"Delivering Military Advantage through multi-national geospatial interoperability"

DGIWG 207

Defence Geospatial Real World Object Index (DGRWI)

Edition: 3.0

Dated: 19 July 2024

Document number:	DGIWG 207
Document title:	Defence Geospatial Real World Object Index (DGRWI)
Document date:	19 July 2024
Edition:	3.0.0
Superseded:	DGIWG 207 Defence Geospatial Real World Object Index (DGRWI) Edition 2.0.0
Document type:	Standard
Responsible Party:	Defence Geospatial Information Working Group (DGIWG)
Audience:	This document is approved for public release and is available on the DGIWG website at http://www.dgiwg.org/dgiwg/
Abstract:	This standard provides information on the purpose and structure of data within the Defence Geospatial Real World Object Index (DGRWI) as part of the Defence Geospatial Information Framework (DGIF).
Copyright:	

Table of Contents

List of Figures

List of Tables

i. Executive Summary

The Defence Geospatial Real World Object Index (DGRWI) is an artifact of the Defence Geospatial Information Framework (DGIF) suite of standards.

The DGRWI is an index of registered Real World Objects (RWO) representing commonly used geospatial terms within the geospatial community or user groups. An individual RWO describes information to identify the standardised representation of this concept within the Defence Geospatial Information Model (DGIM). Thus, the DGRWI supports search and discovery of DGIF content and standardised encoding.

This standard provides covering information on the purpose and structure of the DGRWI as stored in the DGIF Collaborative Environment (DCE) and how RWOs can be added to, or amended, within the DGRWI. The DGRWI content itself is maintained DCE and published as part of the DGIF UML and Excel Workbook outputs. for DGIWG users to query RWO and facilitate construction of DGIF compliant geospatial vector models.

ii. Submitting organizations

Nation	Organisation
United Kingdom	Joint Geospatial Intelligence (JGI)

iii. Document point of contact

All questions regarding this document shall be directed to the editor (secretariat@dgiwg.org) or the contributor organisations:

iv. Revision history

Date	Release	Editors	Primary clauses modified	Description
2024-07-19	0.1	GBR, USA	All	Publication Draft

v. Future work

Document will be revised as set out in the DGIWG Program of Work (PoW).

1 Introduction

The Defence Geospatial Real World Object Index (DGRWI) is an artifact of the Defence Geospatial Information Framework (DGIF) suite of standards.

The DGRWI is an index of registered objects representing commonly used geospatial terms within the geospatial community or user groups. An individual Real World Object (RWO) describes information to identify the standardised representation of this concept within the Defence Geospatial Information Model (DGIM). Thus, the DGRWI supports search and discovery of DGIF content and standardised encoding.

This standard provides information on the purpose and structure of the DGRWI and the registration of RWOs.

1.1 Context

The DGIF suite of standards provides three key artifacts:

- Defence Geospatial Information Model (DGIM) – DGIWG 205
- Defence Geospatial Feature Concept Dictionary (DGFCD) – DGIWG 206
- Defence Geospatial Real World Object Index (DGRWI) – DGIWG 207

These artifacts are interlinked and maintained in the Defence Geospatial Information Framework Collaborative Modelling Environment (DCE). The DGIWG standards documentation for each artifact defines the structure of each artifact, the business rules for how they are maintained and how they can be used for defined geospatial products and outputs.

DGIM. The DGIM is a logical common model that provides unambiguous exchange of geospatial vector data. It allows vector data to be extracted, managed, and provided within a defined schema and specified structure (in the form of a Feature Catalogue and/or a derived application schema) with required attributes.

As a technology-neutral Platform Independent Model (PIM), the DGIM determines the syntactic structure for the data exchange, business rules, and facilitates the generation of product specifications derived from the geospatial vector data model.

DGFCD. The DGFCD provides the set of standardized Feature Concepts, Attributes Concepts, Datatypes, Unit of Measures, and Concepts for Enumeration Values that are used within DGIM. It presents an abstraction of reality as a defined classification of phenomena. Vector geometric entities consisting of points, curves, and surfaces are used when these real world phenomena or objects are modelled digitally. The basic level of classification in the DGIM is the feature type which is then supplemented through use of those additional attributes, datatypes, units of measures and enumerations provided in the DGFCD.

DGWRI. Even though the DGIM contains standardised feature types and attribute concepts from the DGFCD, it may not be consistent, or match with, common terminology used across the Geospatial community and end-user applications. Additionally, these commonly used descriptors or terminology for real world phenomena may not always be realised as explicit Feature Types in the DGIM, However, they may be represented by a feature-attribute combination elsewhere in the DGIM, or named differently.

For example, the term “Quarry” is realised in DGIM by the Feature Type *Extraction Mine* with an attribute of *Extraction mine type = Quarry.* A RWO of **Quarry** is registered in the DGRWI that provides an encoding of this rule and defines a relationship to Extraction Mine in DGIM.

The DGRWI provides the register of the RWOs to make the features easier to query and apply within DGIF compliant models.

1.2 Real World Objects (RWO) and the DGRWI

1.2.1 What is an RWO?

A RWO is a single registered item representing a distinct term commonly used in the Geospatial community, and its reference to how the item is encoded as a geospatial vector within DGIM.

