European Environment Agency | European Topic Centre on Urban, Land and Soil Systems

Task 9: Support the collection of UA enriched dataset
Summary report

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1 OBJECTIVE

In the context of the negotiated procedure EEA/IDM/R0/16/009 the EEA agreed with its Member States to provide support to different Copernicus activities, among other the enrichment of Urban Atlas with land use information. Due to the lack of detailed guidelines for the enrichment, different countries have provided the land use information in different form.

The aim of this task is to collect and review the data deliveries from the Member States, to analyse what has been delivered, the comparability between countries and to finally make a proposal for a more harmonised data collection in the future.

2 DATA COLLECTION

The twenty Member States (MS) shown in Figure 1 (Austria, Bulgaria, the Czech Republic, Croatia, France, Hungary, Greece, Iceland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Switzerland, and the United Kingdom) provided an Urban Atlas dataset enriched with information on land use.

All countries delivered datasets in the GIS format, which enabled them to be open and analyzed in the GIS software. The countries have provided data sets in Shapefile or File Geodatabase, most as a polygon and only one of them as a point data. Twelve countries delivered data for all functional urban areas (UAs), and the remaining eight only for a few selected cities. Some countries included a report containing information about the completed task, metadata and workflow that was used to obtain the final product. A detailed summary of the provided data is presented in Table 1.
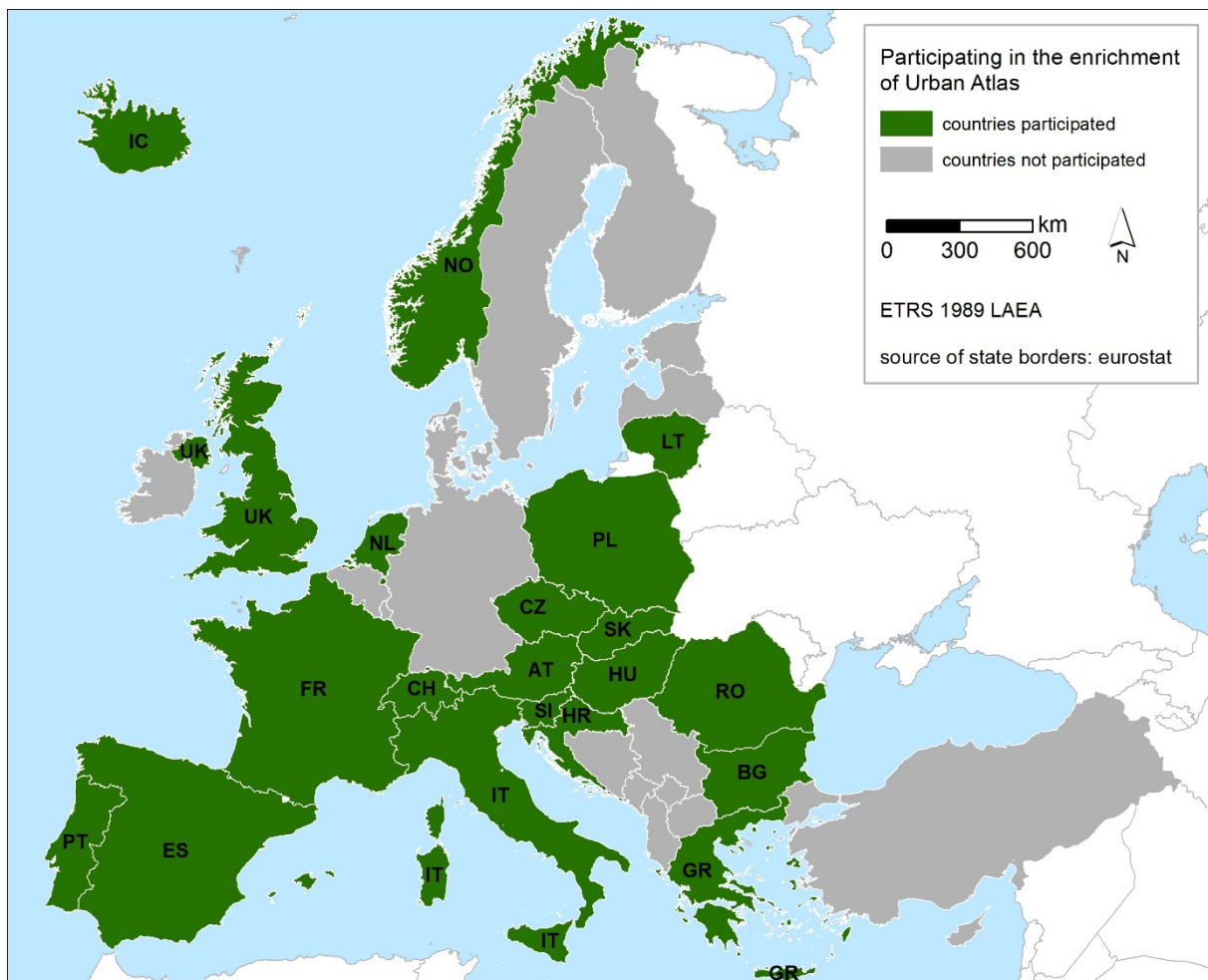

