5 Data content and structure

5.1 Application schemas – Overview

5.1.1 Application schemas included in the IRs

Articles 3, 4 and 5 of the Implementing Rules lay down the requirements for the content and structure of the data sets related to the INSPIRE Annex themes.

IR Requirement
Article 4
Types for the Exchange and Classification of Spatial Objects

1. For the exchange and classification of spatial objects from data sets meeting the conditions laid down in Article 4 of Directive 2007/2/EC, Member States shall use the spatial object types and associated data types, enumerations and code lists that are defined in Annexes II, III and IV for the themes the data sets relate to.

2. Spatial object types and data types shall comply with the definitions and constraints and include the attributes and association roles set out in the Annexes.

3. The enumerations and code lists used in attributes or association roles of spatial object types or data types shall comply with the definitions and include the values set out in Annex II. The enumeration and code list values are uniquely identified by language-neutral mnemonic codes for computers. The values may also include a language-specific name to be used for human interaction.

The types to be used for the exchange and classification of spatial objects from data sets related to the spatial data theme Natural Risk Zones are defined in the following application schema: (see section 5.3)

- **NaturalRiskZones application schema** describes the core normative concepts that build up the INSPIRE *Natural Risk Zones* data theme

The application schemas specify requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc.

NOTE The application schemas presented in this section contain some additional information that is not included in the Implementing Rules, in particular multiplicities of attributes and association roles.

TG Requirement 1	Spatial object types and data types shall comply with the multiplicities defined for the attributes and association roles in this section.

An application schema may include references (e.g. in attributes or inheritance relationships) to common types or types defined in other spatial data themes. These types can be found in a sub-section called “Imported Types” at the end of each application schema section. The common types referred to from application schemas included in the IRs are addressed in Article 3.

IR Requirement
Article 3
Common Types

Types that are common to several of the themes listed in Annexes I, II and III to Directive 2007/2/EC shall conform to the definitions and constraints and include the attributes and association roles set out in Annex I.

NOTE Since the IRs contain the types for all INSPIRE spatial data themes in one document, Article 3 does not explicitly refer to types defined in other spatial data themes, but only to types defined in external data models.

Common types are described in detail in the Generic Conceptual Model [DS-D2.7], in the relevant international standards (e.g. of the ISO 19100 series) or in the documents on the common INSPIRE models [DS-D2.10.x]. For detailed descriptions of types defined in other spatial data themes, see the corresponding Data Specification TG document [DS-D2.8.x].

5.1.2 Additional recommended application schemas

- In addition to the application schemas listed above, the following additional application schema has been defined for the theme *Natural Risk Zones* (see Annex D):

The Floods_Example_Model application schema represents the extension of the core NZ application schema (NaturalRiskZones) as one possible example of how Floods Directive requirements could be addressed.

These additional application schemas are not included in the IRs. They typically address requirements from specific (groups of) use cases and/or may be used to provide additional information. They are included in this specification in order to improve interoperability also for these additional aspects and to illustrate the extensibility of the application schemas included in the IRs.

Recommendation 1	Additional and/or use case-specific information related to the theme Natural Risk Zones should be made available using the spatial object types and data types specified in the following application schema(s): Floods_Example_Model

5.2 Basic notions

This section explains some of the basic notions used in the INSPIRE application schemas. These explanations are based on the GCM [DS-D2.5].

5.2.1 Notation

5.2.1.1. Unified Modeling Language (UML)

The application schemas included in this section are specified in UML, version 2.1. The spatial object types, their properties and associated types are shown in UML class diagrams.

NOTE For an overview of the UML notation, see Annex D in [ISO 19103].

The use of a common conceptual schema language (i.e. UML) allows for an automated processing of application schemas and the encoding, querying and updating of data based on the application schema – across different themes and different levels of detail.

The following important rules related to class inheritance and abstract classes are included in the IRs.

IR Requirement
Article 5
Types

(…)

2. Types that are a sub-type of another type shall also include all this type's attributes and association roles.

3. Abstract types shall not be instantiated.

The use of UML conforms to ISO 19109 8.3 and ISO/TS 19103 with the exception that UML 2.1 instead of ISO/IEC 19501 is being used. The use of UML also conforms to ISO 19136 E.2.1.1.1-E.2.1.1.4.

NOTE ISO/TS 19103 and ISO 19109 specify a profile of UML to be used in conjunction with the ISO 19100 series. This includes in particular a list of stereotypes and basic types to be used in application schemas. ISO 19136 specifies a more restricted UML profile that allows for a direct encoding in XML Schema for data transfer purposes.

To model constraints on the spatial object types and their properties, in particular to express data/data set consistency rules, OCL (Object Constraint Language) is used as described in ISO/TS 19103, whenever possible. In addition, all constraints are described in the feature catalogue in English, too.

NOTE Since "void" is not a concept supported by OCL, OCL constraints cannot include expressions to test whether a value is a *void* value. Such constraints may only be expressed in natural language.

5.2.1.2. Stereotypes

In the application schemas in this section several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [DS-D2.5]. These are explained in Table 1 below.

Table 1 – Stereotypes (adapted from [DS-D2.5])

Stereotype	Model element	Description

applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
leaf	Package	A package that is not an application schema and contains no packages.
featureType	Class	A spatial object type.
type	Class	A type that is not directly instantiable, but is used as an abstract collection of operation, attribute and relation signatures. This stereotype should usually not be used in INSPIRE application schemas as these are on a different conceptual level than classifiers with this stereotype.
dataType	Class	A structured data type without identity.
union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
enumeration	Class	An enumeration.
codeList	Class	A code list.
import	Dependency	The model elements of the supplier package are imported.
voidable	Attribute, association role	A voidable attribute or association role (see section 5.2.2).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.2.2 Voidable characteristics

The «voidable» stereotype is used to characterise those properties of a spatial object that may not be present in some spatial data sets, even though they may be present or applicable in the real world. This does *not* mean that it is optional to provide a value for those properties.

For all properties defined for a spatial object, a value has to be provided – either the corresponding value (if available in the data set maintained by the data provider) or the value of *void*. A *void* value shall imply that no corresponding value is contained in the source spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs.

Recommendation 2 The reason for a *void* value should be provided where possible using a listed value from the VoidReasonValue code list to indicate the reason for the missing value.

The VoidReasonValue type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The property is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the “elevation of the water body above the sea level” has not been included in a dataset containing lake spatial objects, then the reason for a void value of this property would be ‘Unpopulated’. The property receives this value for all spatial objects in the spatial data set.
- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the “elevation of the water body above the sea level” *of a certain lake* has not been measured, then the reason for a void value of this property would be ‘Unknown’. This value is applied only to those spatial objects where the property in question is not known.
- *Withheld*: The characteristic may exist, but is confidential and not divulged by the data provider.

NOTE It is possible that additional reasons will be identified in the future, in particular to support reasons / special values in coverage ranges.

The «voidable» stereotype does not give any information on whether or not a characteristic exists in the real world. This is expressed using the multiplicity:

- If a characteristic may or may not exist in the real world, its minimum cardinality shall be defined as 0. For example, if an Address may or may not have a house number, the multiplicity of the corresponding property shall be 0..1.
- If at least one value for a certain characteristic exists in the real world, the minimum cardinality shall be defined as 1. For example, if an Administrative Unit always has at least one name, the multiplicity of the corresponding property shall be 1..*.

In both cases, the «voidable» stereotype can be applied. In cases where the minimum multiplicity is 0, the absence of a value indicates that it is known that no value exists, whereas a value of void indicates that it is not known whether a value exists or not.

EXAMPLE If an address does not have a house number, the corresponding Address object should not have any value for the «voidable» attribute house number. If the house number is simply not known or not populated in the data set, the Address object should receive a value of *void* (with the corresponding void reason) for the house number attribute.

5.2.3 Enumerations

Enumerations are modelled as classes in the application schemas. Their values are modelled as attributes of the enumeration class using the following modelling style:

- No initial value, but only the attribute name part, is used.
- The attribute name conforms to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

IR Requirement
Article 6
Code Lists and Enumerations

(…)

5) Attributes or association roles of spatial object types or data types that have an enumeration type may only take values from the lists specified for the enumeration type."

5.2.4 Code lists

Code lists are modelled as classes in the application schemas. Their values, however, are managed outside of the application schema.

5.2.4.1. Code list types

The IRs distinguish the following types of code lists.

IR Requirement
Article 6
Code Lists and Enumerations

1) Code lists shall be of one of the following types, as specified in the Annexes:
   a) code lists whose allowed values comprise only the values specified in this Regulation;
   b) code lists whose allowed values comprise the values specified in this Regulation and narrower values defined by data providers;
   c) code lists whose allowed values comprise the values specified in this Regulation and additional values at any level defined by data providers;
   d) code lists, whose allowed values comprise any values defined by data providers.

   For the purposes of points (b), (c) and (d), in addition to the allowed values, data providers may use the values specified in the relevant INSPIRE Technical Guidance document available on the INSPIRE web site of the Joint Research Centre.

The type of code list is represented in the UML model through the tagged value *extensibility*, which can take the following values:

- *none*, representing code lists whose allowed values comprise only the values specified in the IRs (type a);
- *narrower*, representing code lists whose allowed values comprise the values specified in the IRs and narrower values defined by data providers (type b);
- *open*, representing code lists whose allowed values comprise the values specified in the IRs and additional values at any level defined by data providers (type c); and
- *any*, representing code lists, for which the IRs do not specify any allowed values, i.e. whose allowed values comprise any values defined by data providers (type d).