The source of RWO names may vary. They can originate from one or more types:

- A frequently used or understood English-language term/expression for a geographic/geopolitical concept or phenomenon (e.g. **Coal Mine, River**)**.** This may be a formal recognized term from a relevant source or a commonly used English term.
- A designated and/or commonly used Operational, Military, Legal or User Community focused term relevant to DGIF content. This includes frequently used acronyms.
- An alternative/synonymous English term to an existing concept, e.g. **Colliery**, which may also be commonly used. This could potentially include 'slang' terms or terms that originate from different forms/usage of English.
- Terminology from legacy/third party Feature Catalogues/Dictionaries that are used in applications which have not been directly adopted in DGIF, e.g. **Wood**.
- Distinct concepts from DGFCD are also supported by RWOs to ensure a complete index.

Generally, the types of terms included will be common nouns although this is not a finite rule. **Forest** and **Facility** will be included but **Dense Forest** and **Non-Usable Facility** generally would not (unless identified as a distinct and required Noun Phrase, e.g. **All Weather Hard Surface Road** is in common community use). Other terms in the form of a specific descriptive nature, e.g. **Oak Forest**, **Mangrove Swamp**, **Fresh Water**, should be assessed on their merits/use case/usefulness. In all cases, the usefulness of the DGRWI terms and synonyms to the end users is the primary consideration. The terms in the DGRWI are developed to be most familiar to DGIM users, and not every Feature/Attribute combination in DGIM requires a RWO.

Multiple RWOs may reference the same DGIM encoding (multiple terms for the same phenomenon), but a single RWO cannot reference more than one encoding as this would indicate semantic duplication in the model.

Every current RWO is named uniquely even if a term has multiple meanings. Thus, the naming of the RWO can be used to disambiguate terms as required, e.g. **Bank (Earthwork)** vs **Bank (Financial)**, different territorial usages, e.g. **Subway (UK)** vs **Subway (North America)** or even emphasise semantic differences, e.g. **Church (Place of Worship)** vs **Church (Architectural Form)**

A RWO does not have to be a uniquely identifiable or tangible observable object. It can be an intangible or understood concept. An **Administrative Boundary** or a **World Heritage Site** are examples of intangible RWOs.

1.2.2 DGRWI Applications

Support for Search and Find in the Model

The DGRWI allows the identification and retrieval of RWOs without requiring detailed knowledge of the DGIM and DGFCD.

The structure and optimisation of the DGIM may imply that some Real World Phenomena, from a user's perspective, are 'hidden', or not immediately apparent and not directly reflected by the model. A user of the DGIM may wrongly assume that a geographic concept is not realised within DGIF. For example, a user looking for a **Road** may question why a feature called **Road** is not in the DGFCD or DGIM By searching for **Road** (and variations of that term) in the DGRWI, the user will find that a road is represented in DGIF and covered by the *LandTransportationWay* feature concept.

Model Consistency Maintenance

DGIF Modellers can check if real world features are represented by more than one combination of model elements. For example, the model must not define more than one representation of a church. If a church is defined by the attribute *FeatureFunction* code on the feature type *Building*, then it should not also be represented by another modelling element, such as the feature type *Church*. By defining, for example, **Church (Place of worship)** and **Church (Architectural Form)** rather than an ambiguous **Church** concept, highlights and clarifies a distinction This helps avoid semantic duplication and ensures appropriate distinctions between content.

Clarification of User Model Requirements

Requirements are often not expressed in technical terms. For instance, a user may need to model a lake. By searching for **Lake** as a RWO in the DGRWI, the user will connect the requirement to the feature type *Inland Waterbody* associated to the attribute *Inland Water Type.*

Mapping Definition and Transformations

When mapping features between two different models having their own RWO index, searching by their real world terms may help find the corresponding modelling constructs while avoiding deep analysis of the model.

Identifying Synonyms and Language Issues

The terminological definition of RWOs allows the use of synonyms and technical terminology, which in turn addresses the variation in the use of the English language, colloquialisms, and ambiguities. This also makes translations easier.

For example, searching for RWOs; **Pit, Mining Plant, Quarry, Colliery** or **Mine** would all locate the feature type *ExtractionMine* and further defined with certain combination of attributes.

2 Scope

The scope of this standard is to specify the structure of the DGRWI and the process for the registering and maintaining RWOs within the DGRWI.

3 Conformance

This standard identifies a structure specific to DGIWG requirements and ensures the DGRWI content fits within the DCE architecture.

No explicit conformance to the DGRWI is defined. Conformance to DGIF is achieved by being conformant to a DGIF Data Product Specifications.

4 Normative References

The documents listed in Table 1 are necessary to understand and use this standard. For dated references, only the cited edition or version applies. For undated references, the latest edition or version of the referenced document (including any amendments) applies.

Table 1: Normative References

Standard or Specification
ISO 19101:2002 – *Geographic Information*
DGIWG 200 - *Defence Geospatial Information Framework (DGIF) 3.0*
DGIWG 205 - *Defence Geospatial Information Model (DGIM) 3.0*
DGWIG 206 - *Defence Geospatial Feature Concept Dictionary (DGFCD) 3.0*
DGIWG 114 - *DGIWG Metadata Foundation (DMF)*

The informative (non-normative) documents listed in Table 2 are useful to understanding and using this standard. For dated references, only the cited edition or version applies.

Table 2: Informative References

Standard or Specification
ISO 19135:2005 - *Geographic information — Procedures for item registration*

5 Terms, Definitions, Abbreviations, & Acronyms

5.1 Terms and Definitions

The terms and definitions specific to this standard are explained in Table 3.

