UN-GGIM EUROPE

UNITED NATIONS COMMITEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Core Spatial Data Theme Hydrography Recommendation for Content

Working Group A - Deliverable of Task 1.b

Version 1.1 - 2022-08-02

Version History

Version number	Date	Modified by	Comments
1.0	2020.01.10	WG A	Consolidated draft, for review by geostatistical community
1.1	2022.08.02	WG A	Comments from geographic and statistic community taken into account Definitive deliverable

Warning: in the following parts of this document, the paragraphs written in grey e.g. "This document has annexes containing more detailed explanations " are common to all core spatial data themes; they aim to provide context and objectives of core data. The paragraphs written in black are specific to core spatial data theme Hydrography.

Content

1 Executive Summary

In September 2015 the countries of the United Nations adopted the 2030 Agenda for Sustainable Development; a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda are supported by 169 targets and 230 indicators.

Geospatial data supports the measuring, achieving and monitoring of many of the goals and targets set by the 2030 Agenda. The 2030 Agenda demands new data acquisition and integration approaches to improve the availability, quality, timeliness and disaggregation of data. Goal 17 explicitly emphasizes the need for developing capacities and partnerships. In this context the success of the 2030 Agenda depends on senior administrators owning and leading the geospatial efforts in their respective countries.

In Europe, building on the INSPIRE Directive redirecting the focus on a cohesive spatial data infrastructure without gaps in content and discrepancies in quality, stakeholders are working on geospatial standardization and increasing richness of data through Core Data Recommendations for Content that correspond to the first phase of WGA work program. Core data is primarily meant for fulfilling the common user requirements related to SDGs in Member States and European institutions.

Theme ‘Hydrography’ deals with inland water that is a precious natural resource that unfortunately becomes increasingly scarcer and so, fresh water has to be carefully protected and managed in order to fill its various uses. Water is condition of life. This is why data on this theme is strongly necessary to achieve most of the SDG, and especially to SDG 6 about clean water.

Core theme Hydrography focuses on the description of inland waters (rivers, lakes …), of drainage basins and of coastal area (shore, shoreline). One of the main requirements is to ensure correct topology of the hydrographic network. Capturing large scale data as 2.5D, i.e. with its Z coordinate, is encouraged as it enables to forecast the water flow direction. Production of a reference shoreline that may be used to delimitate administrative and regulated areas is also recommended.

Hydrographic features should be captured with some basic attributes (name, persistency, origin, tidal…) and a set of codes or identifiers enabling linking with business data, such as water quality measures.

Hydrography data is necessary at various scales in order to be used by different levels of government. It should ideally be captured at large scale and then derived by generalisation at medium and small scales. The pan-European products EuroRegionalMap and EuroGlobalMap have strongly influenced the recommendations of content for core theme Hydrography and are more or less implementing the medium and small scale levels of detail.

2 Foreword

2.1 Document purpose and structure

2.1.1 Purpose

This document provides the main characteristics of core data for theme Hydrography with focus on the recommendation for content. This document aims to help decision makers (from governments, data producers, national coordination bodies, etc.) to define their policy regarding the improvement of existing data and production of new geospatial data. It addresses digital data.

This document has Annexes containing more detailed explanations targeting the technical people who will be in charge of implementing or adapting core data recommendations (e.g. for production purpose, as source of other standards, etc.).

2.1.2 Structure

The executive summary synthesizes the main conclusions of the Working Group A (WG A) process and results to develop the recommendation for content. It is meant mainly for high level decision makers.

The foreword reminds the general context of core data, the first step achieved by WG A (i.e. selecting core data themes), and it explains the general principles set by WG A to develop the recommendations for content of core data specifications for all selected themes.

The 'recommendation for content' document itself includes four chapters:

- Overview: it provides the general scope of the theme and describes the main use cases addressed;
- Data content: it provides the main characteristics of the recommended content, such as the list of core features and attributes (for vector data), as well as data capture and quality rules;
- Other recommendations: e.g. Coordinate Reference System, Metadata, Delivery;
- Considerations for future: this chapter addresses some key trends or significant user requirements that cannot be considered as core today but that might be considered in future.

The 'recommendation for content' document is meant for medium level decision makers. It is written in natural and not too technical language.

The technical explanations included in annexes describe the relationship between the recommendation for content and the corresponding INSPIRE specification, and contain any other appropriate information useful for this theme.

2.2 Core data context

2.2.1 Rationale for core data

The following background of harmonised pan-European data was identified.[1]

Authoritative geospatial data are used to support both the implementation of public policies and the development of downstream services. Moreover, geospatial data are required to be homogenous to enable the implementation of public policies in a coherent and coordinated way among countries and at regional or global level. Likewise, significant opportunities exist if services developed by industry can be exploited without requiring country specific adaptation.

The INSPIRE Directive has set up the legal and technical framework for harmonisation of the existing data related to the themes in annexes I, II and III. INSPIRE specifications provide common data models that ensure a first step towards interoperability, however ensuring homogeneous content is outside their scope, as they contain no indication about levels of detail, very few recommendations about quality, and as most features and attributes are "voidable", i.e. to be supplied if available or derivable at reasonable cost.

This background led the UN-GGIM: Europe Regional Committee to setup in 2014 the Working Group A on Core Data to deal with core data content and quality, production issues, funding and data availability.

Recommendations for content of core data will complement INSPIRE data specifications by defining the priorities on the core content that is encouraged to be made available in Europe in order to fulfil the main user requirements that are common to many countries, with focus on the SDG related ones.

Core data availability may be ensured either through upgrading of existing data when feasible or through production of new data when necessary.

2.2.2 Core data scope

In its first phase, WG A selected core data themes according to the following criteria: core data is the geospatial data that is the most useful, either directly or indirectly, to analyse, to achieve and to monitor the Sustainable Development Goals.

Among the 34 INSPIRE data themes, 14 have been considered as core including theme Hydrography.

More information about the selection process and results may be found in document 'Core Data Scope - Working Group A - First Deliverable of Task 1.a - Version 1.2' on http://un-ggim-europe.org/content/wg-a-core-data

[1] Extract from the Report by the Preparatory Committee on the establishment of the UN-GGIM: Europe Regional Committee, European Commission Ref. Ares(2014)1491140 - 09/05/2014.

2.3 Document objectives and principles

2.3.1 Encouraging content availability

This deliverable provides recommendations for national governments and data producers, aiming to help them to define their priorities for enriching existing data or producing new data. This deliverable is meant mainly for data producers, however it defines the recommended result and target but not the production process.

2.3.2 Complementing INSPIRE

Core data specifications are built upon INSPIRE data specifications. On one hand, they often simplify INSPIRE by selecting core feature types and attributes and by restricting or clarifying the scope; On the other hand, they enrich INSPIRE by recommending specific levels of detail, quality rules and sometimes data model extensions. Besides, the INSPIRE common terminology is thoroughly used for naming core features and attributes.

Regarding the levels of detail, the ELF (European Location Framework) project terminology has been used. The ELF levels of detail are the following: Global, Regional, Master level 2, Master level 1, Master level 0. These terms are defined in the glossary.

Regarding delivery, core data may be supplied according to several ways. It is expected that, very often, the core data recommendations will be used to enrich and upgrade existing products. In this case, core data will be available through these improved products. Core data may also be delivered through INSPIRE conditions (specifications and services).

2.3.3 Status of core data recommendations

This document contains recommendations that are not legally binding. However, some recommendations are more important than others. This order is indicated as follow:

Core Recommendation X

It is first priority recommendation, considered as both necessary and achievable in principle. Ideally, it should encourage involved stakeholders to launch short-term actions (typically within a couple of years).

Core recommendations are usually addressing only technical aspects and are meant for the organisations in charge of producing this theme. The set of core recommendations defines the basic expectations on core data.

