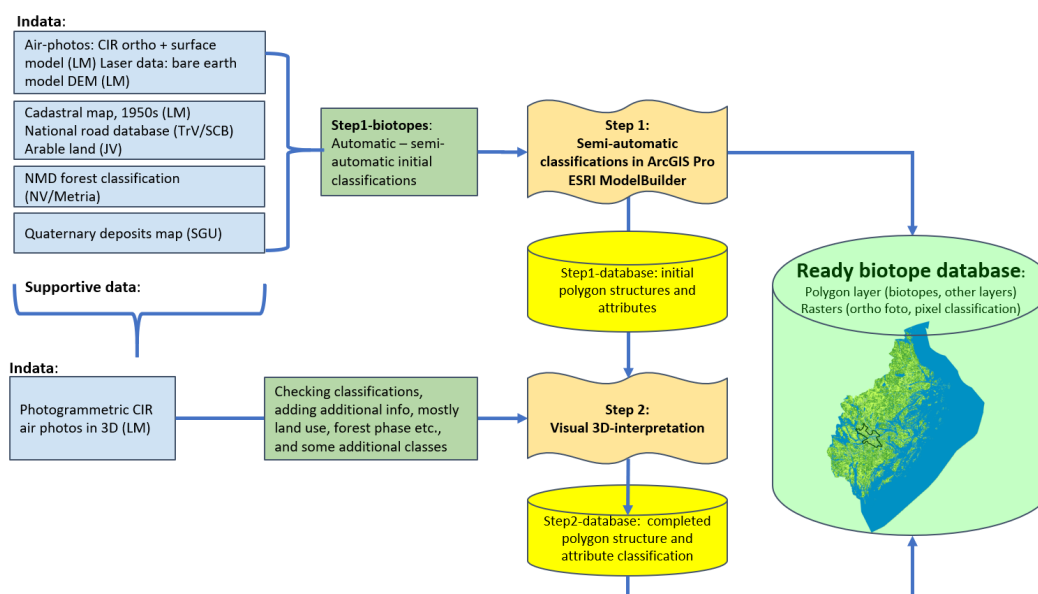


Figure 1. Overview of the main steps of BIOTOP SE. Step 1 (manual part D) must always be performed before step 2 (manual part E) is completed. Only with a well-developed Step1 database can air photo interpretation be minimized, which keeps costs down.

2. What is the Step1 database

The Step1 database is the product of several years of development work and building up technical and operational experience in the effort to develop a biotope database as far as you can get without anyone having been out in the field or drawn their own lines by hand. The database contains biotope-level classes and additional information on surface characteristics such as land use and forest phase. The classes are developed according to the best state of knowledge and are to some extent almost final, but in other parts it requires additional work according to Step 2 in order to be used within the municipality for what it is intended for.

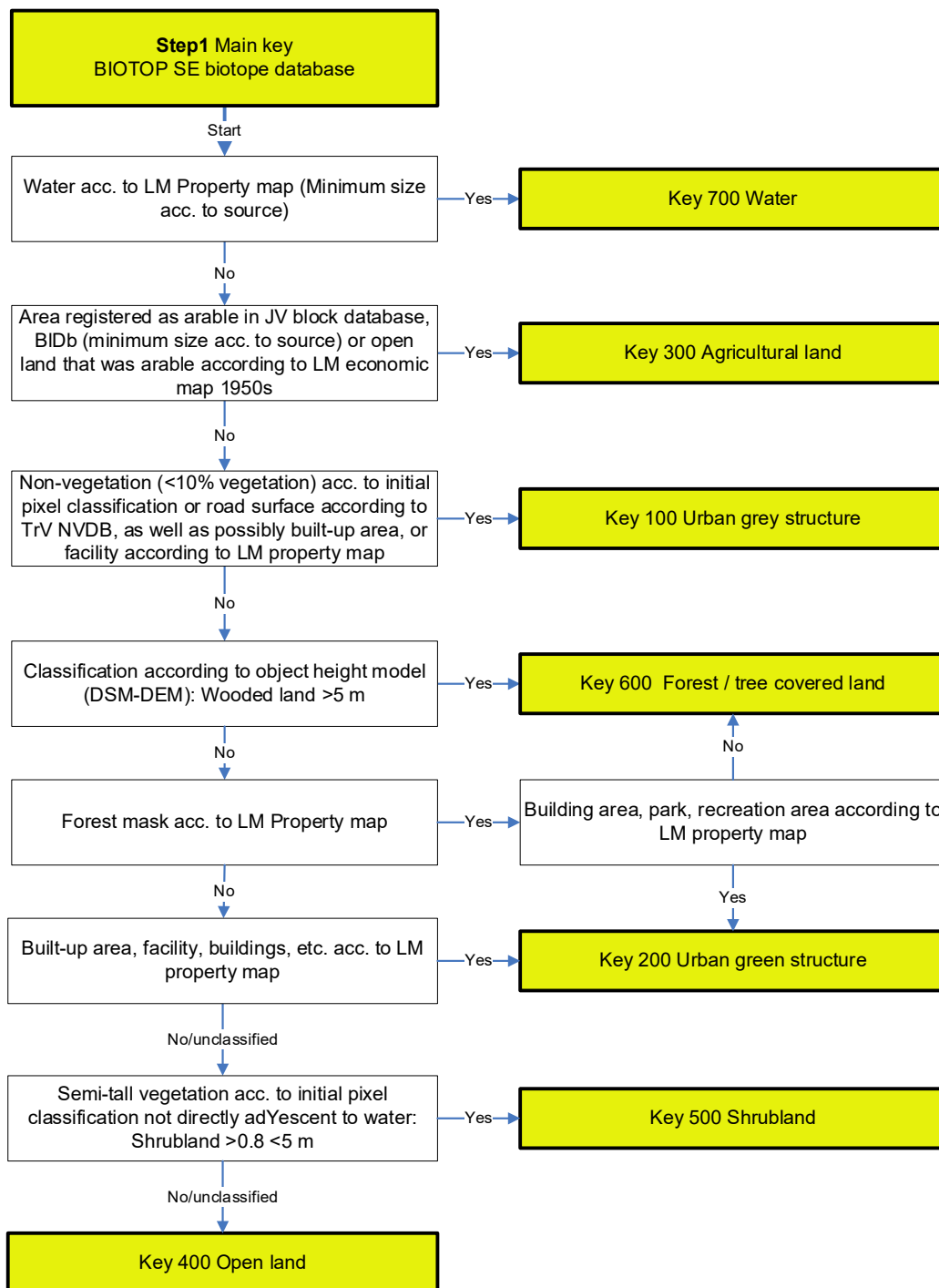
What is mainly missing from the Step1 database is land use in wooded land as well as land use and detailed biotope classification in open land that does not belong to the arable land or the urban structure. In many cases, land use is taken from the property map and sometimes land use proposals have been set based on an automated assessment of certain factors such as object height or spatial context. The estimated land use constitutes a proposal to consider, while the proposals within the forest phase have their own Step1 code to be replaced with the final one when the database has been completed through air photo interpretation.

NB! When it comes to the biotope database, there is no other source material that can automatically be used to validate the correctness of the database. This is a new classification system in which all boundaries have either been taken from another existing source material (e.g., arable land and water), or have been drawn and modified entirely through automated processes with associated generalization principles and many decisions along the way.

3. How the Step 1 database is developed

The work to develop an optimal and useful Step1 database is extensive and in many stages (Figure 1). The ambition is to use relatively simple classifications and robust methods and nationally available data to develop a Step1 database that can be completed through air photo interpretation in a cost-effective and good way. The degree of detail in which the method works creates many surfaces and it is impossible to imagine that each individual surface would need to be confirmed by visual assessment. It is therefore important that the classifications in Step 1 are good enough to, without having to be checked in the field or through digital air photo interpretation in 3D, to be used in general landscape ecological studies and in the municipalities' planning work.

The method is not described in more detail here other than that it is a completely GIS-based method that is essentially implemented as a series of tools composed in ESRI ModelBuilder. The process is run through python scripts and follows a basic workflow depending on the data used to produce the surfaces (Figure 2).



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Figure 2. Master key to the Step1 database. The key shows which basis governs the classification of biotopes within each main class. Appendix 1 lists all primary inputs used and Appendices 5–11 show the structure of each main class from a Step-2 perspective.2

The great advantage of the arrangement is that the method can be used repeatedly and also over areas located outside Stockholm County. The weakest link here is to compile as time-synchronous data as possible for each run. Another weak link is dealing with orthophotos from early spring images before vegetation is sufficiently knocked out. Please note that the on-call authorities do not always produce time layers for the products needed. This mainly applies to the property map which plays a key role. All that is needed is the input specified in Appendix 1.

4. How the database is prepared into Step2 database

4.1. Air photo interpretation

Thanks to the fact that Steg1_databasen exist, the ordering municipality can freely choose which part of the municipality or which Steg1_kod in combination with other attributes to be interpreted and in what order. It is therefore highly likely that the air photo interpreters will move over large distances in the database and make controlled impacts according to the priorities of the ordering municipality. This agile way of working is completely new and can feel unfamiliar to begin with. Traditionally, they have worked in a smaller slice and made a complete mapping there to slowly but surely build up a complete database. However, the new way is the most convenient way for the municipality to get started with the biotope database and finance the work.

The new way of working is made possible entirely by the technical development of the photogrammetric systems in combination with the possibility of attribute-controlled enforcement and seamless movement in the stereo project. This is also why the requirements are so specific when it comes to technical equipment and software (see Submanuals C, D and E).

Geographical and thematic prioritization is strongly preferable to complete interpretation of all surfaces in all codes interpreted in area by area. The benefits are many. The municipality knows that you have time to interpret what is the highest priority, the interpreter can more easily follow their work and vary their interpretation and at the same time stick to well-proven interpretation rules, ie to make one assessment at a time so as not to slip and make different assessments. You then decouple yourself from the stereo model and instead interpret according to different priorities according to selection in different attributes. You can do this alternately in different work shifts, which means that the air photo anchor gets a better working environment where you can finish sub-goals in a different way than in the traditional way of working that has now become outdated.

Some interpretation can be done in 2D by interpreting against high-resolution IRF orthophotos against screen, but most of the necessary interpretation requires 3D interpretation as above.

4.2. Classification and interpretation keys

Interpretive keys are of crucial importance in any classification whether it is an automatic or visual assessment. The keys aim to show the interrelationship of different classes and the decisions that separate them (Appendices 5–11).

However, one key only shows the general features and most important choices and steps in the decision-making process. To understand the classification in depth, it is required to go to the respective biotope and attribute description in Submanual B.

5. Delivery of biotope database

The database is delivered in the form of various data (Appendix 2). The main delivery is the biotope database itself, an ESRI file geodatabase (*.gdb). It may well be that future deliveries will take place in the open format OGC GeoPackage that more and more authorities are switching to. For more information, see <https://www.geopackage.org/>. Currently, the file geodatabase is delivered in two versions, one with a limited number of attribute fields for publication in web GIS and one complete that is prepared for the continued Step2 work where air photo interpretation is intended to fill in and supplement classifications of biotopes and land use that cannot, or with great uncertainty, be produced using the Step1 database's automatic methods.

The delivery also consists of additional data, such as OH_tiles (object height screen) and PixelClass_tiles (initial pixel rating). The initial pixel classification in nine classes is considered particularly useful at a later stage (Appendix 3). All data delivered after completion Step 1 is specified in.

6. Exploring the database

Here are some tips and inspiration on how to start exploring the database. In order to explore the database, some GIS experience and access to appropriate programs as well as orthophoto, preferably IRF (infrared color) require as a background image.

6.1. Possible workflow

As a user, you are advised to do the following to explore a BIOTOPE SE biotope database. Initially, it is important that the person who checks and goes through the database is well acquainted with the area it covers. Since different municipalities have different GIS and systems for visual management of the municipality's geographical data, only overall tips can be given. Note that the GIS used must be able to handle ESRI's geodatabase format. Otherwise, conversion needs to take place.

1. Start by opening your GIS application. Open the database located in Feature Dataset STEP1 or STEP2 depending on the status of the database (Appendix 2).
2. Make sure that the GIS view is set so that the surfaces are transparent and have a thin demarcation and that you have a current orthophoto, preferably IRF as a background (Figure 3). If the database is already styled, it is good if you can browse often called *swipa* between database and orthophoto to compare the classification against reality.
3. Also open the database's attribute table so that searches can be made and so that you can see the contents of the database Whether it is a Step1 database or a database interpreted to Step2, the Biotope field applies to all analyses.
4. A tip is that you start by "wandering" around the database and visit areas that you know well and areas where there are other sources to compare with. Click on surfaces to get the information about how it is classified and compare with your own knowledge and what is in other maps (Appendix 2).
5. Feel free to also open other delivered data such as the initial pixel classification and the layer for historical arable land.

