­­­­­Open Geospatial Consortium

Approval Date: yyyy-mm-dd

Publication Date: yyyy-mm-dd

Reference number of this OGC® project document: OGC xx-xxx

OGC name of this OGC® project document: XXXX

Version: 1.0.0

Category: OGC® Implementation Standard

 Editors:

OGC® GroundWaterML 2.0 - Core

**Copyright notice**

Copyright © 2012 Open Geospatial Consortium
To obtain additional rights of use, visit <http://www.opengeospatial.org/legal/>.

**Warning**

This document is not an OGC Standard. It is distributed for review and comment. This document is subject to change without notice and may not be referred to as an OGC Standard.

Document type:    OGC® Implementation Standard

Document subtype:    Encoding

Document stage:    Approved for Public Release

Document language:  English

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

License Agreement

Permission is hereby granted by the Open Geospatial Consortium, ("Licensor"), free of charge and subject to the terms set forth below, to any person obtaining a copy of this Intellectual Property and any associated documentation, to deal in the Intellectual Property without restriction (except as set forth below), including without limitation the rights to implement, use, copy, modify, merge, publish, distribute, and/or sublicense copies of the Intellectual Property, and to permit persons to whom the Intellectual Property is furnished to do so, provided that all copyright notices on the intellectual property are retained intact and that each person to whom the Intellectual Property is furnished agrees to the terms of this Agreement.

If you modify the Intellectual Property, all copies of the modified Intellectual Property must include, in addition to the above copyright notice, a notice that the Intellectual Property includes modifications that have not been approved or adopted by LICENSOR.

THIS LICENSE IS A COPYRIGHT LICENSE ONLY, AND DOES NOT CONVEY ANY RIGHTS UNDER ANY PATENTS THAT MAY BE IN FORCE ANYWHERE IN THE WORLD.

THE INTELLECTUAL PROPERTY IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. THE COPYRIGHT HOLDER OR HOLDERS INCLUDED IN THIS NOTICE DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE INTELLECTUAL PROPERTY WILL MEET YOUR REQUIREMENTS OR THAT THE OPERATION OF THE INTELLECTUAL PROPERTY WILL BE UNINTERRUPTED OR ERROR FREE. ANY USE OF THE INTELLECTUAL PROPERTY SHALL BE MADE ENTIRELY AT THE USER’S OWN RISK. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR ANY CONTRIBUTOR OF INTELLECTUAL PROPERTY RIGHTS TO THE INTELLECTUAL PROPERTY BE LIABLE FOR ANY CLAIM, OR ANY DIRECT, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM ANY ALLEGED INFRINGEMENT OR ANY LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR UNDER ANY OTHER LEGAL THEORY, ARISING OUT OF OR IN CONNECTION WITH THE IMPLEMENTATION, USE, COMMERCIALIZATION OR PERFORMANCE OF THIS INTELLECTUAL PROPERTY.

This license is effective until terminated. You may terminate it at any time by destroying the Intellectual Property together with all copies in any form. The license will also terminate if you fail to comply with any term or condition of this Agreement. Except as provided in the following sentence, no such termination of this license shall require the termination of any third party end-user sublicense to the Intellectual Property which is in force as of the date of notice of such termination. In addition, should the Intellectual Property, or the operation of the Intellectual Property, infringe, or in LICENSOR’s sole opinion be likely to infringe, any patent, copyright, trademark or other right of a third party, you agree that LICENSOR, in its sole discretion, may terminate this license without any compensation or liability to you, your licensees or any other party. You agree upon termination of any kind to destroy or cause to be destroyed the Intellectual Property together with all copies in any form, whether held by you or by any third party.

Except as contained in this notice, the name of LICENSOR or of any other holder of a copyright in all or part of the Intellectual Property shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Intellectual Property without prior written authorization of LICENSOR or such copyright holder. LICENSOR is and shall at all times be the sole entity that may authorize you or any third party to use certification marks, trademarks or other special designations to indicate compliance with any LICENSOR standards or specifications.