Good Practice X
It is second priority recommendation; if adopted, it will provide significant added value to core data; it indicates a relevant trend to be adopted as much as possible. It encourages involved stakeholders to take these recommendations into account in long term, if not possible in short term.

NOTE: some of these good practices may be quite easy to achieve and are already effective in some countries whereas some others may be more difficult to achieve. This is typically the case when these good practice recommendations involve other stakeholders in addition to the organisations in charge of producing this theme, and when they address not only technical aspects but also legal or organisational ones.

A "core data set" should contain the minimum data defined by the core recommendations (and ideally also by the good practices) of this deliverable but may of course contain more and/or better information.

2.4 Abbreviations

CRS	Coordinate Reference System
ELF	European Location Framework
EGM	EuroGlobalMap
ERM	EuroRegionalMap
SDG	Sustainable Development Goal
UN-GGIM	United Nations initiative on Global Geospatial Information Management
HY	INSPIRE theme Hydrography
WFD	Water Framework Directive
WG A	(UN-GGIM: Europe) Working Group on Core data

2.5 Glossary

2.5.1 Levels of detail

Global	Level of detail defined by ELF: data to be used generally at scales between 1: 500 000 and 1: 1 000 000, i.e. mainly at international level
Regional	Level of detail defined by ELF: data to be used generally at scales between 1: 100 000 and 1: 500 000; data mainly for national or regional (European or cross-border) actions.
Master level 2	Level of detail defined by ELF: data to be used generally at scales between 1: 25 000 and 1: 100 000); data mainly for regional (sub-national) actions.
Master level 1	Level of detail defined by ELF: data to be used generally at scales between 1: 5 000 and 1: 25 000; data mainly for local level actions.
Master level 0	Level of detail defined by ELF: data to be used generally at scales larger than 1: 5 000; typically, data at cadastral map level, mainly for local level actions.

NOTE: the above definitions are indicative; in practice, detailed data (Master levels) may also be required also by national, European or international users.

2.6 Reference documents

INSPIRE Data Specification on Hydrography – Technical Guidelines 3.1:
http://inspire.ec.europa.eu/id/document/tg/hy

EuroGeographics/ ERM V11.1 Data Specification

https://eurogeographics.org/wp-content/uploads/2018/05/ERM_v11-1_DataSpecification.pdf

EuroGeographics/ EGM V10.0 Data Specification

https://eurogeographics.org/wp-content/uploads/2018/04/EGM_Specification_v10.pdf

3 Overview

3.1 General scope

<u>Definition:</u> Theme Hydrography relates to the description of surface inland waters. It includes the hydrographic network and associated drainage basins, lakes, rivers, other inland water features and the shoreline. [WG A definition]

NOTE 1: The scope of Core data theme Hydrography is based on the INSPIRE theme Hydrography. In practice, it includes almost whole content of sub-theme HydroNetwork and significant part of sub-theme PhysicalWaters.

NOTE 2: In order to avoid data production duplication, the navigability characteristics of inland waterways that are in INSPIRE under sub-theme Water Transport Network have been considered under core theme Transport Networks.

More detailed comparison with INSPIRE is available in Annex A.

NOTE 3: The theme is limited to surface inland waters. Underground waters and sea waters are not considered as being part of core theme Hydrography.

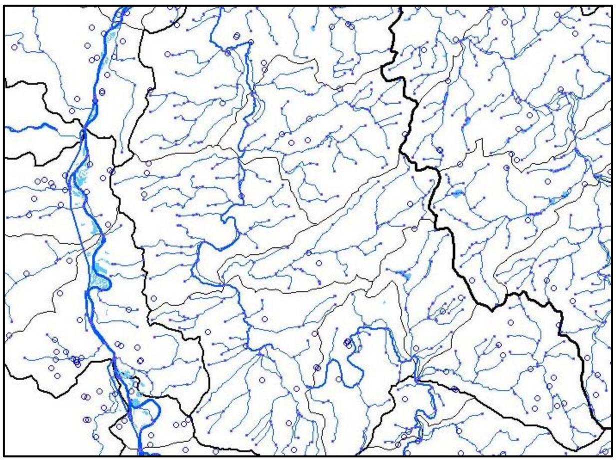


Figure 1: Example of data on theme Hydrography

3.2 Use cases

Theme 'Hydrography' deals with inland water that is a precious natural resource that unfortunately becomes increasingly scarcer and so, fresh water has to be carefully protected and managed in order to fill its various uses. However, water is also a source of risk by propagating floods or pollution.

In the analysis phase, locations of surface waters and river networks are keys to understand water flows and assets, to predict different kinds of floods and water pollutions. Data about Hydrography is also required for various environmental studies, e.g. to understand ecosystems (such as wetlands) or to forecast the climate change and its impacts. In addition, the hydrography will also influence transport system as watercourses may be both obstacles to road or rail transport and means of transport, if they are navigable. Watercourses and their floodplains have impact on the built development.

In the operational phase, the Hydrography data will be used to decide on the protection and on the exploitation measures. For instance, strips along watercourses will become protected areas where it will be forbidden to spread pesticides; the presence of a river will imply specific protection when depolluting a contaminated area; the various water users have to manage the resource, at drainage basin level; choosing relevant location of a new water treatment plant or of water monitoring sensors can be done only with knowledge of hydrographic data. All these decisions have to be applied and monitored and Hydrography data is also quite useful for delivering water abstraction permits, for reporting to European directives, such as the Water Framework Directive, or for SDG indicators.

As other topographic data, Hydrography is also required for communication purposes in 2D maps and in 3D models.

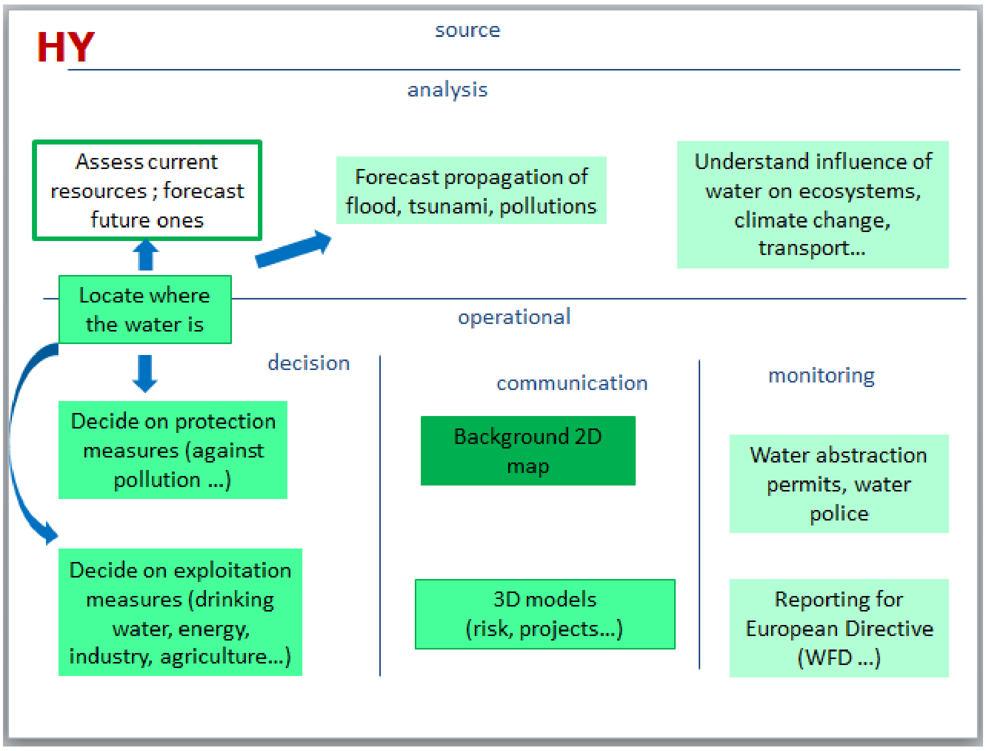


Figure 2: Map of use cases for theme HY

4 Data content

4.1 Features types and attributes

Core Recommendation 1
Core data should include the first priority feature types and attributes of the following tables.

