Title: A7.3-D3 Profiles for transboundary catchment - scope

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Working Group:

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Short Description:

Goal of this draft is to define the scope of the final version of the Profile(s).

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000	Sisi Zlatanova	new, rfc	
001	Jiri Horak, Marketa Hanzlova	Comments	Added comments on the structure
002	Sisi Zlatanova	Text editing	
003	Jiri Horak, Marketa Hanzlova	Text editing	

1 Table of contents

2 Introduction

The Transboundary Catchment Scenario aims at developing a cross-border application case emphasising the harmonisation needs and steps needed for successful hydrological model development. The application case can be seen as a guidance service for users operating in the water domain, for water monitoring in border regions, and for adaptive and integrated water management in shared river basins. The scenario aim is to demonstrate that harmonised data sets help in developing integrated hydrological models, which represent a tool necessary for joint, collaborative and integrated management improving the decision-making in transboundary catchment areas (e.g. erosion modelling, ecological modelling, flood protection, shared and coordinated usage of water sources, coordinated water source protection).

This scenario use case focuses on different data harmonization problems, mechanism and techniques taken to solve this problem while developing a transboundary rainfall-runoff (RR) model, as an example on the Roia/Roya River Basin, for the purpose of runoff prediction (estimation of peak discharge etc.) and subsequent other modelling (i.e. erosion, flooding) and management purposes.

The developed HUMBOLDT Tools for data harmonisation are applied on the data required for the modelling. The demonstration is extended with post-harmonisation stories:

- modelling with non-harmonised data
- modelling with harmonised data using the HUMBOLDT Framework tools
- comparison of both results (e.g.: results for harmonised data sets are by 20 % better) and discussion of advantages, disadvantages, conditions for application etc.

The purpose of the previous versions of this document (7.3-D1 and 7.3-D2) was to stay close to the Scenario. The purpose of this final version, 7.3-D3 is to take a broader view and consider the application domain the Scenario belongs to, i.e. the more general water management domain.

3 Scope of the Profile

A target data model has been created according to the scenario use case considering INSPIRE Data Specification documents (as available). Furthermore, regarding the objectives of this document, it was looked at broader application domain perspective and a wider data model has been drafted.

3.1 Transboundary Catchments Scenario Data Model

Scenario use case scope is:

- Hydrological modelling, water management
- Provision of harmonised hydrography
- Water level and discharge predictions

Considering the use case, the available datasets and discussions with the end users on the required functionalities, a target model was developed, as is shown in Figure 1.