Recommendation 3 Additional values defined by data providers should not replace or redefine any value already specified in the IRs.

NOTEThis data specification may specify recommended values for some of the code lists of type (b), (c) and (d) (see section 5.2.4.3). These recommended values are specified in a dedicated Annex.

In addition, code lists can be hierarchical, as explained in Article 6(2) of the IRs.

IR Requirement
Article 6
Code Lists and Enumerations

(…)

2) Code lists may be hierarchical. Values of hierarchical code lists may have a more generic parent value. Where the valid values of a hierarchical code list are specified in a table in this Regulation, the parent values are listed in the last column.

The type of code list and whether it is hierarchical or not is also indicated in the feature catalogues.

5.2.4.2. Obligations on data providers

IR Requirement
Article 6
Code Lists and Enumerations

(….)

3) Where, for an attribute whose type is a code list as referred to in points (b), (c) or (d) of paragraph 1, a data provider provides a value that is not specified in this Regulation, that value and its definition shall be made available in a register.

4) Attributes or association roles of spatial object types or data types whose type is a code list may only take values that are allowed according to the specification of the code list.

Article 6(4) obliges data providers to use only values that are allowed according to the specification of the code list. The "allowed values according to the specification of the code list" are the values explicitly defined in the IRs plus (in the case of code lists of type (b), (c) and (d)) additional values defined by data providers.

For attributes whose type is a code list of type (b), (c) or (d) data providers may use additional values that are not defined in the IRs. Article 6(3) requires that such additional values and their definition be made available in a register. This enables users of the data to look up the meaning of the additional values used in a data set, and also facilitates the re-use of additional values by other data providers (potentially across Member States).

NOTE Guidelines for setting up registers for additional values and how to register additional values in these registers is still an open discussion point between Member States and the Commission.

5.2.4.3. Recommended code list values

For code lists of type (b), (c) and (d), this data specification may propose additional values as a recommendation (in a dedicated Annex). These values will be included in the INSPIRE code list register. This will facilitate and encourage the usage of the recommended values by data providers since the obligation to make additional values defined by data providers available in a register (see section 5.2.4.2) is already met.

Recommendation 4 Where these Technical Guidelines recommend values for a code list in addition to those specified in the IRs, these values should be used.

NOTE For some code lists of type (d), no values may be specified in these Technical Guidelines. In these cases, any additional value defined by data providers may be used.

5.2.4.4. Governance

The following two types of code lists are distinguished in INSPIRE:

- *Code lists that are governed by INSPIRE (INSPIRE-governed code lists).* These code lists will be managed centrally in the INSPIRE code list register. Change requests to these code lists (e.g. to add, deprecate or supersede values) are processed and decided upon using the INSPIRE code list register's maintenance workflows.

  INSPIRE-governed code lists will be made available in the INSPIRE code list register at *http://inspire.ec.europa.eu/codelist/<CodeListName>*. They will be available in SKOS/RDF, XML and HTML. The maintenance will follow the procedures defined in ISO 19135. This means that the only allowed changes to a code list are the addition, deprecation or supersession of values, i.e. no value will ever be deleted, but only receive different statuses (valid, deprecated,

superseded). Identifiers for values of INSPIRE-governed code lists are constructed using the pattern *http://inspire.ec.europa.eu/codelist/<CodeListName>*/<value>.

- *Code lists that are governed by an organisation outside of INSPIRE (externally governed code lists).* These code lists are managed by an organisation outside of INSPIRE, e.g. the World Meteorological Organization (WMO) or the World Health Organization (WHO). Change requests to these code lists follow the maintenance workflows defined by the maintaining organisations. Note that in some cases, no such workflows may be formally defined.

Since the updates of externally governed code lists is outside the control of INSPIRE, the IRs and these Technical Guidelines reference a specific version for such code lists.

The tables describing externally governed code lists in this section contain the following columns:

- The *Governance* column describes the external organisation that is responsible for maintaining the code list.
- The *Source* column specifies a citation for the authoritative source for the values of the code list. For code lists, whose values are mandated in the IRs, this citation should include the version of the code list used in INSPIRE. The version can be specified using a version number or the publication date. For code list values recommended in these Technical Guidelines, the citation may refer to the "latest available version".
- In some cases, for INSPIRE only a subset of an externally governed code list is relevant. The subset is specified using the *Subset* column.
- The *Availability* column specifies from where (e.g. URL) the values of the externally governed code list are available, and in which formats. Formats can include machine-readable (e.g. SKOS/RDF, XML) or human-readable (e.g. HTML, PDF) ones.

Code list values are encoded using http URIs and labels. Rules for generating these URIs and labels are specified in a separate table.

Recommendation 5 The http URIs and labels used for encoding code list values should be taken from the INSPIRE code list registry for INSPIRE-governed code lists and generated according to the relevant rules specified for externally governed code lists.

NOTE Where practicable, the INSPIRE code list register could also provide http URIs and labels for externally governed code lists.

5.2.4.5. Vocabulary

For each code list, a tagged value called "vocabulary" is specified to define a URI identifying the values of the code list. For INSPIRE-governed code lists and externally governed code lists that do not have a persistent identifier, the URI is constructed following the pattern *http://inspire.ec.europa.eu/codelist/<UpperCamelCaseName>*.

If the value is missing or empty, this indicates an empty code list. If no sub-classes are defined for this empty code list, this means that any code list may be used that meets the given definition.

An empty code list may also be used as a super-class for a number of specific code lists whose values may be used to specify the attribute value. If the sub-classes specified in the model represent all valid extensions to the empty code list, the subtyping relationship is qualified with the standard UML constraint "{complete,disjoint}".

5.2.5 Identifier management

IR Requirement
Article 9
Identifier Management

1. The data type Identifier defined in Section 2.1 of Annex I shall be used as a type for the external object identifier of a spatial object.
2. The external object identifier for the unique identification of spatial objects shall not be changed during the life-cycle of a spatial object.

NOTE 1 An external object identifier is a unique object identifier which is published by the responsible body, which may be used by external applications to reference the spatial object. [DS-D2.5]

NOTE 2 Article 9(1) is implemented in each application schema by including the attribute *inspireId* of type Identifier.

NOTE 3 Article 9(2) is ensured if the *namespace* and *localId* attributes of the Identifier remains the same for different versions of a spatial object; the *version* attribute can of course change.

5.2.6 Geometry representation

IR Requirement
Article 12
Other Requirements & Rules

1. The value domain of spatial properties defined in this Regulation shall be restricted to the Simple Feature spatial schema as defined in Herring, John R. (ed.), OpenGIS® Implementation Standard for Geographic information – Simple feature access – Part 1: Common architecture, version 1.2.1, Open Geospatial Consortium, 2011, unless specified otherwise for a specific spatial data theme or type.

NOTE 1 The specification restricts the spatial schema to 0-, 1-, 2-, and 2.5-dimensional geometries where all curve interpolations are linear and surface interpolations are performed by triangles.

NOTE 2 The topological relations of two spatial objects based on their specific geometry and topology properties can in principle be investigated by invoking the operations of the types defined in ISO 19107 (or the methods specified in EN ISO 19125-1).

5.2.7 Temporality representation

The application schema(s) use(s) the derived attributes "beginLifespanVersion" and "endLifespanVersion" to record the lifespan of a spatial object.

The attributes "beginLifespanVersion" specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set. The attribute "endLifespanVersion" specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set.

NOTE 1 The attributes specify the beginning of the lifespan of the version in the spatial data set itself, which is different from the temporal characteristics of the real-world phenomenon described by the spatial object. This lifespan information, if available, supports mainly two requirements: First, knowledge about the spatial data set content at a specific time; second, knowledge about changes to a data set in a specific time frame. The lifespan information should be as detailed as in the data set (i.e., if the lifespan information in the data set includes seconds, the seconds should be represented in data published in INSPIRE) and include time zone information.

NOTE 2 Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

IR Requirement
Article 10
Life-cycle of Spatial Objects

(…)

3. Where the attributes beginLifespanVersion and endLifespanVersion are used, the value of endLifespanVersion shall not be before the value of beginLifespanVersion.

NOTE The requirement expressed in the IR Requirement above will be included as constraints in the UML data models of all themes.

Recommendation 6 If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

5.2.7.1. Validity of the real-world phenomena

The application schema(s) use(s) the attributes "validFrom" and "validTo" to record the validity of the real-world phenomenon represented by a spatial object.

The attributes "validFrom" specifies the date and time at which the real-world phenomenon became valid in the real world. The attribute "validTo" specifies the date and time at which the real-world phenomenon is no longer valid in the real world.

Specific application schemas may give examples what “being valid” means for a specific real-world phenomenon represented by a spatial object.

IR Requirement
Article 12
Other Requirements & Rules

(…)

3. Where the attributes validFrom and validTo are used, the value of validTo shall not be before the value of validFrom.

NOTE The requirement expressed in the IR Requirement above will be included as constraints in the UML data models of all themes.

5.2.8 Coverages

Coverage functions are used to describe characteristics of real-world phenomena that vary over space and/or time. Typical examples are temperature, elevation, precipitation, imagery. A coverage contains a set of such values, each associated with one of the elements in a spatial, temporal or spatio-temporal domain. Typical spatial domains are point sets (e.g. sensor locations), curve sets (e.g. isolines), grids (e.g. orthoimages, elevation models), etc.