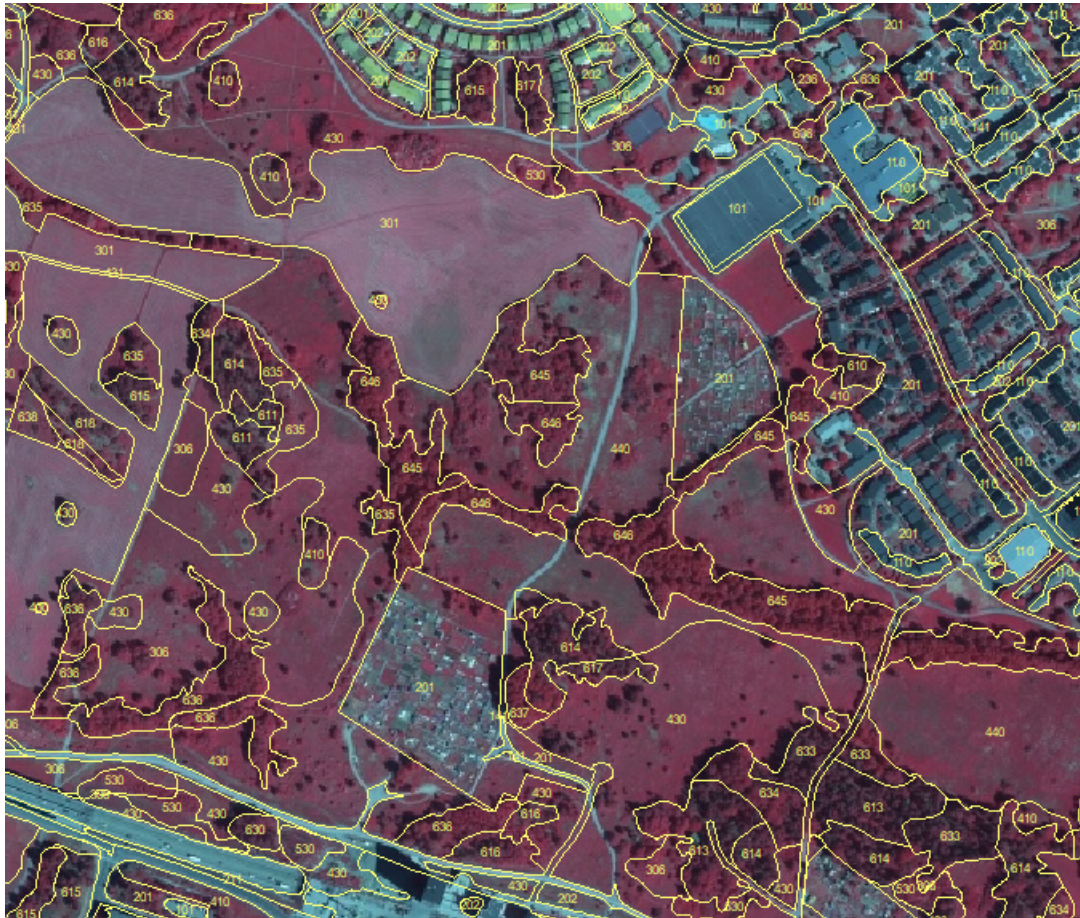


Figure 3 Examples of what the database might look like when exploring it. Transparent surfaces with clear demarcation and if desired, the Biotop code can be loaded, but this is not necessary.³

6. Furthermore, you can make searches of different groupings and visit the results of them, e.g. **all pine forest on SGU mountain in the day** with 50, 60 or 34 to see what they look like. **Forest phase 50** are those rocky outcrops that have pine forest according to NMD but that in object height do not exceed 5 m, ie probably the most low-growing, sparse and interesting rocky forests. **Forest phase 60** are those that are 5–15 m high and forest phase 34 corresponds to trees >15 m high. That these would be rocky ground forest according to ecological definition is not likely but is due to the fact that SGU's mapping depth is 0.5 m, so even areas with thin soil cover are counted as rocky ground. Or you look for all the urban green structure with lush character, deciduous forest, etc. These surveys provide an overall picture of the distribution throughout the municipality of various classes and characteristics.

7. Structural structure of the database

As with any classification system, it takes time to understand its overall importance and how different thematic levels and supporting attributes can be used together for optimal analyses.

All attribute fields have number codes basically. In the database, domains have been built up that have been associated with the database's attribute fields. As long as the data remains in the database, the name of the code will be visible in plain text. If you export data to SHAPE format or use a GIS that cannot handle domains, only the codes will follow. This is an established way to facilitate analysis in code format and reduce the size of GIS data as the text never has to be printed in the attribute field.

7.1. Thematic hierarchical division of biotope classes

The two hierarchical levels that make up the biotope division itself are **Main Class and Biotope**. Biotope is the most important level and the code is an amalgamation of two other codes; **Steg1_kod and Steg2_kod**. For definitions and general description, see Sub-Manual B. An intermediate level has been introduced to facilitate the colouring of the database and merge the corresponding Steg1_koder and Steg2_koder for a clearer colour scheme. This category is called Biotop_LIGHT. The interrelationship of the different codes to each other is presented in Appendix 4. Below is a brief description of the database attribute fields.

Main class

Main class constitutes the top hierarchical level of the classification system with seven broad main classes (Table 1) calculated automatically from Biotope.

Status in the biotope database

In the database there is the encoding of the main class, which in even hundreds corresponds to the first digit of the Biotop code. I.e. all biotopes of **the main class 700 (water) start at the number 7**. Note that updating lines in a particular attribute that depends on one code in another attribute is not automated. Main class can be used for easy search and illustration of the database on a small scale, but is not of greater value to users. The code is checked and possibly updated before use.

Table 1. 1 *The main class is the top hierarchical level of the BIOTOPE SE. The structure is driven both by the new technologies and by new needs to further divide the urban environment into gray and green components, as well as clarify the composition of the landscape at a regional level.*

Main class	Definition
100 Urban grey structure, <i>Appendix 5</i>	All land with removed vegetation both hardened soil and non-sealed land, including buildings. The cut-off point between urban grey structure and urban green structure is at the threshold of 10% involvement of vegetation . The main part of this class is produced in Step 1 through automatic classifications.
200 Urban green structure <i>Appendix 6</i>	Green structure in urbanly affected areas. All urban environment >10% vegetation , i.e. plots of land, grassy areas, parks, etc. Delimited with the support of the building map built-up areas, etc. and the distribution of the components non-vegetation, low, semi-high and high vegetation that are developed in Step 1.
300 Arable land <i>Appendix 7</i>	Own main class to emphasize arable land, other arable land and former arable land in the regional perspective . Information for this is taken from the Swedish Board of Agriculture's block database and the economic map's arable land from mainly the 1950s. The year varies across Sweden.
400 Open land <i>Appendix 8</i>	All open terrestrial-semiaquatic soil that is not included in the other main classes. Mainly semi-natural soil, both vegetation-covered and substrate-dominated . As Steg1_Kod, these classes are unsafe. Only Steg2_kod provide detailed information, i.e. all surfaces of the class must be interpreted air photo.
500 Bushland <i>Appendix 9</i>	Own main class to capture the extent of the dense shrublands (>50% bush cover). The biotope classes in this main class will for the most part be divided into Step 2 via visual assessment. In the Step1 database, the shrub land is divided according to the four humidity regimes , only in Step 2 they are classified by type of shrubland, e.g. thorny shrubs or willow bushes.
600 Forest/Wooded land <i>Appendix 10</i>	Main class for all wooded land that is judged to be forest due to land use, but also other wooded land. Tree-covered soil, basically >10% tree cover and >5 m tall trees with forest type classification from NMD. Not tree-covered land under the forest mask of the property map, depending on context and input, becomes disturbed tree-covered land, conduit streets. Tree-covered land that is judged to be embedded in the urban environment is included in the main class 200 (231–237 urban green structure of tree character). Sparsely wood-bearing traditional grassland is included in the main class 400.
700 Water <i>Appendix 11</i>	All aquatic surface . The extent of the water is taken from the new national shoreline (NSL) of the property map. This saves a lot of interpretation work. In Steg1_kod, an initial classification of open and vegetation-covered waters into three classes is indicated. Instead, the air photo interpretation assesses only aquatic vegetation, larger urban facilities and possible land use.

Biotope

Biotope belongs to **hierarchical level 2** which is the most detailed level with its own class code, a total of **114 classes**. Of these, 66 are common to both Step 1 and Step 2, while **23 are unique Steg1_koder** (temp working codes),

and 25 are unique Steg2_koder (which must be air photo interpreted). See further under the respective attribute description below. All codes in Biotope are a combination of preliminary Steg1_kod that are overwritten with Steg2_kod when available. The purpose of this attribute is to be able to display a complete biotope database even before air photo interpretation is started or completed. The field is the one to use when the database is used in illustrations and for analysis.

Status in the biotope database

In the delivered Step1 database, Biotope contains a copy of the codes in Steg1_kod. Note that updating lines in a particular attribute that depends on one code in another attribute is not automated. The code should always be checked and possibly updated before use. As a biotope database goes through Step 2, the biotope code will also be updated.

To determine whether a biotope code is Steg1_Kod or Steg2_kod, you need to look in the attribute fields Steg1_kod and Steg2_kod. If it says Null in Step2 code, the Biotope code is a Steg1_kod. If there is a Steg2_kod and says 999 in Steg1_kod, then the Biotope Code is a Steg2_kod and thus of higher reliability. Some biotopes such as buildings, roads and railways, as well as fine-meshed urban green structure, should not be handled in Step 2. These are then marked as Steg2_kod and marked as 1 in the attribute Auto_Steg2.

Steg1_kod

In general, it can be said that the Step 1 code reflects the data that has been used, which, as has previously been described, is not always sufficient for the analyzes that users want to make of the landscape. Steg1_kod is the initial level from the first stage of the hybrid method where the classification is made completely without visual interpretation support. It contains 90 classes and is based entirely on a clever split-stage merging of carefully selected and processed existing data from various national databases and automatic classification and image processing of orthophotos and air photo-based surface models. Of these, 23 classes are unique to Step1 and consist either of initial working codes that may remain in the database, or those classes that must be visually assessed by air photo interpreters in order for the database to be definitively usable at the level of detail. The remaining codes are common with Step 2.

Steg1_kod should in principle never be used in any analysis of the database as soon as air photo interpretation has begun and there is Steg2_koder. Then the Biotop attribute is used instead. As soon as a Steg2_kod is set, Steg1_koden is replaced by 999 because it then no longer applies. The code 999 must never be overwritten in Biotope, then the database can no longer be analyzed. Keeping the old Step1 code to see what was correctly interpreted is not appropriate because the new assessed surface may constitute an amalgamation of more Step-1 surfaces. If you want to compare with the original Step1 database's encoding, you have to do an overlay

analysis between the original Step1 database before it is processed by air photo interpreters in Step2.

Status in the biotope database

Before air photo interpretation, there should always be a complete set of preliminary biotope codes that are the result of the preparatory work with the Step1 database. Steg1_kod is then identical to Biotope. When a Steg2_kod is set, Steg1_kod should always be 999.

Steg2_kod

Steg2_kod belongs to hierarchical level 2 which is the most detailed level with its own class code where only the 91 codes representing surfaces visually assessed by an air photo interpreter can be entered. For 65 of these classes, the compliance with the Step1 class is 1:1 and then the code is the same.

Status in the biotope database

The initial Step1 database contains no surfaces with Steg2_kod except for those common codes where no air photo interpretation is needed or planned (e.g. infrastructure and buildings). Before air photo interpretation begins, all surfaces that need to be interpreted have the code Null. As air photo interpretation continues, Null is replaced with a current Steg2_kod.

Biotop_LIGHT

Biotop_LIGHT is a generalization of Biotope to be able to color the database and also work with a merger of Step1 and Step2 codes. The attribute contains 84 classes in which all unique Steg2_koder are merged with the nearest Steg1_kod. The generalization is arbitrarily made to meet general needs for a simplified database and aims at nothing more than to make things easier for the viewer. The code is made up of four digits to avoid confusion with other attribute codes (Appendix 12).

Status in the biotope database

In the delivered biotope database, Biotop_LIGHT is automatically calculated from Biotope. Note that updating lines in a particular attribute that depends on one code in another attribute is not automated. The code should always be checked and possibly updated before use.