Figure 1: Countries provided an Urban Atlas dataset enriched with information on land use.

Table 1: Data provided by European countries to enrich the Urban Atlas with information on land use.

Country		All functional urban areas (FUAs)/ cities	Number of		Type/format data	Textual description	Workflow description
code	name		delivered FUAs cities	missing FUAs cities			
AT	Austria	No	5	1	Vector polygon, Shapefile	Yes	Yes
BG	Bulgaria	Yes	17	0	Vector polygon, File Geodatabase	Yes	Yes
CH	Switzerland	Yes	10	0	Vector polygon, Shapefile	Yes	Partly
CZ	Czech Republic	Yes	15	0	Vector polygon, Shapefile	Yes	No
ES	Spain	No	70	10	Vector polygon, Shapefile	Yes	No
FR	France	No	82	3	Vector polygon, Shapefile	No	No
GR	Greece	Yes	9	0	Vector polygon, Shapefile	Yes	Yes
HR	Croatia	No	1	6	Vector polygon, Shapefile	Yes	Yes
HU	Hungary	No	4	15	Vector polygon, File Geodatabase	Yes	Yes
IC	Iceland	Yes	1	0	Vector polygon, Shapefile	Yes	Partly
IT	Italy	No	26	58	Vector polygon, Shapefile	No	No
LT	Lithuania	Yes	6	0	Vector polygon, Shapefile	Yes	No
NL	Netherlands	Yes	34	0	Vector polygon, Shapefile	Yes	Yes
NO	Norway	Yes	6	0	Vector polygon, Shapefile	Yes	Partly
PL	Poland	Yes	58	0	Vector polygon, Shapefile	Yes	Partly
PT	Portugal	No	11	2	Vector polygon, Shapefile	No	No
RO	Romania	Yes	35	0	Vector point, Shapefile	No	No
SI	Slovenia	Yes	2	0	Vector polygon, Shapefile	No	No
SK	Slovakia	Yes	8	0	Vector polygon, Shapefile	Yes	No
UK	United Kingdom	No	4	86	Vector polygon, Shapefile	Yes	Yes

3 ANALYSIS OF MEMBER STATE DELIVERIES

3.1 ASSESSMENT CRITERIA

To analyze the deliveries from different countries, the following criteria were used:

- Which data were delivered?
  - Were all cities delivered or only a selection of cities?
  - In what format were the data delivered?
  - Was a text description of the dataset delivered?
  - Was a description of the workflow provided?
- What was enriched?
  - Were all polygons of UA enriched?
  - Which attributes were provided – what was the structure of the dataset?
  - How many attributes does the dataset have?
  - Were the data provided separately for each FUA or for the entire MS?
- Enrichment methodology?
  - Was the enrichment done in full detail or by data aggregation?
  - What was the generalisation procedure?
- Enrichment data source?
  - What was the source of enrichment: OSM, national data, other?
  - What was the availability / accessibility of data for different tasks?
  - Were the data confidential or a license was needed?
  - What was the quality and acquisition time / time period of data?
  - What was the level of detail? (spatial, thematic)
  - Was a description of thematic detail of source data available? (number of classes, different themes covered)
  - Was the description of the source data classes available?
- Standard nomenclature or national specific?
  - Was the EAGLE nomenclature used?
  - Was a conversion matrix from the national nomenclature to EAGLE delivered?
  - Were there any issues and/or limitations discovered?
- EAGLE LU classes present per MS
  - Was the number of classes listed?
  - Which classes at level 1 and/or 2 are present?
  - Which classes are absent in all MS and/or present in all MS?
- Suggestions made by Member States
- Other issues detected during the product review

3.2 RESULTS

The datasets provided by Member States have been verified in accordance with the assessment criteria set out in Chapter 3.1 and summarized in Tables 1-7.