Table 3: Definitions Applicable to this Standard

Term	Definition
Attribute	A characteristic of a feature.
Application Schema	Conceptual schema for data required by one or more applications [ISO 19101].
Conceptual Model	Model that defines concepts of a universe of discourse [ISO 19101].
Datatype	Specifies how the value of an Attribute shall be abstractly represented through one or more fields, each capturing an aspect of information required to completely specify a value in the domain of the datatype. NOTE 1: A simple datatype consists of a single field containing a primitive data value (e.g. a real number). NOTE 2: A complex datatype consists of multiple fields, at least one of which contains a data value, while others may contain metadata about the data value(s).

Term	Definition
Enum	Values that are members of the domain of a specific enumerated datatype. These listed values are often referred to simply as "enums".
Feature	Abstraction of real world phenomena [ISO 19101]. NOTE: A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.
Feature Attribute	Characteristic of a feature [ISO 19101]. NOTE: A feature attribute may occur as both Feature Attribute Type and a Feature Attribute Instance, while only representing a single Feature. A Feature Attribute Type has a name, a data type, and a domain associated to it. A Feature Attribute Instance has an attribute value taken from the domain of Feature Attribute Type.
Feature Catalogue	Catalogue containing definitions of the feature types occurring in one or more sets of geographic data [ISO 19110].
Geographic Data	Data with implicit or explicit reference to a location relative to the Earth. NOTE: Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.
Metamodel	Model that defines a modeling language [ISO 19103]
Physical Quantities	A set of physical quantities that characterize the properties of a phenomenon, body, or substance, where the property has a magnitude that can be expressed as a number (physical value) and a reference quantity - referred to as a "unit of measure".
Real World Object	An existing geographic (or geospatial) occurrence whose characteristics can be described/identified. EXAMPLE: A Wooden Bridge, A Mosque, A Divided Highway.
Real World Object Tuple	A three element Feature Type-Attribute-Value combination used to describe a RWO.
Units of Measure	A set of units of measure, organized by physical quantity, where a unit of measure is a predefined amount of the concerned physical quantity. EXAMPLE: a metre "of length" or kilogram "of mass"
Universe of Discourse	View of the real or hypothetical world that includes everything of interest [ISO 19101]

5.2 Abbreviations and Acronyms

The acronyms used in this standard are specified in Table 4:

Table 4: Acronyms Applicable to this Standard

Acronym	Definition
DCE	DGIF Collaborative Modelling Environment
DGFCD	Defence Geospatial Feature Concept Dictionary
DGIF	Defence Geospatial Information Framework

Acronym	Definition
DGIM	Defence Geospatial Information Model
DGIWG	Defence Geospatial Information Working Group
DGRWI	Defence Geospatial Real World Object Index
ISO	International Organization for Standardization
OCL	Object Constraint Language
PIM	Platform Independent Model
QA	Quality Assurance
RWO	Real World Object
TC211	ISO Technical Committee 211 - Geographic information/Geomatics
UML	Unified Modelling Language
VMST	Vector Models and Schema Team

6 Logical Structure

6.1 Metamodel

The DGRWI provides the index of RWOs and their representation in the DGIM. Like the DGIM, the DGRWI is maintained in the DCE which provides the underlying metamodel. The DGRWI metamodel includes one basic UML element: **Real World Object (RWO)**.

The RWO element is connected to one or more relevant *Feature Types* or *Types* within the DGIM using the *Representation* link. The RWO provides a definition based on the content of the connected elements.

Figure 1 depicts the DGRWI metamodel in UML . A detailed description of DGRWI metamodel (e.g. all used stereotypes and tagged values) is provided at **Annex A.**

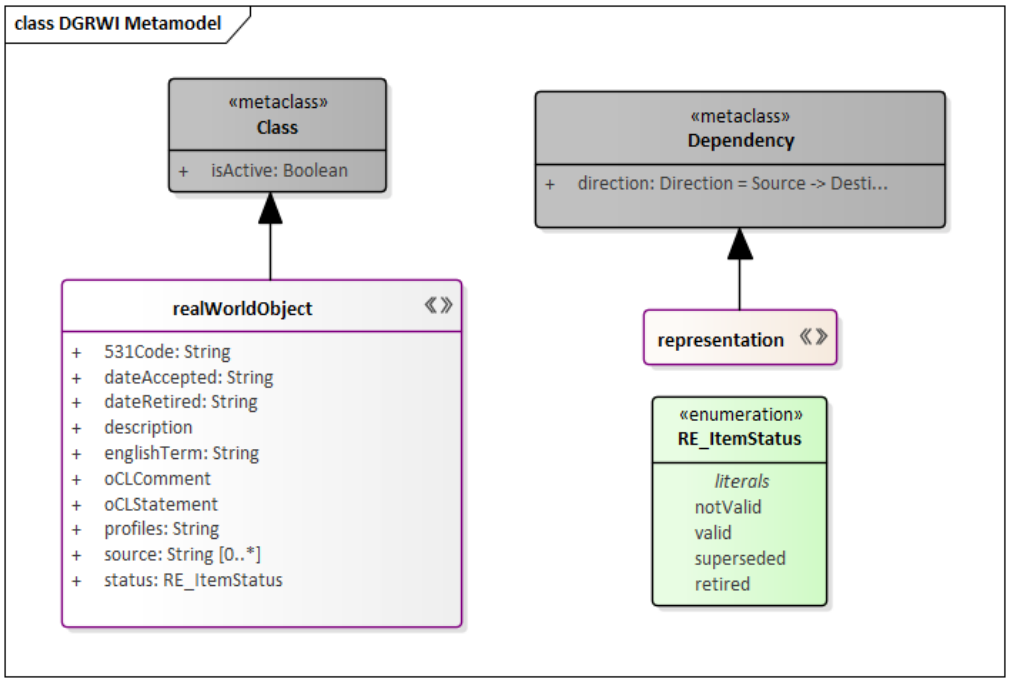

Figure 1: UML Representation of the DGRWI Metamodel

7 Content Rules

Each RWO entry in the DGRWI requires specific information. The following sections provide additional information and guidance on the content of these entries which will be used by those maintaining the DGRWI. This information assists both the submitter of Change Proposals in inputting or maintaining RWO information within DCE, as well as individuals defining or preparing candidate RWO information to VMST.