7.2. Descriptive attributes

In addition to the two hierarchical biotope levels, there are some descriptive attributes that are surface-delimiting but do not further affect the biotope name itself. A biotope can have the same code in Biotope but be divided into further detail depending on e.g. land use and forest phase. All classes of land use broken down by main categories are given in Appendix 13. For the sake of overview, the descriptive attributes to be indicated for which biotopes in each main class are listed in Table 2 below. The attributes included are: land use, forest phase, tree layer, semi-high vegetation, salinity, humidity, and

size. Of these, it is mainly land use and forest phase that are there to characterize the surfaces further.

Status in the biotope database

The initial Step1 database contains automatically computed attributes where possible. Otherwise, it says NULL. In many cases, some descriptive attributes should not be specified for all biotopes. For example, salinity is indicated only in the main class of 700 water. All other land is then given the code 999, which shows that the attribute should not be entered there.

Land use is taken, where appropriate, from the different layers of the property map and the block database, but there is also an effort to figure out likely land use through contextual overlay analyses during the construction of the database. For example, the extent of arable land on the first economic map (40s–70s) is used to indicate whether wooded land is today located on former arable land. This provides both land use and forest phase suggestions (young-middle-aged). Even in the Open land, these areas are inlaid with land use former arable land and automatic coding as arable land, cultivated grassland.

The forest phase is calculated automatically through a simpler tree height analysis in combination with humidity regime. On dry-wet land, trees that are 5–15 m high are counted each young-middle-aged forest, and proposals for land use there become clear traces of forestry. On mountains today, the trees are not expected to be so high due to the properties of the substrate, which is why these trees are not suggested to be young-middle-aged. Tree layers and semi-high vegetation can only be indicated whether or not there is according to the simple height criteria >10% high vegetation or 30-50% semi-high vegetation. To say something about the type of trees or shrubs, as well as the forest phase here, the surfaces must be air photo interpreted.

7.3. Administrative attributes

In addition to the above-listed descriptive attributes, in the version intended for Step2 work, there are additional attributes that are there to help the consultant prioritize and manage the database during the further work. These are e.g.: Kommun_PRIO, Batch_PRIO, Signature, etc.

Status in the biotope database

Most of these make no sense to show to the public in a web map or in the contexts in which the original Step1 database is to be visualized and managed. They are therefore removed there and are only available in the version that is prepared for further work and further analysis.

8. Origin of biotope classes by main class

Here is a very brief summary of each main class and an overview can be found in Table 1. For detailed information refer to Submanual B. The smallest general mapping unit is 0.1 ha, but e.g. islands, small waters, field reindeer and arable islets can be significantly smaller, the latter down to

close to 30 m². Since these were included in the substrate data and are of great interest to know about, they are allowed to remain in the database and in that case are sized-marked so as not to blur during the processing process (see attributes Size).

Table 2. Descriptive attributes specified for biotopes of the respective main class. Explanation: A = is calculated automatically. FT/S1 A = attribute is automatically calculated in Step 1 but is supplemented and checked in air photo interpretation in Step 2. Gray-marked areas should not be manually interpreted air photo, but are continuously calculated manually by a consultant by automatic calculation based on other attributes until the interpretation is completed. S1 = Step1 and S2 = Step2 (i.e. supplementary air photo interpretation). Gray areas with – means that the attribute should not be specified at all. The code should then always be 999.

Attribute \ Main class	100 Urban grey structure	200 Urban green structure	300 Agricultural land, Arable land (301–303)	300 Agricultural land, cultivated grassland (310–340)	400 Open land	500 Shrubland	600 Forest/Wooded land	700 Water
Main class	A	A	A	A	A	A	A	A
Biotop_LIGHT	A	A	A	A	A	A	A	A
Biotope	A	A	A	A	A	A	A	A
Step1_kod	A	A	A	A	A	A	A	A
Step2_kod	FT/S1a	FT/S1a	FT/S1a	FT/S1a	FT/S1a	FT/S1a	FT/S1/A	FT/S1a
Land use	S1 A/ (FT)	S1 A/ (FT)	FT/S1a	Ft	Ft	Ft	FT/S1a	S2 FT
Forest phase	-	S1 A/ S2 FT	FT/S1a	FT/S1a	FT/S1a	FT/S1a	FT/S1 A /	-
Tree layers	-	S1 A/ S2 FT	-	(S1 A) / FT	(S1 A) / FT	(S1 A) / FT	-	-
Semi-high vegetation	-	-	-	(S1 A) / FT	(S1 A) / FT	-	-	-
Salinity	-	-	-	-	-	-	-	A
Moisture	-	-	-	S1 A	A	A	A	A
Size	-	A	A	-	A	A	A	A

100 Urban grey structure

The primary source for urban gray structure is BIOTOPE SE's initial pixel classification that distinguishes with high precision all non-vegetation from soil covered by vegetation through analysis of infrared orthophotos, surface models and soil model. The boundaries within the main class are an intricate combination of the surveyor's built-up areas, construction areas and smaller properties, as well as open land with buildings. For biotopes, see Appendices 4 and 5.

No division takes place into humidity regimes as these surfaces are often strongly urbanly affected and thus do not follow the natural humidity regime.

200 Urban green structure

The primary source of urban green structure is BIOTOPE SE's initial pixel classification, which with high precision distinguishes all non-vegetation from land covered by vegetation. The boundaries within the main class are an intricate combination of the surveyor's built-up areas, construction areas and smaller properties, as well as open land containing buildings. No division into humidity classes is made here as the urban environment is often so pervasively affected when it comes to humidity regime.

No division takes place into humidity regimes as these surfaces are often strongly urbanly affected and thus do not follow the natural humidity regime.

The minimum mapping unit for this class is generally 0.1 ha, but in order not to lose the fine-meshed green structure, areas down to 200 m² have been saved and are then marked as fine-meshed urban green structure in the Size attribute field. These can contain anything and as these can become very many, no attempt is made to classify them in detail in Step 2 unless special reasons exist. For biotopes, see Appendices 4 and 6.

300 Agricultural land

The primary source of Agricultural land is arable land that is extracted from the Swedish Board of Agriculture's block database and contains land use and type of crop divided into crop rotation, fruit growing and energy forest.

In addition to the block-laid arable land, BIOTOPE SE uses the arable land from the oldest economic map from the 1950s to distinguish potential cultivated grassland, i.e. grassland that has been arable and thus cannot be expected to house the same species-rich flora as semi-natural grasslands.

The division of the cultivated grassland in the Step1 database follows the rough humidity regimes as for the main class 400 - 600. However, arable land is not divided according to humidity regime.

The classification of cultivated grassland (Biotope 310–340) is as uncertain as the rest of the Open land in the main class 400, which means that all automatically coded surfaces need air photo interpretation to get the right

land use and thus end up in the right biotope class, which can often be 200 in areas with expanding buildings.

The minimum mapping unit for this class is the size found in the block database, which can be less than 0.1 ha. For biotopes, see Appendices 4 and 7.

400 Open land

This main class is the most important and yet the most uncertainly classified in the entire database. Here is everything that has not been able to be transferred to other main classes through support in the input data. The main class thus includes everything from plots of land and ruderal lands to the finest grasslands. The entire main class 400 must thus be interpreted to sort out what is what. This is the linchpin of BIOTOPE SE; to try to delineate everything that can be said about and then focus the manual interpretation work on the most difficult and at the same time most important areas.

The division in the Step1 database follows the rough humidity regimes mountains according to SGU, coarse sediment according to SGU, wetland according to SGU and the property map and other things that can be summarized as dry-wet. The minimum mapping unit for this class is generally 0.1 ha, but islands, field reindeer and arable islets can be significantly smaller, the latter down to close to 30 m². For biotopes, see Appendices 4 and 8.

500 shrubland

This class consists of land dominated by semi-high vegetation outside the urban structure and woodland. The classification is based on the initial pixel classification and is thus dependent on the fact that the bushes are present and that the leaves have knocked out at the time of registration.

The division in the Step1 database follows the coarse humidity regimes as for the main class 400 and 600. Only in Step 2 is an assessment made of the nature of the shrubland, e.g. needles, leaves, thorny shrubs or willow bushes.

The minimum mapping unit for this class is generally 0.1 ha, but islands, field reindeer and arable islets can be significantly smaller, the latter down to close to 30 m². For biotopes, see Appendices 4 and 9.

600 Forest/Wooded land

The primary source for urban wooded land is BIOTOPE SE's initial pixel classification, which with high precision distinguishes all vegetation from land that is not covered by vegetation and divides the vegetation into different height ranges.

The division in the Step1 database follows the rough humidity regimes as for the main class 400 and 500.

However, not all tree-covered land has trees in all locations and therefore the Property Map's forest mask and hygge according to NMD are also used as input. The minimum mapping unit for this class is generally 0.1 ha, but

islands, field reindeer and arable islets can be significantly smaller, the latter down to close to 30 m². For biotopes, see Appendices 4 and 10.

700 Water

The primary source of water is the surveyor's property map which contains all the water in accordance with the national shoreline NSL. Salinity is taken from the existing source, or by manual delimitation of seas towards lake.

The primary source of aquatic vegetation is the initial pixel classification of BIOTOPE SE, which includes classified pixels as vegetation in all lakes and seas <50 m from the coast (Appendix 3). Already in the Step1 database, water can be classified into three classes, open water, water with potential overwater vegetation, as well as water with potential floating leaf vegetation. This classification is possible thanks to automatic classification of vegetation by combination with the object height which is obtained by subtracting the LM's ground model from the LM's surface model.

Problems with this classification are primarily connected with the timing of shooting during the season. Early air photos before aquatic vegetation is fully developed will underestimate its distribution. Otherwise, solar reflexes, waves and wave foam can create strange artifacts that overestimate the extent of water vegetation.

All water has been interpreted in Step 2 and the primary contribution there is partly the construction in water (bathing areas, marinas and port areas), partly control of overwater vegetation, floating leaf vegetation and the mixed class in between and water with imminent high vegetation.

The minimum mapping unit for this class follows the minimum size according to the water mask of the property map, i.e. significantly less than 0.1 ha. Here, the customer may also have chosen to add information about small waters that are not even visible in aerial photographs. For biotopes, see Appendices 4 and 11.

9. Attachments

Appendix 1. Data used to build the Step1 database

Appendix 2. List of data supplied with the biotope database

Appendix 3. BIOTOPE SE Initial pixel classification

Appendix 4. BIOTOPE SE total list at biotope level

Appendix 5. Detailed key to biotopes within the main class 100 Urban gray structure

Appendix 6. Detailed key to biotopes within the main class 200 Urban green structure.

Appendix 7. Detailed key to biotopes within the main class 300 Agricultural land.

Appendix 8. Main class 400 Open land

Appendix 9. Overview of the main class 500 Shrubland.

Appendix 10. Overview of the biotopes in the main class 600 Forest / wooded land

Appendix 11. Overview of the biotopes of the main class 700 Water.

Appendix 12. Explanation of Biotop_LIGHT styling of the BIOTOPE SE database.

Appendix 13. Complete list of land use classes by land use category

Appendix 1. Data used to build the Step1 database

Here is a complete overview of the data that builds up BIOTOPE SE's Step1 database. For detailed information on the methodology see Submanual D.

Raster data from the National Land Survey

The initial pixel classification is the foundation of BIOTOPE SE's Step1 database and is the result of a fully automated process. The initial pixel classification is. This pixel product is used in several places in the work to develop different boundaries and characterize the content of the surfaces. The following elements are included:

- IRF orthophotos (as current as possible) in SWEREF99 TM in 2.5 km squares TIFF.
- Surface models from air photos from the same time as orthophotos in SWEREF99 TM in 2.5 km squares TIFF.
- National DEM (ground model in 2 m resolution) SWEREF99 TM in 2.5 km squares TIFF.

The property map from the land survey,

The property map, or Topo 10 as it is called from 2022, is our most detailed nationwide layer showing the extent of water, forest and settlement areas, etc. The following layers are used:

- Extent of water according to the new national shoreline
- The extent of the forest land, in order to simplify the delimitation of open land that should nevertheless be forest (clear-cut and temporary or substrate-based low-growth forest)
- Sankmarken. This is merged with SGU's organic soils into a wetland layer and is used to characterize open and wooded soil.
- Built-up areas, civil engineering areas, property divisions
- Buildings, used to find green roofs and also to find urban land that is not demarcated in built-up areas or with appropriate property boundaries.
- Conduit streets

The first economic map from the land survey (around the 1950s)

This map shows the extent of arable land (in yellow) from a time around the 1950s. The more we can limit the extent of the potentially semi-natural soil,

the better. This layer gives BIOTOPE SE some time depth in forest and Open land.