3.2.1 Enriched dataset

The countries enriched the urban atlas with information on land use in a variety of ways. Only eleven countries have enriched all polygons of urban atlas with information on land use, other countries have only made them for classes 1.1.x-1.2.x. Table 2 shows that fourteen countries performed the enrichment per UA/FUAs cities, while the other countries delivered it as one dataset for the entire MS. In addition, the attributes enriched were divers. However, most countries enriched the urban atlas dataset with attributes indicating LUA level 1 and level 2 code per polygon. Only Romania provided data as point shapefile, without enrichment with information on land use. Romania sent a file with information on points of interests for UAs, such as: church, hospital/polyclinic, museum, and school, what makes it difficult to compare with all other datasets.

Table 2: Summary of data provided by European countries to enrich the Urban Atlas with information on land use.

Country code	Enriched dataset		Number of new attributes	Dataset per FUA or MS
	UA polygons enriched	**Attributes enriched UA polygons**		
AT	all	% for 7 combined level 1/2 LUAs per polygon	7	FUA
BG	only 26 UA classes with OSM content	OSM buildings and POI attributes	19	MS
CH	only 1.2.1	LUA level 1/2 code per polygon	4	FUA
CZ	only 1.1.x and 1.2.1	LUA level 2 code per polygon	1	FUA
ES	all	LUA level 1/2 + % of dominant class + % for all classes present as string + number of constructions per polygon	5	FUA
FR	all	LUA level 1/2 code per polygon	6	FUA
GR	only 1.1.x and 1.2.1	LUA level 1/2 code per polygon + source of land use data	3	FUA
HR	only 1.1.x and 1.2.1	LUA level 1/2 codes per polygon, 4 most important LUAs within polygon	8	FUA
HU	all	LUA level 2 code per polygon	83	MS
IC	all	LUA level 1/2 code per polygon	2	FUA
IT	all	LUA level 2 code per polygon, 2 most important LUAs within polygon	2	FUA
LT	all	LUA level 1/2 codes per polygon	2	FUA
NL	all	% and area for 18 combined level 1/2 LUAs per polygon	36	MS
NO	all	LUA level 1/2 code per polygon	2	MS
PL	only 11xxx, 121xxx	LUA level 1/2 code per polygon	4	FUA
PT	all	LUA level 1/2 code per polygon	2	MS
RO	-	Name of objects (clinic, museum, school, church)	1	FUA
SI	all	Number of objects per polygon	7	MS
SK	all	LUA level 1/2 code per polygon	2	FUA
UK	only 1.2.1, 1.1.x	LUA level 2 code per polygon	7	FUA

"-" no-info, or does not apply

3.2.2 Methodology

Table 3 shows that the countries enriched the urban atlas with various methods. The most common method was intersection followed by aggregation of UA polygons with (national) data on LU data. However, also for a lot of countries the methodology was not described or no report was delivered. Only three countries have enriched the data with full detail, assigning one or more classes of land use to the polygon of the urban atlas by its proportion. The remaining countries have made only one by one translation (or majority of land use per polygon) of the polygon of information on the land use to the urban atlas data thus generalize the final product. Croatia had an intermediate solution by presenting also information on 2nd, 3rd and 4th land use per UA polygon for Zagreb.

Table 3: Summary of methodology used by European countries to enrich the Urban Atlas with information on land use.

Country code	Methodology		
	Full detail[1]	**Type of methodology**	**Generalisation**
AT	Yes	Intersection and aggregation	No
BG	No	Intersection and aggregation	No
CH	No	Intersection and aggregation	Yes
CZ	No	-	Yes
ES	Yes	Intersection and aggregation	No
FR	No	-	-
GR	No	Intersection and manual/visual photointerpretation	Yes
HR	No	Intersection and aggregation	Yes
HU	No	Intersection and aggregation	Yes
IC	No	The largest proportional area in a polygon	Yes
IT	No	-	Yes
LT	No	Manually/visually photointerpretation	Yes
NL	Yes	Intersection and aggregation	No
NO	No	The largest proportional area in a polygon	Yes
PL	No	Intersection and aggregation	Yes
PT	No	-	-
RO	-	-	-
SI	-	-	-
SK	No	-	-
UK	No	Intersection and aggregation	Yes

[1] Full detail means that more than 1 LUA could be present in a UA polygon, so no majority

"-" no-info, or does not apply

3.2.3 Source data

Most countries have provided textual information about the source of data used to enrich the urban atlas with information on land use. These data are diverse in relation to their type and format. The level of background information on the source data used is often limited. None of the countries indicated difficulties with the accessibility of this data or their confidentiality. Table 4 shows, however, that many countries did not mention information on accessibility and confidentiality in the reports provided.