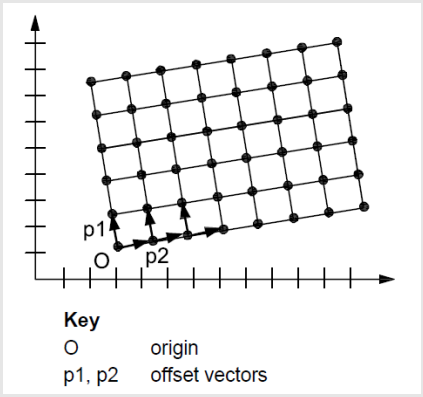
In INSPIRE application schemas, coverage functions are defined as properties of spatial object types where the type of the property value is a realisation of one of the types specified in ISO 19123.

To improve alignment with coverage standards on the implementation level (e.g. ISO 19136 and the OGC Web Coverage Service) and to improve the cross-theme harmonisation on the use of coverages in INSPIRE, an application schema for coverage types is included in the Generic Conceptual Model in 9.9.4. This application schema contains the following coverage types:

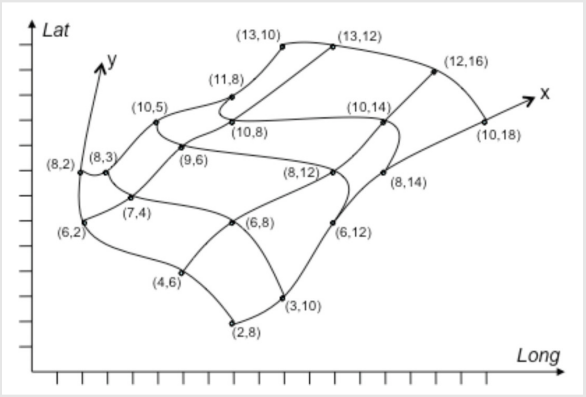
- *RectifiedGridCoverage*: coverage whose domain consists of a rectified grid – a grid for which there is an affine transformation between the grid coordinates and the coordinates of a coordinate reference system (see Figure 4, left).
- *ReferenceableGridCoverage*: coverage whose domain consists of a referenceable grid – a grid associated with a transformation that can be used to convert grid coordinate values to values of coordinates referenced to a coordinate reference system (see Figure 4, right).

In addition, some themes make reference to the types TimeValuePair and Timeseries defined in Taylor, Peter (ed.), *OGC® WaterML 2.0: Part 1 – Timeseries, v2.0.0,* Open Geospatial Consortium, 2012. These provide a representation of the time instant/value pairs, i.e. time series (see Figure 5).

Where possible, only these coverage types (or a subtype thereof) are used in INSPIRE application schemas.



(Source: ISO 19136:2007)



(Source: GML 3.3.0)

Figure 4 – Examples of a rectified grid (left) and a referenceable grid (right)

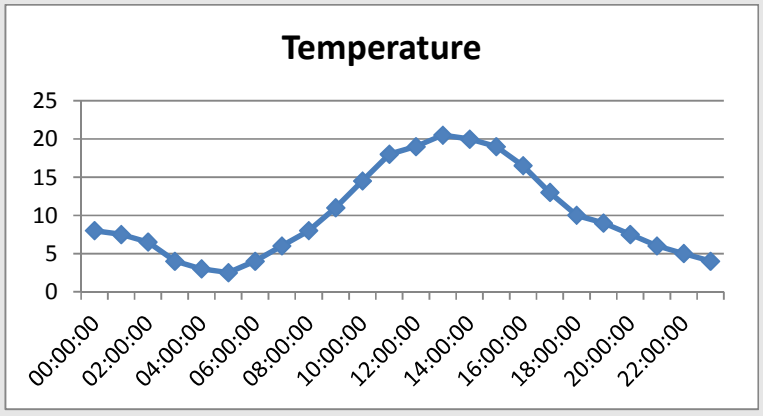


Figure 5 – Example of a time series

5.3 Application schema NaturalRiskZones

5.3.1 Description

5.3.1.1. Narrative description

The application schema covers elements that are seen as necessary to describe INSPIRE *Natural Risk Zones*. This common model schema allows users to model the main concepts as defined in Chapter 2 (hazard, vulnerability, exposure, risk and observed event).

We present in these data specifications a model in which the concepts are abstract and can be specialized both in vectors (and therefore based upon EN-ISO 19107 standard) and in coverages (and therefore based upon EN-ISO 19123 Standard).

This is done in order to create a framework which enables exchanges of data that are either vectors or coverages, considering that any of the 4 spatial objects can be modelled in one of those 2 ways.

There are 4 kinds of spatial objects that are modelled both as vectors and as coverages:

- **Hazard area**
- **Exposed element**
- **Risk zone**
- **Observed event**

For each of them, 3 spatial object types are created:

- An abstract spatial object type that contains the properties (attributes, or constraints) of the spatial object that are common both to its vector representation and to its coverage representation. These abstract spatial object types have their names prefixed by “Abstract”.

- A vector spatial object type that is generated from the abstract spatial object. It has the properties that are specific to the vector representation, such as the definition of the geometry.

- A coverage spatial object type that is generated both from the abstract spatial object and a generic coverage spatial object type (detailed later in the chapter). It has the properties that are specific to coverage representation, such as the definition of the domain and the definition of the range. These coverage spatial object types have their names suffixed by “Coverage”.

NOTE If a data provider has data in a vector form, then he will make use of the vector spatial object types. If a data provider has data in a coverage form, then he will make use of the coverage spatial object types.

5.3.1.2. UML Overview

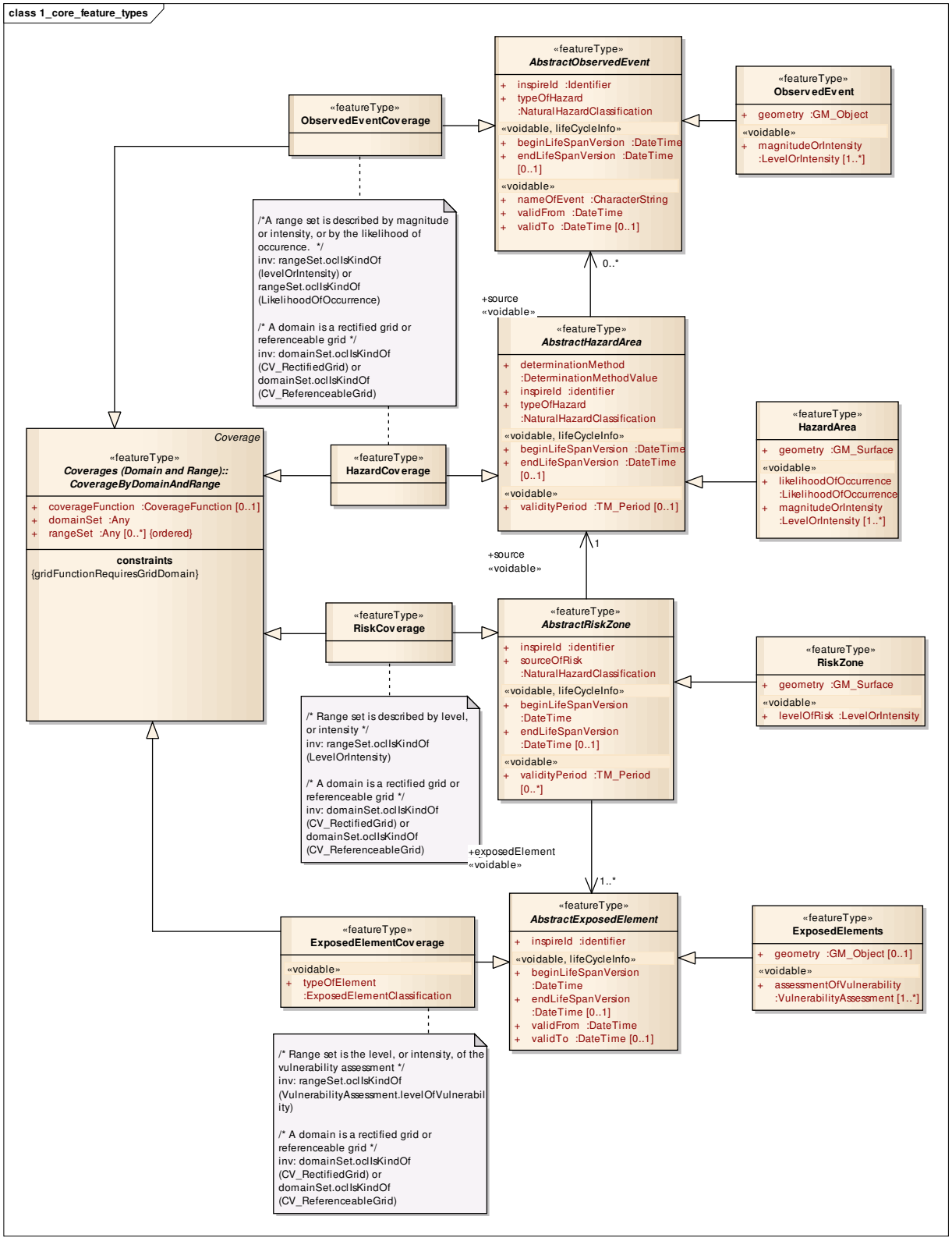


Figure 6 – UML class diagram: Overview of the NaturalRiskZones application schema