Other map layers from lantmäteriet

- Municipal and county boundaries,
- the land surveyor's division of the country into 2.5x2.5 km and 5x5-km squares (SWEREF99 TM) and 2.5x2.5 km squares (RT90 2.5 gon v).

Map material from the Swedish Transport Administration

- NVDB, national road database. Both road width and wear bearing
- NJDB, National Railway Database. Track width.

Map material from the Swedish Board of Agriculture

What is used in the Step1 database straight off is the block database's arable land. The pasture is not used because its delimitation is not compatible with the biotope database.

- The geometry from the block database, and extended socket that also indicates the land use in more detail.
- TUVA, i.e. the national layer of meadow and pasture inventory for land use in pasture (both open and wood-clad).

Forest classification from National Land Cover Data (NMD)

The most detailed and nationwide forest classification available today is the one found in the National Land Cover Data. Therefore, BIOTOPE SE chooses to use it, despite the fact that it has some weaknesses in certain classes such as deciduous leaves. The hope is that NMD will improve over time and then the biotope database will also be improved.

Map material from SGU

The material used is the soil map with information about the loose soil cover. All classes of the soil map have been simplified to four, mountains in the day, coarse sediment (sand-gravel) and wetland (all organic soils), as well as other humidity regime. Note that the earth map in some parts of Sweden has geometric problems. This is true from experience mainly in areas with sea and coast. But even otherwise, mismatches can exist. SGU is currently working on improving the location determination in the soil map, which is very positive. Mismatch between the soil map and reality leads to direct misclassifications of the humidity regimes in BIOTOPE, which is why a check, and any situation correction, should always be done before it is used.

Appendix 2. List of data supplied with the biotope database

Note that all references to a specific database are replaced with %AOI%_%IP_YEAR%, where AOI is the name of the distribution of the delivered database (usually municipality) and IP_YEAR corresponds to the year of the orthophotos and surface models used. Other data is attempted to match as far as possible with %IP_year%.

Delivered dataset	Format	explanation
BIOTOP_SE_DBM220630_%AOI%_%IP_YEAR%_LEVERERAD.gdb	ESRI file geodatabase	Geodatabase with domains (which expresses all attributes in plain text) and geodatabase geometry (Feature Class) in two versions. One for publication in the own web map and / or planning system and one for continued air photo interpretation in Step 2. The difference between these databases is only the number of attributes displayed.
%AOI%_%IP_YEAR%_Step1_databas_DBM220630_LEVERERAD	Feature class i feature dataset STEG1	If it's a Step1 database that has been delivered
%AOI%_%IP_YEAR%_Step2_databas_DBM220630_LEVERERAD	Feature class i feature dataset STEG2	If it's a Step2 database that has been delivered
%AOI%_PixelClass_%IP_YEAR%.tif	Raster TIFF	Merging of all PixelClass_files (input) across the entire mapped area. Here you can see details about the initial pixel classification in nine classes: <div style="background-color: #f0f0f0; padding: 5px; margin: 5px 0;"> <ul style="list-style-type: none"> 11 Låg vegetation (<0,8m) 12 Halvhög vegetation (>0,8m and <4,5m) 13 Hög vegetation (>4,5m) 21 Låg icke-vegetation (<0,8m) 22 Halvhög icke-vegetation (>0,8m and <2,2m) 23 Hög icke-vegetation (>2,2m) 31 Låg föreslagen vegetation (<0,8m) 32 Halvhög föreslagen vegetation (>0,8m and <4,5m) 33 Hög föreslagen vegetation (>4,5m) </div> <p>See Appendix 3</p>
_Metadata_BIOTOP_SE	File folder	Metadata consists of the following lines until the next bold header
BIOTOP_SE Database Template DBM220630.xlsx	Excel	Excel file containing all attributes and each domain in plaintext. This can be compared to a master file for the classification system. Used to get a comprehensive overview of the classes of the different attributes.
Style files for the official color coding (Appendix 12) and the initial pixel rating for styling in different GIS environments	*.lyr (ArcGIS Desktop), *.lyrx, (ArcGIS Pro) *.qml, *.qlr (QGIS and other application	BIOTOP_SE_DBM220630_biotop_LIGHT_SE.lyr BIOTOP_SE_DBM220630_Biotop_LIGHT_SE.lyrx BIOTOP_SE_DBM220630_biotop_LIGHT_SE.qml BIOTOP_SE_DBM220630_biotop_LIGHT_SE.qlr

Delivered dataset	Format	explanation
	environments that cannot load ESRI ArcGIS format	BIOTOP_SE_DBM220630_Huvudklasser.lyr BIOTOP_SE_DBM220630_Huvudklasser.lyrx BIOTOP_SE_DBM220630_Huvudklass.qlr BIOTOP_SE_DBM220630_Huvudklass.qml BIOTOP_SE_IP_Class_SE.lyr BIOTOP_SE_IP_Class_SE.lyrx BIOTOP_SE_IP_CLASS_SE.qlr BIOTOP_SE_IP_CLASS_SE.qml

The following data is supplied with the Seg1 database. They constitute sub-results in the preparation of input data for the Stage 1 modelling. These can be used separately or together with the database for various analyzes but are not an actual part of the biotope database. Note that these are likely missing for older prototype versions of BIOTOP SE (older than DBM220630 run in the final method).

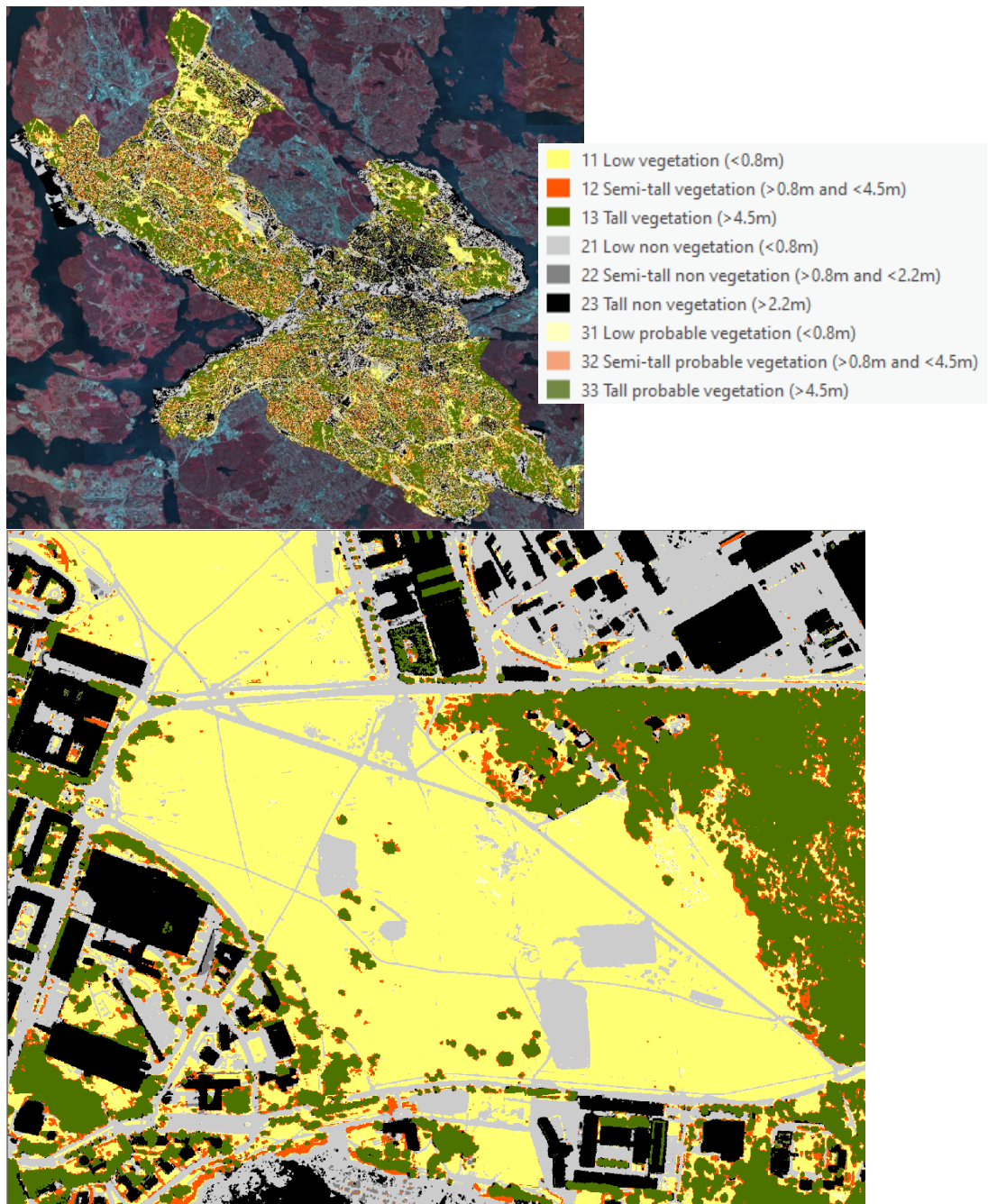
input_BIOTOP_SE_%A OI%_%IP_YEAR%	File folder	The contents of the folder are as shown in the following lines until the next bold header. <i>NOTE: this folder is only delivered to the customer from version 4, i.e. DBM220630. These data should NOT be used in analyses except possibly Input_BIOTOP_SE_%AOI%_%IP_YEAR%.gdb</i>
OH_tiles	Folder with raster (TIFF)	Object height grid 1 m resolution for the surface models from 2019 in 2.5 km squares (according to the division of the land survey). Can be merged into one large raster or you use the raster mosaic in BIOTOP_SE_Presteg1_Sodertalje_2019.gdb
PixelClass_tiles	Folder with raster (TIFF)	Initial pixel rating 1 m resolution in 2.5 km squares (according to the surveyor's classification). Can be merged into one large raster or you use the raster mosaic in BIOTOP_SE_Presteg1_Sodertalje_2019.gdb. Used to see details of the classes of non-vegetation, probable vegetation (most often dry areas) and vegetation divided into three elevation ranges; low, semi-high and high.
Input_BIOTOP_SE_%AOI%_%IP_YEAR%.gdb	file geodatabase	Geodatabase containing adaptations of various inputs that have subsequently been used in the structure of the Step 1 database. Several of these layers can be used in other contexts and in the continued Step2 work.

		<p>Geodatabase, for processed inputs, content</p> <ul style="list-style-type: none"> BIOTOP_SE_Presteg1_Sodertalje_2019.gdb <ul style="list-style-type: none"> ▶ BND ▲ Composite_vector_layers <ul style="list-style-type: none"> composit_MOISTURE composit_URBAN ▲ Historical_arable <ul style="list-style-type: none"> Sodertalje_Historical_arable ▲ JV_vectors <ul style="list-style-type: none"> Blockdatabasen_arable Blockdatabasen_non_arable ▲ LM_vectors <ul style="list-style-type: none"> Byggnader_mt40kvm_punkt Byggnader_mt40kvm_yta Land_Vatten Ledningsgator Sankmark Skogsmask ▶ Subareas ▲ TrV_NVDB <ul style="list-style-type: none"> Infrastruktur ▶ nmd2018_BS <ul style="list-style-type: none"> OH_mosaic PixelClass_mosaic
modellresultat_BIOTOP_SE_Steg1_%AOI%_%IP_YEAR%	File folder with all the model results from the Step1 process	Here are all the results from all Step1 models. This data has no practical use, but may be useful to archive in case troubleshooting of the method would be necessary.

Appendix 3. BIOTOPE SE Initial pixel classification

BIOTOPE SE comes with the initial pixel classification produced from IRF orthophotos, photogrammetric surface models and the national soil model. The layer is used at the beginning of Step1 production and can be said to be the very essence of the method.

The pixel resolution is 1 m. In this substrate you can basically see every single path with worn-out vegetation, every tree and shrub. The layers can be very useful if you want to increase the information in the biotope database, which is a generalized vector product.



Appendix 4. BIOTOPE SE total list at biotope level

The most granular level specified in the Biotop attribute is a combination of the Step1 database codes and the Step2 database codes. In this way, surfaces with different degrees of processing can coexist in the same database. The list of page numbers contains hyperlinks that you can click (hold down Ctrl) to quickly get to the biotope description in Chapter 6.

Common Step1 and Step2 codes are marked with bold numbers in the Biotope column. Work codes in Step1 are highlighted in bold in the Steg1_kod column, and Unique Codes for Step 2 are highlighted in bold in the Steg2_kod column.