Table 4: Summary of source data used by European countries to enrich the Urban Atlas with information on land use.

Country code	Source data used for Enrichment				
	Source	**Data name**	**Type/format of data**	**Accessibility**	**Confidentiality**
AT	AGWR II - https://www.statistik.at/web_de/services/adress_gwr_online/index.html	Census of buildings and addresses	Tables	-	-
BG	Open street map	Buildings_a_free, pois_free, pofw_free	ESRI Shapefile	Free	No
CH	Federal Statistical Office (FSO)	Statent	Point data of a regular 100 m x 100 m grid	-	-
CZ	-	-	-	-	-
ES	Geographic reference information on Settlements (IGR Poblaciones), on Land Cover and Land Use (SIOSE) and Cadastre	IGR Poblaciones, SIOSE and Cadastre	-	-	-
FR	-	-	-	-	-
GR	Cadastre information; National Orthophotos, GE, GE StreetView....	-	-	-	-
HR	Real_use layer within real_use_2011HTRS96TM.mdb database	-	Personal geodatabase	-	-
HU	National Cadastre; National Land Parcel Identification System for Agriculture (LPIS)	Subdivision database, LPIS land cover classes, road and railways network, hydrography networks, national administrative units, ortophoto, normalized difference surface model	-	-	-
IC	National Planning Agency	http://data-reykjavik.opendata.arcgis.com/search?tags=a%C3%B0alski pulag	-	-	-
IT	-	-	-	-	-
LT	In-situ data, aerial photographs via www.geoportal.lt	Topographical data, Forest Inventories, Hydrographic information, Conservation and protected areas, Location of Renewable plants	-	Hydrography and protected areas are INSPIRE datasets	-
NL	BBG - https://www.pdok.nl/introductie/-/article/cbs-bestand-bodemgebruik or https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische%20data/natuur%20en%20milieu/bestand-bodemgebruik	Bestand Bodem Gebruik 2012 (BBG2012)	Vector	Open	No
NO	Statistics Norway (SSB); NIBIO	Land use map "SSBArealbruk"; land resource map	-	-	-
PL	Geodesy and Cartography Office	National topographic database - BDOT 10K	-	-	-
PT	-	-	-	-	-
RO	-	-	-	-	-
SI	-	-	-	-	-

Country code	Source data used for Enrichment		Type/format of data	Accessi bility	Confide ntiality
	Source	**Data name**			
SK	Google Earth, City map	Thematic data, satellite images, aerial photos, city maps	-	-	-
UK	-	Ordnance Survey Open Green Space (GS) dataset (which includes function and place names) and the Open Map Local dataset	-	-	-

"-" no-info, or does not apply

3.2.4 Level of details

Only nine countries present information on the number of classes and give a description of the land use classes of the source database used for enrichment (Table 5). For the countries that delivered information on the number of thematic classes of the source data the picture is divers, from more general thematic detail to very high level of thematic detail (range from 14 to 74 classes). The majority of countries did not provide information on the reference date, the update frequency and the spatial detail of the source data used for the enrichment.

Table 5: Summary of level of detail of source data used by European countries to enrich the Urban Atlas with information on land use.

Country code	Level of detail of source data				
	Number of thematic classes	**Description of classes**	**Reference date**	**Update frequency**	**Spatial detail**
AT	14	Yes	-	Continuously	-
BG	17	Yes	Yes	Continuously	-
CH	28	-	2016	-	1 ha
CZ	-	-	-	-	-
ES	-	-	-	-	-
FR	-	-	-	-	-
GR	67	Yes	-	-	-
HR	38	Yes	2011	-	1:5000
HU	74	Yes	-	-	-
IC	-	-	-	-	-
IT	-	-	-	-	-
LT	-	-	-	-	-
NL	38	Yes	2012	3 years	0.1-1ha
NO	34	Yes	2012	-	1:5000
PL	-	Yes	2012-2016	-	1:10000
PT	-	No	-	-	-
RO	-	-	-	-	-
SI	-	No	-	-	-
SK	29	-	2008	-	1:20000
UK	-	Yes	-	-	-