<u>Good Practice 1</u>
In addition, it is recommended to provide the second priority feature types and attributes of the following tables.

NOTE 1: There may be first priority attributes on features considered as second priorities; if the feature is captured (good practice), it should be captured with its core attributes ; if not, the feature might be meaningless or useless.

4.1.1 Common attributes

Type	Attribute	Values / enumeration	Priority
Common attributes	identifier	CharacterString (or integer)	**1**
	beginLifespanVersion	Date Time	**2**
	endLifespanVersion	Date Time	**2**

Table 1: Common attributes

4.1.2 Hydrographic Network

Type	Attribute	Values / enumeration	Priority
Watercourse Link (priority 1)	geometry	GM_Curve	1
	level	VerticalPositionValue * onGroundSurface * suspendedOrElevated * underground	1
	persistence	HydrologicalPersistenceValue * dry * ephemeral * intermittent * perennial	1
	tidal	boolean	1
	flow	LinkDirectionValue * bothDirections * inDirection * inOppositeDirection	1
	streamOrder	CharacterString	1
	hydroIdentifier	CharacterString	1
	name	GeographicalName	1
	origin	OriginValue * manMade (for canals) * natural	1
	fictitious	Boolean	1
	TransEuropean Transport Network	TenTNetworkValue * Core TenT Network * Comprenhensive TenT Network * No TenT Network	1
	CEMTClass (navigability class)	CEMTClassValue * I *II *III * IV *Va *Vb * VIa *VIb *VIc *VII	1
Watercourse (priority 1)	definition	Set of watercourse links	1
	hydroIdentifier	CharacterString	1
	name	GeographicalName	1

Type	Attribute	Values / enumeration	Priority
HydroNode (priority 1)	geometry	GM_Point	1
	name	GeographicalName	1
	hydroNodeCategory	hydroNodeCategoryValue * boundary * flowconstriction * flowRegulation * junction * outlet * source	1

Table 2: Expected content of Hydro Network

NOTE 1: The CEMTClass defines the type of vessel that may navigate (CEMT states for "European Conference of Ministers of Transport»). If this information is too difficult to capture, an alternative solution would be to indicate, by a Boolean value, if the watercourse link is navigable or not (for commercial purposes).

NOTE 2: A Watercourse is an aggregate of all the watercourse links having the same hydroIdentifier and/or the same name and being the neighbour of one another. This feature type is a bit redundant as it could be derived from the watercourse links but it is more user-friendly to have the aggregation done once by the data producer than many times, i.e. once by each user.

4.1.3 Other hydrographic features

Type	Attribute	Values / enumeration	Priority
Watercourse Area (priority 1)	geometry	GM_Surface	1
	name	GeographicalName	1
	persistence	HydrologicalPersistenceValue * dry * ephemeral * intermittent * perennial	1
	tidal	boolean	1
	origin	OriginValue * manMade * natural	1
Standing Water (priority1)	geometry	GM_Object (Surface or Point)	1
	name	GeographicalName	1
	persistence	HydrologicalPersistenceValue * dry * ephemeral * intermittent * perennial	1
	tidal	Boolean	1
	origin	OriginValue * manMade (at least in case of dams) * natural	1
	hydroIdentifier	CharacterString	2

NOTE 1: The width of the watercourse may be derivable from the WatercourseArea geometry. If this feature is not captured (this may be the case for minor watercourses), an alternative solution is to provide the width range as an attribute on WatercourseLink features.

Type	Attribute	Values / enumeration	Priority
Drainage Basin (priority 1)	geometry	GM_Surface	1
	name	GeographicalName or CharacterString	1
	hydroIdentifier	CharacterString	1
	basinOrder	CharacterString	
Shoreline (priority 1)	geometry	GM_Curve	1
	waterLevel	WaterLevelValue *highestHighWater *highWater *lowestLowWater *lowWater * meanSeaLevel * …	1
	origin	OriginValue * manMade * natural	2
Shore (priority 1)	geometry	GM_Surface	1
Dam (priority 1)	geometry	GM_Object	1
	hydroIdentifier	CharacterString	2
Lock (priority 1)	geometry	GM_Object	1
	hydroIdentifier	CharacterString	2
Falls (priority 2)	geometry	GM_Primitive	1
	name	GeographicalName	1

Table 3: Expected content of other hydrographic features

NOTE 1: The attribute waterLevel may take values in the INSPIRE code list that includes around 40 values. To keep the table synthetic, only a few values have provided as examples.

NOTE 2: The attribute hydroIdentifier aims to identify real-world entities. This is why it is recommended to capture it on feature types for which there is a 1:1 relationship between the real-world entity and the database feature at any representation scale. In practice, this hydro identifier has to be captured mainly on watercourses and on drainage basins. In addition, it is advised to capture it when possible on standing waters, locks and dams.

NOTE 3: Regarding Drainage Basins, the “name” is generally a code that may be identical to the hydro identifier. If this is not the case, both attributes should be captured.

4.1.4 Temporal aspects

Core Recommendation 2
Current, valid features are considered as core data.

NOTE 1: In other words, efforts to capture features of the past (obsolete, destroyed, disused) or features of the future (under project, under construction) are not considered as a priority.

NOTE 2: Core data being minimum data, a data producer may of course also capture features of the past or features of the future as additional data; in these cases, it is advised to document the attribute "condition" in order to make distinction between past, current and future features. In practice, for Hydrography, the case is mainly limited to artificial watercourses (canals).

However, once features have been captured, it is recommended to keep them in the data base, even after their end in the real world.

Good Practice 2
It is recommended to manage the history of features, using the mechanism provided by the INSPIRE data specifications: versioning and life-cycle attributes.

NOTE 1: The life-cycle attributes are the beginLifespanVersion and the endLifespanVersion (already included in table 1).

NOTE 2: The versioning and life-cycle attributes enable change-only updates; they also enable to retrieve the status of geographic Hydrography data, at any time of the past (since the adoption of these mechanisms).

NOTE 3: The above Core recommendation and good practice may look contradictory but in fact they are not. Let us imagine a data producer deciding to implement the core recommendations and good practices of this deliverable from 2020:

- In a first step, according to the above Core recommendation, first priority is to capture the features that are valid (in 2020), as they are both the most useful and the easiest to be captured. For instance, capturing features from the past would require significant efforts for limited benefits.
- In a second step, for instance in 2025, a given entity disappears in the real-world; the related feature – already captured in 2020 – should be kept in the database as "deprecated", which is documented by the life-cycle attributes of INSPIRE. This may be done rather easily just through proper database management.

NOTE 4: If keeping deprecated features in same database as current ones raises issues (e.g. for maintenance of the hydrographical network), an alternative solution would be to keep these deprecated features in a separate layer of historic data.

4.2 Levels of detail

Core Recommendation 3
Core data on Hydrography should be produced at least at Master Level 1 and at Regional and Global levels.

NOTE 1: The recommended method is to ensure the initial capture of Hydrography data at Master Level 1 or better and to get the other levels of detail by generalisation from the Master Level 1 data. The generalisation process implies mainly selection of main features and simplification of geometry.

NOTE 2: Regarding Regional and Global levels, this core recommendation has already been (more or less) achieved through the pan-European products of EuroGeographics: EuroRegionalMap and EuroGlobalMap. The efforts to maintain such products should be continued in future.

NOTE 3: When there is no explicit indication about concerned level(s) of detail, it means that the core recommendation, good practice or NOTE applies to all core levels of detail, namely Master Level 1, Regional, Global.