This Agreement is governed by the laws of the Commonwealth of Massachusetts. The application to this Agreement of the United Nations Convention on Contracts for the International Sale of Goods is hereby expressly excluded. In the event any provision of this Agreement shall be deemed unenforceable, void or invalid, such provision shall be modified so as to make it valid and enforceable, and as so modified the entire Agreement shall remain in full force and effect. No decision, action or inaction by LICENSOR shall be construed to be a waiver of any rights or remedies available to it.

Contents

1 Abstract Erreur ! Signet non défini.

2 Keywords Erreur ! Signet non défini.

3 Preface Erreur ! Signet non défini.

4 Submitting Organizations Erreur ! Signet non défini.

5 Submitters Erreur ! Signet non défini.

6 Future Work Erreur ! Signet non défini.

7 Changes to the OGC® Abstract Specification Erreur ! Signet non défini.

8 Scope Erreur ! Signet non défini.

9 Conformance Erreur ! Signet non défini.

10 References Erreur ! Signet non défini.

11 Terms and Definitions Erreur ! Signet non défini.

11.1 coverage **Erreur ! Signet non défini.**

11.2 domain feature **Erreur ! Signet non défini.**

11.3 element <XML> **Erreur ! Signet non défini.**

11.4 feature **Erreur ! Signet non défini.**

11.5 GML application schema **Erreur ! Signet non défini.**

11.6 GML document **Erreur ! Signet non défini.**

11.7 GML schema **Erreur ! Signet non défini.**

11.8 measurement **Erreur ! Signet non défini.**

11.9 observation **Erreur ! Signet non défini.**

11.10 observation procedure **Erreur ! Signet non défini.**

11.11 observation result **Erreur ! Signet non défini.**

11.12 property <General Feature Model> **Erreur ! Signet non défini.**

11.13 sampled feature **Erreur ! Signet non défini.**

11.14 sampling feature **Erreur ! Signet non défini.**

11.15 sampling point **Erreur ! Signet non défini.**

11.16 schema <XML Schema> **Erreur ! Signet non défini.**

11.17 sensor **Erreur ! Signet non défini.**

12 Conventions Erreur ! Signet non défini.

12.1 Requirements class **Erreur ! Signet non défini.**

12.2 Requirement **Erreur ! Signet non défini.**

12.3 Conformance class **Erreur ! Signet non défini.**

12.4 Identifiers **Erreur ! Signet non défini.**

12.5 Conceptual schemas **Erreur ! Signet non défini.**

12.6 External package abbreviations **Erreur ! Signet non défini.**

12.7 Abbreviated terms **Erreur ! Signet non défini.**

12.8 UML notation **Erreur ! Signet non défini.**

12.9 Finding requirements and recommendations **Erreur ! Signet non défini.**

13 Background Erreur ! Signet non défini.

13.1 Technical Basis **Erreur ! Signet non défini.**

13.2 Overview of GroundWaterML2.0-Core **Erreur ! Signet non défini.**

13.3 Observations and Measurements overview **Erreur ! Signet non défini.**

14 The nature of hydrological observations Erreur ! Signet non défini.

14.1 Observations and forecasts **Erreur ! Signet non défini.**

15 Information Model 7

15.1 Logical Model 7

16 Requirements Classes 11

16.1 Structural overview of requirements classes 11

16.2 Package dependencies 12

16.3 Use of vocabularies 13

16.4 Requirements Class: XML rules 13

16.5 Requirements Class: GroundWaterML2-Core 15

16.6 Requirements class: observations (OM\_Measurement) 16

16.7 Requirements Class: GeoSciML v3.2 GeologicUnit 16

16.8 Requirements Class: GW\_HydrogeoUnit 17

16.9 Requirements Class: GW\_Aquifer 19

16.10 Requirements Class: GW\_ConfiningBed 19

16.11 Requirements Class: GW\_ManagementArea 21

16.12 Requirements Class: GW\_FluidBody 23

16.13 Requirements Class: GW\_HydrogeoVoid 25

16.14 Requirements Class: GW\_BodySurface 26

16.15 Media Types for groundwater data 27

17 XML Implementation (normative) Erreur ! Signet non défini.

17.1 XML encoding principles **Erreur ! Signet non défini.**

Annex A Abstract test suite (normative Erreur ! Signet non défini.