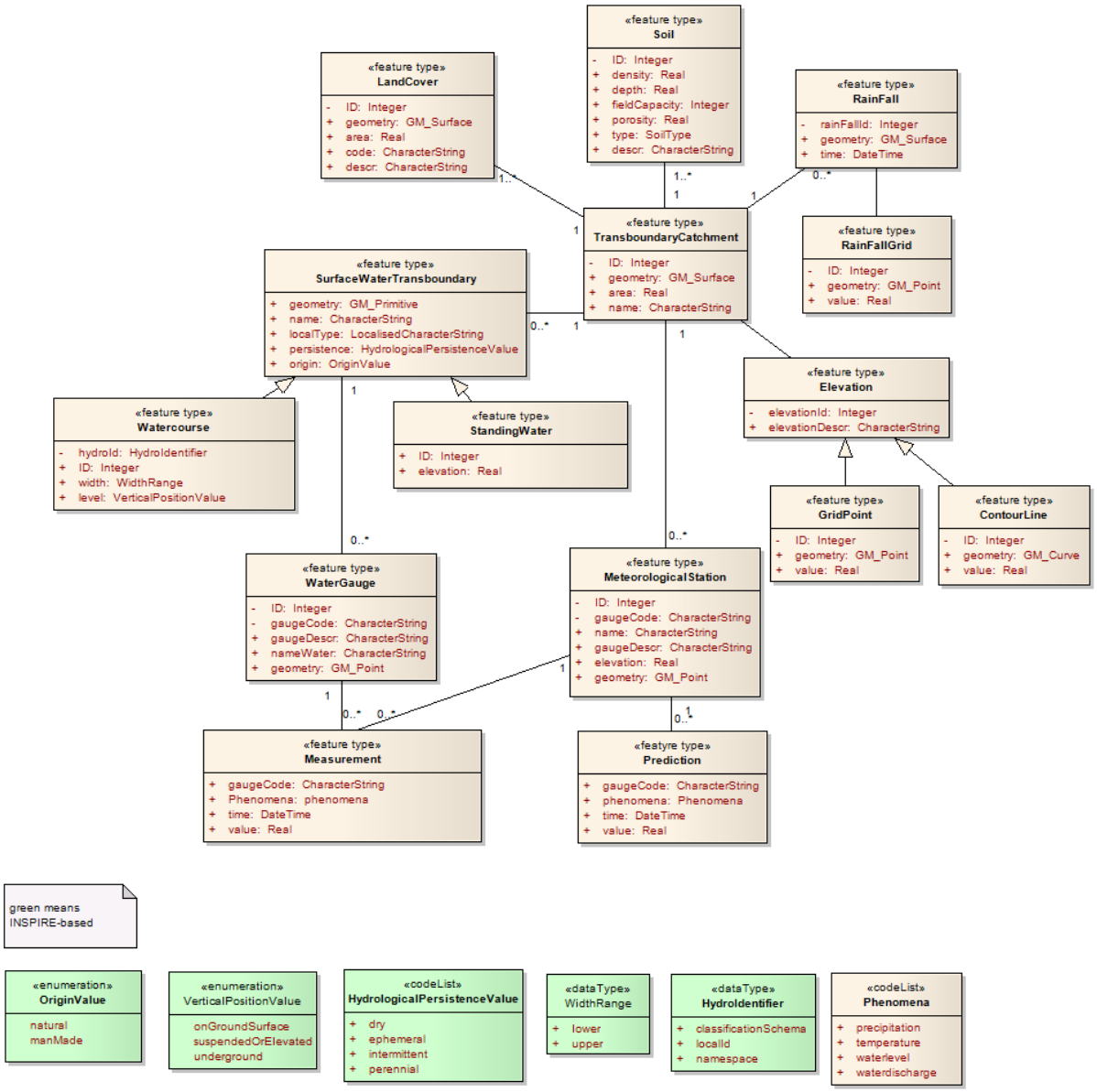

Fig. 1 INSPIRE based target data model

It is important to highlight that the data model is INSPIRE based but not fully INSPIRE adopted. The specific use case of the scenario and the complexity of the INSPIRE hold back the full adoption. Therefore, some features are based on the INSPIRE features using different names to avoid extensive attribute implementation. The following INSPIRE Data Themes were considered during building the model:

- Hydrography data theme (INSPIRE Annex I) to exchange hydrological information (applied for dataset related to water network, e.g. watercourse, water bodies, etc.)
- Elevation data theme (INSPIRE Annex II) and Geographical Grid Systems (INSPIRE Annex I, 2) for Digital Terrain Model (altitude information necessary for watershed schematisation)
- Land cover data theme (INSPIRE Annex II) for land cover information influencing runoff

- Environmental Monitoring Facilities data theme (INSPIRE Annex III) and Meteorological Geographical Features data theme (INSPIRE Annex III) for measurements (time series of water discharge, precipitation etc.).

3.2 Wider Application Domains of the Scenario's Data Model

The application of hydrological modelling covers various aspects of water management, landscape management, protection of ecosystems, but also efficient and regardful economical utilization of water sources (e.g. irrigation systems, hydroelectric power plants, water for technological plants).

The final model for data harmonisation can be applied for even broader scope of applications where it is necessary to eliminate barriers between different sources for data related to landscape and water domains. The existence of barriers is strongly evident in the transboundary regions, but also similar harmonisation issues in one country may arise due to existing incompatibilities in geometry (mainly horizontal and vertical conflation issues) and in attribute schemas.

The examples of applications are:

- planning large investments in shared drainage basins, especially those highly influencing water discharge (flow) or land cover (e.g. in the spring areas) or water quality or quantity of groundwater reservoirs. These applications may or may not require a hydrological modelling; in any case they claim to utilize consistent datasets for land use/cover domain and finally influence other water related activities.
- improvement of the status and protection of water bodies. The legal aspects are related mainly to the Water Framework Directive (WFD) which is in the implementation process throughout the EU. The practical requirements are generated by protection against erosion, desertification, salinization; groundwater protection etc.
- Protection of water bodies including planning, designing, construction, protection of water management equipments (mainly on rivers) like weirs, sluices, gates, etc.
- Planning of new gauges localization (precipitation gauges, discharge gauges) and gauge network optimization
- protection against flooding (including flash floods, mudflows etc.):
    - warning systems, early warning in scope of transboundary. These applications are supported also by the eRiska scenario.
    - means to decline the impact of flooding (polders, banks, dykes, levees, etc.)
    - dam, polders and weirs construction planning and operative plans for regulations (environmental issues)
- water transport (i.e. regulation of water levels necessary for shipping, adjustment of the river bed)
- aquatic production (fishery, plants etc.)
- agricultural applications (soil protection, irrigation systems, crop planning and optimization)
- forestry (soil protection, fire protection, optimization of the forest plants)
- dry seasons (water balance, planning of water uptakes, regulation of the irrigation)

- forecast of the long-term groundwater balance
- better long-term scenarios of impacts of the climate change on water availability, balance and quality, forestry and agriculture

The prepared data model and appropriate transformation procedures using Humboldt tools can be applied for the all above mentioned applications. Some of them require to cover additional data requirements (e.g. for water management equipments a full description of river profiles, river banks, river bed are necessary).