7.1 Name

The UML class name represents the alphaCode; a unique alphanumeric value that may be used to designate the RWO, *e.g. CanalTunnel*. A RWO is defined in UpperCamelCase denotation. with a capital letter and reflecting the English Term of the concept. For example, *Bridge*, *InlandWater*, or *FloodControlStructure*. As such it should be human readable.

The alphaCode is also called the Primary Code and represents a human readable name and can be longer than 25 characters. It should be used as primary identification although, as some information systems may be not able to use identifiers of this length, a Secondary Code (see Alias) may also be used. The alphaCode should reflect the 'English Term' selected for the RWO.

The (class) name is a unique alphaCode for each RWO. Certain special characters should not be used:

- There shall be no alphaCode beginning with a non-alphabetic character.
- There shall be no diacritics in alphaCodes.
- A range shall be expressed with the term "to".
- A hyphen ("-") and parenthesis ("(",")") shall be removed.
- For objects whose names are naturally numeric, consider adding a prefix.

7.2 531 Code

A unique alphanumeric value that formally represents the secondary code. In the context of RWOs, this can be considered a unique identifier.

The 531 Code consist of the prefix RWO followed by a five-digit unique number, e.g. RWO_12345. It is not permissible to have two RWOs with the same 531 Code.

A query has been set up in DCE to determine the next available Code available.

The 531 Code is consistent with the Alias (see above).

7.3 Alias

The alias informally represents the Secondary Code. This is a unique alphanumeric value that may be used to designate this concept for the purposes of data interchange within the DGIF in technology-specific limited circumstances, *e.g. RWO_00578.* The Secondary Code should only be used when the alphaCode cannot be used in the system environment.

The Alias is consistent with the 531 Code (see below).

7.4 Element Notes

These are general notes about the entry used to contain human readable information about the DGIM Elements that the RWO describes. The format is:

-- Representation: --

Tunnel has attribute meansTransportation with value inlandWaterVessel

This is a reformatted version on the content of the OCL Comment (see Section 7.9).

7.5 Date Accepted

The date when the element was accepted to be a valid element with the DGRWI. This should be entered in the format of DD/MM/YYYY

7.6 Date Retired

The date when the element was retired from the DGRWI and became *retired* or *superseded*. This should be entered in the format of DD/MM/YYYY

7.7 Description

A general comment, or additional information about the RWO. A RWO may have additional information attached to better describe the concept if this is unclear from the term alone. This could include a description to provide further clarification. There are no restrictions on the character content.

7.8 English Term

A unique English phase or term that identifies the RWO with the following characteristics:

Source: Consideration should be given to the terminology a user may use to search for a concept, such as:

- A widely understood English term for the concept, e.g. **Coal Mine.** This may be a formally recognized term from a relevant source or a common colloquially used English term.
- A designated and/or commonly used Operational, Military, Legal or User Community focused term relevant to DGIF content scope.
- An alternative/synonymous English term to an existing concept or other RWO e.g. **Colliery.**
- Legacy Feature Catalogues/Dictionary concepts. Feature types used in applications which have not been directly adopted in DGIF are candidates for RWO objects as this supports data mapping activities. These should only be terms in common use.

In all cases, consider terms that are of potential relevance to the end user. Typically, the term will be a Noun or Noun Phrase.

Spelling: The words used for the English Term should conform to the Oxford English Dictionary. However, commonly used English terms or spellings that are nation-specific could be considered for inclusion as additional RWOs synonyms (e.g. the American spelling of **Harbor**) if they are in official usage.

Non-English Terms: RWO terms from other languages need to be translated to the English equivalent. In rare cases, when a non-English RWO cannot be translated into English, consideration will be given to using the term in the original language. However, justification is required. The Description should be used to record both the original language and justification.

Uniqueness: The English Term shall be unique for each current entry in the DGRWI. Effort should be taken to distinguish between similar but semantically different objects. The only exception for using a non-unique term is the re-introduction of a former, previously retired term, with new encoding. The Description should be used to record justification.

Context or Semantic Clarification / Disambiguation: If two or more distinct RWOs result in the same English term (i.e. a homonym - a single English word with two different meanings), e.g. Bank, then the English Term in DGRWI should be disambiguated using parentheses to distinguish between the subject or context, e.g**. Bank (Financial)** and **Bank (Earthwork).**

Territorial Disambiguation: If an object name can have semantically different meanings in different English-speaking territories, e.g. Subway, and cannot be distinguished by context, the English Term in DGRWI should be disambiguated using parentheses to distinguish the appropriate territory e.g. **Subway (USA).** Common territories could include GBR, USA, Commonwealth, and USACAN.