"-" no-info, or does not apply

3.2.5 Nomenclature

Table 6 shows that most of the countries used the EAGLE nomenclature to enrich the UA polygons. The exceptions are Bulgaria where they used OSM nomenclature to enrich UA and Romania where no information is available. Half of the countries present national examples and/or interpretation of the EAGLE nomenclature. Only six countries provide conversion matrices on how national data is matched to the EAGLE nomenclature. In most countries all 7 LUA level 1 classes are present. Exceptions are Austria and Switzerland with only four level 1 classes present, but also France with five, and Spain and Portugal with six level 1 classes present. Hungary expanded the EAGLE nomenclature of two additional classes to conform with domestic characteristics of country's cities. The LUA level 2 classes present per country are more diverse as they range from 5 to 30 (out of 33 LUA level 2 classes defined). The number of LUA classes at level 1 and level 2 present in the country is an indication of the thematic diversity of national source data used for enrichment and/or an indication for diversity within the countries FUA's. Of course the number of FUA's enriched per country is also a factor influencing the number of classes present.

Table 6: Summary of nomenclature used by European countries to enrich the Urban Atlas with information on land use.

Country code	Nomenclature						
	EAGLE	Examples	Conversion matrix	Number of classes			
				Present (level 1)	Absent (level 1)	Present (level 2)	Absent (level 2)
AT	Yes	No	Yes	4	3	5	28
BG	No	No	No	-	-	-	-
CH	Yes	Yes	No	4	3	14	19
CZ	Yes	Yes	No	7	0	28	5
ES	Yes	No	No	6	1	13	20
FR	Yes	No	No	5	2	10	23
GR	Yes	No	Yes	7	0	29	4
HR	Yes	No	Yes	7	1	10	23
HU	Yes	Yes	No	9	-	-	-
IC	Yes	Yes	No	7	0	18	14
IT	Yes	No	No	7	0	20	13
LT	Yes	Yes	No	7	0	28	5
NL	Yes	No	Yes	7	0	13	20
NO	Yes	No	Yes	7	0	17	16
PL	Yes	Yes	Yes	7	0	30	3
PT	Yes	No	No	6	1	18	15
RO	-	-	No	-	-	-	-
SI	-	-	No	-	-	-	-
SK	Yes	Yes	No	7	0	23	10
UK	Yes	Yes	No	-	-	-	-

"-" no-info, or does not apply

3.2.6 Nomenclature – classes (Typology?)

Table 7 shows, besides the number of classes present (see Table 6), the list of LUA level 1 and 2 classes present and absent in the countries. At LUA level 1, class 7000 is absent in all countries with class absence. At LUA level 2, class 7400 is absent in all countries. Some little popular classes are 1500, 2300, 2400, 2500, 3500, 6400, 6500, 7100, 7300, 7500 and 7600. Only a very limited number of countries came up with UA polygons enriched with LUA level 3 codes or codes for boundary effects.

Table 7: Summary of classes in the nomenclature used by European countries to enrich the Urban Atlas with information on land use.