The data model can be also extended according to additional data source available and relevant for the given purpose. Below (Tab. 1) represents a extended list of datasets required for hydrological modelling and its related application domains.

Tab. 1 Extended list of required datasets

• Geometry data • Topography (DEM - Digital Elevation Model) • Topology • Aquifer thickness and Lateral Extent • Aquifer boundaries • River Network • Cross sectional area of the river • Structure and Diversion sites (water) • Cross sectional area particularly where the structure are found • Meteorological data • Time series of Rainfall data • Temperature • Humidity • Wind speed • Solar radiation • Water table elevation • Time-series records of river flow	• Discharges and Intakes • Measured data both on the extraction and inflow site (water) • Type and extent of recharge area (nutrients) • Rate of recharge (nutrients) • Type and extent of discharge area (nutrients) • Rate of recharge (nutrients) • Type and extent of discharge area (nutrients) • Rate of discharge (nutrients) • Land use • Vegetation cover and vegetation type • Geophysics – soil type • Geology • About aquifer • Types of Aquifer • Aquifers characteristics • Lithological variation within the aquifer • Lateral flow to the river

4 Relevant data models and services

Considering objectives of this document and wider scope of application of the model/profile, a was prepared as an example of the possible application in water management domain (see Figure 2).

Figure 2 shows integration of several standard data specifications, green coloured are adopted from the INSPIRE and pink coloured are based on OGC Specifications.

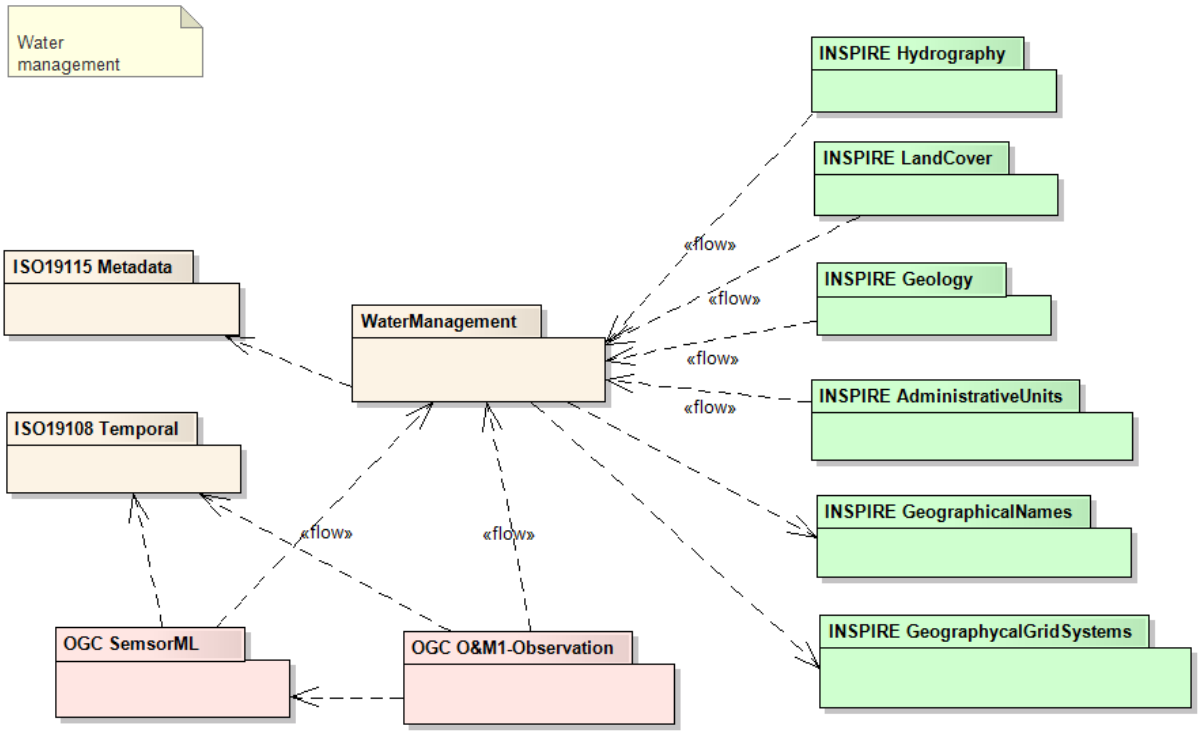

Fig. 2 'Wider-scope' based data model - example of water management domain conceptual schema

4.1 Relevant INSPIRE Data Themes

The wider application scope of the scenario data model may relate to other INSPIRE Data Themes. The following INSPIRE data themes could extend the already derived elements of the data themes:

- Geology (INSPIRE Annex II, 4),
- Geographical Names (INSPIRE Annex I, 3),
- Administrative Units (INSPIRE Annex I, 4),
- Transport Networks (INSPIRE Annex I, 7).