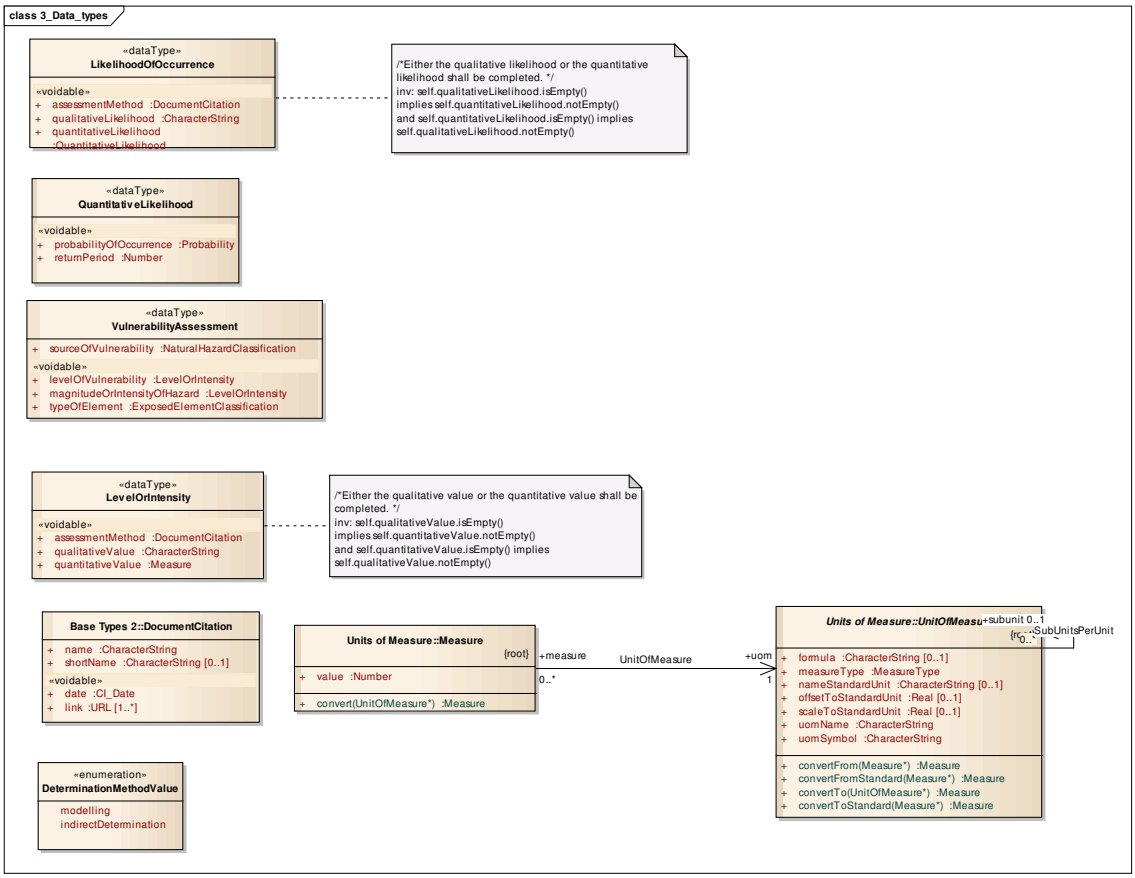


Figure 7: UML class diagram: Overview of the NaturalRiskZones data types

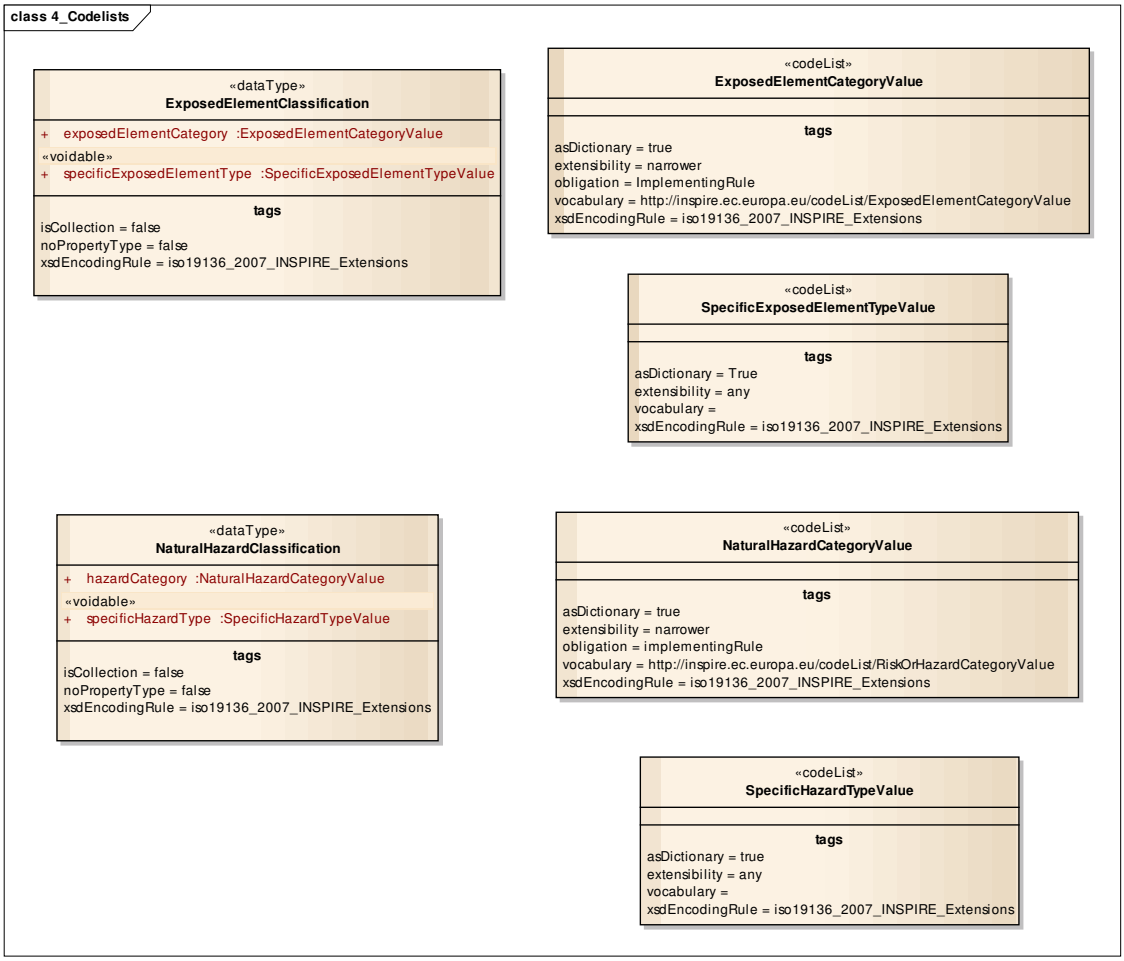


Figure 8: UML class diagram: Overview of the NaturalRiskZones code lists

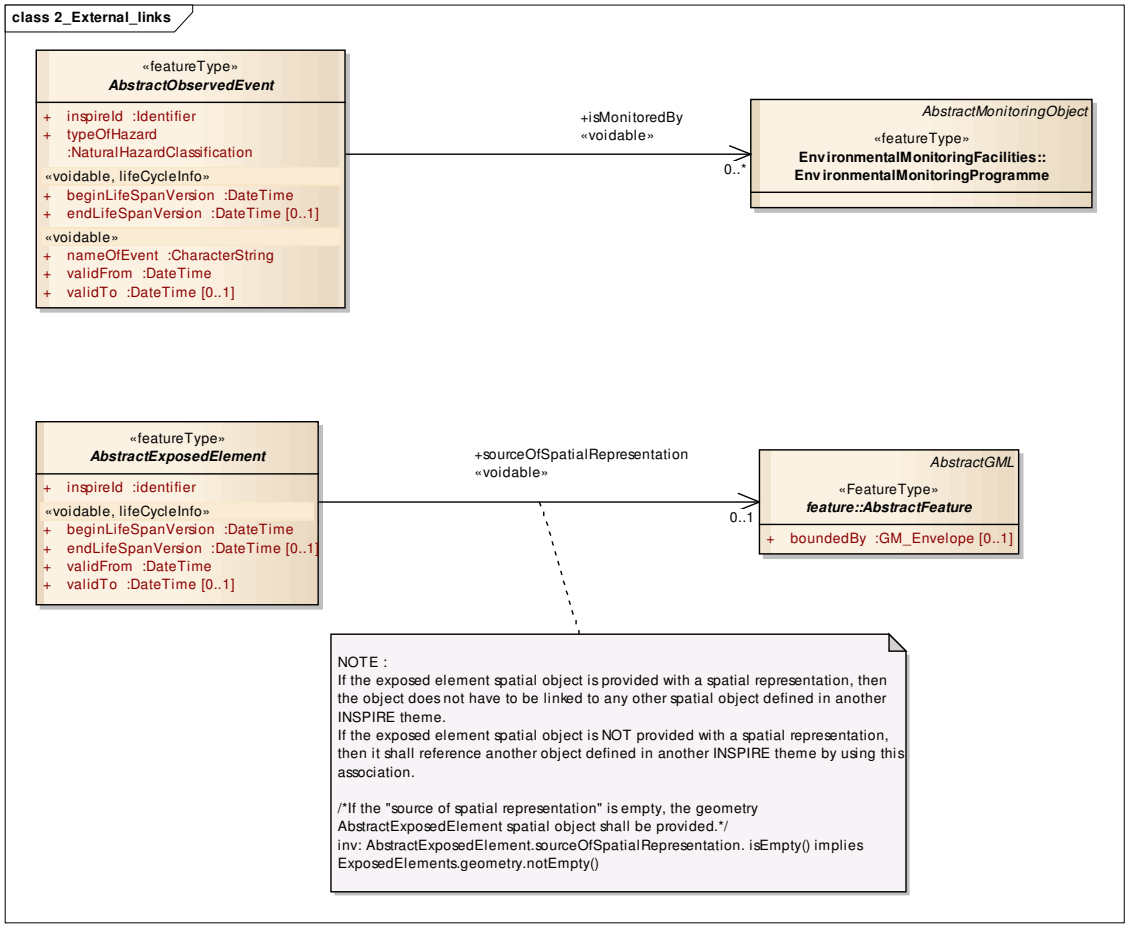


Figure 9: UML class diagram: Overview of the External links

Detailed description of major types:

HAZARD AREAS

Hereunder are detailed the following spatial object types:

- *"AbstractHazardArea"*
- *"HazardAreaVector"*
- *"HazardCoverage"*

The following data types are also detailed:

- *"DeterminationMethod"*
- *"NaturalHazardClassification"*
- *"LikelihoodOfOccurrence"*
- *"LevelOrIntensity"*

Common properties of "*AbstractHazardArea*"

The objects of the "HazardArea" spatial object type have following properties:

- An identifier
- **A method of determination**: There are several ways to delineate the perimeter of a hazard: to compute it according to a model, or to define it by interpretation of available data and/or information. This is modelled using the "*DeterminationMethod*" data type. This data type, (enumeration) has 2 possible values :
    - "modelling"
    - "indirect determination"

- **A type of hazard**: this property is modelled with a "*NaturalHazardClassification*" data type

  Natural hazards classifications from the scientific literature focus in the nature of the processes or in the origin of the process itself, the physics, chemistry or biology involved (or all together) in causing damage with little regard (if any) for damage itself. They deal with finite systems or finite processes with finite variables and finite expectable results.

  Due to the fact that in natural hazard community there is not a widely accepted and used classification of types of natural hazards, the TWG NZ team, in order to facilitate interoperability of hazard data, has defined a list of generic types of hazards.

  A data type "*NaturalHazardClassification*" containts:
    - An attribute that refers to the code list: "*NaturalHazardCategoryValue"*. This hierarchical code list has been elaborated to facilitate high level interoperability. It is already populated with a dozen of natural hazard types (see Annex C). However this code list can be extended by hazard data providers with narrower terms.
    - An attribute that refers to the empty code list: "*SpecificHazardTypeValue"*. This code is a placeholder to enable a hazard data provider to enter a specific denomination of a hazard type.

- The date the object was entered in the dataset, and the date the object was removed or superseded from the dataset. Those attributes are "*beginLifeSpanVersion*" and "*endLifeSpanVersion*"

- The period of validity ("*validityPeriod*"):
  The period of validity is the future finite time frame where the hazard applies. The same hazard assessment can be valid for a specific period, or even for several specific periods: the hazard assessment of forest fires may actually be valid only in summer, or maybe in summer or in winter (but not all year long). This attribute can also be used for multi-temporal hazard analysis.

- An association link to the "*Observed events*"

  It is possible to use the location of an observed event as an input for the hazard area modeling. A hazard area may therefore have an observed event as a "source". An association link

between the “hazard area” spatial object type and the “observed event” spatial object type is set to express this. A hazard area may have 0 (if no observed event was used during the process of hazard area modelling) or 1 observed event. This association link can only be navigated from the hazard area to the observed event.

Specific properties of “HazardArea”
The discrete representation of a hazard area has also the geometry as mandatory, which is modeled as a “*GM_Surface*”. All hazard areas are therefore modeled as polygons.
It has also the following two attributes:

- **The likelihood of occurrence**
  The likelihood of occurrence is a general concept relating to the chance of an event occurring. This is modeled by the “*LikelihoodOfOccurrence*” data type.

  It is assumed that a likelihood of occurrence can be expressed either qualitatively, or quantitatively. Moreover, a value without any further explanation is of very little interest.
  The data type “*Likelihood of occurrence*” is a set of 3 attributes:
    - An “assessmentMethod”, which refers to the method used to express the likelihood of a hazard event
    - A “*qualitative*Likelihood”, which enables to describe in narrative form the assessment of the likelihood of occurrence of a hazard.event.
    - A “*quantitative*Likelihood, which is either a probability of occurrence, or a return period.

  A return period is a long-term average interval of time or number of years within which an event will be equaled or exceeded. The probability of occurrence is the inverse value of the return period. Therefore 2 attributes are modeled: a “*returnPeriod*” attribute and a “*probabilityOfOccurrence*” attribute.

- **The magnitude, or intensity**
  A magnitude, or intensity, can be expressed either qualitatively, or quantitatively. Moreover, a value without any further explanation is of very little interest.

  The data type *“LevelOrIntensity*” is a set of 3 attributes:
    - A qualitative value, which is a character string
    - A quantitative value, which is modeled as a measure (that is to say a number and a unit)
      - **A reference to the method** in which further information can be taken. This is modeled using the INSPIRE common data type “*DocumentCitation*”.that is described in the INSPIRE Generic Conceptual Model.

Specific properties of “HazardAreaCoverage”
In the related coverage representation, the values that vary over space (and therefore declared as the range of the coverage) are either the **magnitude or intensity** of a hazard, or the **likelihood of occurrence** of a hazard.

EXPOSED ELEMENTS

Hereunder are detailed the following spatial object types:

- “AbstractExposedElement”
- “ExposedElement”
- “ExposedElementCoverage”

The following types are also detailed:

- “VulnerabilityAssessment”
- “ExposedElementClassification”,
- ”RiskOrHazardCategoryValue”.

Common properties of “*AbstractExposedElement*”

The "*ExposedElement*" spatial object type refers to the spatial representation of people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. The assessment or calculation of vulnerability may be conducted over those spatial objects.

The "*AbstractExposedElement*" is linked to the "*AbstractFeature*" GML type.

NOTE Potentially, any kind of any object of the real world can be considered as being exposed to a natural hazard, and therefore could fit in this spatial object type. Some of them may also be provided under another INSPIRE spatial object type.

To properly model exposed elements two scenarios are taken into account:

- The spatial representation of an exposed element is defined and provided by another INSPIRE theme. In this case, the exposed element object shall reference the object. The reference is made by instantiating the association link between "*ExposedElement*" and the abstract GML "*AbstractFeature*". This "*AbstractFeature*" encompasses any spatial object type of any INSPIRE data specifications. Object referencing is used to avoid any duplication of geometry between INSPIRE spatial objects.
- An exposed element is not defined in another INSPIRE theme. In this case, the spatial representation of the object shall be provided using the INSPIRE NZ "*ExposedElement*" spatial object type, and the object does not have to be linked to any other spatial object defined in another INSPIRE theme.

The "***ExposedElement*"** spatial object type has also following properties:

- An identifier
- The date the object was entered in the dataset, and the date the object was removed or superseded from the dataset. Those attributes are "*beginLifeSpanVersion*" and "*endLifeSpanVersion*"
- The date the object started to exist in the real world, and the date from which the object no longer exist in the real world (if so). Those attributes are "*validFrom*" and "*validTo*".

Specific properties of the "*ExposedElement*"

The geometry of a discrete representation of an exposed element is modelled as "*GM_Object*", and basically allows any kind of geometric primitives. The multiplicity of this attribute is "0 or 1", due to the fact that an exposed element can reference another object defined in another INSPIRE data theme.
In addition to this, any spatial object of the "*ExposedElementVector*" spatial object type has the "**assessmentOfVulnerability**" as a voidable attribute.
The same exposed element may have one or several vulnerability assessments, as the assessment depends both on the type of natural hazard it is exposed to and on the level or intensity of the hazard.

Any "VulnerabilityAssessment" has following properties:

- the "*sourceOfVulnerability*"
  This refers to the type of hazard to which the vulnerability of the exposed element is assessed (or calculated) using the "*NaturalHazardClassification*".
- The "levelOfVulnerability"

This is the result of the assessment of the vulnerability. This property is modeled as a "LevelOrIntensity" data type.

- The magnitude, or intensity, of the hazard according to which the vulnerability of the exposed element is assessed (or calculated). This property is modeled as a "LevelOrIntensity" data type.
- The "*typeOfElement*"

As there is currently not a widely used list or classification of types of exposed elements, a data type called "ExposedElementClassification" was defined to facilitate data interoperability.
It contains:

- A mandatory attribute that refers to an existing code list: the "ExposedElementCategoryValue". This hierarchical code list has been elaborated to facilitate high level interoperability. It is already populated with generic types of exposed elements (see Annex C). However this code list can be extended by exposed data providers with narrower terms.

- An attribute that refers to the empty code list: "SpecificExposedElementTypeValue". This code is a placeholder to enable exposed data providers to enter a specific denomination of a exposed element type.

Specific properties of "*ExposedElementCoverage*"
The exposed element coverage has the attribute, which is the "typeOfElement". This is modelled by the ""*ExposedElementClassification*" data type.