A.1 Introduction **Erreur ! Signet non défini.**

17.2 A.2 Conformance class: XSD-XML rules **Erreur ! Signet non défini.**

Annex B Example XML instances (informative) Erreur ! Signet non défini.

Annex C Use cases and requirements (informative) Erreur ! Signet non défini.

17.3 Commercial Use Case **Erreur ! Signet non défini.**

17.4 Policy **Erreur ! Signet non défini.**

17.5 Environmental **Erreur ! Signet non défini.**

17.6 Scientific **Erreur ! Signet non défini.**

17.7 Technologic **Erreur ! Signet non défini.**

Annex D Revision history Erreur ! Signet non défini.

Annex E Bibliography Erreur ! Signet non défini.

Table of Figures

[Figure 1 - Observation as defined by O&M **Erreur ! Signet non défini.**](#_Toc391299629)

[Figure 2 – The hydrologic cycle [4] **Erreur ! Signet non défini.**](#_Toc391299630)

[Figure 3. UML of the GWML2-Core GW\_HydrogeoUnit Logical Model. 8](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299631)

[Figure 4. UML of the GSML2-Core groundwater properties Logical Model 9](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299632)

[Figure 5. UML of the GW\_FluidBody Logical Model 10](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299633)

[Figure 6. GroundWaterML2.0 over view of Requirements Classes 11](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299634)

[Figure 7. GroundWaterML2.0-Core external dependencies. 12](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299635)

[Figure 8. Requirements Class for XML rules. 15](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299636)

[Figure 9. UML specification for GW\_HydrogeoUnit 18](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299637)

[Figure 10. UML specification for GW\_Aquifer 19](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299638)

[Figure 11. UML specification for GW\_ConfiningBed. 21](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299639)

[Figure 12. UML specification for GW\_ManagementArea 22](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299640)

[Figure 13. UML specification for GW\_FluidBody 24](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299641)

[Figure 14. UML specification for GW\_HydrogeoVoid. 26](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299642)

[Figure 15. UML specification for GW\_BodySurface. 27](file:///C%3A%5CRepos%5CGroundwater%5CInformationModel%5CRequirements%5CGroundWaterML2-Requirements.docx#_Toc391299643)

# Information Model

This standard defines the conceptual models for the description of groundwater observations and interpretive data, making use of ISO19156 as the base conceptual model. The standardization target for the UML conformance classes are:

Encoding models derived from the conceptual model of this standard.

Software implementations seeking compliance to this standard.

## Logical Model

The Logical Model for the GroundWaterMl2-Core <<Application Schema>> is summarized in three UML diagrams. Figure xx focuses on the groundwater hydrogeological unit (GW\_HydrogeoUnit) and its relationships to associated features. Figure xx presents the groundwater properties and relationships, and Figure xx the fluid body (GW\_FluidBody) properties and relationships. These are all ‘views’ of the same GroundWaterMl2-Core Logical Model.

Naming conventions …



Figure 1. UML of the GWML2-Core GW\_HydrogeoUnit Logical Model.



Figure 2. UML of the GSML2-Core groundwater properties Logical Model



Figure 3. UML of the GW\_FluidBody Logical Model

# Requirements Classes

## Structural overview of requirements classes

The requirements classes of the standard are structured as shown in **Erreur ! Source du renvoi introuvable.**.

Figure 4. GroundWaterML2.0 over view of Requirements Classes

## Package dependencies

GroundWaterML2-Core has dependencies on other external standards. These dependencies are shown in Figure XX.

Figure 5. GroundWaterML2.0-Core external dependencies.

## Use of vocabularies

Controlled vocabularies, also known as code-lists, are used in data exchange to identify particular concepts or terms, and sometimes relationships between them. For example, an organisation may define a controlled vocabulary for all observed phenomena that are to be exchanged between parties. Some of these definitions may be related in hierarchies or through other relationships such as equivalence.

GroundWaterML2.0 specifies that a full set of vocabularies for data exchange should be established as a first step for groundwater data exchange.

These vocabularies are defined within the OGC definition namespace (**http://www.opengis.net/def/groundwaterml/2.0/**), which is governed by the OGC Naming Authority (OGC-NA). The OGC-NA is responsible for processing requests to change or add new definitions to this namespace. The procedures for the OGC-NA are outlined in OGC document 09-046 (OGC-NA – Procedures) and the structure of URIs is outlined in OGC 09-048 (OGC-NA – Name type specification – definitions).