7.9 Object Constraint Language (OCL) Comment

A human readable definition of the OCL statement representing the tuple(s) that defines the RWO. Example:

/*Tunnel has attribute meansTransportation with value inlandWaterVessel */

See **Annex B** for detailed information about correct syntax.

This statement should be logical when read in English and made consistent with the feature concept (taking care with ‘and’ / ‘or’ statements; introduce ‘where’ and ‘if’ etc, as required). Avoid logic ambiguity.

(The OCL statement and the OCL comment are normative and are combined within the constraint of the RWO class).

7.10 Object Constraint Language (OCL) Statement

The pure OCL statement for the constraint. This contains the OCL encoding of the tuple(s) that defines the Object. The OCL statement and the OCL comment are normative and have to be copied in the constraint of the RWO class.

The OCL statement starts with the term "entity" followed by consecutive numbers of elements used for the representation. Example:

inv: entity1.ditchFunction.valueOrReason.value=Ditch_ditchFunction::irrigation

See **Annex B** for detailed information about correct OCL syntax and format for different modelling scenarios represented by RWOs.

7.11 Profiles

An identification name of a DGIF application/specification which uses the RWO. The impact of any change in the model or dependent specifications relating to the RWO can be identified and communicated.

7.12 Source

The source for the element to allow additional research in the management process. This may include a reference to a formal glossary of terminology.

7.13 Status

The status of the element following ISO 19135 specifications. Allowed values are; *valid*, *not-valid*, *retired*, *superseded*. Only valid items are part of the current model.

8 Governance and Maintenance

The management of the DGIF, including the DGRWI conforms to the governance process established by the DGIWG Vector Data Technical Panel (P1) and executed by the Vector Models and Schema Team (VMST). Changes to the DGIF standard, the DGRWI, its artefacts, and content shall conform to the described process. See DGIWG 200 – DGIF, Annex A for more information.

9 Quality Assurance

Proposed changes to the DGRWI shall be verified to ensure that the proposal conforms to the rules set out in this standard. It is the responsibility of the submitting party to perform this verification. The DGRWI steward will also perform Quality Assurance (QA) checks during the DGIF management cycle. The steward will communicate any identified issues to the originator of the change proposal for resolution prior to the proposal being formally considered for integration into the standard.

Annex A- Metamodel for the Defence Geospatial Real World Object Index (DGRWI)

A.1 Introduction

The following Annex is not necessary for the usage of the DGRWI, nor is it a requirement to understand these concepts. The chapter briefly describes the metamodel as it is used in the DCE.

The DGIF Metamodel (See Figure A-1) consists of many stereotypes and their associated properties.

These stereotypes were created to cover specific requirements for ISO compliance. For example, to follow the stereotypes as defined within ISO/TC211 or, even more importantly, to represent all specific items in the artifacts of DGIF, DGIM, DGFCD and the DGRWI.

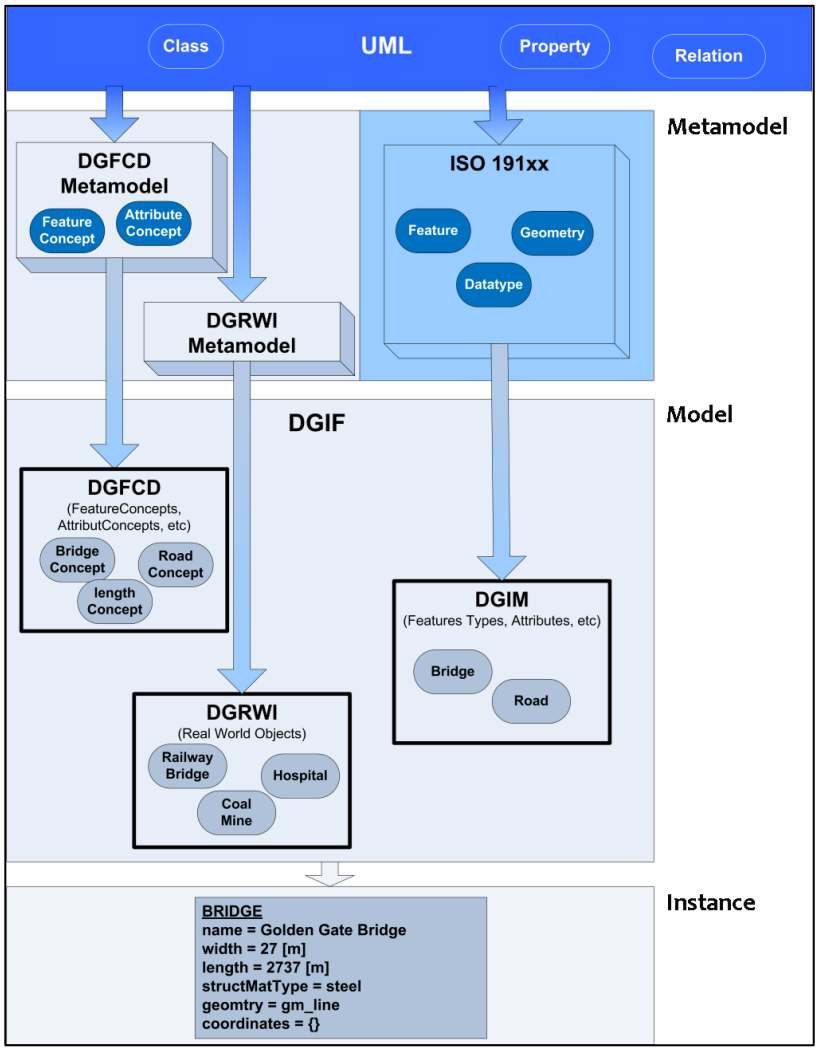

Figure A-1: DGIF metamodel

A.2 DGRWI Stereotypes for Classes

The stereotype description consists of information about the Meta Class it extends, the properties it owns, the links to other stereotypes that may exist, and an example.