4.3 Geographical extent

Core Recommendation 4
Core data on Hydrography should be available on whole national land territory, including the shore.

NOTE 1: By definition (chapter 3.1), theme Hydrography has been restricted to surface inland waters and shoreline.

4.4 Data capture

4.4.1 Single production data set for Hydro Network, Physical Waters and navigability

The INSPIRE theme Hydrography includes two instantiable application schemas: Hydro Network and Physical Waters. The repartition of hydrographic data between two sub-themes may also occur in the existing geographic management system of some countries, with NMCAs generally responsible for production of data about Physical Waters and Water Offices or Environmental Agencies responsible for the production of Hydro Network data.

However, the recommendations for content of core theme, are recommending, for each expected level of detail, a single production data base from which the INSPIRE sub-themes Hydro Network and Physical Waters could be derived. In practice, in case of common entities between Hydro Network and Physical Waters, the attributes of each sub-theme should be carried on a single geometry (per level of detail). A single data set is considered as more convenient for users, allowing easy use and avoiding geometric discrepancies.

Similar issue and proposed solution also occur for the navigability information of watercourses (that is in INSPIRE under sub-theme Water Transport Network.

Good Practice 3
For each level of detail, it is advised to capture the content of (INSPIRE) sub-themes Hydro Network and Physical Waters and the navigability information of (INSPIRE) sub-theme Water Transport Network in a single production database.

NOTE 1: In practice, this will imply coordination between data producers, if there are several ones dealing with Hydrography data.

NOTE 2: In addition, for the Member States who have to report for EU Directives, it may be of interest to enrich this single production database with the attributes required by the concerned

Directives, such as the Water Framework Directive in order to enable the derivation of reporting units as defined by Annex III of INSPIRE.

4.4.2 Geometry representation

Core Recommendation 5
Core feature types should be captured with relevant geometric representation.

NOTE 1: The geometric representation is indicated in tables 2 and 3. The question arises when there is a choice, for instance {Surface, Line or Curve} for waterfalls, locks or dams. At Master level 1, the relevant geometry may be a surface, a curve (or in limited cases, a point) whereas at Regional level, these features should likely be represented as points.

Core Recommendation 6
At least, the large scale hydrographic network should be captured as 2.5 D data.

NOTE 1: 2.5D data means that geometry of features is represented in a three-dimensional space with the constraint that, for each (X, Y) position, there is only one Z.

In practice, 2.5 D data enables to derive the profile of a river and so, to understand and forecast the flow direction or a pollution of flood propagation.

NOTE 2: It is also advised to capture other features as 2.5D data. For instance, it would enable to derive the elevation value of a lake (or other Standing Water) by extracting the common Z value of its perimeter. However, 2.5D is not enough to get a 3D representation of the lake and to derive its volume or depth.

NOTE 3: This recommendation states mainly for the Master Level 1; at Regional and Global levels, the generalisation process would degrade the reliability and interest of the Z value.

4.4.3 Feature and attribute selection

Regional and Global levels offer a generalised view of the Hydrography theme where only the most relevant features according to the level of detail have been selected.

Good Practice 4
As a general rule, for the common features types between core data and ERM/EGM, it is advised to use the selection criteria of ERM and EGM.

NOTE 1: The selection criteria of EGM and ERM benefit from a long experience of production process and user feed-back.

Some attributes are especially relevant for the generalized Levels of Detail (Regional and Global), such as the TransEuropean Transport Network information.

Some of the alternative solutions mentioned in this document have also been implemented by ERM and EGM, such as the addition of the width range attribute on Watercourse Links (to compensate the generalisation impact of Watercourse Areas).

NOTE 2: At large scale, it is expected that all hydrographic features (listed in chapter 4.1) will be captured. No selection criterion has to be applied since the Master level 1 database should provide a complete view of the real world.

4.4.4 Geographical Names

In theme Hydrography, not all features have names: however, this is generally the case of watercourses, of standing waters and of some waterfalls, locks, dams, hydrographic nodes, shores, etc.

Core Recommendation 7
When a feature has one or several names, these names should be captured.

NOTE 1: Geographical names are key information as they are a familiar way for most users to identify and locate features.

NOTE 2: In practice, data producers may manage these names in theme Hydrography but also in theme Geographical Names as a toponymal data base. The first option is more user-friendly but the alternative one is quite acceptable as long as there is an easy way to join the name stored in toponymal database to the related hydrographic feature.

NOTE 3: The names should be captured, according to the recommendations stated in document "Spatial Core Data theme Geographical Names – Recommendations for content", i.e. with the name spelling and with information on its language, status and (if relevant) source.

4.4.5 Shoreline

Core Recommendation 8
A reference shoreline should be captured for Master Level 1.

NOTE 1: This reference shoreline should be used for the regulated areas having the shoreline (or part of it) among their boundaries. It may also be used for the delineation of coastal Administrative Units and Cadastral Parcels.

NOTE 2: This reference shoreline should generally correspond to some high water level; it may be for instance defined by Highest High Water or by Mean High Water (as the INSPIRE feature type Coastline).

NOTE 3: Other types of shorelines may be of interest, e.g. to monitor coastal erosion or to delimit the shore (i.e. a low water level shoreline).

4.5 Quality

4.5.1 Completeness

Core Recommendation 9
Completeness should be ensured at least for the first priority feature types, according to the selection criteria of chapter 4.4.

NOTE: In practice, it is recognised that 100% completeness may be difficult to achieve; the (very) minimum aim should be to maintain completeness of 95% of core hydrographic feature types.

4.5.2 Geometric accuracy

Waterbodies geometry varies across time according to the season and to the past and recent meteorological conditions. As a consequence, there is no permanent reference geometry with well-defined accuracy.

As a general rule, the geometric accuracy should be adapted to the level of detail. For Master Level 1, accuracy should be around 10 m, it should be around 125 m for Regional Level and around 1000 m for Global Level.

4.5.3 Topologic consistency

Core Recommendation 10
Great care has to be taken to ensure that the topology of the hydrographic network data respect the real world topology.

NOTE 1: This implies that the continuity of hydrographic network should be ensured when a watercourse crosses a lake or when it flows underground. The attribute “fictitious” is devoted to document the approximate geometries used to ensure the network continuity.

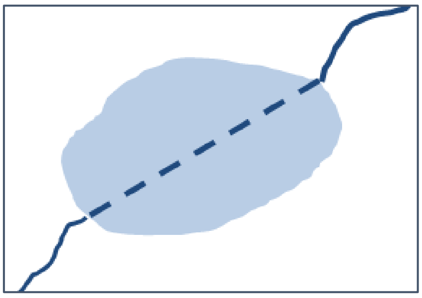


Figure 3: A fictitious geometry is used to ensure the watercourse continuity within a lake

NOTE 2: One of the topologic constraints is to avoid creating nodes in case of grade separated crossings, as there is no junction in real-life. The case may arrive for canals located on a bridge.

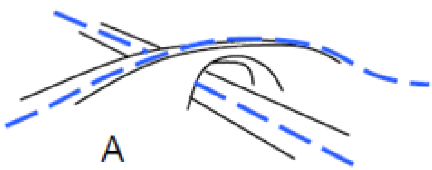
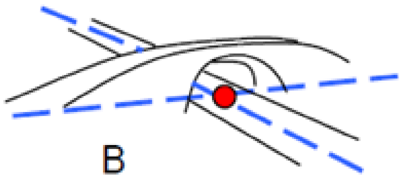
		
Real world: canal on a bridge over a river	Modelling option to be chosen in the dataset (no node)	Modelling option to be avoided in the dataset (with node)

Figure 4: Grade separate crossing

NOTE 3: Regarding Figure 4, the information about which watercourse is above and which watercourse is below may be derived from the 2.5D data and/or from the “level” attribute.