It is envisaged that GroundWaterML2.0 will be used alongside existing sets of vocabularies as agreed upon within communities. The parties involved in exchange will determine the vocabularies that are to be used in exchanged. Future work within the Hydrology Domain Working Group should address the area of controlled vocabularies for the groundwater domain. These vocabularies require a governance structure that allows changes to be made as definitions evolve.

## Requirements Class: XML rules

Groundwater features and their properties will be encoded in XML using standard GML encoding rules.

|  |  |
| --- | --- |
| **Requirements class** | /**[req/xsd-xml-rules](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Target type** | XML data document |
| **Dependency** | http://www.w3.org/TR/xmlschema-2 |
| **Dependency** | http://www.opengis.net/doc/IS/GML/3.2/clause/2.4 |
| **Dependency** | http://www.opengis.net/spec/SWE/2.0/req/xsd-simple-components  |
| **Dependency** | urn:iso:dis:iso:8601:2004:clause:4 |
| **Requirement** | /req/xsd-xml-rules/time-zone |
| **Requirement** | /req/xsd-xml-rules/unit-of-measure |
| **Requirement** | /req/xsd-xml-rules/swe-types |
| **Recommendation** | /req/xsd-xml-rules/xlink-title |
| **Recommendation** | /req/xsd-xml-rules/vocabulary-references  |

The date-time formats will conform to ISO standards.

|  |  |
| --- | --- |
| **/req/xsd-xml-rules/iso8601-time** | All date-time elements shall be encoded using ISO8601 extended time format |

Note that this precludes the use of time-coordinate systems such as UNIX time. This is specified in order to be maximally consistent with WML2 requirements. The time zone will be included in the time element.

|  |  |
| --- | --- |
| **/req/xsd-xml-rules/time-zone** | The value of each time element shall include a time zone definition using a signed 4 digit character or a ‘Z’ to represent Zulu or Greenwich Mean Time (GMT). This is defined by the following regular expression: (Z|[+-]HH:MM) |

The units of measure shall be taken from a standard water quality vocabulary governed by the groundwater community. The unit of measure must be suitable for the observed property (constraint inherited from OM\_Observation).

|  |  |
| --- | --- |
| **/req/xsd-xml-rules/unit-of-measure** | All units of measure shall be specified using the URI for an individual from the class http://qudt.org/schema/qudt#Unit defined in http://environment.data.gov.au/water/quality/def/unit |

Some SWE Common types are restricted to avoid ambiguity.

|  |  |
| --- | --- |
| **/req/xsd-xml-rules/swe-types** | When using the SWE Common types, the following elements shall not be used: swe:quality (*AbstractSimpleComponentType)*, swe:nilValues (*AbstractSimpleComponentType)*, swe:constraint (*QuantityType*, *QuantityRangeType*, *CategoryType*). The attributes ‘*optional’* and ‘*updatable’* from the base type ‘*AbstractDataComponent’* shall not be used. |

The xlink:title attribute ought contain a text label when an xlink:href refers to a controlled vocabulary or ontology.

|  |  |
| --- | --- |
| **/req/xsd-xml-rules/xlink-title** | If an xlink:href is used to reference a controlled vocabulary item, the element should encode the xlink:title attribute with a text label of the referenced item. |

Vocabulary references made via xlink:href ought to be a resolvable URI in the form of an HTTP URL.

|  |  |
| --- | --- |
| **/rec/xsd-xml-rules/vocabulary-references**  | When specifying references to vocabulary (code) items using an xlink:href, a resolvable HTTP URL should be used which, when resolved, should provide suitable description of the concept being referenced.  |

This requirements class defines common rules and recommendations for all XML instances.

Figure 6. Requirements Class for XML rules.