In the related coverage representation, the values that vary over space (and therefore declared as the range of the coverage) **level or intensity of the vulnerability of assessment.**

RISK ZONES

Hereunder are detailed the following spatial object types:
- "AbstractRiskZone"
- "RiskZone"
- "RiskZoneCoverage"

Common properties of "*AbstractRiskZone*"
A risk zone is defined as the spatial extent of a combination of the consequences of an event (hazard) and the associated probability/likelihood of its occurrence.
It has following properties:
- An identifier
- A "*sourceOfRisk*"
  The source of risk refers to the type of hazard that engenders the risk. In the model, the "*sourceOfRisk*" refers to the "*NaturalHazardClassification*" data type.
- The date the object was entered in the dataset, and the date the object was removed or superseded from the dataset. Those attributes are "*beginLifeSpanVersion"* and "*endLifeSpanVersion*"
- A period of validity ("*validityPeriod*"). – see Hazard Zones section above.
- An association to the "*HazardArea*"
  The delineation of a risk zone results from the co-occurrence over the same place of a natural hazard with elements that are vulnerable to this hazard type. As a consequence, a risk zone is potentially linked to a hazard area (and vice-versa as the creation of a hazard area spatial object may have preceded the creation of a risk zone object).
  An association link between the "*HazardArea"* spatial object type and the "*RiskZone*" spatial object type is set to express this. Each risk zone should have 1 hazard area as a source.
  This association link is voidable, and can only be navigated from the risk zone to the hazard area.
- An association to the "*ExposedEelement*"
  In the same way as there is a link between hazard area and risk zone, there is also a link between risk zone and exposed elements. A risk zone is potentially linked to exposed elements in so far as an exposed element should have been identified as such within the process of production of a risk zone.
  An association link between the "ExposedElement" spatial object type and the "RiskZone" spatial object type is set to express this. There is at least one exposed element for each risk zone.
  This association link is voidable, and can only be navigated from the risk zone to the exposed element.

Specific properties of "RiskZone"
The vector representation of a risk zone is modelled as a "*GM_Surface*". All risk zones are therefore modelled as polygons.
It has also the following attribute:
- The *"levelOfRisk"*.
  It is an assessment of the combination of the consequences of an event (hazard) and the associated probability/likelihood of the occurrence of the event. This property is modelled as a "*LevelOrIntensity"* data type.

Specific properties of "RiskZoneCoverage"

In the related coverage representation, the values that vary over space (and therefore declared as the range of the coverage) is the level of risk. As the level of risk is modelled by the "*LevelOrIntensity*" data type, the constraint on the range set of the coverage addresses the "*LevelOrIntensity*" data type.

OBSERVED EVENTS

Hereunder are detailed the following spatial object types:

- *"AbstractObservedEvent"*
- *"ObservedEvent"*
- *"ObservedEventCoverage"*

Common properties of "*AbstractObservedEvent*"
An observed event refers to the spatial representation of a natural phenomenon relevant to the study of natural hazards which occurred, or is currently occurring, and which have been observed.

The abstract observed event spatial object type has following properties:

- An identifier
- A "*typeOfHazard*": this property is modelled using the "*NaturalHazardClassification*" data type
- The "nameOfEvent": an observed event can have a commonly known name (such as the "Xynthia" tempest that stroke part of the Atlantic coast-line of France in early 2010).
- "*ValidFrom*": which provides piece of information about the date of appearance of the event ("February 26th 2010" for the "Xynthia" tempest)
- "*ValidTo*" : which provides piece of information about the ending date of the event ("March 1st 2010" for the "Xynthia" tempest)
- The date the object was entered in the dataset, and the date the object was removed or superseded from the dataset. Those attributes are "*beginLifeSpanVersion"* and "*endLifeSpanVersion*"
- An association to the "EnvironmentalMonitoringProgram"

As it is a spatial object that may exist in the real world, an observed event can be monitored. To express this, an voidable association link is set between the "*AbstractObservedEvent*" spatial object type, and the "*EnvironmentalMonitoringProgram*" spatial object type designed by TWG EF. An observed event can be monitored by 0, 1 or several environmental monitoring programs.

Specific properties of "*ObservedEvent*"
The vector representation is modelled as a "*GM_Object*". This basically encompasses all types of geometric primitives.
It has also following attribute:
"*magnitudeOrIntensity"* which is modelled using the data type "*LevelOrIntensity*".

Specific properties of "*ObservedEventCoverage*"
In the related coverage representation, the values that vary over space (and therefore declared as the range of the coverage) are either the magnitude or intensity, or the likelihood of occurrence.

5.3.1.3. Consistency between spatial data sets

IR Requirement
Annex IV / Section 12.6.
Theme-specific Requirements

(1) Where a RiskZone is associated with a HazardArea, the RiskZone and the HazardArea shall overlap.
(2) Where a RiskZone is associated with an ExposedElement, the ExposedElement shall overlap with the RiskZone.

5.3.1.4. Identifier management

All key spatial object types (HazardArea, RiskZone, ExposedElement and ObservedEvent) shall be assigned an inspireID in accordance with the rules for Identifier Management defined in section 14 of

D2.5 Generic Conceptual Model. The requirement for an inspireID follows Recommendation 27 from section 14 of D2.5:

From Section 14 of D2.5 Generic Conceptual Model

Recommendation 27	It is strongly recommended that unique identifiers should be provided for spatial object types where references from other spatial objects are expected to be applicable.

The inspireID is required for those spatial objects to enable references from non-spatial resources to be established. The inspireID shall be a persistent, external object identifier. This means that the inspireID shall provide a consistent identifier enabling multiple non-spatial resources to be linked to the same object.

The identifier assigned as the inspireID shall follow the four requirements for external object identifiers:

1. **Uniqueness**: the identifier shall not be assigned to any other INSPIRE spatial object.

   NOTE 1: Different versions of the spatial object shall have the same identifier

   NOTE 2: Identifiers must not be re-used
2. **Persistence:** once assigned the identifier shall remain unchanged during the life-time of a spatial object
3. **Traceability:** a spatial object (or specific version) can be accessed based on its identifier
4. **Feasibility:** the system for defining identifiers has been designed to allow existing identifiers to be used

The inspireID contains three properties: localID, namespace and a «voidable» version. Where an INSPIRE Download Service provides access to multiple versions of spatial objects, the version parameter should be included to enable third parties to include the version of the spatial object when the referencing.

Recommendation 7	It is strongly recommended that a version is included in the inspireId to allow different versions of a spatial object to be distinguished.

5.3.1.5. Modelling of object references

In case that the spatial representation of an exposed element is defined and provided by another INSPIRE theme, the exposed element object shall reference that external object. The reference is made by instantiating the association link between “ExposedElement” and the abstract GML “AbstractFeature”. This “AbstractFeature” encompasses any spatial object type of any INSPIRE data specifications. Object referencing is used to avoid any duplication of geometry between INSPIRE spatial objects.

Recommendation 8	Member States and/or National Spatial Data Infrastructures should agree on the external information systems to share spatial objects that fulfill the definition of “ExposedElement” spatial object type.

5.3.2 Feature catalogue

Feature catalogue metadata

Application Schema	INSPIRE Application Schema NaturalRiskZones
Version number	3.0

Types defined in the feature catalogue

Type	Package	Stereotypes
AbstractExposedElement	NaturalRiskZones	«featureType»
AbstractHazardArea	NaturalRiskZones	«featureType»
AbstractObservedEvent	NaturalRiskZones	«featureType»
AbstractRiskZone	NaturalRiskZones	«featureType»
ExposedElement	NaturalRiskZones	«featureType»
ExposedElementCategoryValue	NaturalRiskZones	«codeList»
ExposedElementClassification	NaturalRiskZones	«dataType»
ExposedElementCoverage	NaturalRiskZones	«featureType»
HazardArea	NaturalRiskZones	«featureType»
HazardCoverage	NaturalRiskZones	«featureType»
LevelOrIntensity	NaturalRiskZones	«dataType»
LikelihoodOfOccurrence	NaturalRiskZones	«dataType»
NaturalHazardCategoryValue	NaturalRiskZones	«codeList»
NaturalHazardClassification	NaturalRiskZones	«dataType»
ObservedEvent	NaturalRiskZones	«featureType»
ObservedEventCoverage	NaturalRiskZones	«featureType»
QuantitativeLikelihood	NaturalRiskZones	«dataType»
RiskCoverage	NaturalRiskZones	«featureType»
RiskZone	NaturalRiskZones	«featureType»
SpecificExposedElementTypeValue	NaturalRiskZones	«codeList»
SpecificHazardTypeValue	NaturalRiskZones	«codeList»
VulnerabilityAssessment	NaturalRiskZones	«dataType»

5.3.2.1. Spatial object types

5.3.2.1.1. AbstractExposedElement

AbstractExposedElement (abstract)	
Definition:	SOURCE : [UNISDR, 2009] People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.
Stereotypes:	«featureType»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the exposed element.
Multiplicity:	1
Attribute: beginLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.