Country code	Nomenclature				Number of new classes	New codes
	Classes					
	Present (level 1)	Absent (level 1)	Present (level 2)	Absent (level 2)		
AT	2000, 3000, 4000, 5000	1000, 6000, 7000	2100, 3100, 3300, 3500, 5100	1100, 1200, 1300, 1400, 1500, 2200, 2300, 2400, 2500, 3200, 3400, 4100, 4200, 4300, 5200, 5300, 6100, 6200, 6300, 6400, 6500, 6600, 7100, 7200, 7300, 7400, 7500, 7600	0	-
BG	-	-	-	-	-	-
CH	1000, 2000, 3000, 4000	5000, 6000, 7000	1100, 1200, 1300, 1400, 2100, 2200, 2300, 2400, 2500, 3100, 3200, 3300, 3400, 4300	1500, 3500, 4100, 4200, 5100, 5200, 5300, 6100, 6200, 6300, 6400, 6500, 6600, 7100, 7200, 7300, 7400, 7500, 7600	0	-
CZ	all	none	1100, 1200, 1300, 1400, 1500, 2100, 2200, 2300, 2400, 3100, 3200, 3300, 3400, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6300, 6500, 6600, 7100, 7200, 7300, 7500	2500, 3500, 6400, 7400, 7600	2	-
ES	1000, 2000, 3000, 4000, 5000, 6000	7000	1100, 1200, 1300, 1400, 3100, 3300, 3400, 4100, 4200, 4300, 6100, 6200, 6600	1500, 2100, 2200, 2300, 2400, 2500, 3200, 3500, 5100, 5200, 5300, 6300, 6400, 6500, 7100, 7200, 7300, 7400, 7500, 7600	2	6310, 6320
FR	2000, 3000, 4000, 5000, 7000	1000, 6000	2300, 2400, 3100, 3200, 3300, 3400, 4100, 4300, 5200, 7100	1100, 1200, 1300, 1400, 1500, 2100, 2200, 2300, 2400, 2500, 3100, 3500, 4200, 5100, 5300, 6100, 6200, 6300, 6400, 6500, 6600, 7200, 7300, 7400, 7500, 7600	0	-
GR	all	none	1100, 1200, 1300, 1400, 1500, 2100, 2200, 2300, 2400, 3100, 3200, 3300, 3400, 3500, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6300, 6500, 6600, 7100, 7200, 7300, 7500	2500, 6400, 7400, 7600	1	3111
HR	all	7000	1200; 2100; 3100; 3300; 3400; 4100; 4300; 5100; 5200; 6100	1100, 1300, 1400, 1500, 2200, 2300, 2400, 2500, 3200, 3500, 4200, 5300, 6200, 6300, 6400, 6500, 6600, 7100, 7200, 7300, 7400, 7500, 7600	0	-
HU	-	-	-	-	0	-

Country code	Nomenclature					
	Classes				Number of new classes	New codes
	Present (level 1)	Absent (level 1)	Present (level 2)	Absent (level 2)		
IC	all	none	1100, 1300, 1400, 2100, 2300, 3100, 3200, 3300, 3400, 4100, 4200, 4300, 5100, 5300, 6100, 6500, 6600, 7100	1200, 1500, 2200, 2400, 2500, 3500, 5200, 6200, 6300, 6400, 7200, 7300, 7400, 7500, 7600	0	-
IT	all	none	1100, 1200, 1300, 1400, 1500, 2100, 2200, 3100, 3400, 3500, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6300, 7200	2300, 2400, 2500, 3200, 3300, 6400, 6500, 6600, 7100, 7300, 7400, 7500, 7600	0	-
LT	all	none	1100, 1200, 1300, 1400, 2100, 2200, 2300, 2400, 2500, 3100, 3200, 3300, 3400, 3500, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6300, 6400, 6500, 6600, 7300, 7500	1500, 7100, 7200, 7400, 7600	12	2242; 2442; 3220; 3320; 3330; 3341; 3343; 3412; 3431; 3434; 3435; 3436
NL	all	none	1100, 1200, 1300, 2500, 3100, 3300, 3400, 4100, 6100, 6300, 6500, 7100, 7500	1400, 1500, 2100, 2200, 2300, 2400, 3200, 3500, 4200, 4300, 5100, 5200, 5300, 6200, 6400, 6600, 7200, 7300, 7400, 7600	2	0 and 9999
NO	all	none	1100, 1200, 2000, 2500, 3100, 3300, 3400, 3500, 4000, 4100, 4200, 4300, 5100, 5300, 6300, 6600, 7000	1300, 1400, 1500, 2100, 2200, 2300, 2400, 3200, 5200, 6100, 6200, 6400, 6500, 7100, 7200, 7300, 7400, 7500, 7600	0	-
PL	all	none	1100, 1200, 1300, 1400, 1500, 2100, 2200, 3100, 3200, 3300, 3400, 3500, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6300, 6400, 6500, 6600, 7100, 7200, 7300, 7400, 7500, 7600	2300, 2400, 2500	1	0
PT	1000, 2000, 3000, 4000, 5000, 6000	7000	1100, 1200, 1300, 1400, 2400, 2500, 3100, 3300, 3400, 3500, 4100, 4300, 5100, 5200, 6100, 6200, 6300, 6600	1500, 2100, 2200, 2300, 3200, 4200, 5300, 6400, 6500, 7100, 7200, 7300, 7400, 7500, 7600	0	-
RO	-	-	-	-	0	-
SI	-	-	-	-	0	-
SK	all	none	1100, 1200, 1300, 1400, 2100, 2200, 2300, 2400, 3100, 3200, 3300, 3400, 3500, 4100, 4200, 4300, 5100, 5200, 5300, 6100, 6200, 6600, 7600	1500, 2500, 6300, 6400, 6500, 7100, 7200, 7300, 7400, 7500	0	-
UK	-	-	-	-	-	-

"-" no-info, or does not apply

3.3 CONCLUSIONS

The data provided in this task by most of countries may be successfully compared to each other, however, there are some issues that may limit the analysis and the comparability of results.