## Requirements Class: GroundWaterML2-Core

The XML encoding of the GroundWaterML2-Core features and their properties shall conform to the properties, data types and cardinalities defined in the GroundWaterML2-Core Logical Model UML (Figure xx).

|  |  |
| --- | --- |
| **Requirements class** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Target type** | XML data document |
| **Dependency** | /req/xsd-xml-rules |
| **Dependency** | /req/geosciml-geologicunit |
| **Dependency** | **/req/observation** |
| **Requirement** | /req/core-uml |
| **Recommendation** |  |

The properties, constraints, cardinalities and associations documented in the UML will be honoured in the XML.

|  |  |
| --- | --- |
| /req/core-uml | All XML elements SHALL conform to the GroundWaterML2-Core Logical Model UML as defined at **http://www.opengis.net/def/groundwaterml/2.0/ftc** |

## Requirements class: observations (OM\_Measurement)

Concrete observations of groundwater properties use the OMXML element OM\_Measurement. The observed property common to these elements inherited from OM\_Observation must be taken from the GroundWaterML2-Core Logical Model. The feature of interest property common to these elements also must come from the GroundWaterML2-Core Logical Model feature catalogue. The units of measure used in the result are taken from a groundwater vocabulary.

|  |  |
| --- | --- |
| **Requirements class** | **/req/observation** |
| **Target type** | **XML data document** |
| **Dependency** | **http://www.opengis.net/spec/OMXML/2.0/req/observation** |
| **Requirement** | **/req/observation/observed-property** |
| **Requirement** | /req/observation/feature-of-interest |

The observed property of the observation is to be a property in the GroundWaterML2-Core Logical Model.

|  |  |
| --- | --- |
| **/req/observation/observed-property** | The XML element om:observedProperty SHALL have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/ftc#PropertyKind** defined in **http://www.opengis.net/def/groundwaterml/2.0/def/property** |

The ultimate feature of interest (domain sampled feature) is to be a feature in the GroundWaterML2-Core Logical Model.

|  |  |
| --- | --- |
| **/req/observation/feature-of-interest** | The XML element om:featureOfInterest SHALL have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/ftc#Feature** defined in **http://www.opengis.net/def/groundwaterml/2.0/def/feature** |

This is the core requirements class for all XML instances of groundwater observations.

## Requirements Class: GeoSciML v3.2 GeologicUnit

GW\_HydrogeoUnit is a specialization of GeologicUnit from GeoSciML v3.2 <<Application Schema>> Geologic Unit. The requirements for this GML application schema have not been formally described. This requirements class describes the specific GeoSciML v3.2 GeologicUnit requirements for GroundWaterML2-Core.

|  |  |
| --- | --- |
| **Requirements class** | /req/geosciml-geologicunit |
| **Target type** | XML data document |
| **Dependency** | http://xmlns.geosciml.org/GeologicUnit/3.2 |
| **Requirement** | /req/geosciml-geologicunit/hydrogeounit |
| **Requirement** | /req/geosciml-geologicunit/type |

The GW\_HydrogeoUnit is a specialization of a GeoSciML v3.2 GeologicUnit.

|  |  |
| --- | --- |
| /req/geosciml-geologicunit/hydrogeounit | A GW\_HydrogeoUnit is a kind of GeologicUnit and SHALL inherit all properties and requirements of GeologicUnit. |

The type of GeologicUnit is a hydrogeologic unit.

|  |  |
| --- | --- |
| /req/geosciml-geologicunit/type | The XML element gsml:geologicUnitType SHALL have an xlink:href property whose value is the URI for an individual from the class **http://resource.geosciml.org/classifier/cgi/geologicunittype/hydrogeologic\_unit** |

## Requirements Class: GW\_HydrogeoUnit

Hydrogeologic units (GW\_HydrogeoUnit) are any soil or rock unit or zone which by virtue of its hydraulic properties has a distinct influence on the storage or movement of groundwater (after ANS, 1980).

|  |  |
| --- | --- |
| **Requirements class** | /**[req/gw\_hydrogeounit](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Recommendation** | /req/unit-media |

The porosity type term should come from an appropriate porosity type vocabulary.

|  |  |
| --- | --- |
| /req/unit-media | The XML element gwml2:gwUnitMedia SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/porosity-type-term** |



Figure 7. UML specification for GW\_HydrogeoUnit

## Requirements Class: GW\_Aquifer

An aquifer is a body of ground that contains / potentially contains / potentially contained sufficient saturated permeable material to yield significant quantities of water to wells and springs (after Lohman and others, 1972).