NOTE 4: Core recommendation n° 9 addresses the respect of topology by the geometric representation but also through the explicit associations between the watercourse links and their initial and final nodes. Therefore, it is advised to implement the network associations between watercourse links and watercourse nodes.

NOTE 5: Another topologic constraint is to ensure the network continuity at international boundaries. Ideally, this should be done by geometry edge-matching. An alternative is to use the INSPIRE feature Network Connection.

4.5.4 Update frequency

Good Practice 5 The update frequency for theme Hydrography should be six years or better

NOTE 1: This minimum update frequency is driven by reporting obligations (for European Union) and is considered as a reasonable target for a theme with slow natural evolutions, at least in most cases.

NOTE 2: In addition to the systematic 6 years scanning of hydrographic data, it is advised to set up a continuous update process to deal with the significant changes, due to human actions (e.g. new canal, new dam creating new artificial lake).

5 Other recommendations

5.1 Coordinate Reference System (CRS)

5.1.1 Horizontal CRS component

Good Practice 6 Core data should be stored and managed in a CRS based on datum ETRS89 in areas within its geographical scope, either using geographic or projected coordinates.

NOTE 1: Geographical scope of ETRS-89 excludes over-sea territories, such as Canary Islands or French Guyana or Madeira Islands and Azores Islands. In these cases, it is recommended to use a CRS based on ITRS (International Terrestrial Reference System).

NOTE 2: Storing and managing data in CRS based on international datum facilitates the import of measures from modern sensors, ensures that data is managed in a well-maintained geodetic framework and of course, facilitates the export of data into international CRS (e.g. those mandated by INSPIRE).

NOTE 3: If core data at regional and global levels has to be provided as a single data set on an area including over-sea territories, it is recommended to use as CRS geographic coordinates with any realisation of the International Terrestrial Reference System (ITRS), known as International Terrestrial Reference Frame (ITRF). At small or medium scales, all ITRS realisations can be considered as equivalent, as deviations between them are negligible compared to data accuracy.

5.1.2 Vertical CRS component

<u>Good Practice 7</u>
It is recommended to use for the Z coordinate a gravity-related height, ideally given in EVRS as vertical component of the Coordinate Reference System.

NOTE 1: EVRS states for European Vertical Reference System.

NOTE 2: It is reminded it is advised to capture for Master Level 1, hydrographic data as 2.5D.

5.2 Metadata

<u>Good Practice 8</u>
Core data should be documented by metadata for discovery and evaluation, as stated in the INSPIRE Technical Guidelines for metadata and for interoperability.

NOTE: This is an INSPIRE recommendation (only the INSPIRE Implementing Rules are legally binding for the Member States belonging to the European Union, but the Technical Guidelines are considered necessary to make the European Spatial Data Infrastructure work in practice). For the other countries, this is a way to make their data easily manageable by transnational users.

5.3 Delivery

It is expected that core data will be made available through improved existing products (or new products) or as INSPIRE data, and perhaps as specific core products (delivery issues still have to be investigated by the working group).

<u>Good Practice 9</u>
Core data corresponding to INSPIRE theme Hydrography should be made available according to the INSPIRE Technical Guidelines for interoperability, for metadata and for services.

NOTE 1: This is an INSPIRE recommendation (only the INSPIRE Implementing Rules are legally binding for the Member states belonging to the European Union, but the Technical Guidelines are considered necessary to make the European Spatial Data Infrastructure work in practice). For the other countries, this is a way to make their data easily manageable by transnational users.

NOTE 2: Core data may be used to derive both the INSPIRE data on HydroNetwork and on PhysicalWaters.

6 Considerations for future

6.1 Whole water information

As water is condition of life, data about water is necessary for analysing, achieving or monitoring many SDGs, especially SDG 6 (clean water) and 14 (life under water). Water data is scattered among several INSPIRE themes: Hydrography (inland surface waters), Geology (underground waters), Sea Regions and Oceanography.

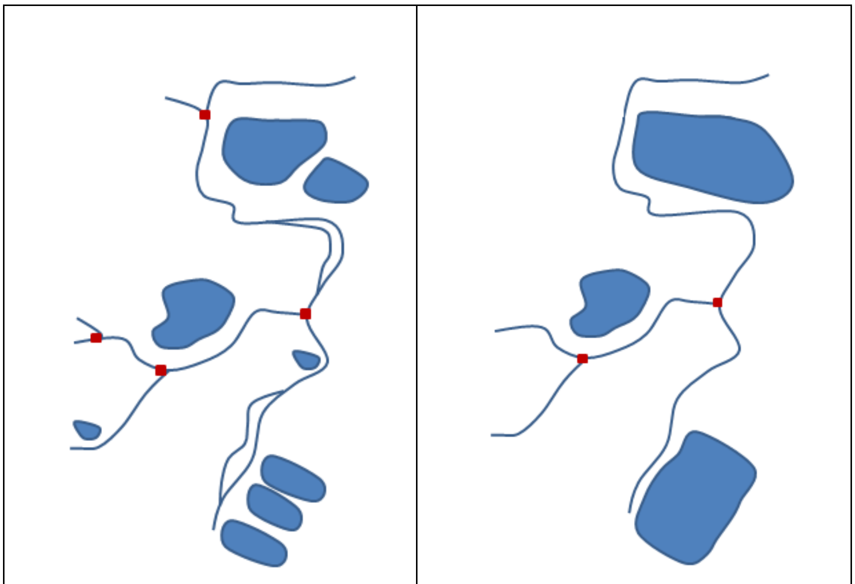
In a first phase, WG A selected only Hydrography as core theme mainly for feasibility reasons, i.e. due to the practical necessity to select limited number of priority themes. However, it should be recognised that a similar work regarding the identification of core content for underground and sea waters would be quite meaningful and useful.

This might be future actions to be envisaged by UN-GGIM: Europe (for underground waters) and ideally by UN-GGIM (world) for sea waters.

6.2 Linking business data to theme Hydrography

The core theme Hydrography is limited to a basic description of topographic rivers, lakes, drainage basins, etc. However, many public policies dealing with the SDG require lots of other business data, related for instance to water quality. This linking might be done using various identifiers included or not in this document: the database identifier, the hydro identifier (real-world identifier), the Pfafstetter and the WFD waterbody codes.

Getting a real-world identifier is quite challenging for Hydrography data as the view on real entities may change according to the level of detail: due to the generalisation process, some watercourse links will be merged, this may also occur for several small lakes or ponds close to one another.



Master Level 1 data	Generalised data

Figure 5: Different representations depending on level of detail

Various data producers have developed various strategies: for instance, in the ERM product, the hydro identifier is valid for the whole watercourse no matter of international borders or level of detail; some national producers have a reference dataset at a given level of detail that is used to attach business data; European directives are requiring specific codes.

Linear referencing might also be considered. Until now, Marker Posts (e.g. kilometric points) that may be used in linear referencing are not included in core data recommendations.

It may be questioned if this variety of practices and high number of codes and identifiers is the most efficient way to cope with the issue of linking business data to the geographic description of the hydrographic theme. So, it is recommended to encourage further research, knowledge exchange and standardization activities on this topic.

6.3 Linking time series to theme Hydrography

In addition, there would be interest in linking decades of monitoring data to the geographic data on hydrography, e.g. to monitor evolutions in water quality or quantity. This would of course raise lots of difficulties, especially if the past data on Hydrography is completely missing.

As Hydrography is a theme with slow evolutions, the first step might be to try to link past monitoring data to current hydrographical data and to assess the gaps, difficulties and potential solutions.

A more ambitious step would be to produce historical data on Hydrography from the sets of aerial photographs that were taken during past decades. However, this could be quite challenging to set up an efficient production method.

Testing, research and cost-benefit analysis are clearly required and should be encouraged.

7 Annex A: Relationship with INSPIRE

7.1 Data model

The UML models provided in this annex are only graphical illustrations of the core recommendations and of the good practices present in this document.