Biotope	Steg1_kod	Steg2_kod	Main class	Biotop-LIGHT	Biotope class (Biotope)
100	100		100	1001	Unclassified non-vegetation, possibly not urban grey structure (removed vegetation) (Step1_code1)
101	101		100	1001	Non-vegetation, suggested urban grey structure (Step1_code)
110			100	1010	Tall non-vegetation, mainly buildings
120			100	1001	Suggested sealed urban grey structure
130			100	1001	Suggested non-vegetation, unsealed urban grey structure
141			100	1041	Infrastructure, road area sealed, and bridge over water
142			100	1042	Infrastructure, road area gravel/unsealed
150			100	1050	Infrastructure, railway area, mainly unsealed
200	200		200	2010	Urban green structure - unclassified (temp. working code in step 1)
210			200	2010	Urban green structure of open character
211			200	2010	Urban green structure road verges
212			200	2012	Green roof: sedum, turf, grass, herbs, shrubs etc
220			200	2020	Urban green structure of lush (fruit trees, berry shrubs) character
230	230		200	2030	Urban green structure of unclassified wooded character (Step1_code)
231			200	2031	Urban green structure of wooded character, according to NMD pine dominated
232			200	2032	Urban green structure of wooded character, according to NMD spruce dominated
233			200	2033	Urban green structure of wooded character, according to NMD mixed conifer dominated
234			200	2034	Urban green structure of wooded character, according to NMD mixed coniferous and deciduous
235			200	2035	Urban green structure of wooded character, according to NMD deciduous dominated
236			200	2036	Urban green structure of wooded character, according to NMD hardwood dominated
237			200	2037	Urban green structure of wooded character, according to NMD deciduous mixed with hardwood
238	238		200	2038	Urban green structure of disturbed wooded character (temp. working code in step 1)
240			200	2040	Urban green structure of grey character
250			200	2050	Urban green structure on SGU bedrock outcrop
301			300	3001	Agricultural land - arable rotation crop

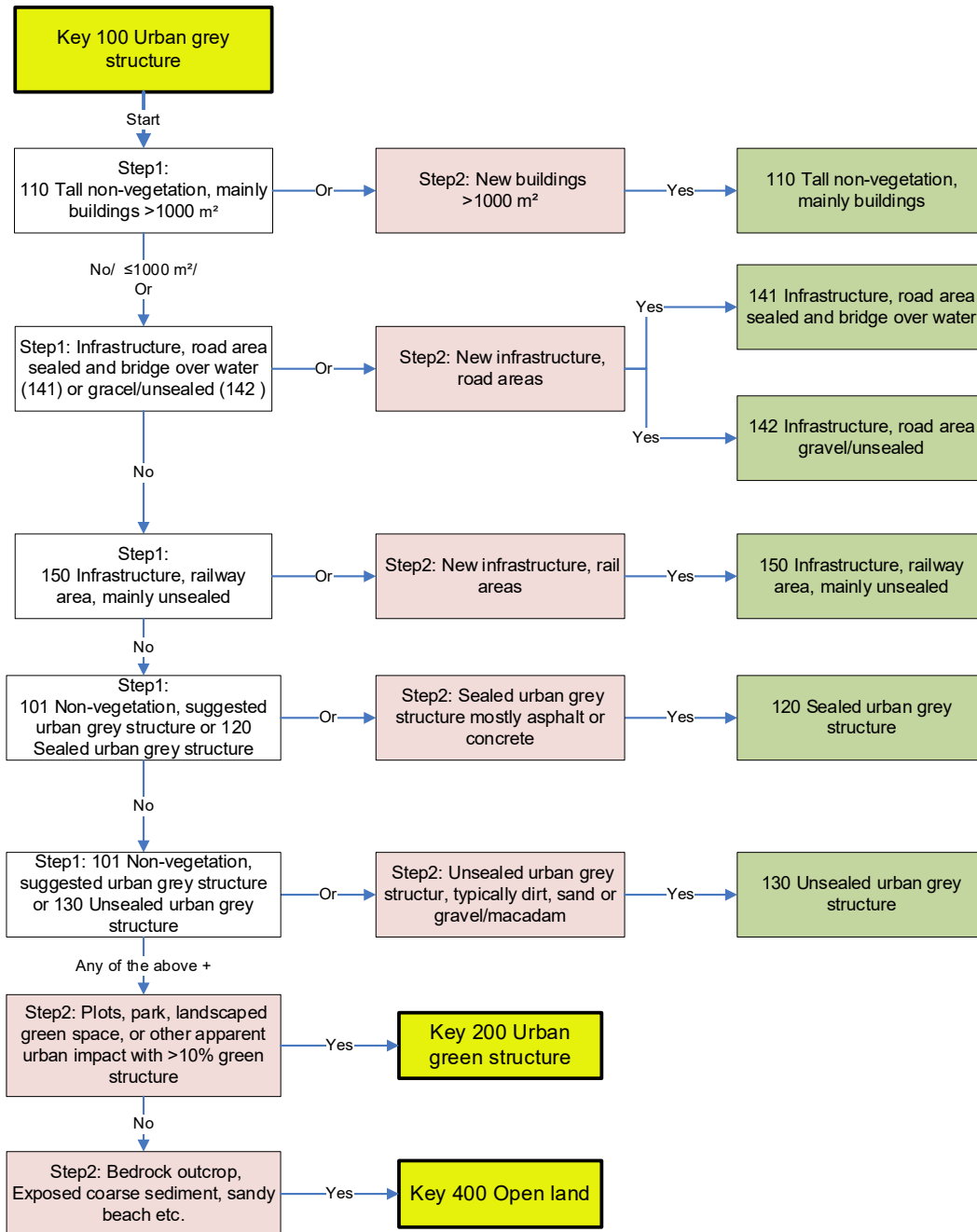
Biotope	Steg1_kod	Steg2_kod	Main class	Biotop-LIGHT	Biotope class (Biotope)
302			300	3002	Agricultural land - permanent crop, fruit, berry, garden
303			300	3003	Agricultural land - permanent crop, energy forest
310			300	3010	Agricultural land - suggested cultivated grassland on SGU bedrock outcrop
320			300	3020	Agricultural land - suggested cultivated grassland on SGU coarse sediment
330			300	3030	Agricultural land - suggested cultivated grassland on remaining moisture regime
340			300	3040	Agricultural land - suggested cultivated grassland on SGU/fastighetskarta wetland
410	410		400	4010	Open-semi open land on SGU bedrock outcrop (Steg1_kod)
411			400	4011	Open substrate dominated land, bedrock
412			400	4012	Open substrate dominated land, boulders and stones
413			400	4013	Open substrate dominated land, gravel and sand
420	420		400	4020	Open-semi open land on SGU coarse sediment (Steg1_kod)
421		421	400	4020	Open dry grassland/grass heath
430	430		400	4030	Open-semi open on remaining moisture regime (Step1_code)
431			400	4031	Arable field verge towards road
432		432	400	4030	Open dry-mesic grassland
433		433	400	4030	Open mesic-moist grassland
440			400	4040	Open-semi open land on SGU/fastighetskarta wetland
447			400	4047	Dense reeds, typically on wetland but not in water
499	499		400	9999	Land lacking leading to unclassified in Step 1 (Nodata)
500	500		500	5000	Shrub land (temp. working code in step 1)
510	510		500	5010	Shrub land on SGU bedrock outcrop (Step1_code)
511		511	500	5010	conifer shrubland (incl. Juniper), on SGU bedrock (>50% SC)
512		512	500	5010	Mixed shrub land, on SGU bedrock (>50% SC)
513		513	500	5010	Thorny shrub land (Rosaceae), on SGU bedrock (>50% SC)
515		515	500	5010	Other deciduous shrubs, incl. Mixture of 513-514, on SGU bedrock (>50% SC)
520	520		500	5020	Shrub land on SGU coarse sediment (Step1_code)
521		521	500	5020	conifer shrubland (incl. Juniper), on SGU coarse sediment (>50% SC)
522		522	500	5020	Mixed shrub land, on SGU coarse sediment (>50% SC)
523		523	500	5020	Thorny shrub land (Rosaceae), on SGU coarse sediment (>50% SC)
524		524	500	5020	Willow shrubs, on SGU coarse sediment (>50% SC)
525		525	500	5020	Other deciduous shrubs, incl. Mixture of 533-534, on SGU coarse sediment (>50% SC)
530	530		500	5030	Shrub land on remaining moisture regime (Step1_code)
531		531	500	5030	conifer shrubland (incl. Juniper), on dry - wet land (>50% SC)
532		532	500	5030	Mixed shrub land, on dry - wet land (>50% SC)
533		533	500	5030	Thorny shrub land (Rosaceae), on dry - wet land (>50% SC)
534		534	500	5030	Willow shrubs, on dry - wet land (>50% SC)

Biotope	Steg1_kod	Steg2_kod	Main class	Biotop-LIGHT	Biotope class (Biotope)
535		535	500	5030	Other deciduous shrubs, incl. Mixture of 520-540, on dry - wet land (>50% SC)
540	540		500	5040	Shrub land on SGU/fastighetskarta wetland (Step1_code)
541		541	500	5040	conifer shrubland (incl. Juniper), on SGU/fastighetskarta wetland (>50% SC)
542		542	500	5040	Mixed shrub land, on SGU/fastighetskarta wetland (>50% SC)
544		544	500	5040	Willow shrubs, on SGU/fastighetskarta wetland(>50% SC)
545		545	500	5040	Other deciduous shrubs, incl. Mixture of 543-544, on SGU/fastighetskarta wetland (>50% SC)
600	600		600	6000	Tree covered land (temp working code in step 1)
610	610		600	6010	Unclassified forest/tree covered land on SGU bedrock outcrop (temp working code in step 1)
620	620		600	6020	Unclassified forest/tree covered land on SGU coarse sediment (temp working code in step 1)
630	630		600	6030	Unclassified forest/tree covered land on remaining moisture regime (temp working code in step 1)
640	640		600	6040	Unclassified forest/tree covered land on SGU/property map wetland (temp working code in step 1)
611			600	6011	Pine dominated forest/tree covered land on SGU bedrock outcrop
621			600	6021	Pine dominated forest/tree covered land on SGU coarse sediment
631			600	6031	Pine dominated forest/tree covered land on remaining moisture regime
641			600	6041	Pine dominated forest/tree covered land on SGU/property map wetland
612			600	6012	Spruce dominated forest/tree covered land on SGU bedrock outcrop
622			600	6022	Spruce dominated forest/tree covered land on SGU coarse sediment
632			600	6032	Spruce dominated forest/tree covered land on remaining moisture regime
642			600	6042	Spruce dominated tree covered on SGU/property map wetland
613			600	6013	Mixed coniferous forest/tree covered land on SGU bedrock outcrop
623			600	6023	Mixed coniferous forest/tree covered land on SGU coarse sediment
633			600	6033	Mixed coniferous forest/tree covered land on remaining moisture regime
643			600	6043	Mixed coniferous forest/tree covered land on SGU/property map wetland
614			600	6014	Mixed coniferous and deciduous forest/tree covered land on SGU bedrock outcrop
624			600	6024	Mixed coniferous and deciduous forest/tree covered land on SGU coarse sediment
634			600	6034	Mixed coniferous and deciduous forest/tree covered land on remaining moisture regime
644			600	6044	Deciduous mixed coniferous forest/tree covered land on SGU/property map wetland
615			600	6015	Deciduous dominated forest/tree covered land on SGU bedrock outcrop
625			600	6025	Deciduous dominated forest/tree covered land on SGU coarse sediment
635			600	6035	Deciduous dominated forest/tree covered land on remaining moisture regime