Geology Data Theme connects to this scope on the bases of water management (groundwater), environmental planning and protection, geo-hazards with connection to hydrology. Furthermore, geomorphological features are important for hydrodynamic modelling.

Geographical Names Data Theme may assist in integrated water management (e.g. location search, jurisdictional rights) especially in transboundary cases where as well translation of geographical names may be useful.

Administrative Units Data Theme ties up with integrated water management in scope of Water Framework Directive together with the above mentioned Geographical Names. Moreover, cadastral parcels play important element in disaster use cases - assessment of affected areas, flood predictions (evacuation plans) and so forth.

Transport Networks Data Theme proposes relationship based on use cases, such as disaster management, environmental impact assessment, rerouting & diversions. The transport infrastructure (road, railways) influenced by water bodies plays important knowledge base for the mentioned use cases e.g. risk of damages by flooding - damages of bridges, evacuation roads in flood risk events, and so forth.

4.2 Relevant OGC specifications

OGC (The Open Geospatial Consortium, Inc.®) specifications related to sensor networks, observations and measurements could be adopted in scope of the wider application domain. For example it can include the following specifications:

- Observations and Measurements (OM) Specification [http://www.opengeospatial.org/standards/om]
- Sensor Model Language (SensorML) Specification [http://www.opengeospatial.org/standards/sensorml]
- OpenGIS Transducer Markup Language (TML) Encoding Specification [http://www.opengeospatial.org/standards/tml]
- Sensor Observation Service (SOS) Specification [http://www.opengeospatial.org/standards/sos]

OGC provides schemas and examples in XML and XSD file formats.

4.3 WaterOneFlow Web Services & WaterML Specifications

WaterOneFlow is a term for a group of web services created by and for the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) community. CUAHSI is an organization representing more than 100 US universities that is supported by the National Science Foundation to develop infrastructure and services for the advancement of hydrologic science. CUAHSI web services facilitate the retrieval of hydrologic observations information from online data sources using the SOAP protocol. CUAHSI WaterML (below referred to as WaterML) is an XML schema defining the format of messages returned by the WaterOneFlow web services [Zlatavsky I. et al, 2007].

The specification could be considered for wider application domain as well.

4.4 Relevant WFD specifications

EU Water Framework Directive lays down a set of instruments and procedures to analyse the socio-economic and environmental impacts of current water uses and to develop measures aimed at establishing a sustainable regime of resource utilisation. The environment is recognised as a

legitimate water user (resulting in allocation of water to maintain riverine ecosystems), and the environmental costs of different policy options have to be taken into consideration. The adopted Directive 2000/60/EC is a prominent example of integrated water policy [compendium].

The European Union published the “Council Directive establishing a framework for Community action in the field of water policy” (2000/60/EC), known as the Water Framework Directive (WFD) in December, 2000. The WFD partly replaces and partly augments existed legislation to provide a comprehensive framework, identifying common principles towards which Member States have to orient their efforts. The Directive integrates all water resources, ecological objectives, water uses and functions, interdisciplinary analyses and expertise within a common policy framework [compendium].

In the perspective of the above statement, a timetable for WFD implementation was planed. The key milestones are listed below (Tab. 2).

Tab. 2 Timetable for implementation of WFD [http://ec.europa.eu/environment/water/water-framework/info/timetable_en.htm]

Year	Issue	Reference
2000	Directive entered into force	Art. 25
2003	Transposition in national legislation Identification of River Basin Districts and Authorities	Art. 23 Art. 3
2004	Characterisation of river basin: pressures, impacts and economic analysis	Art. 5
2006	Establishment of monitoring network Start public consultation (at the latest)	Art. 8 Art. 14
2008	Present draft river basin management plan	Art. 13
2009	Finalise river basin management plan including programme of measures	Art. 13 & 11
2010	Introduce pricing policies	Art. 9
2012	Make operational programmes of measures	Art. 11
2015	Meet environmental objectives First management cycle ends Second river basin management plan & first flood risk management plan.	Art. 4
2021	Second management cycle ends	Art. 4 & 13
2027	Third management cycle ends, final deadline for meeting objectives	Art. 4 & 13

Guidance documents and technical reports have been produced to assist stakeholders to implement the WFD. Guidance Documents are intended to provide an overall methodological approach, and are needed to be tailored to specific circumstances of each EU Member State [Guidance Document No. 22].