The recommendations for content are represented by highlighted the selected attributes in the following way:

Core recommendation

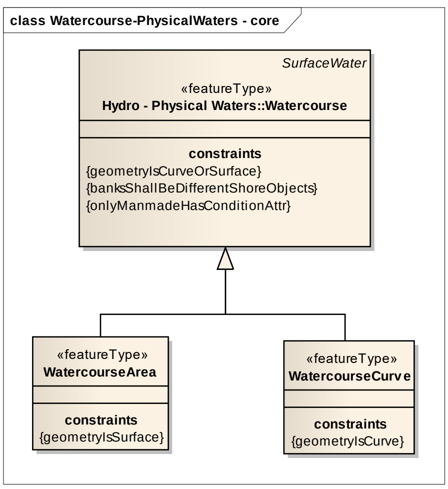
Good practice

7.1.1 Comparison between Core Data and INSPIRE content

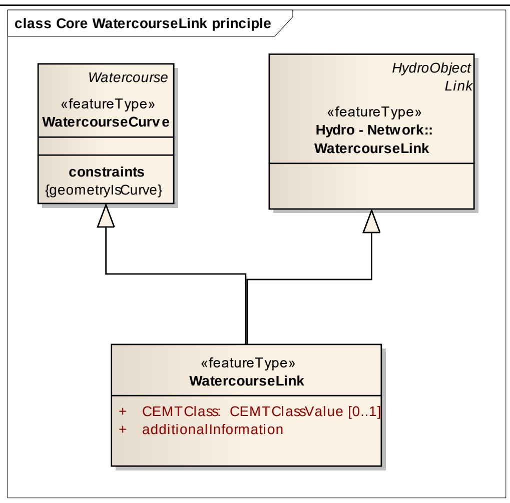
7.1.1.1 General principle

INSPIRE data model includes two instantiable application schemas: HydroNetwork and PhysicalWaters, representing two different views on more or less the same real-world entities. More especially, there is clear overlap between these 2 schemas regarding watercourses that are present in HydroNetwork schema as WatercourseLink (and WatercourseLinkSequence) and in PhysicalWaters schema as Watercourse.

The core data proposed model is based on the assumption that a single production database is the most efficient way to deal with hydrographic data and should enable derivation of INSPIRE data, both for HydroNetwork and for PhysicalWaters. As a consequence, the modelling of watercourses has been modified in order to gather all relevant attributes on a single geometry.



Feature Type "Watercourse" of Physical Waters has been split according its geometric representation (curve or surface)



Core feature type WatercourseLink inherits both of INSPIRE WatercourseLink (HydroNetwork) and from the WatercourseCurve derived from Physical Waters. In addition, it carries navigability information (WaterTransportNetwork) and other attributes.

Figure 6: Modelling principles for core data

7.1.1.2 Hydrographic network

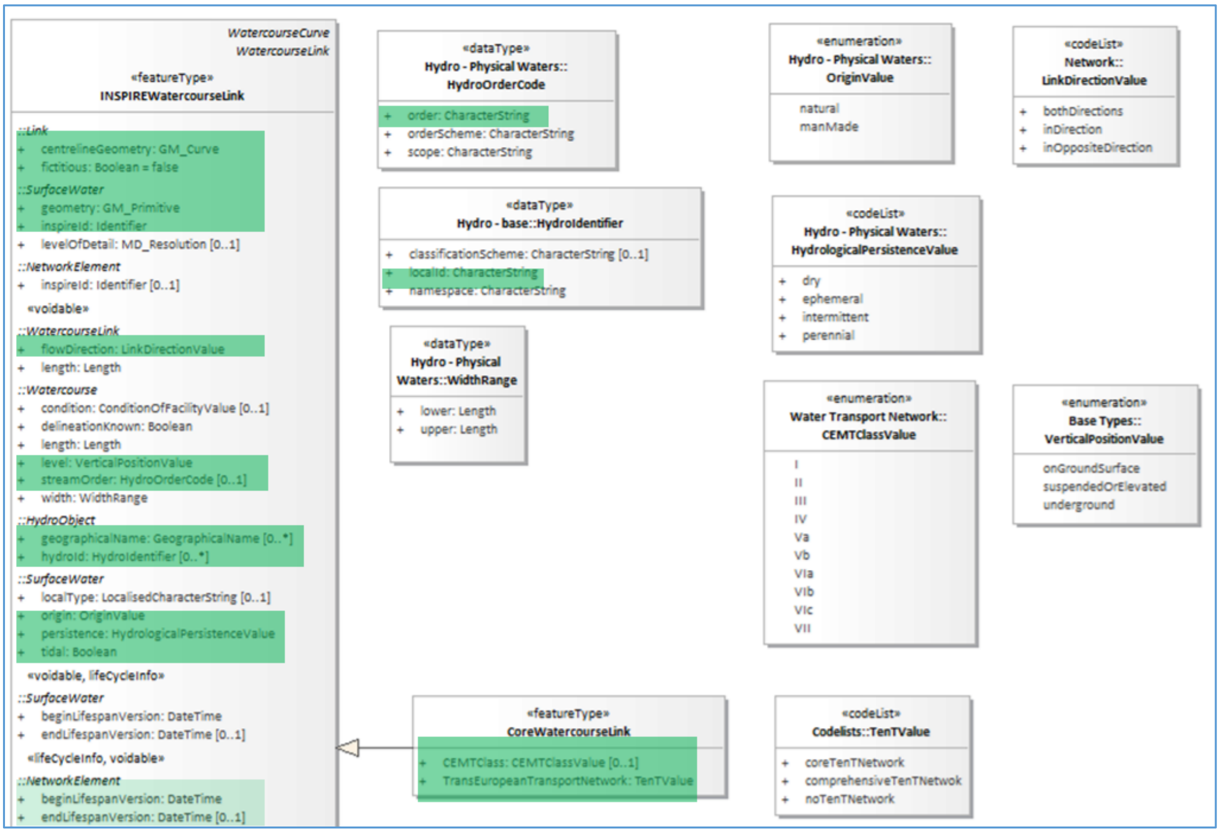


Figure 7: Core feature type WatercourseLink

NOTE 1: Core feature type WatercourseLink has most of the attributes of INSPIRE feature type WatercourseLink (from HydroNetwork) and of INSPIRE feature type Watercourse (from PhysicalWaters). In addition, it has navigability information (attribute CEMTClass from INSPIRE Water Transport Network) and the additional attribute TransEuropeanTransportNetwork.

NOTE 2: Regarding the attributes" inspireId", "hydroid" and "streamOrder", it may be enough to capture the main information (i.e. the local identifier or the order); the other sub-attributes (e.g. namespace, orderScheme) are just providing the context, they have generally constant values that may be provided when delivering data for INSPIRE.

NOTE 3: In opposite, the name has to be provided as a GeographicalName, i.e. the name itself with at least its language, status and (if relevant) source.