The properties are described using following terms:

- **Item**: The name of the stereotype's property (either a standard UML property or a specially created property for this stereotype).
- **Definition/Content**: The description of the property.
- **Datatype**: The name of a general datatype (e.g. Text or Real).
- **Multiplicity**: Defines a number for how often a property can be used.
- **Normative**: A Boolean field defining if it is mandatory for a property to be populated.
- **Generation**: A note about the source of property content if it is not mandatory. Usually, properties that have information about generation are populated automatically from other properties.
- **DCE Data type**: The datatype that is used in the DCE. In case of big text fields (>255 characters) a specific datatype called "Memo" is used.

The DGRWI consists of the following stereotype:

A.2.1 Real World Object

Meta Class: Class

This stereotype represents a realWorldObject as defined in the DGRWI.

A.2.1.1 Properties

The following information is attached to a realWorldObject:

Item	Definition/Content	Data type	Multi-plicity	Norm.	Gen	DCE Datatype
Standard UML properties and other fields						
(class) name	The alphaCode as defined in the DGRWI.	String	1	YES		
alias	The 531 Code as defined in the DGRWI	String	1	YES		
notes	A human readable statement about the DGIM Elements that the RWO describes.	Memo	1	NO	Version of OCL comment	
Stereotype properties (tagged values)						
531 Code	The 531 Code as defined in the DGRWI consisting of the String "RWO_" followed by a five-digit number, for example "RWO_04325".	String	1	YES		String
dateAccepted	The date the item was accepted and became valid.	Date	1	YES		String
dateRetired	The date the item was retired.	Date	1	YES		String
description	A general comment about the RWO.	String	0..1	NO		Memo
englishTerm	The English term designating the phenomenon	String	1	YES		String

Item	Definition/Content	Data type	Multi-plicity	Norm.	Gen	DCE Datatype
oCLComment	A human readable definition of the OCL statement as an OCL Comment	String	1	YES		Memo
oCLStatement	The pure OCL statement for the constraint.	String	1	YES		Memo
profiles	Comma separated list of identifiers that define in which profiles the RWO is applicable.	String	0..1	YES	see chapter 11	String
source	The source from which the name is originating	String	0..* **(separated by semicolon)**	NO		String
status	The status of the RWO as defined in ISO 19135 ('valid', 'notValid', 'retired', 'superseded')	RE_ItemStatus	1	YES		RE_ItemStatus

A.2.1.2 Links

A realWorldObject is connected to a ***featureType(s)*** and/or ***type(s*****)** to represent the OCL Statement in a graphical way. These links are consistent with the Real World Object Tuple(s).

The normative information about the connection between a realWorldObject and an Entity-Attribute-Value Tuple is the oCLstatement and the oCLcomment. The OCL constraint is derived from these fields.

The target role is designated as “entity” with a consecutive number depending on the connections, for example “entity1” for a RWO that is only connected to one type.

A.2.1.3 Example

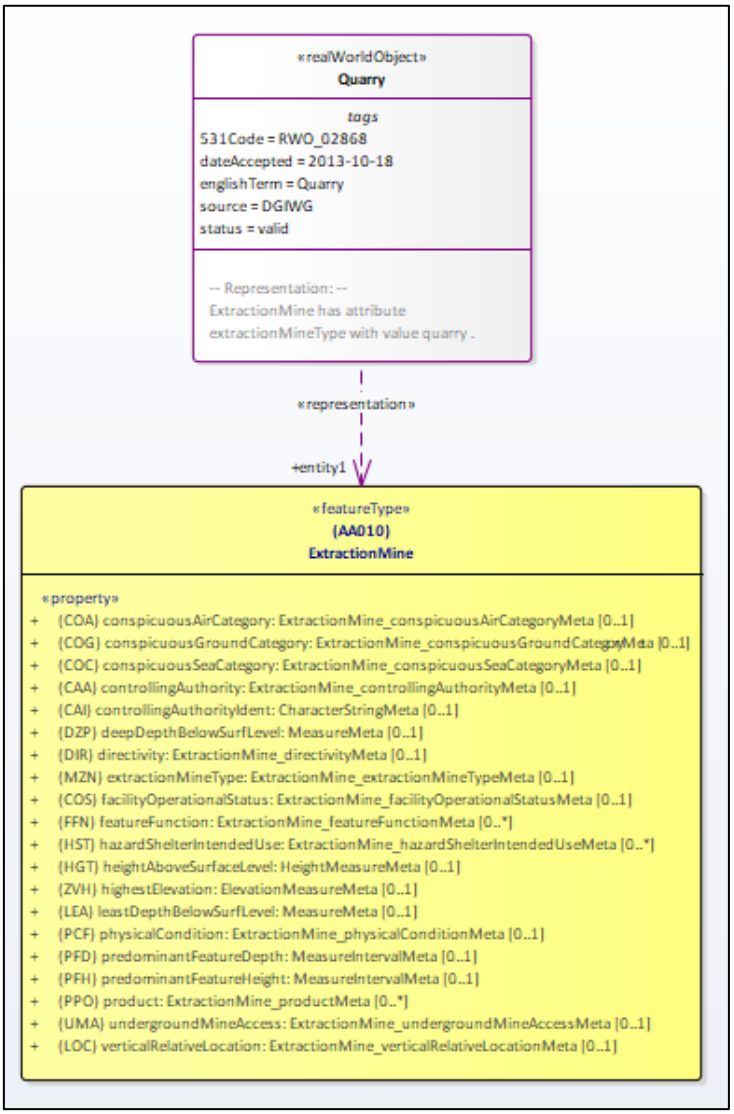

Figure A-2: Example of Stereotype used in the Model

A.2.2 DGRWI Stereotypes for Connectors

The DGRWI consists of the following stereotypes for connectors.