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_aquifer** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gw\_hydrogeounit](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Recommendation** | /req/aquifer-type |

The porosity type term should come from an appropriate porosity type vocabulary.

|  |  |
| --- | --- |
| /req/aquifer-type | The XML element gwml2:gwAquiferType SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/aquifer-type-term** |



Figure 8. UML specification for GW\_Aquifer

## Requirements Class: GW\_ConfiningBed

A confining bed is a layer of rock having very low porosity and in consequence hydraulic conductivity that hampers the movement of water into and out of an aquifer (Heath 1983).

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_confiningbed** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gw\_hydrogeounit](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Recommendation** | /req/conductivity-confinement-type |
| **Recommendation** | /req/spatial-confinement-type |

The degree of confinement type term (e.g. aquiclude) should come from an appropriate confinement type vocabulary.

|  |  |
| --- | --- |
| /req/conductivity-confinement-type | The XML element gwml2: gwConductivityConfinement SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/conductivity-confinement-type-term** |

The degree of spatial confinement type term (e.g. "unconfined-confined", "partially confined") should come from an appropriate spatial confinement type vocabulary.

|  |  |
| --- | --- |
| **/req/spatial-confinement-type** | The XML element gwml2: gwSpatialConfinement SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/spatial-confinement-type-term** |



Figure 9. UML specification for GW\_ConfiningBed.

## Requirements Class: GW\_ManagementArea

An area of ground identified for groundwater management purposes and can be delineated by human factors such as policy or regulation concerns, as well as hydrogeological or hydrological concerns. A groundwater management area does not necessarily align exactly with hydrogeological or hydrological boundaries.

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_management-area** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Requirement** | /req/gw\_areayield-result |
| **Recommendation** | /req/gw\_areayield-property |
| **Recommendation** | /req/management-area-type |

The result of the area yield of the aquifer or management area (e.g. specific yield, safe yield, license yield etc. but excludes well yield) shall be a quantity range of type swe:QuantityRange.

|  |  |
| --- | --- |
| /req/gw\_areayield-result | The XML element om:result associated with the gwml2: gwAreaYield SHALL have a data type swe:QuantityRange |

The type of yields of the aquifer or management area (e.g. specific yield, safe yield, license yield etc. but excludes well yield) should come from an appropriate yield type vocabulary.

|  |  |
| --- | --- |
| /req/gw\_areayield-property | The XML element om:observedProperty associated with gwml2:gwAreaYield SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/area-yield-property-term** |

The type of management area (e.g. restricted use zone, irrigation area, consumption area) should come from an appropriate management area type vocabulary.

|  |  |
| --- | --- |
| /req/management-area-type | The XML element gwml2: gwAreaType SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/management-area-type-term** |



Figure 10. UML specification for GW\_ManagementArea

## Requirements Class: GW\_FluidBody

A distinct body of some fluid (liquid, gas) that fills the voids of a container such as an aquifer, system of aquifers, water well, etc; in hydrogeology this body is usually constituted from groundwater, but the model allows for other types of fillers e.g. petroleum.

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_fluid-body** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Requirement** | /req/gw\_body-volume |
| **Recommendation** | /req/fluid-body-quality |

The result of the volume or quantity of water present in a container at a certain time shall be a quantity range of type swe:QuantityRange.

|  |  |
| --- | --- |
| /req/gw\_body-volume | The XML element om:result associated with the gwml2:gwBodyVolume SHALL have a data type swe:QuantityRange |

The type of mixtures associated with the fluid body (e.g. solution, suspension, emulsion, precipitate) should come from an appropriate mixture type vocabulary.

|  |  |
| --- | --- |
| /req/gw\_mixture-type | The XML element gwml2:gwMixture associated with gwml2:gwBodyConstituent SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/mixture-type-term** |

The categorical assessment of fluid quality (e.g. saline, brackish, fresh, turbide, sulfurous, mixed, 1000-3000mg/l tds, etc.) should come from an appropriate fluid quality vocabulary.

|  |  |
| --- | --- |
| /req/fluid-body-quality | The XML element gwml2: gwBodyQuality SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/fluid-body-quality-term** |



Figure 11. UML specification for GW\_FluidBody

## Requirements Class: GW\_HydrogeoVoid

Voids represent the spaces inside (hosted by) a unit or its material (e.g. the pores in an aquifer, or in the sandstone of an aquifer). Voids are hosted by a container (e.g. an aquifer), and can contain water bodies. Voids are differentiated from 'porosity' in that porosity is the proportion of void volume to total volume (i.e. container plus voids), while voids are the spaces themselves. Their delineation as a distinct entity is necessary, for example, to capture the volume of fractures in an aquifer.