In the context of the WFD implementation strategy, a working group dedicated to the development of technical specifications for implementing a Geographical Information System (GIS) for the reporting needs of the WFD was established in 2001 under the coordination of the Joint Research Centre. The working group, with the support of most Member States, the Commission, Eurostat and the European Environmental Agency (EEA) produced Guidance Document no 9 Implementing the Geographical Information System Elements (GIS) of the Water Framework Directive, which was published in 2003 [Guidance Document No. 22].

Since then, significant changes have been made to the way in which data and geographic information are gathered, reported and shared at the European level and these made it necessary for the Guidance Document to be updated and extended to the needs for EU water legislation and electronic reporting within Water Information System for Europe (WISE). A Drafting Group under the auspices of

the WISE Technical Group carried out this task starting in 2007, including a number of consultations with the experts from the Member States through GIS workshops (held in January and November 2008) and via working group on reporting (WG D under CIS) and Strategic Coordination Group. In 2008, an updated WISE GIS Guidance Document was presented to the Water Directors and approved [Guidance Document No. 22].

WISE provides a repository for a wide range of GIS datasets. These datasets include those compiled by Member States for regulatory reporting and for other voluntary purposes as well as the WISE Reference GIS datasets. Each set of data is termed a theme. The themes within WISE are:

1. WISE Reference GIS datasets (Data models are not yet available for these themes)

2. Member State submitted GIS datasets, including data relating to:

- Water Framework Directive
- State of the Environment Reporting (WISE-SoE)
- Urban Waste Water Treatment Directive (Consolidated Schema is available)
- Bathing Waters Directive
- Nitrates Directive (Data models are not yet available for these themes)
- Drinking Water Directive (Data models are not yet available for these themes)
- Floods Directive
- Marine Strategy Directive (Data models are not yet available for these themes)
- E-PRTR (Data models are not yet available for these themes)

The WISE viewer also accommodates a number of background and external GIS data sets – a list of these datasets may be found in the Appendix 05 of the Guidance Document.

An updated list of publicly visible layers can be found at:
http://www.eea.europa.eu/themes/water/mapviewers

Detailed information on the GIS layers within each theme, including technical data specifications as defined by the INSPIRE Data Specification Methodology, is available in the Appendix 05 of the Guidance Document.

Under the WFD reporting requirements, several of GIS layers will have relationship to each other. Figure 3 shows the relationship between the WFD Articles 3 and 5 submitted data.