AbstractExposedElement (abstract)	
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: endLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the exposed element started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the exposed element no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Association role: sourceOfSpatialRepresentation	
Value type:	AbstractFeature
Definition:	The source object which is used to represent the exposed element.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: If the "source of spatial representation" is empty, the geometry AbstractExposedElement spatial object shall be provided.	
Natural language:	If the "source of spatial representation" is empty, the geometry AbstractExposedElement spatial object shall be provided.
OCL:	inv: AbstractExposedElement.sourceOfSpatialRepresentation. isEmpty() implies ExposedElement.geometry.notEmpty()

5.3.2.1.2. AbstractHazardArea

AbstractHazardArea (abstract)	
Definition:	An area affected by a natural hazard.
Description:	A natural hazard is a natural process or phenomenon that may cause loss of life, injury or other impacts, property damage, loss livelihoods and services, social and economic disruption, or environmental damage. [Council of The European Union - Commission Staff Working Paper - Risk Assessment and Mapping Guidelines for Disaster Management].
Stereotypes:	«featureType»
Attribute: beginLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: determinationMethod	

AbstractHazardArea (abstract)	
Value type:	DeterminationMethodValue
Definition:	Specifies if the hazard area result is delineated after modelling or determined after interpretation.
Multiplicity:	1
Attribute: endLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the hazard area.
Multiplicity:	1
Attribute: typeOfHazard	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of natural hazard.
Multiplicity:	1
Attribute: validityPeriod	
Value type:	TM_Period
Definition:	Future finite time frame where the hazard applies.
Description:	It is an interval of dates, or the expression of a time frame for which the estimates are meant (eg: until 2090; summer of 2011; winter seasons until 2015).
Multiplicity:	0..1
Stereotypes:	«voidable»
Association role: source	
Value type:	AbstractObservedEvent
Definition:	The observed event that triggered the modelling of a hazard area.
Multiplicity:	0..*
Stereotypes:	«voidable»

5.3.2.1.3. AbstractObservedEvent

AbstractObservedEvent (abstract)	
Definition:	A natural phenomenon relevant to the study of natural hazards which occurred and which has been observed.
Stereotypes:	«featureType»
Attribute: beginLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: endLifeSpanVersion	
Value type:	DateTime

AbstractObservedEvent (abstract)	
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the spatial object.
Multiplicity:	1
Attribute: nameOfEvent	
Value type:	CharacterString
Definition:	common name of the observed event.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: typeOfHazard	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of hazard.
Multiplicity:	1
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the observed event started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the observed event no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Association role: isMonitoredBy	
Value type:	EnvironmentalMonitoringProgramme
Definition:	The program that monitors the observed event.
Multiplicity:	0..*
Stereotypes:	«voidable»

5.3.2.1.4. AbstractRiskZone

AbstractRiskZone (abstract)	
Definition:	A risk zone is the spatial extent of a combination of the consequences of an event (hazard) and the associated probability/likelihood of its occurrence.
Stereotypes:	«featureType»
Attribute: beginLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»

AbstractRiskZone (abstract)	
Attribute: endLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the spatial object.
Multiplicity:	1
Attribute: sourceOfRisk	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of hazard which is the source of risk.
Multiplicity:	1
Attribute: validityPeriod	
Value type:	TM_Period
Definition:	Future finite time frame where the model applies.
Description:	It is an interval of dates, or the expression of a time frame for which the estimates are meant (eg: until 2090; summer of 2011; winter seasons until 2015).
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: source	
Value type:	AbstractHazardArea
Definition:	The hazard which is considered for the creation of the risk zone object.
Multiplicity:	1
Stereotypes:	«voidable»
Association role: exposedElement	
Value type:	AbstractExposedElement
Definition:	The element that is within a hazardous area.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.1.5. ExposedElementCoverage

ExposedElementCoverage	
Subtype of:	AbstractExposedElementCoverageByDomainAndRange
Definition:	A coverage representating continuous information about exposed elements.
Stereotypes:	«featureType»
Attribute: typeOfElement	
Value type:	ExposedElementClassification
Definition:	A classification of the exposed element.
Multiplicity:	1
Stereotypes:	«voidable»

ExposedElementCoverage	
Constraint: DomainisrectifedGridOrReferenceableGrid	
Natural language:	A domain is a rectified grid or referenceable grid
OCL:	inv: domainSet.oclIsKindOf(CV_RectifiedGrid) or domainSet.oclIsKindOf(CV_ReferenceableGrid)
Constraint: Range set is the levelOfVulnerability of VulnerabilityAssessment	
Natural language:	Range set is the level, or intensity, of the vulnerability assessment
OCL:	inv: rangeSet.oclIsKindOf(VulnerabilityAssessment.levelOfVulnerability)

5.3.2.1.6. HazardCoverage

HazardCoverage	
Subtype of:	CoverageByDomainAndRangeAbstractHazardArea
Definition:	A coverage representing continuous information about a type of natural hazard.
Stereotypes:	«featureType»
Constraint: DomainIsRectifiedGridOrReferenceableGrid	
Natural language:	A domain is a rectified grid or referenceable grid
OCL:	inv: domainSet.oclIsKindOf(CV_RectifiedGrid) or domainSet.oclIsKindOf(CV_ReferenceableGrid)
Constraint: RangeSet is levelOrIntensity, or likelihoodOfOccurrence	
Natural language:	A range set is described by magnitude or intensity, or by the likelihood of occurence. As "magnitude or intensity" is modelled by the "LevelOrIntensity" data type, the constraint refers to this data type
OCL:	inv: rangeSet.oclIsKindOf(levelOrIntensity) or rangeSet.oclIsKindOf(LikelihoodOfOccurrence)

5.3.2.1.7. ObservedEventCoverage

ObservedEventCoverage	
Subtype of:	CoverageByDomainAndRangeAbstractObservedEvent
Definition:	A coverage representing continuous information about observed events.
Stereotypes:	«featureType»
Constraint: DomainIsRectifiedGridOrReferenceableGrid	
Natural language:	A domain is a rectified grid or referenceable grid
OCL:	inv: domainSet.oclIsKindOf(CV_RectifiedGrid) or domainSet.oclIsKindOf(CV_ReferenceableGrid)
Constraint: RangeSet is levelOrIntensityOr LikelihoodOfOccurrence	
Natural language:	range set is described by magnitude or intensity, or by the likelihood of occurence. As "magnitude or intensity is modeled by the "LevelOrIntensity" data type, the constraint refers to this data type
OCL:	inv: rangeSet.oclIsKindOf(levelOrIntensity) or rangeSet.oclIsKindOf(LikelihoodOfOccurrence)

5.3.2.1.8. RiskCoverage

RiskCoverage	
Subtype of:	CoverageByDomainAndRangeAbstractRiskZone
Definition:	A coverage representation of natural risks.

RiskCoverage	
Stereotypes:	«featureType»
Constraint: DomainIsRectifedGridOrReferenceableGrid	
Natural language:	A domain is a rectified grid or referenceable grid
OCL:	inv: domainSet.oclIsKindOf(CV_RectifiedGrid) or domainSet.oclIsKindOf(CV_ReferenceableGrid)
Constraint: Range set is levelOrIntensity	
Natural language:	A range set is described by level, or intensity
OCL:	inv: rangeSet.oclIsKindOf(LevelOrIntensity)

5.3.2.1.9. ObservedEvent

ObservedEvent	
Subtype of:	AbstractObservedEvent
Definition:	Discrete spatial objects representing natural phenomenon relevant to the study of natural hazards which occurred, or is currently occuring, and which has been observed.
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Object
Definition:	Geometric representation of the spatial extent covered by the observed event.
Multiplicity:	1
Attribute: magnitudeOrIntensity	
Value type:	LevelOrIntensity
Definition:	An expression of the magnitude or the intensity of a phenomenon.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.1.10. HazardArea

HazardArea	
Subtype of:	AbstractHazardArea
Definition:	Discrete spatial objects representing a natural hazard.
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Surface
Definition:	Geometric representation of spatial extent covered by the hazard area.
Multiplicity:	1
Attribute: likelihoodOfOccurrence	
Value type:	LikelihoodOfOccurrence
Definition:	Likelihood is a general concept relating to the chance of an event occuring.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: magnitudeOrIntensity	
Value type:	LevelOrIntensity
Definition:	An expression of the magnitude or the intensity of a phenomenon.

HazardArea	
Description:	It may address a value within the Richter scale, or a description of the european macro-seismic scale, or a flood flow, etc...
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.1.11. RiskZone

RiskZone	
Subtype of:	AbstractRiskZone
Definition:	Discrete spatial objects representing the spatial extent of a combination of the consequences of an event (hazard) and the associated probability/likelihood of its occurrence.
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Surface
Definition:	Geometric representation of spatial extent covered by this risk zone.
Multiplicity:	1
Attribute: levelOfRisk	
Value type:	LevelOrIntensity
Definition:	The level of risk is an assessment of the combination of the consequences of an event (hazard) and the associated probability/likelihood of the occurrence of the event.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.1.12. ExposedElement

ExposedElement	
Subtype of:	AbstractExposedElement
Definition:	Discrete spatial objects representing exposed element.
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Object
Definition:	Geometric representation of the exposed element.
Description:	If the feature is linked to a spatially referenced INSPIRE feature, then it has no geometry. If not, then it has a geometry.
Multiplicity:	0..1
Attribute: assessmentOfVulnerability	
Value type:	VulnerabilityAssessment
Definition:	Assessment of the vulnerability of the exposed element.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.2. Data types

5.3.2.2.1. VulnerabilityAssessment

VulnerabilityAssessment	
Definition:	Assessment of the vulnerability.
Description:	It contains piece of information about the source the vulnerability, about the level of vulnerability and about the magnitude or intensity of the hazard for which vulnerability is assessed.
Stereotypes:	«dataType»