Biotope	Steg1_kod	Steg2_kod	Main class	Biotop-LIGHT	Biotope class (Biotope)
645			600	6045	Deciduous dominated forest/tree covered land on SGU/property map wetland
616			600	6016	Hardwood dominated forest/tree covered land on SGU bedrock outcrop
626			600	6026	Hardwood dominated forest/tree covered land on SGU coarse sediment
636			600	6036	Hardwood dominated deciduous forest/tree covered land on remaining moisture regime
646			600	6046	Hardwood dominated forest/tree covered land on SGU/property map wetland
617			600	6017	Mixed deciduous forest/tree covered land on SGU bedrock outcrop
627			600	6027	Mixed deciduous forest/tree covered land on SGU coarse sediment
637			600	6037	Mixed deciduous forest/tree covered land on remaining moisture regime
647			600	6047	Mixed deciduous forest/tree covered land on SGU/property map wetland
608	608		600	6038	Non tree covered land under cadastral map's forest mask (temp working code in step 1)
618			600	6018	Clear-cut/other disturbed tree covered land on SGU bedrock outcrop
628			600	6028	Clear-cut/other disturbed tree covered land on SGU coarse sediment
638			600	6038	Clear-cut/other disturbed tree covered land on land on remaining moisture regime
648			600	6048	Clear-cut/other disturbed tree covered land SGU/property map wetland
700	700		700	7000	Water unclassified (temp working code in step 1)
710	710		700	7010	Water without water vegetation (Step1_code)
711		711	700	7011	Open water without installations
712		712	700	7012	Open water with installations
721			700	7020	Water with suggested floating vegetation (hydrophytes) (Step1_code)
720	720		700	7020	Water with over-water vegetation (helophytes)
722		722	700	7020	Water with floating vegetation (hydrophytes)
723		723	700	7020	Water with mixed water vegetation (helophytes/hydrophytes)
726			700	7020	Water with tall vegetation, overhanging or in permanent water

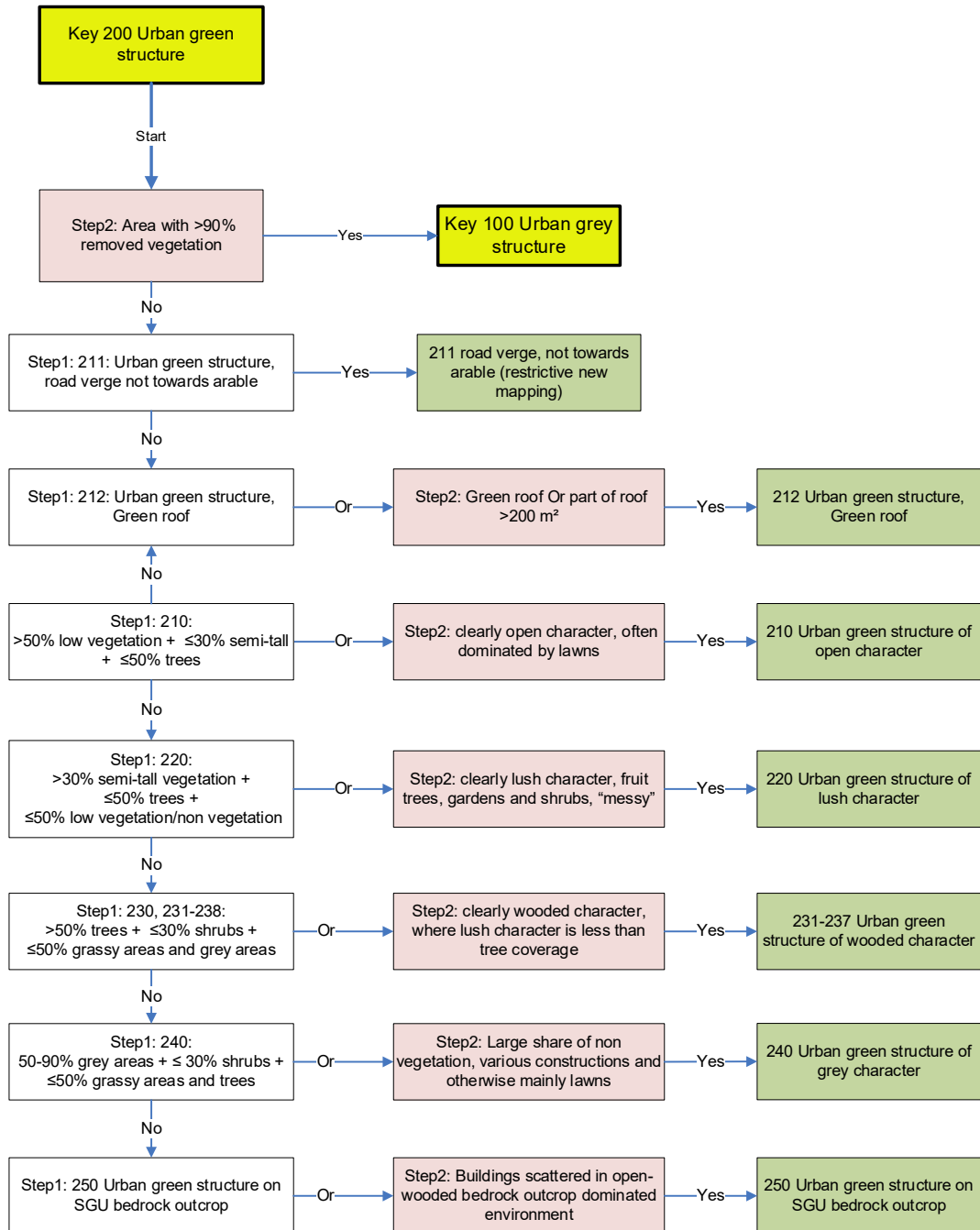
**Appendix 5. Detailed key to biotopes within the main class 100
Urban grey structure**

Note that the Step1 database contains slightly more classes (white boxes) than the air photo-interpreted Step2 database (green boxes). This is due to uncertainties in the classification that can be marked for easier handling in Step 2.



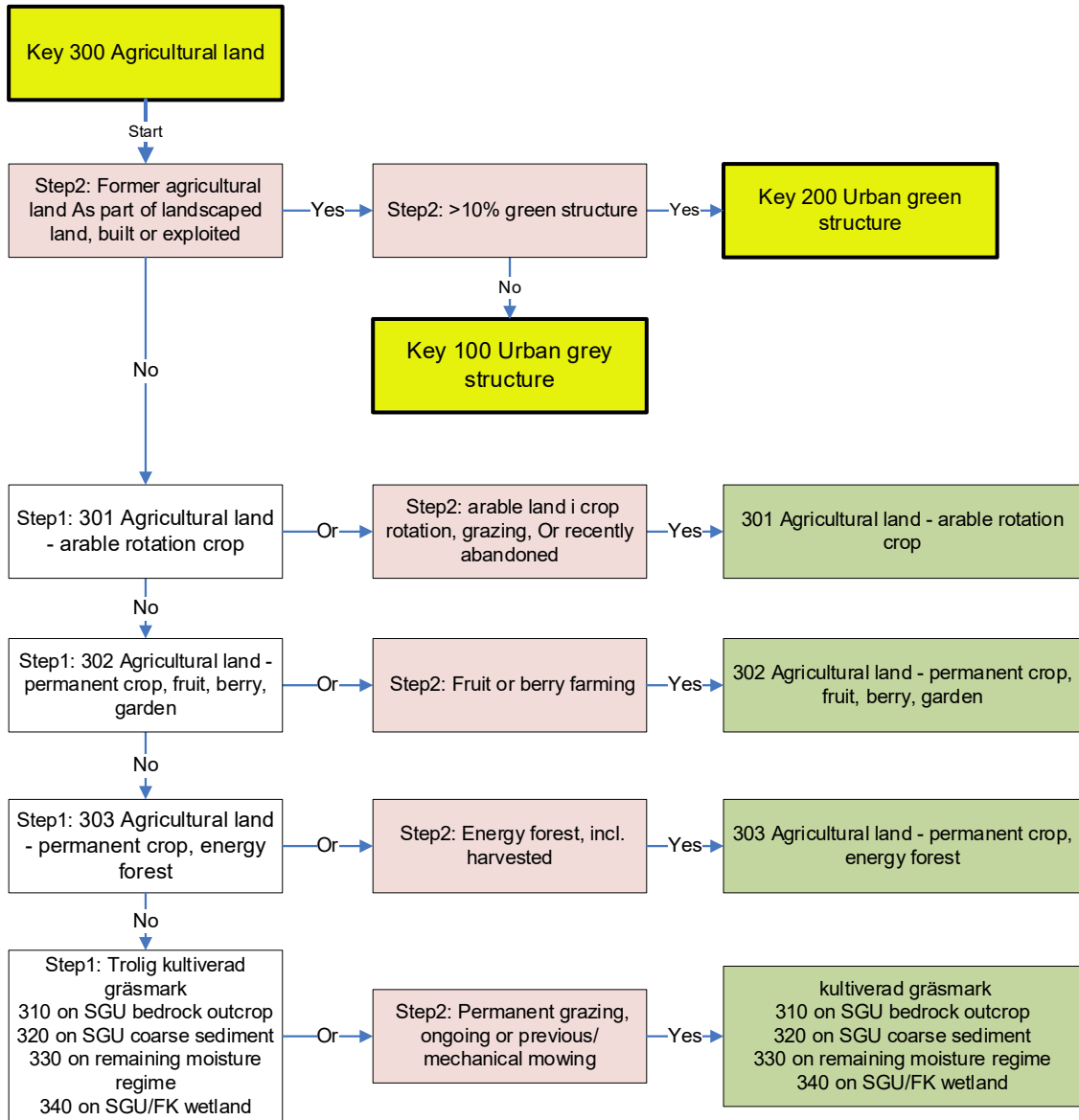
**Appendix 6. Detailed key to biotopes within the main class 200
Urban green structure.**

Note that the Step1 database contains slightly more classes (white boxes) than the air photo-interpreted Step2 database (green boxes). This is due to uncertainties in the classification that can be marked for easier handling in Step 2.



Biotope database template DBM220630 Helle Skånes (22-11-07)

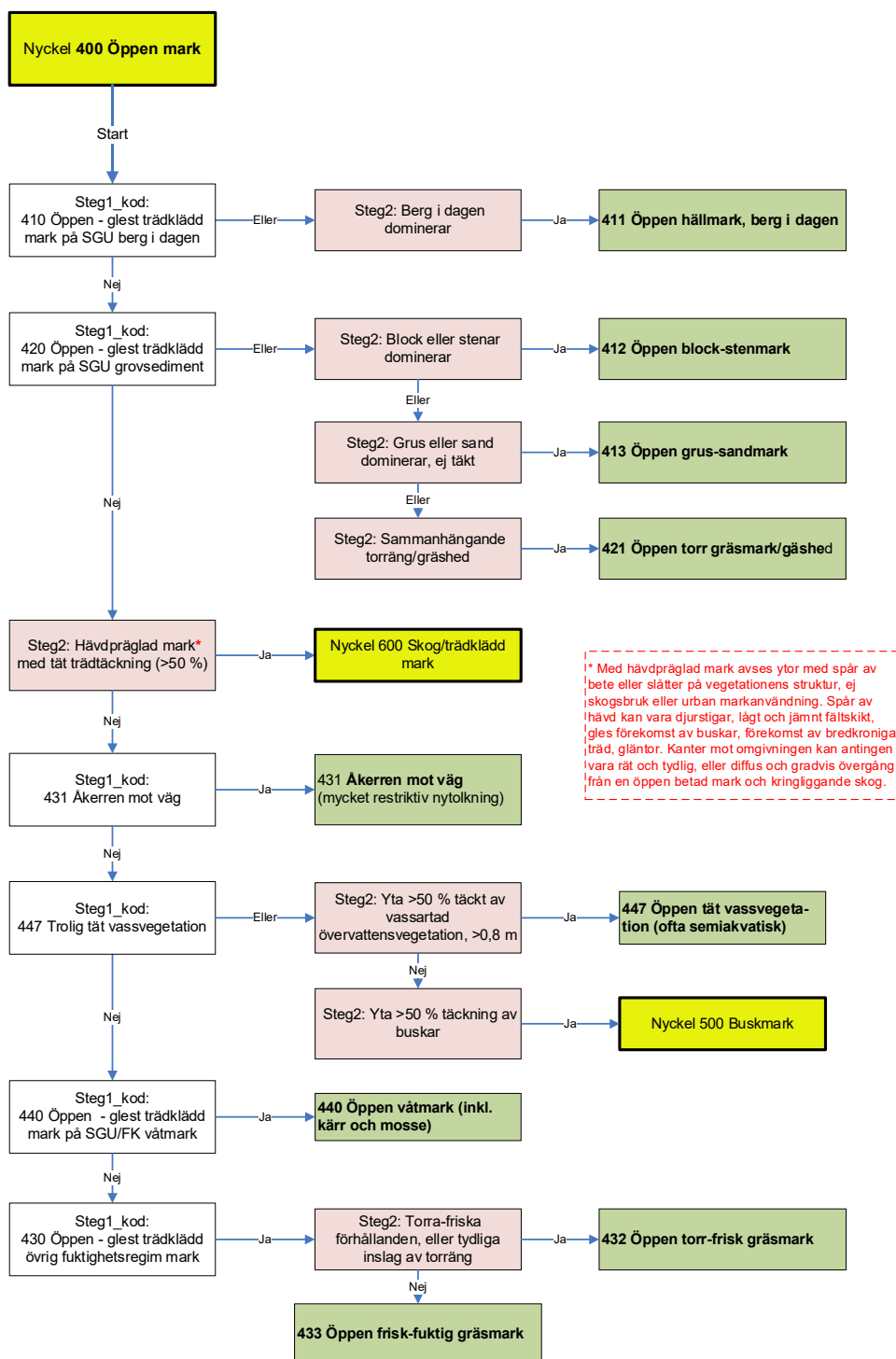
**Appendix 7. Detailed key to biotopes within the main class 300
Agricultural land.**