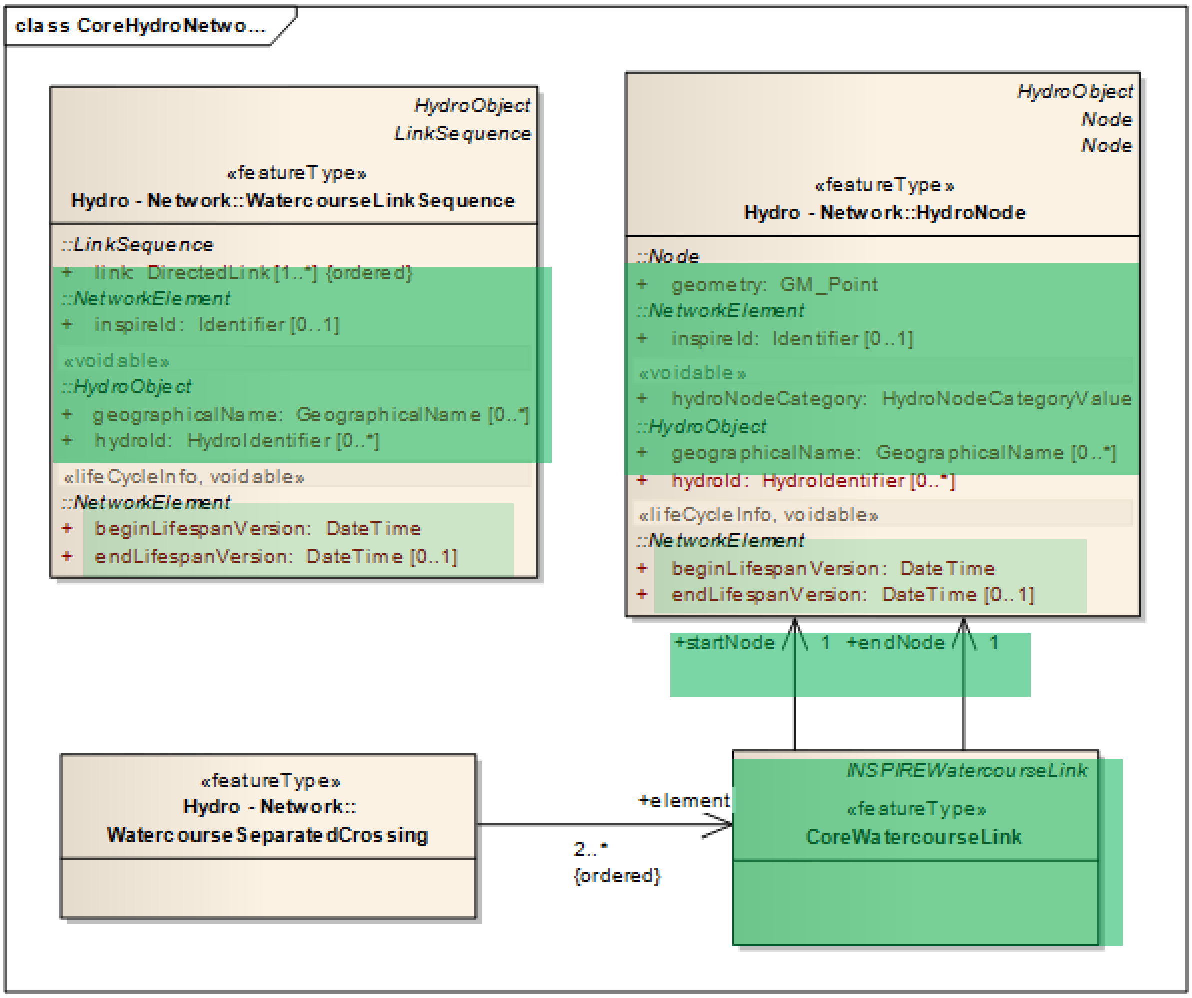


Figure 8: Core Hydrographic network

NOTE 1: The INSPIRE feature type WatercourseSeparatedCrossing has not been considered as necessary. This document already includes recommendation about topologic consistency and the attribute "level" giving the position of the watercourse link related to the ground, making the grade separated crossing redundant information.

NOTE 2: The association between watercourse links and watercourse nodes is highlighted to illustrate recommendation about topologic consistency (NOTE 3 in clause 4.5.3).

7.1.1.3 Other hydrographic features

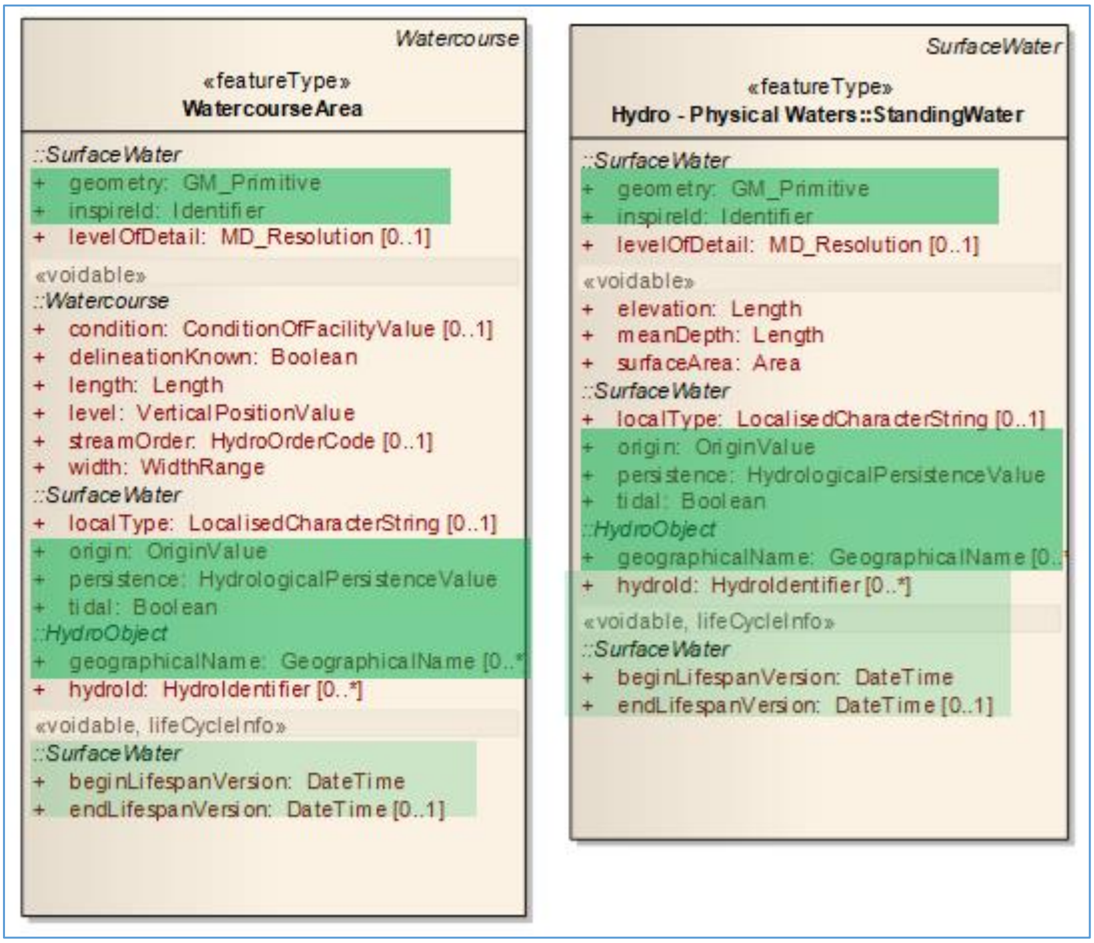


Figure 9: Core other feature types (1)

NOTE 1: As explained in 7.1.1.1, core feature type WatercourseArea is a sub-type of INSPIRE feature type Watercourse (in PhysicalWaters).