Each stereotype description consists of information about the Meta Class it extends, the properties it owns, the links to other stereotypes that may exist, and an example.

A.2.2.1 Representation

A representation is the connection between a realWorldObject with its represented ***featureType(s)*** and/or ***type(s*****)**

Source Class	Source Role	Source Mult	Target Class	Target Role	Target Mult	Dir
realWorldObject		0..*	Entity	entity[no]	1..3	->

Currently a representation does not have specific tagged values attached to it.

Annex B - Real World Object (RWO) Tuples and OCL Encoding

B.1 Tuples

A RWO tuple is Feature/Type-Attribute-Value combination from the DGIM that is required to represent a RWO.

A RWO must be represented by at least one tuple. It is possible to combine multiple **tuples** into a single tuple that will define more complex distinct objects. In the case of using more than one tuple it is understood to be a combination ('AND') and not as alternatives ('OR'). In theory, any number of tuples can be designated but in practice, no more than three is recommended. Additional tuples can be used for different attributes from the same Feature Type or Type, or from independent Feature Types or Types.

Examples:

RWO "**Canal**"

- DGIM Tuple 1: Feature Type = *Canal* (no Attribute or Value)

RWO "**Irrigation Ditch**"

- DGIM Tuple 1: Feature Type = *Ditch*; Attribute Type = *ditchFunction*; Value = *irrigation*

RWO "**Historic Palace**"

- Tuple 1: Feature Type = *Building*; Attribute Type = *featureFunction*; Value = *palace* AND
- Tuple 2: Feature Type = *Building*; Attribute Type = *historicSignificance*; Value = *historic*

RWO "**Buddhist Monastery Facility**" (and its synonym RWO "**Lamasery")**

- Tuple 1: Feature Type = *Facility*; Attribute Type = *featureFunction*; Value = *religiousActivities* AND
- Tuple 2: Type = *ReligiousInformation;* Attribute Type = *religiousDesignation;* Value = *Buddhism* AND
- Tuple 3: Type = ReligiousInformation; Attribute Type = religiousFacilityType; Value = monastery

RWO "**Fresh Water Well**"

- Tuple 1: Feature Type = *WaterWell* AND
- Tuple 2: Type = *WaterResourceInformation*; Attribute Type = *waterType*; Value = *fresh*

B.2 OCL Encoding

All RWOs require an OCL encoding. The identified tuple values and types are used to define the appropriate OCL Statement.

Tuples are presented as OCL Statements within the DCE. An OCL Statement is a pure OCL encoding of the relevant tuple(s). An OCL Comment is a standardised human readable version of the OCL Statement. Care should be taken to ensure that the logic of this statement, when read as English, is consistent with the concept (care with 'AND' / 'OR' statements; introduce 'WHERE' and 'IF' etc, as required).

The OCL Statement must be written to the RWO Tagged Values OCL Statement field as well as the OCL Constraint field.

It is important to identify the Attribute type (e.g. Enumeration, IntegerMeta, etc) used in a tuple as this affects the OCL Encoding.

The OCL Constraint of a RWO in DGRWI is always referring to one or more Feature Type and/or Type classes in the DGIM. The aim of the OCL is to identify how a RWO is represented by feature-attribute or feature-association combination in the DGIM. For example: RWO **Metal-Bridge** refers to feature type *Bridge* in DGIM with property *structMatType* **=** *metal.* To indicate which DGIM Feature Type the OCL is referring to, the target name of connecting representation link is used.

As all representations between RWOs and corresponding Feature Type classes in DGIM have the target name **entity1**, this name must be used for the role in DCE. If there are two or more Feature Type/Types involved, the target name would be **entity2**, **entity3**, etc.

The following provides syntax and examples of OCL Encoding for tuples with various common attribute types. (This is not a definitive list for all types. If the Attribute Type is not listed below, advice should be sought).

B.2.1 Tuples that contain no attribution (Type only)

OCL Syntax:

inv: self.entity1.oclIsKindOf(**Type**)

Examples:

RWO "**Canal**"

- DGIM Tuple 1: Feature Type = *Canal* (no Attribute or Value)
- OCL Statement = inv: self.entity1.oclIsKindOf(Canal)
- OCL Comment = /* Canal */

B.2.2 Tuples using attributes with enumerations

OCL Syntax:

inv: entity1.**propertyName**.valueOrReason.value = **enumerationName**::**enum**

Examples:

RWO "**Irrigation Ditch**"

- DGIM Tuple 1: Feature Type = *Ditch*; Attribute Type = *ditchFunction*; Value = *irrigation*
  - OCL Statement

    inv: entity1.ditchFunction.valueOrReason.value=Ditch_ditchFunction::irrigation
  - OCL Comment