Many countries have pointed out problems that may affect the enriched polygons of the urban atlas. The main issue is related to the geometry of objects and topology, because it is unlikely that many land use parcels fit exactly into the enriched dataset. This makes it difficult to assign land use classes to urban atlas polygons. Some UAs polygons were large and intersected with several land use polygons, which made it difficult to enrich the datasets. Most countries have solved this issue by aggregating information and assigning the most frequent land use class or the largest proportional area in the polygon. In addition, in some cases, the UAs polygons overlapped only partly with LU polygons, which additionally results in differences in data enrichment.

Two main methodologies could be discerned: 1. A GIS based methodology of intersection of UA with national source data (whether or not followed by aggregation), 2. Manually attribution of LUA classes to UA polygons.

1. Enrichment by intersection should result in an enriched database with per LUA an attribute indicating their presence (% and/or ha). As the enrichment exercise is not dealing with the enhancement of geometry, but with the enhancement of attribution, the geometry of the UA dataset should be taken as basis and the UA polygons should be enriched with LU information derived from an intersection with, if available, the national spatial data source.

2. Enrichment on manual basis by interpretation of AP, or

3. other ancillary data will be limited to one or two attributes, i.e. LUA level 1 and/or 2.

The attributes filled in during the enrichment were not defined beforehand. It was not clear what information is expected from Member States. Only the majority land use class (LUA class) or for example also per LUA class their presence in absolute terms, relative importance and/or surface area (ha).

Due to different methods used and attribute fields defined by the countries an integration of the different countries into one harmonized dataset reflecting e.g. the majority LUA level 1/2 per UA polygon is not directly in scope/sight.

The issue that may disable the enrichment of all UAs with information about the use of land is the lack of such data for all the cities, what was raised by Croatia, which possesses such data only for the capital. In addition, the United Kingdom has drawn attention to the licensing issue for Northern Ireland, which has resulted in the enrichment of only a few demonstrations in the UK.

Another point is the different source of data used for enrichment, its validity, resolution and quality, what may contribute to low comparability of results between all cities. An indication for the comparability is the number of classes present in the source data and the number of LUA level 1 or level 2 classes present in the enriched UA datasets. The thematic richness of the source data is reflected in this parameter.

The description of the source data used in the enrichment exercise is not provided in standardized way which does not allow to compare the data between countries. Harmonization between countries based on common methodology and/or EAGLE nomenclature is not directly leading to comparable datasets. It depends also largely on the content of national source data used (thematic, spatial and temporal detail).

Further, the question of the extension of the EAGLE classes has been raised, as can be seen by the fact that some countries have generated new classes because those that are represented in the EAGLE nomenclature were not sufficient to use the richness present in

the national datasets. However, EAGLE level 3 classes can be easily aggregated to EAGLE level 2 classes. It is suggested to define a minimum set of classes encompassing the majority of existing classes and actually required ones.

A standardized format for reporting on the enrichment of UA by MS should be made available and used by the countries to have a more standardized methodology, description of source data used etc.

4 SUGGESTIONS FOR A FUTURE HARMONIZED APPROACH

In the following, we suggest a guideline that may help in the next approach of the enrichment of UAs with the information on the land use.

The most important issues that should be met are:

- a technical report template containing information about what has been done, the type of used methods, the data type and the processing steps should be provided;

- the folder structure of data delivered should be defined beforehand;

- the names of delivered files should be pre-defined;

- the data should be provided for as one file for MS for all UAs present in country;

- the data should be provided in the same format what would allow easy and fast comparison of datasets delivered by different MS (e.g. File geodatabase, which allows countries with a large number of cities to be enriched, to provide data entirely as a single file);

- the projection and coordinate system for all countries should be the same to avoid difficulties in loading and displaying data for all UAs across Europe (e.g. Projected Coordinate System: ETRS 1989 LAEA and Projection: Lambert Azimuthal Equal Area);

- the data should have the same attribute table – the number of columns and their type should be pre-defined;

- enriched datasets should have information/attributes on % and/or area of all LUAs present within the UA polygons of the FUAs covered (if the enrichment is done by intersection)