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_hydrogeo-void** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Recommendation** | /req/void-type |

The void type porosity term should come from an appropriate porosity type vocabulary.

|  |  |
| --- | --- |
| /req/void-type | The XML element gwml2:gwVoidType SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/porosity-type-term** |



Figure 12. UML specification for GW\_HydrogeoVoid.

## Requirements Class: GW\_BodySurface

A surface on a body of groundwater, for a local or regional area, e.g. piezometric, potentiometric, water table, salt wedge, etc.

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_body-surface** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Recommendation** | /req/surface-type |

The surface type term should come from an appropriate porosity type vocabulary.

|  |  |
| --- | --- |
| /req/surface-type | The XML element gwml2:gwSurfaceType SHOULD have an xlink:href property whose value is the URI for an individual from the class **http://www.opengis.net/def/groundwaterml/2.0/surface-type-term** |



Figure 13. UML specification for GW\_BodySurface.

## Requirements Class: GW\_Well

A well or a water well is a shaft or hole sunk, dug or drilled into the Earth to extract water (IGH1379). A Monitoring station is an observation site (e.g. well) used to watch for the advent of an anticipated condition, generally undesirable, such as the advance of the salt-water front in a coastal area where salt-water encroachment is occurring, or the movement of a pollutant injected into a disposal well. IGH0806

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_well** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Dependency** | http://www.w3.org/TR/xmlschema-2 |
| **Dependency** | http://www.opengis.net/doc/IS/GML/3.2/clause/2.4 |
| **Dependency** | <http://www.opengis.net/specs/SWE/2.0/req/xsd-simple-components> |
| **Dependency** | Sampling features |
| **Dependency** | /req/well-construction |
| **Dependency** | GeoSciML Borehole |
|  |  |

## Requirements Class: Geology\_Log

A geologic log (Geology log) is a collection of lithologic observations along the path of a bore. Lithologic observations can be either a Geologic unit or Earth materials.

|  |  |
| --- | --- |
| **Requirements class** | /**req/gw\_well** |
| **Target type** | XML data document |
| **Dependency** | /**[req/gwml2-core](http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules)** |
| **Dependency** | http://www.w3.org/TR/xmlschema-2 |
| **Dependency** | http://www.opengis.net/doc/IS/GML/3.2/clause/2.4 |
| **Dependency** | <http://www.opengis.net/specs/SWE/2.0/req/xsd-simple-components> |
| **Dependency** | Sampling features |
| **Dependency** | /req/well-construction |
| **Dependency** | GeoSciML-Core |
| **Dependency** | GeoSciML-EarthMaterial |
| **Dependency** | O&M |
| **Dependency** | Discrete Coverage |
| **Requirement** | **/req/geologic\_log\_result** |

The geologic log is encoded as a CV\_Discrete\_Coverage

|  |  |
| --- | --- |
| /req/geologic\_log\_coverage | The XML element om:result associated with the gwml2:gwBodyVolume SHALL have a data type CV\_Discrete\_Coverage |

Depth shall be expressed as linear distance from reference elevation

|  |  |
| --- | --- |
| /req/geologic\_log\_depth | The fromDepth and toDepth of a LogValue shall be the linear distance along the bore path from the parent well gwWellReferenceElevation. |

fromDepth must be closer to reference elevation

|  |  |
| --- | --- |
| /req/geologic\_log\_depthOrder | The fromDepth of a LogValue shall be the closest to gw\_WellReferenceElevation while the toDepth shall be the farthest. |

## Media Types for groundwater data

Groundwater data conforming to this specification is encoded in GML-conformant XML documents. The standard MIME-type and sub-type for GML data should be used to indicate the encoding in internet exchange, as specified in **Erreur ! Source du renvoi introuvable.**, namely

application/gml+xml