Biotope database template DBM220630 Helle Skånes (22-11-07)

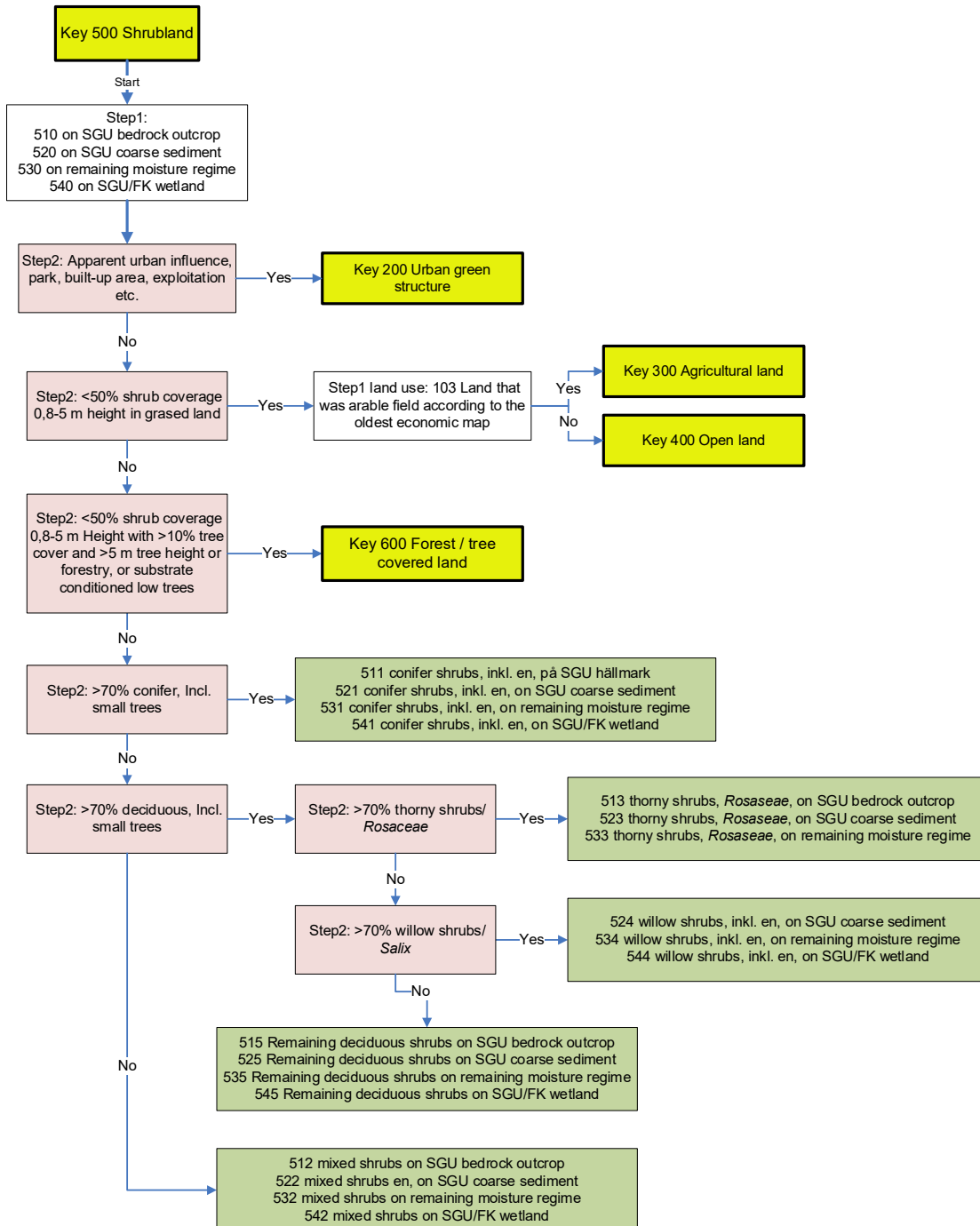
Appendix 8. Main class 400 Open land

Here are the 400 classes highlighted in bold. Note that the Step1 database contains fewer classes (white boxes) than the air photo-interpreted Step2 database (green boxes).



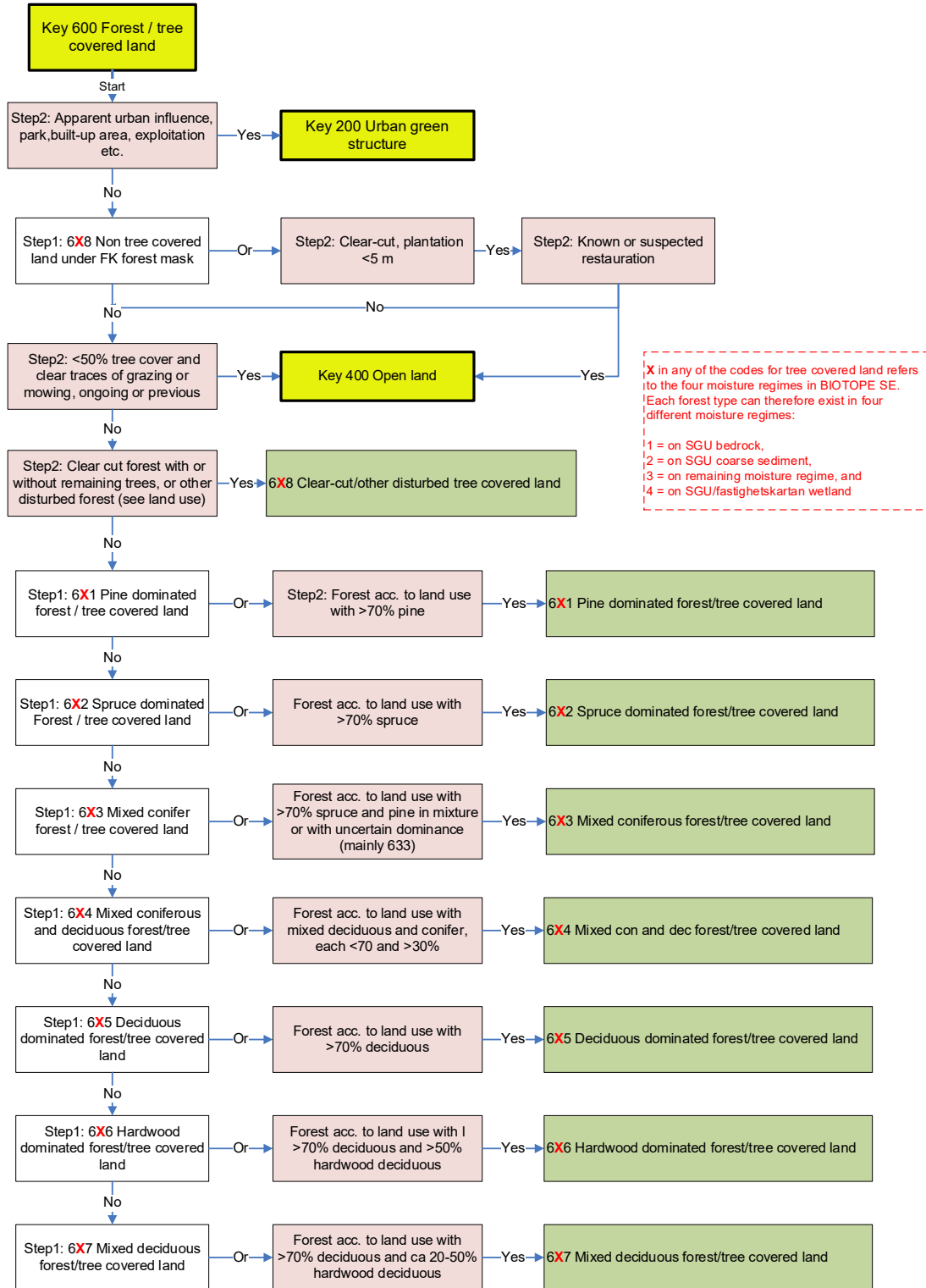
Appendix 9. Overview of the main class 500 Shrubland.

Note that the Step1 database contains fewer classes (white boxes) than the air photo-interpreted Step2 database (green boxes).



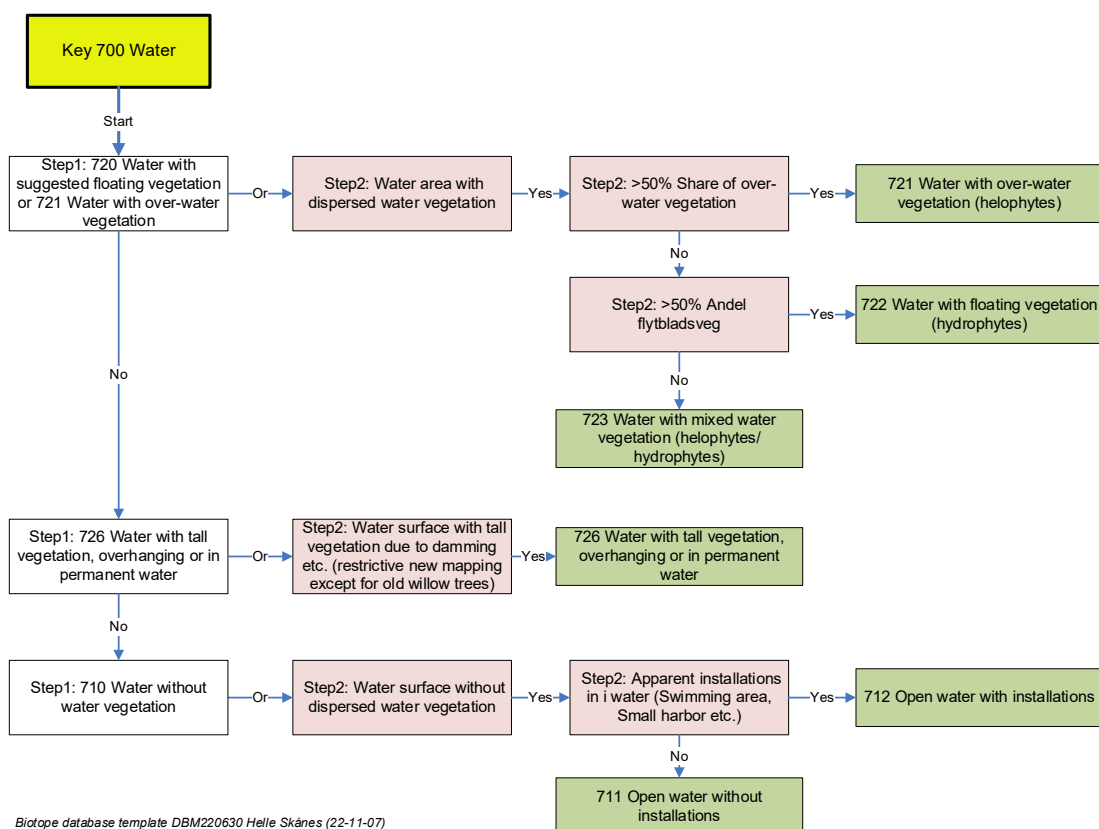
Biotope database template DBM220630 Helle Skånes (22-11-07)

Appendix 10. Overview of the biotopes in the main classes 600 Forest/wooded land



Biotope database template DBM220630 Helle Skånes (22-11-07)

Appendix 11. Overview of the biotopes of the main class 700 Water.



Appendix 12. Overview of codework and mannerisms in the Biotop_LIGHT attribute.

Here is a brief summary of the color management in BIOTOP SE's official color scheme Biotop_LIGHT. The color scale has been worked out for a long time. Perhaps it is not optimal to indicate vegetation-covered soil in pink, but it has not been possible to find enough shades of green to show all vegetation in green. For the same reasons and the fact that BIOTOPE SE contains new unique codes, it has not been possible or appropriate to follow the colour scheme of any other known classification system (e.g. national soil cover data). The full legend is visible on the following pages of this appendix.