- the enrichment should be performed according to the EAGLE nomenclature, if possible (Table 8);

- a conversion matrix of land use classes to EAGLE should be provided by MS;

- a good description of the national data source (number of classes, spatial detail, update frequency, definition of classes, accessibility etc.) should be included in the report provided with data;

- the number of FUAs present in the countries should be harmonized with the ones available through EEA's website;

- UA boundaries overarching national boundaries. Harmonised national MS boundaries should be used to clip UA polygons to avoid that UA polygons are sometimes not be covered by national data (at the countries boundary);

- a kind of EAGLE LUA rest class should be created for land uses that are not covered/are missed/can not be translated to the current EAGLE LUA level1/level2 nomenclature, as e.g. ocean/sea is not covered (only inland water).

Table 8: EAGLE nomenclature: Level 1 and Level 2

Level 1 class	LU_Level_1_code	Level 2 class	LU_Level_2_code
Primary Production	1000	Agriculture	1100
		Forestry	1200
		Mining and Quarrying Quarrying extraction sites	1300
		Aquaculture and Fishing	1400

Level 1 class	LU_Level_1_code	Level 2 class	LU_Level_2_code
		Other Primary Production	1500
Secondary Production	2000	Raw Industry	2100
		Heavy End Product Industry	2200
		Light End Product Industry	2300
		Energy production	2400
		Other Industry	2500
Tertiary Production	3000	Commercial Services	3100
		Financial, Professional and Information Services	3200
		Community Services	3300
		Cultural, Entertainment and Recreational Services	3400
		Other Services	3500
Transport networks, Logistics and Utilities	4000	Transport networks	4100
		Logistics and Storage Services	4200
		Utilities	4300
Residential Use	5000	Permanent Residential Use	5100
		Residential Use with Other Compatible Uses	5200
		Other Residential Use (Non-Permanent)	5300
Other Uses	6000	Transitional Areas	6100
		Abandoned Areas	6200
		Natural Areas Not In Other Economic Use	6300
		Areas Where Any Use Allowed	6400
		Areas Without Any Specified Planned Use	6500
		Not Known Use	6600
Inland Water Functions	7000	Drinking Water	7100
		Irrigation Water	7200
		Fire-fighting Water	7300
		Artificial Snow Water	7400
		Water Retention Area	7500
		Water Energy Reservoir	7600

Extracted from the EAGLE matrix Land Use attributes:
https://land.copernicus.eu/eagle/content-documentation-of-the-eagle-concept/manual/content-documentation-of-the-eagle-concept/b-thematic-content-and-definitions-of-eagle-model-elements/part-ii-land-use-attributes

Step by step guideline for future harmonized approach of urban atlas enrichment with information on land use:

1. Download the Urban Atlas dataset (https://www.eea.europa.eu/data-and-maps/data/urban-atlas)

2. Create a File Geodatabase named "Enriched_UA_XX" and import all Urban Atlas datasets into this database. And integrate all UA shapefiles into one country feature class UA_XX (if possible)

   Please note that XX is the country code, which are the first two signs in the ZIP file downloaded in Point 1 (e.g. AT, BE, BG, CY, CZ, …)

3. Import the XX_DB2012 database used for the enrichment into the File Geodatabase

   Please note that XX_DB2012 is the national land use database

4. Import and convert the look up table into the File Geodatabase

   Please note that the look up table contains the information on the link between the national classes and the LUA level 1 and/or 2

   Please note that the attributes could look like:

   OBJECTID, XX2012, Description, LUA_LEVEL2, LUA_name

         1,   10,   Railroad,   4100, Transports networks

   In which XX2012 is the country class equivalent to the LUA_LEVEL2 code.

5. Join the field LUA_LEVEL2 to feature class XX_DB2012 on XX2012 code

6. Overlay (Identity) feature class XX_2012 with UA_XX -> UA_DB2012_XX feature class

7. Frequency on attribute table of feature class UA_DB2012_XX. Input is OBJECTID (from UA_XX) and LUA_LEVEL2. Summarize shape_area -> UA_DB2012_XX_frq

8. Create two additional columns for each LUA_LEVEL1/2 code to attribute table UA_XX. One named "Area" and one named "Percentage". Type "Double", Type Name "Real".

   Or create two additional columns named: "LU_Level_1", "LU_Level_2" with the type set as "String" for the majority LUA_Level1/2

9. Walk through all records of UA_XX and on basis of the OBJECTID get the values from the frequency table