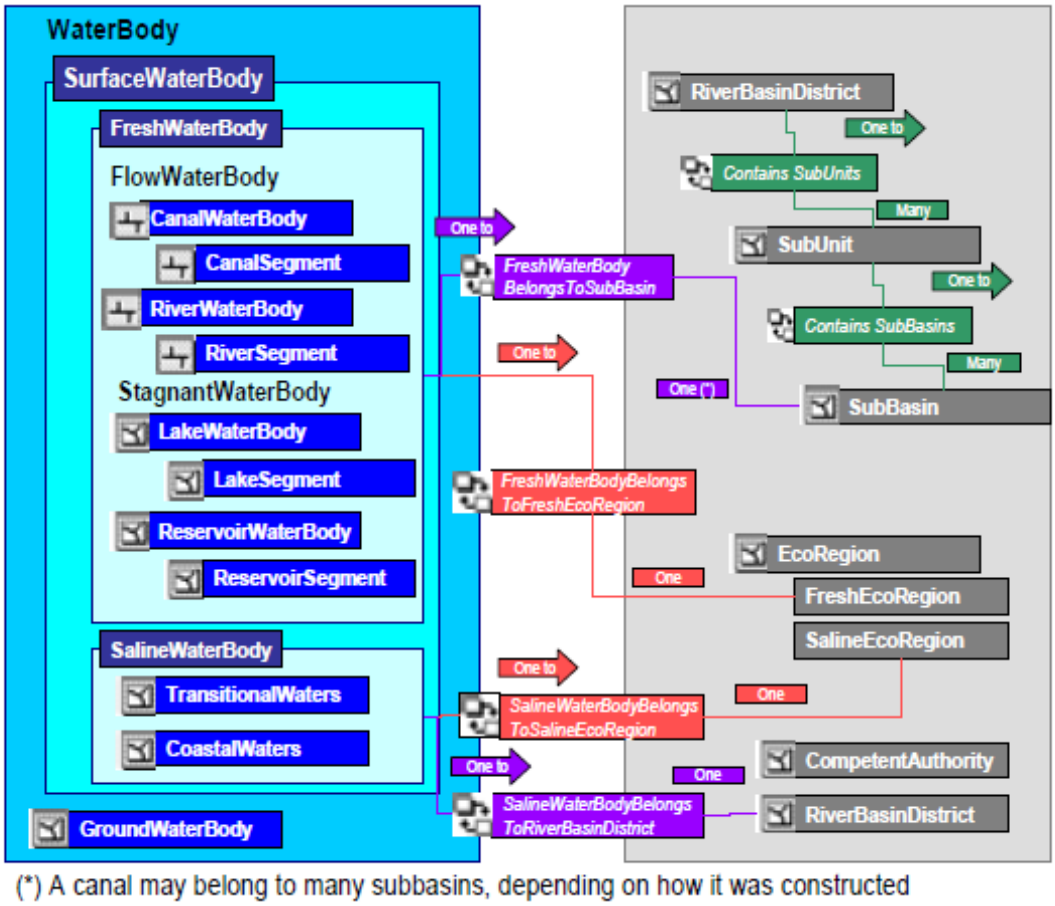

Fig. 3 Relationship between features reported under WFD Articles 3 and 5 [Guidance Document No. 22]

Further information on the data models associated with each of the themes is available in The Guidance Document No. 22 in Chapter 5.3 and in its Appendix 06. Data models and schemas are made available at the schema repository on the web site of the European Topic Centre on Water [http://water.eionet.europa.eu/schemas].

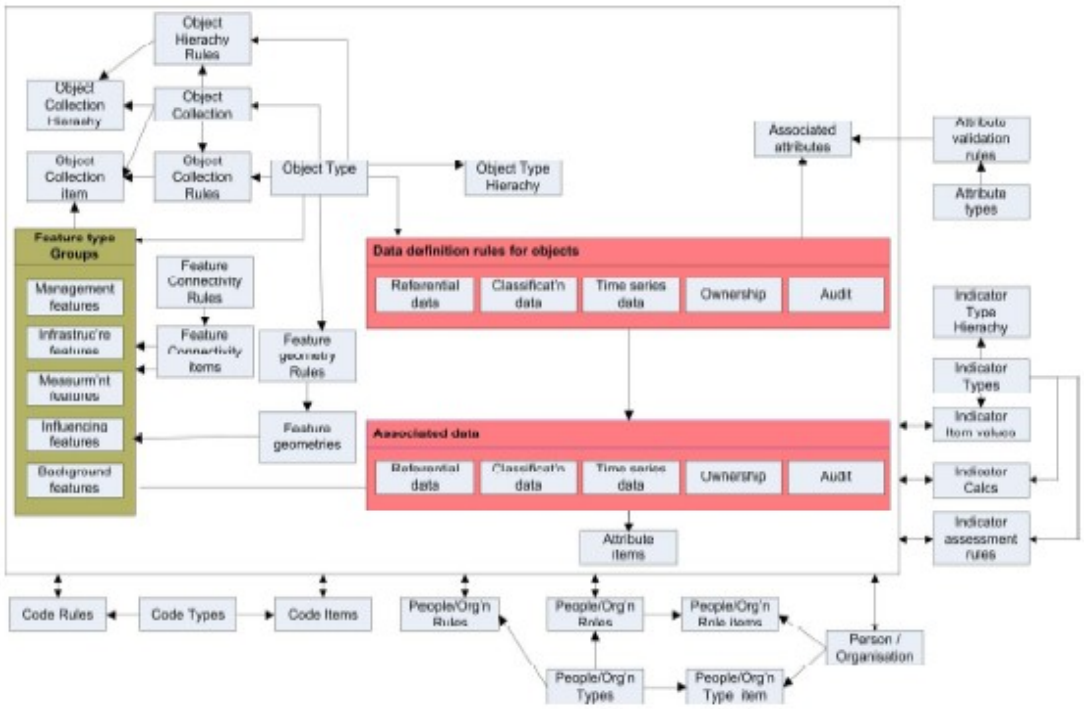

Fig. 4 WISE conceptual model [Guidance Document No. 22]