VulnerabilityAssessment	
Attribute: sourceOfVulnerability	
Value type:	NaturalHazardClassification
Definition:	The type of hazard for which the vulnerability is assessed.
Multiplicity:	1
Attribute: levelOfVulnerability	
Value type:	LevelOrIntensity
Definition:	Level of vulnerability.
Description:	When assessed quantitatively, it is a percentage.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: magnitudeOrIntensityOfHazard	
Value type:	LevelOrIntensity
Definition:	An expression of the magnitude or the intensity of a phenomenon.
Description:	It may address a value within the Richter scale, or a description of the european macro-seismic scale, or a flood flow, etc...
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: typeOfElement	
Value type:	ExposedElementClassification
Definition:	A classification of the exposed element.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.2.2. NaturalHazardClassification

NaturalHazardClassification	
Definition:	This class provides piece of information about the nature of the natural hazard as well as the type of hazard which is the source of risk.
Stereotypes:	«dataType»
Attribute: hazardCategory	
Value type:	NaturalHazardCategoryValue
Definition:	A generic classification of types of natural hazards or risks.
Multiplicity:	1
Attribute: specificHazardType	
Value type:	SpecificHazardTypeValue
Definition:	Additional classification of the natural hazard that further specifies the hazard type according to a nomenclature that is specific to this dataset.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.2.3. LevelOrIntensity

LevelOrIntensity	
Definition:	Quantitative or qualitative assessment of either risk, hazard or vulnerability.
Description:	Common concept for assessing the level of risk, or the level of hazard, or the level of vulnerability.
Stereotypes:	«dataType»
Attribute: qualitativeValue	

LevelOrIntensity	
Value type:	CharacterString
Definition:	A qualitative assessment of the level or intensity.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: quantitativeValue	
Value type:	Measure
Definition:	A quantitative assessment of the level or intensity.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: assessmentMethod	
Value type:	DocumentCitation
Definition:	A citation to the method used to express the level or intensity.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: either the quantitative value or the qualitative value must be completed.	
Natural language:	either the qualitative value or the quantitative value must be completed.
OCL:	inv: self.qualitativeValue.isEmpty() implies self.quantitativeValue.notEmpty() and self.quantitativeValue.isEmpty() implies self.qualitativeValue.notEmpty()

5.3.2.2.4. LikelihoodOfOccurrence

LikelihoodOfOccurrence	
Definition:	Likelihood is a general concept relating to the chance of an event occurring.
Description:	Likelihood is generally expressed as a probability or a frequency. [EXCIFF].
Stereotypes:	«dataType»
Attribute: qualitativeLikelihood	
Value type:	CharacterString
Definition:	A qualitative assessment of the likelihood of occurrence of a hazard.
Description:	Sometimes, this is known as susceptibility.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: quantitativeLikelihood	
Value type:	QuantitativeLikelihood
Definition:	A frequency of occurence or return period of a hazard phenomenon.
Description:	Sometimes, this is known as susceptibility.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: assessmentMethod	
Value type:	DocumentCitation
Definition:	A citation to the method used to express the likelihood.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: Either the qualitative likelihood or the quantitative likelihood must be completed.	
Natural language:	either the qualitative likelihood or the quantitative likelihood must be completed.

LikelihoodOfOccurrence	
OCL:	inv: self.qualitativeLikelihood.isEmpty() implies self.quantitativeLikelihood.notEmpty() and self.quantitativeLikelihood.isEmpty() implies self.qualitativeLikelihood.notEmpty()

5.3.2.2.5. QuantitativeLikelihood

QuantitativeLikelihood	
Definition:	A frequency of occurrence or return period of a hazard phenomenon.
Stereotypes:	«dataType»
Attribute: probabilityOfOccurrence	
Value type:	Probability
Definition:	The probability of occurrence of a hazard event, expressed as a value between 0 and 1.
Description:	This is the inverse value of the return period.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: returnPeriod	
Value type:	Number
Definition:	Long-term average interval of time or number of years within which an event will be equalled or exceeded [UNESCO].
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.2.6. ExposedElementClassification

ExposedElementClassification	
Definition:	This class provides piece of information about the nature of the exposed element which is relevant to risk analysis.
Stereotypes:	«dataType»
Attribute: exposedElementCategory	
Value type:	ExposedElementCategoryValue
Definition:	A generic classification of the types of elements that are exposed to a risk.
Multiplicity:	1
Attribute: specificExposedElementType	
Value type:	SpecificExposedElementTypeValue
Definition:	An additional denomination of exposed element according to a nomenclature that is specific to this dataset.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.3. Enumerations

5.3.2.3.1. DeterminationMethodValue

DeterminationMethodValue	
Definition:	An enumeration to describe the method used to define the area of hazard or risk.
Description:	There are several ways to delineate the perimeter of a hazard or a risk : to model it, or to assess it indirectly
URI:	
Value:	**modelling**
Definition:	The area has been computed according to a model.
Value:	**indirectDetermination**

DeterminationMethodValue	
Definition:	The area has been defined by interpretation of available data and/or information.

5.3.2.4. Code lists

5.3.2.4.1. SpecificExposedElementTypeValue

SpecificExposedElementTypeValue	
Definition:	An additional denomination of exposed elements.
Description:	The allowed values for this coded list comprise the values defined by data providers.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/SpecificExposedElementTypeValue
Values:	The allowed values for this code list comprise any values defined by data providers.

5.3.2.4.2. SpecificHazardTypeValue

SpecificHazardTypeValue	
Definition:	An additional classification of the natural hazard.
Description:	The allowed values for this coded list comprise the values defined by data providers.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/SpecificHazardTypeValue
Values:	The allowed values for this code list comprise any values defined by data providers.

5.3.2.4.3. NaturalHazardCategoryValue

NaturalHazardCategoryValue	
Definition:	A generic classification of types of natural hazards.
Extensibility:	narrower
Identifier:	http://inspire.ec.europa.eu/codelist/RiskOrHazardCategoryValue
Values:	The allowed values for this code list comprise the values specified in *Annex C* and narrower values defined by data providers.

5.3.2.4.4. ExposedElementCategoryValue

ExposedElementCategoryValue	
Definition:	A classification of the exposed element.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ExposedElementCategoryValue
Values:	The allowed values for this code list comprise the values specified in *Annex C* and additional values at any level defined by data providers.

5.3.2.5. Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.3.2.5.1. AbstractFeature

AbstractFeature (abstract)	
Package:	feature
Reference:	Geographic information -- Geography Markup Language (GML) [ISO 19136:2007]

5.3.2.5.2. CharacterString

CharacterString

CharacterString	
Package:	Text
Reference:	Geographic information -- Conceptual schema language [ISO/TS 19103:2005]

5.3.2.5.3. CoverageByDomainAndRange

CoverageByDomainAndRange (abstract)	
Package:	Coverages (Domain and Range)
Reference:	INSPIRE Data Specifications – Base Models – Coverage Types, version 1.0 [DS-D2.10.2]
Definition:	Coverage which provide the domain and range as separate properties.

5.3.2.5.4. DateTime

DateTime	
Package:	Date and Time
Reference:	Geographic information -- Conceptual schema language [ISO/TS 19103:2005]

5.3.2.5.5. DocumentCitation

DocumentCitation	
Package:	Base Types 2
Reference:	INSPIRE Generic Conceptual Model, version 3.4 [DS-D2.5]
Definition:	Citation for the purposes of unambiguously referencing a document.

5.3.2.5.6. EnvironmentalMonitoringProgramme

EnvironmentalMonitoringProgramme	
Package:	EnvironmentalMonitoringFacilities
Reference:	INSPIRE Data specification on Environmental Monitoring Facilities [DS-D2.8.III.7]
Definition:	Framework based on policy relevant documents defining the target of a collection of observations and/or the deployment of AbstractMonitoringFeatures on the field. Usually an Environmental Monitoring Programme has a long term perspective over at least a few years.

5.3.2.5.7. GM_Object

GM_Object (abstract)	
Package:	Geometry root
Reference:	Geographic information -- Spatial schema [ISO 19107:2003]

5.3.2.5.8. GM_Surface

GM_Surface	
Package:	Geometric primitive
Reference:	Geographic information -- Spatial schema [ISO 19107:2003]

5.3.2.5.9. Identifier

Identifier	
Package:	Base Types
Reference:	INSPIRE Generic Conceptual Model, version 3.4 [DS-D2.5]
Definition:	External unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object.
Description:	NOTE1 External object identifiers are distinct from thematic object identifiers. NOTE 2 The voidable version identifier attribute is not part of the unique identifier of a spatial object and may be used to distinguish two versions of the same spatial object. NOTE 3 The unique identifier will not change during the life-time of a spatial object.

5.3.2.5.10. Measure

Measure	
Package:	ProductionAndIndustrialFacilitiesExtension
Reference:	INSPIRE Data specification on Production and Industrial Facilities [DS-D2.8.III.8]
Definition:	Declared or measured quantity of any kind of physical entity.

5.3.2.5.11. Number

Number (abstract)	
Package:	Numerics
Reference:	Geographic information -- Conceptual schema language [ISO/TS 19103:2005]

5.3.2.5.12. Probability

Probability	
Package:	Truth
Reference:	Geographic information -- Conceptual schema language [ISO/TS 19103:2005]

5.3.2.5.13. TM_Period

TM_Period	
Package:	Temporal Objects
Reference:	Geographic information -- Temporal schema [ISO 19108:2002/Cor 1:2006]