Of course, the user may add their own colors when analyzing and using databases from BIOTOP SE, but at all times when the database is to be presented as just a BIOTOP SE database, Biotop_LIGHT should be used. This is also to ensure that the comparative effect is the same if you put several municipalities' databases next to each other.

In addition to color grading, there is a consistent and well-thought-out use of scraping and anomalous information regarding humidity regime in addition to the color coding. BIOTOPE SE uses four coarse humidity regimes based on SGU's soil map with additions from the property map's marshland layer. This is done in all main classes except urban gray and green structure as well as Agricultural land as shown below. Interpret each box relative to the specified humidity class in the top blue-highlighted row (top figure).

- All but urban grey and green structure (main class 100, 200), and arable land are consistently divided into four **broad moisture regimes** based on SGU jordartskarta

Bedrock outcrop according to SGU	Coarse sediments according to SGU	Dry to wet (remaining land, from fine sediments to morain/till)	Wetland according to SGU and Fastighetskartan
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- Tree covered urban green structure  Pine = brunt

- Disturbed nature Clear cuts, power lines, restored grasslands, forest without trees...



Water with constructions

		Biotop_LIGHT
100 Urban grey structure	}	1000 Low to semi tall non-vegetation, possibly not urban grey structure (removed vegetation)
		1001 Low to semi tall urban grey structure (removed vegetation)
		1010 Tall non-vegetation/urban grey structure, buildings
		1041 Infrastructure, cealed roads and bridges
		1042 Infrastructure, gravel roads
		1050 Infrastructure, railways
200 Urban green structure	}	2010 Urban green structure of open character, or not yet classified
		2012 Green roof: sedum, turf, grass, herbs, shrubs etc
		2020 Urban green structure of lush character (fruit trees, berry shrubs etc)
		2040 Urban green structure of grey character
		2050 Urban green structure on SGU bedrock outcrop
		2300 Urban green structure of wooded character without tree species from NMD
		2301 Urban green structure of wooded character, according to NMD pine dominated
		2302 Urban green structure of wooded character, according to NMD spruce dominated
		2303 Urban green structure of wooded character, according to NMD mixed coniferous
		2304 Urban green structure of wooded character, according to NMD mixed (con/dec)
		2305 Urban green structure of wooded character, according to NMD deciduous dominated
		2306 Urban green structure of wooded character, according to NMD hardwood dominated, including exotic species
2307 Urban green structure of wooded character, according to NMD mixed deciduous with hardwood, including exotic species		
2308 Urban green structure of disturbed wooded character, where trees could not be registered (uncertain class)		
300 Agricultural land	}	3001 Agricultural land , field in crop, ley field, fallow or grazed arabele field
		3002 Agricultural land (fruit and berry farms)
		3003 Agricultural land (energy forest)
		3010 Open to semi open cultivated grassland (arable land in the 1950s) on SGU bedrock outcrop
		3020 Open to semi open cultivated grassland (arable land in the 1950s) on SGU coarse sediment
		3030 Open to semi open cultivated grassland (arable land in the 1950s) on on remaining moisture regime
400 Open land	}	3040 Open to semi open cultivated grassland (arable land in the 1950s) on SGU/FK wetland
		4010 Open land or wooded pasture on SGU bedrock outcrop
		4011 Open bedrock outcrop with limited vegetation cover
		4012 Open substrate dominated land, boulders and stones or Open gravel-sand dominated open to semi open land
		4020 Open land or wooded pasture on SGU coarse sediment
		4030 Open land or wooded pasture, dry-moist, typically grassland
		4031 Arable field verge towards road
500 Shrubland	}	4040 Open land or wooded pasture on wet land, typically grassland, including open coastal grassland
		4070 Dense reeds, typically on wetland but not in water
		5000 Shrubland without support from SGU data
		5010 Shrubland regardless of type, on SGU bedrock outcrop
		5020 Shrubland regardless of type, on SGU coarse sediment
		5030 Shrubland regardless of type, on on remaining moisture regime
		5040 Shrubland regardless of type, on SGU/FK wetland

Code	Description	Notes
6000	Tree covered land (temporary working code in step 1)	
6010	Unclassified forest/tree covered land on SGU bedrock outcrop (temporary working code in step 1)	
6020	Unclassified forest/tree covered land on SGU coarse sediment (temporary working code in step 1)	NMD-code missing
6030	Unclassified forest/tree covered land on remaining moisture regime (temporary working code in step 1)	
6040	Unclassified forest/tree covered land on SGU/fastighetskartan wetland (temporary working code in step 1)	
6011	Pine dominated forest/tree covered land on SGU bedrock outcrop	60X1 pine
6021	Pine dominated forest/tree covered land on SGU coarse sediment	
6031	Pine dominated forest/tree covered land on remaining moisture regime	
6041	Pine dominated forest/tree covered land on SGU/fastighetskartan wetland	
6012	Spruce dominated forest/tree covered land on SGU bedrock outcrop	60X2 spruce
6022	Spruce dominated forest/tree covered land on SGU coarse sediment	
6032	Spruce dominated forest/tree covered land on remaining moisture regime	
6042	Spruce dominated tree covered on SGU/fastighetskartan wetland	
6013	Mixed coniferous forest/tree covered land on SGU bedrock outcrop	60X3 mixed conifer
6023	Mixed coniferous forest/tree covered land on SGU coarse sediment	
6033	Mixed coniferous forest/tree covered land on remaining moisture regime	
6043	Mixed coniferous forest/tree covered land on SGU/fastighetskartan wetland	
6014	Mixed coniferous and deciduous forest/tree covered land on SGU bedrock outcrop	60X4 mixed con / dec
6024	Mixed coniferous and deciduous forest/tree covered land on SGU coarse sediment	
6034	Mixed coniferous and deciduous forest/tree covered land on remaining moisture regime	
6044	Deciduous mixed coniferous forest/tree covered land on SGU/fastighetskartan wetland	
6015	Deciduous dominated forest/tree covered land on SGU bedrock outcrop	60X5 deciduous
6025	Deciduous dominated forest/tree covered land on SGU coarse sediment	
6035	Deciduous dominated forest/tree covered land on remaining moisture regime	
6045	Deciduous dominated forest/tree covered land on SGU/fastighetskartan wetland	
6016	Hardwood dominated forest/tree covered land on SGU bedrock outcrop	60X6 hardwood dec
6026	Hardwood dominated forest/tree covered land on SGU coarse sediment	
6036	Hardwood dominated deciduous forest/tree covered land on remaining moisture regime	
6046	Hardwood dominated forest/tree covered land on SGU/fastighetskartan wetland	
6017	Mixed deciduous forest/tree covered land on SGU bedrock outcrop	6XX7 mixed dec
6027	Mixed deciduous forest/tree covered land on SGU coarse sediment	
6037	Mixed deciduous forest/tree covered land on remaining moisture regime	
6047	Mixed deciduous forest/tree covered land on SGU/fastighetskartan wetland	
6018	Clear-cut/other disturbed tree covered land on SGU bedrock outcrop	6XX8 Tree covered land without trees: clear cuts etc.
6028	Clear-cut/other disturbed tree covered land on SGU coarse sediment	
6038	Clear-cut/other disturbed tree covered land on remaining or unknown moisture regime	
6048	Clear-cut/other disturbed tree covered land SGU/fastighetskartan wetland	
7000	Water without classification of water vegetation due to ortho photo earlier than the end of May	
7010	Water without water vegetation with or without constructions (open water)	
7011	Water without water vegetation (open water)	
7012	Water without water vegetation (open water)	
7020	Water with water vegetation (floating, over-water or mixed, overhanging tall vegetation)	
9999	Land lacking indata or, for other reasons, was not assigned a Step1_code (Nodata)	

NMD

Appendix 13. Complete list of land use classes by land use category

The list's code system is grouped by a number of logical groups such as forestry, cultivation, and urban land use. Note that the land use list should be kept to a minimum to avoid too much work during step 2 air photo interpretation. However, some land use classes can usefully be taken from the municipality's existing data or other sources.

Land use	Code	Main source
Forestry		
Suggested (automatic) influence by forestry	100	Any suggestion in Step 1, not listed in Step 2
Apparent traces of forestry	101	Any suggestion in Step 1 otherwise visually in Step 2
No apparent traces of forestry or other land use	102	Any suggestion in Step 1 otherwise visually in Step 2
Land that was arable field according to the oldest economic map, automatic	103	Suggestions in Step 1, not listed in Step 2
Farmland and seminatural grassland		
Arable land in crop rotation, incl. ley field, fallow and grazing	201	Suggestions in Step 1 from Agricultural Blocks + Visually
Permanent crop	202	Suggestions in Step 1 from Agricultural Blocks + Visually
Traces of ongoing or ceased grazing or mowing	203	Any suggestion in Step 1 from Agricultural Blocks + Visually
Encroaching with traces of past grazing, stag headed trees, secondary or delayed encroachment of shrubs and trees	204	Mainly visually in Step 2
Equestrian facility/beef cattle farm, horse-racecourse etc.	205	Mainly visually in Step 2
Not encroaching, no apparent land use (no traces of grazing or mowing)	206	Mainly visually in Step 2
Encroaching, no apparent land use (no traces of grazing or mowing)	207	Any suggestion in Step 1 otherwise visually in Step 2
Known or suspected restauration of grassland or other nature conservation, e.g., wildlife ponds or coastal meadows	208	Any suggestion in Step 1 otherwise visually in Step 2
Natural disturbance		
Traces of fire, (forest fire, grass fire), storm felling, beaver gnaw etc	301	Mainly visually in Step 2
Traces of flooding or beaver damming	302	Mainly visually in Step 2
Traces of insect infestation, bird colonies etc.	303	Mainly visually in Step 2
Urban exploitation		
Current exploitation, road construction, building site, or other ongoing activity	401	Any suggestion in Step 1 otherwise visually in Step 2
Landfill, waste dump, ongoing or previous	402	Suggestions in Step 1 from The Property Map + Visually

Excavation site, mine etc, ongoing or previous	403	Suggestions in Step 1 from The Property Map + Visually
Transmission/power line through forest	404	Suggestions in Step 1 from The Property Map + Visually
Other urban land use		
Mechanical mowing or other extensive management to keep area open	501	Mainly visually in Step 2
Sports/recreational area, exercise facility/camping/school yard/playground/castle/park, including private land, and other community function	502	Mainly visually in Step 2
Golfing area	504	Suggestions in Step 1 from The Property Map
Ski slope, sledding hill, ski tracks	505	Suggestions in Step 1 from The Property Map
Swimming area on land, including beach, and within flanges or markings in water	506	Mainly visually in Step 2
Allotment garden/allotment/plant nursery and other horticulture	507	Suggestions in Step 1 from The Property Map
Church ground including cemetery	508	Suggestions in Step 1 from The Property Map
Airport/air strip	509	Suggestions in Step 1 from The Property Map
Small harbor, permanent installations on land or piers and boats in water	510	Mainly visually in Step 2
Harbor, quay, lock area or other urban infrastructure related to water	511	Suggestions in Step 1 from The Property Map
Purification/sedimentation dam	512	Suggestions in Step 1 from The Property Map
Dam, swimming pool, or water filled mine pit or excavation	513	Suggestions in Step 1 from The Property Map
Fish/water cultivation	514	Mainly visually in Step 2
Parking area	515	Mainly visually in Step 2
Area with artificial grass, typically soccer ball field or unspecified sports field	516	Mainly visually in Step 2
Motor sports	517	Suggestions in Step 1 from The Property Map
Lawn, short cut intensive lawn mowing	518	Mainly visually in Step 2
Soccer ball field, tennis court, and unspecified sports field	519	Suggestions in Step 1 from The Property Map
Clear remaining urban influence, unspecified or other than 501-598	599	Visually in Step 2 when land use is missing in Step 1
Detached houses in residential area/low buildings	601	Suggestions in Step 1 from The Property Map
Taller houses/ apartment blocks	602	Suggestions in Step 1 from The Property Map
City center	603	Suggestions in Step 1 from The Property Map

Industrial land use area or other form of facilities private/community	604	Suggestions in Step 1 from The Property Map
Scattered detached house/low buildings/rural farms/unknown type in the outside LM built up areas, typically in the countryside	605	Proposal from processing in prestep1 of the property boundaries and buildings of the property map.
Building/building complexes	611	Classified in Step 1 from The Property Map
Railway, railway yard, train station	701	Classified in Step 1 from Statistics Sweden
Infrastructure, road	702	Classified in Step 1 from Statistics Sweden
Bridge over water	704	Classified in Step 1 from Statistics Sweden
Apparent traces of other land use not in the list	900	All surfaces must have a land use in the end