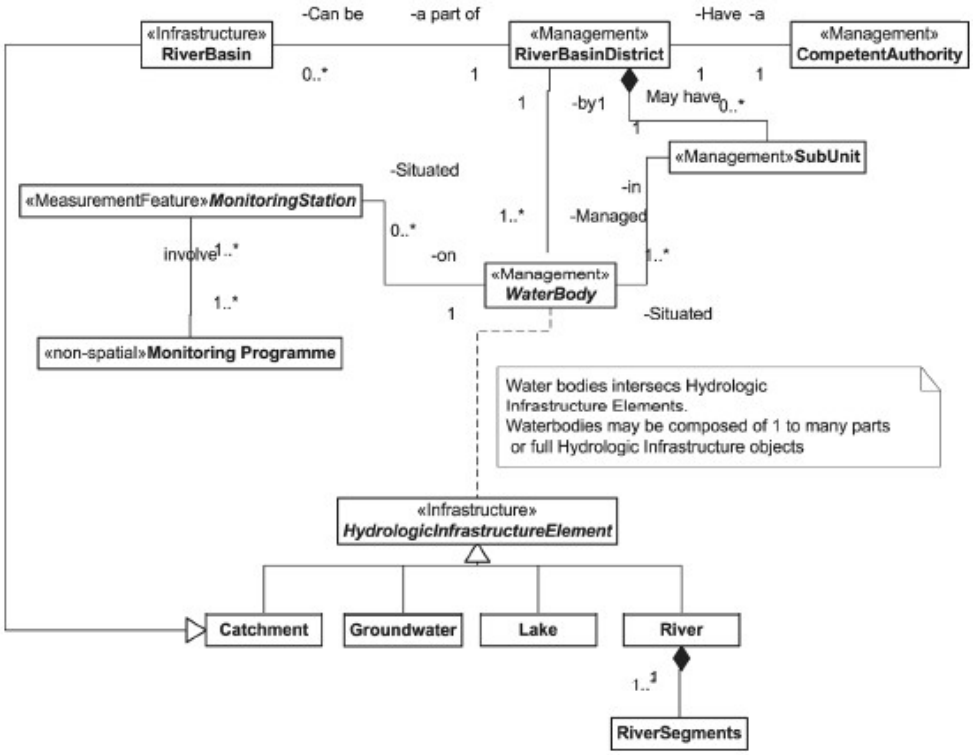

Fig. 5 Part of the WISE conceptual data model relating to the Water Framework Directive [Guidance Document No. 22]

Moreover mentioned above, the INSPIRE Data Specification on Hydrography documentation includes WFD based data model, shown in following figure (Fig. 6).