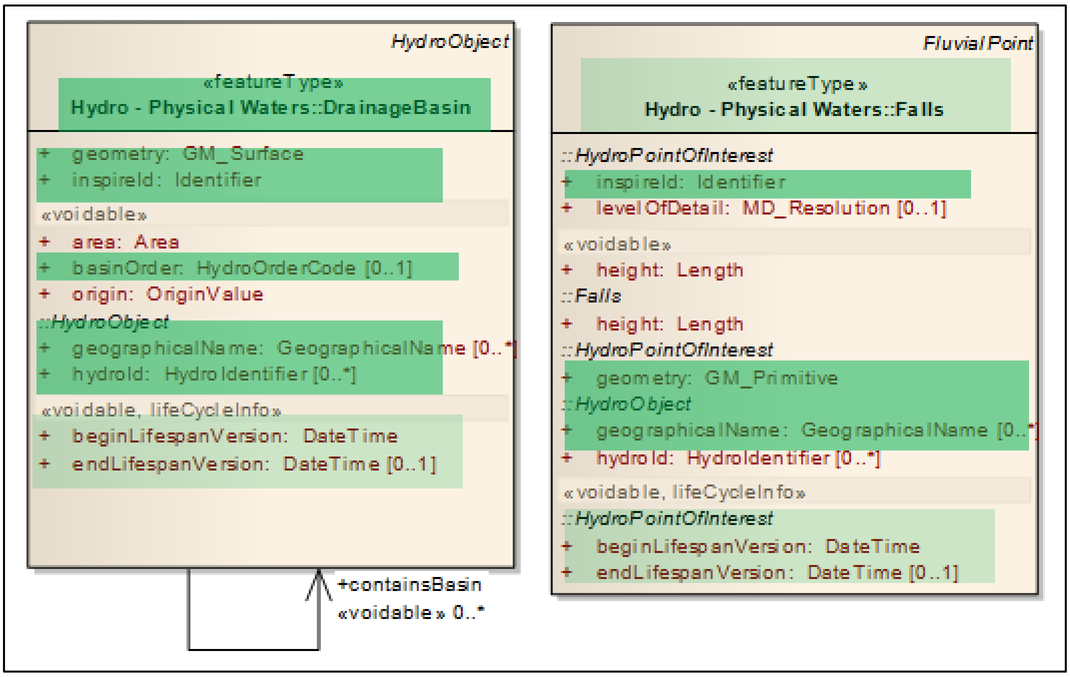


Figure 10: Core other feature types (2)

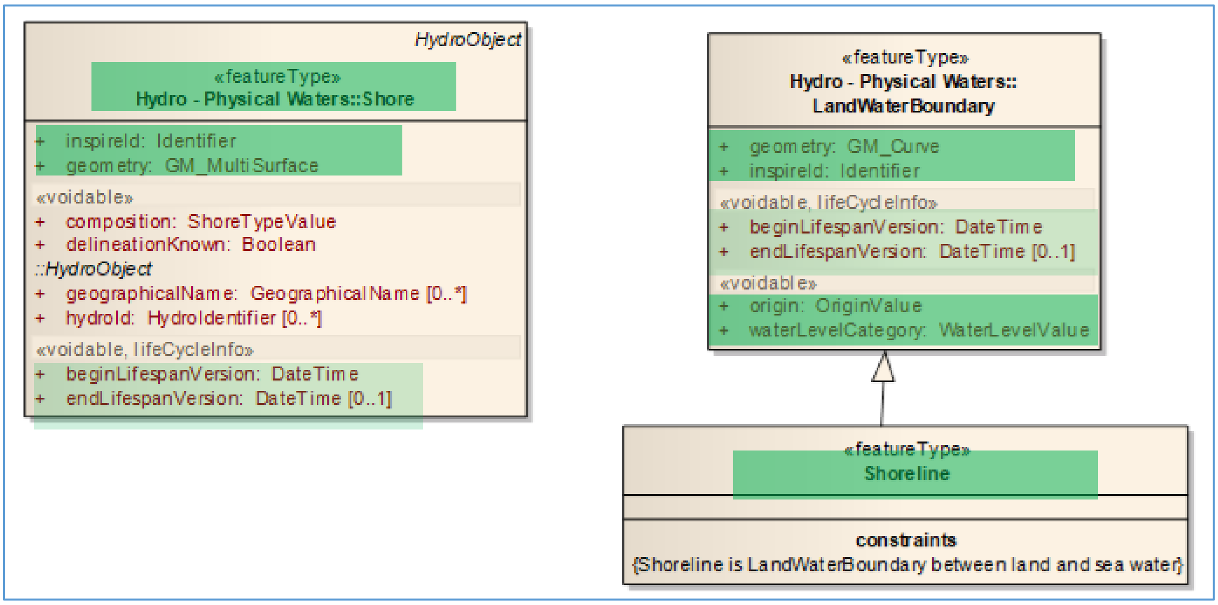


Figure 11: Core other feature types (2)

NOTE 1: INSPIRE theme Hydrography includes feature type LandWaterBoundary. Only the boundary between land and sea waters, namely the Shoreline, has been considered as core data. The boundaries between land and inland waters are already provided through the geometry of features in WatercourseArea or StandingWater.

7.1.2 Alternative implementation data model

It is reminded that the above figures are just illustrations of the expected content of core data aiming to enable easy comparison with INSPIRE. Of course, they may be used as starting point for implementing the structure of a production database but it is up to the data producer to decide on it.

Other modelling choices are possible. Typically, if there are several data producers in charge of theme Hydrography, separate data models may be envisaged for HydroNetwork and for PhysicalWaters. This is not advised (see Good Practice 3 in clause 4.1.1) but it may be acceptable at least for short-term solution.

This document recommends a feature Watercourse, defined as a set of neighbour watercourse links having the same name. This aims to facilitate data capture by factorising some attributes, such as name and hydro identifier. However, it is also possible to capture these attributes on each individual watercourse link and to let users derive themselves the watercourses if needed or in opposite to create the watercourse with its own geometry (and attributes) in order to offer a more user friendly product.

In INSPIRE, the feature type Shoreline is present in theme Sea Regions; it is modelled with more details than the core data recommendations. The INSPIRE data model of Sea Regions may be of interest for data producers willing to capture more detailed data about the shoreline.

7.2 Other

7.2.1 Scope

Though the INSPIRE definition defines theme Hydrography as "Hydrographic elements, including marine areas and all other water bodies and items related to them, including river basins and sub-basins", in practice the INSPIRE Data Specification focuses on the description of inland waters. As a result, this is quite similar to the scope of core theme Hydrography.

However, in order to avoid data duplication, WG A has considered that some INSPIRE feature types were already included in other core themes and that therefore there was no reason to include them in Hydrography. This is mainly the case for feature types Wetland (to be rather considered under theme Land Cover).

7.2.2 Levels of detail – Quality

Whereas INSPIRE is designed in order to accept as much as possible any existing data, at any scale and of whatever quality, the present document states clearly the expected levels of details (Master Level 1, Regional and Global).

Regarding quality, both INSPIRE and core data are encouraging topologic consistency. In addition core data includes some requirements about completeness and update frequency.

8 Annex B: Methodology

Core data specifications have been elaborated based on one hand on user requirements (with focus on the ones related to SDG) and on the other hand on INSPIRE data specifications.

8.1 Data model

Main part of the WG A work has consisted in selecting the priority content from the INSPIRE data models.

In practice, the core data recommendations for content have been strongly influenced by the assumption that **a single production database** (for a given level of detail) was a geographic information management good practice, enabling to derive the INSPIRE data about HydroNetwork, about PhysicalWaters and the navigability information of the INSPIRE Water Transport Network and avoiding geometry duplication in the production process.

As reference document, WG A has also taken into account the specifications of the EuroGeographics pan-European product EuroRegionalMap (ERM) that has been under a continuous production and improvement process for more than 10 years.

In a second phase, the WG A has carefully reviewed the INSPIRE data models, according to the above preliminary analysis. The selection of priority feature types and attributes has been done through evaluating the user requirements (SDG analysis, some user interviews, Eurostat requirements about ERM-EGM) against the feasibility. A few additional attributes have been included when considered as necessary.

8.2 Levels of detail

It has been considered that the priority levels of detail are Master Level 1, Regional and Global.

The selection of Master Level 1 is due to the fact that many SDG related use cases implying Hydrography data take place at local level and so require large scale data.

Regional and Global levels have also be selected as priority levels of detail because generalised data is required for many applications on wide extent (e.g. on whole Europe) and also because the corresponding data is already more or less implemented through ERM and EGM.