    / Ditch has attribute ditchFunction with value irrigation */*

RWO "**Path**"

- DGIM Tuple 1: Feature Type = *LandTransportationWay*; Attribute Type = *meansTransportation* Value = *pedestrian*
- OCL Statement

  inv: entity1.meansTransportation.valueOrReason.value = LandTransportation-Way_meansTransportation::pedestrian
- OCL Comment

  / LandTransportationWay has attribute meansTransportation with value pre-destrian */*

RWO "**Historic Palace**"

- Tuple 1: Feature Type = *Building*; Attribute Type = *featureFunction*; Value = *palace* AND
- Tuple 2: Feature Type = *Building*; Attribute Type = *historicSignificance*; Value = *historic*
- OCL Statement

  inv:

  entity1.featureFunction.valueOrReason.value=Building_featureFunction::pal-ace and entity1.historicSignificance.valueOrReason.value=Building_historic-Significance::historic
- OCL Comment

  / Building has attribute featureFunction with value palace and Building has at-tribute historicSignificance with value historic */*

RWO "**Buddhist Monastery Facility**" (and its synonym RWO "**Lamasery")**

- Tuple 1: Feature Type = *Facility*; Attribute Type = *featureFunction*; Value = *re-ligiousActivities* AND
- Tuple 2: Type = *ReligiousInformation;* Attribute Type = *religiousDesignation;* Value = *buddhism* AND
- Tuple 3: Type = ReligiousInformation; Attribute Type = religiousFacilityType; Value = monastery
- OCL Statement

inv: entity1.featureFunction.valueOrReason.value=Facility_featureFunction::religiousActivities and entity2.religiousDesignation.valueOrReason.value=ReligiousInfo_religiousDesignation::buddhism and entity2.religiousFacilityType.valueOrReason.value=ReligiousInfo_religiousFacilityType::monastery

- OCL Comment

  / Facility has attribute featureFunction with value religiousActivities and ReligiousInfo has attribute religiousDesignation with value buddhism and ReligiousInfo has attribute religiousFacilityType with value monastery */*

B.2.3 Tuples using attributes with type MeasureMeta

OCL Syntax:

inv: entity1.**propertyName**.valueOrReason.value = **numericValue**

Example:

RWO "**Small Area Forest**"

- Tuple 1: Feature Type = *Forest*; Attribute Type = *area*; Value = *<10000*
- OCL Statement

  inv: entity1.area.valueOrReason.value < 10000

- OCL Comment

  / Forest has attribute area with value <10000 */*

B.2.4 Tuples using attributes with type IntegerMeta

OCL Syntax:

inv: entity1.**propertyName**.valueOrReason.value = **numericValue**

Example:

RWO "**Two Storey Building**"

- Tuple 1: Feature Type = *Building*; Attribute Type = *floorCount*; Value = *2*
- OCL Statement

  inv:entity1.floorCount.valueOrReason.value=2

- OCL Comment

  / Building has attribute floorCount with value 2 */*

B.2.5 Tuples using attributes with type BooleanMeta

OCL Syntax:

inv: entity1.**propertyName**.valueOrReason.value=**true/false**

Example:

RWO "**Temporary Checkpoint**"

- Tuple 1: Feature Type = *Checkpoint*; Attribute Type = *permanent*; Value = *False*
- OCL Statement

  inv: entity1.permanent.valueOrReason.value=false
- OCL Comment

  / Checkpoint has attribute permanent with value false */*

B.2.6 Tuples using attributes with type CharacterStringMeta

OCL Syntax:

inv: entity1.**propertyName**.valueOrReason.value=**'Character String'**

Example:

RWO "**US State**"

- DGIM Tuple 1: Feature Type = *AdministrativeDivision;* Attribute Type = *administrativeUnitTypeName;* Value = *US State*
- OCL Statement

  inv: entity1.administrativeUnitTypeName.valueOrReason.value='US State'
- OCL Comment

/ AdministrativeDivision has attribute administrativeUnitTypeName with value US State */*

B.2.7 Tuples using combination of types

OCL Syntax:

Appropriate syntax for each tuples attribute type joined by 'AND'.

Examples:

RWO "**Fresh Water Well**"

- Tuple 1: Feature Type = *WaterWell* AND
- Tuple 2: Type = *WaterResourceInfo*; Attribute Type = *waterType*; Value = *fresh*
- OCL Statement

  inv: self.entity1.oclIsKindOf(WaterWell) and entity2.waterType.valueOrReason.value=WaterResourceInfo_waterType::fresh
- OCL Comment

  / WaterWell where WaterResourceInfo has attribute waterType with value fresh */*

B.2.8 OCL Syntax for Navigation over Associations

If a RWO is defined by the existence of the association between feature types/types, the syntax would be:

*inv: entity1.**associationTargetName2**->notEmpty()*

where **entity1** is association target name from the RWO to Feature Type 1 and ***associationTargetName2*** is association target name from Feature Type 1 to Feature Type 2.

Example:

RWO "**Capital**" (refers to the Populated Place that is a capital of a Geopolitical Entity)

- Tuple 1: Feature Type 1 = ***PopulatedPlace***
- Tuple 2: Feature Type 2 = ***GeopoliticalEntity***
- Association from Feature Type 1 to Feature Type 2, Association Target Name = **isCapitalOf**

- OCL Statement
  inv: entity1.isCapitalOf->notEmpty()

- OCL Comment
  / PopulatedPlace has association to GeopoliticalEntity with target name isCapitalOf */*