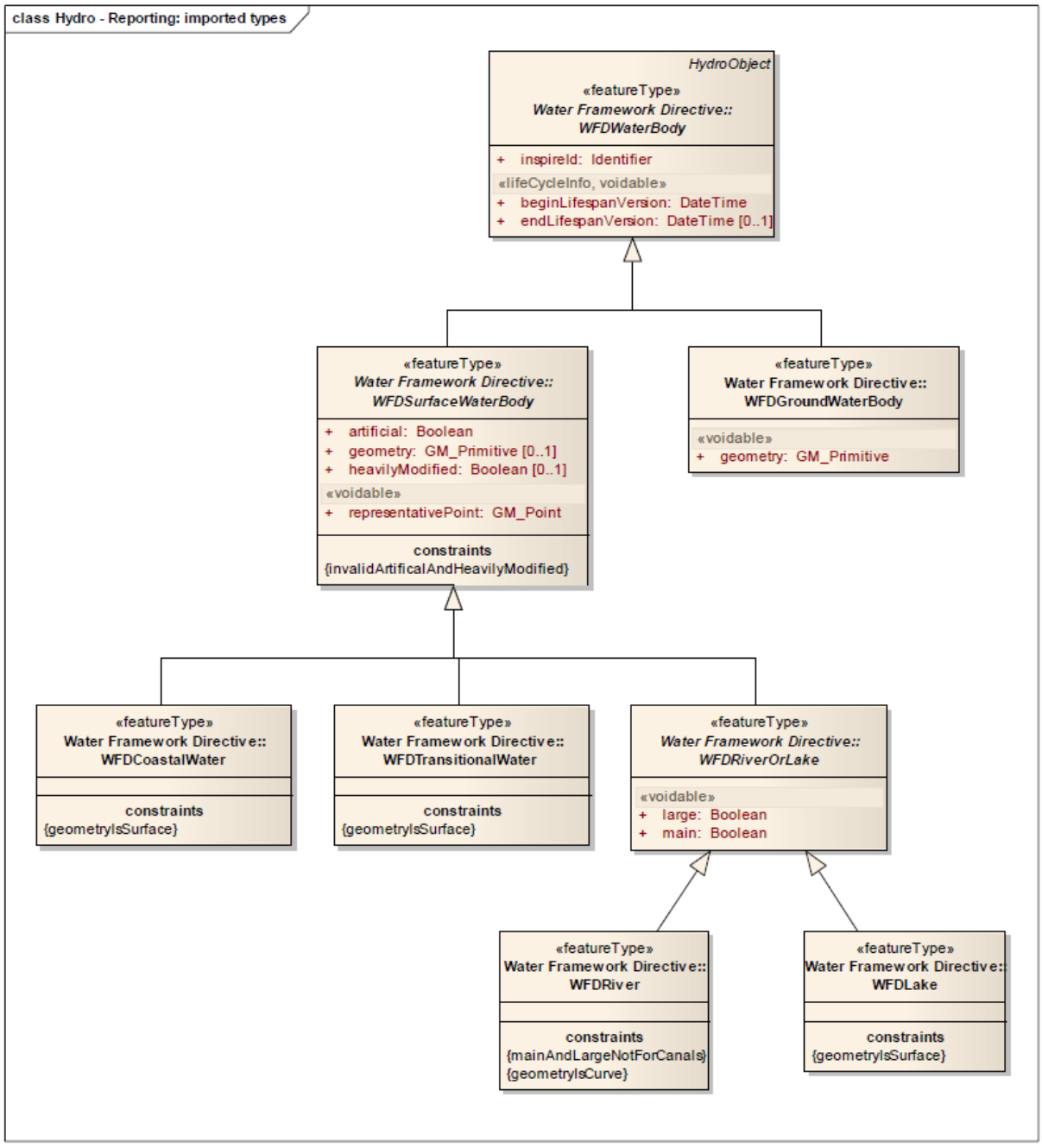

Fig. 6 UML class diagram: 'Water Framework Directive' application schema spatial object types [INSPIRE Data Specification on Hydrography]

5 Related projects and international initiatives

A list of international / EU projects, which deal with data harmonisation and/or water domain related initiatives/projects:

EUWI

In 2002, at the World Summit for Sustainable Development in Johannesburg, it was launched the "European Union Water Initiative" EUWI-Water for Life. EUWI is an international political initiative, not a financial mechanism. It takes a partnership approach with national governments, donors, the water industry, NGOs and other stakeholders. A number of working groups has been established. Working groups have either a regional focus (e.g. Africa, Mediterranean, EECCA and Latin America) or they concentrate on cross-cutting issues (e.g. Research, Finance). The Coordination Group (CG) ensures coherence of all EUWI activities.

http://www.euwi.net/

NATURE-SDI*plus*

This Network aims, through state-of-the-art methodologies and best practice examples, to improve harmonisation of national datasets and make them more accessible and exploitable. Therefore, it contributes to the INSPIRE implementation with specific reference to a cluster of data themes on nature conservation. An objective of the NATURE-SDI*plus* Network is to involve new stakeholders; share data and best practices; improve and stimulate exploitation and the re-use of information on nature conservation.

http://www.nature-sdi.eu/

EURADIN

From EURADIN Project perspective the concept of harmonisation look at proposing a solution to achieve their interoperability of address information and thus facilitating the effective access, reuse and exploitation of that content, which will promote the creation of new added value products and services across Europe. It considers harmonising as part of the address data flow process according to the definition "Harmonising is a process to make data compliant to agreed specifications"

https://www.euradin.eu

GIS4EU

The GIS4EU project aim is to provide base cartography datasets for Europe on the following themes: administrative units, hydrography, transportation networks, elevation. Therefore, the project intends to develop a common data model in order to enable access to consistent and homogenous reference data provided by cartographic authorities of different countries and levels (national, regional and local). The definition of data harmonisation used by the GIS4EU project is closely related to the INSPIRE one: "Providing access to data through network services in a representation that allows for combining it with other harmonised data in a coherent way by using a common set of data product specifications this includes agreements about coordinate reference systems, classification systems, application schemas etc."

http://www.gis4eu.eu

MEDISOLAE-3D

Medisolae-3D, closed in November 2009, focused on data harmonisation as a process to generate a harmonised collection of spatial datasets relevant to both Inspire and non-Inspire themes of 100

Mediterranean islands, structured according to a formal data model created before the release of the Inspire Data Specifications, which is easily transformable into a collection of spatial datasets fully compliant to the Inspire Data Specifications.

http://www.medisolae-3d.eu/

6 References

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Guidance Document No. 22 - Updated Guidance on Implementing the Geographical Information System (GIS) Elements of the EU Water legislation:
The main text of the document is available on CIRCA at:
http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title
Appendices to the guidance are available on EEA CIRCA at:
http://eea.eionet.europa.eu/Public/irc/eionet-circle/eionettelematics/library?l=/technical_developments/wise_technical_group/updated_2ndedition/appendices_updated&vm=detailed&sb=Title
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