# Appendix A – Detailed Mapping between UML and OWL.

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| **Ontology** | **UML Type** | **UML Name** | **Description** | **OWL Type** | **OWL Name** | **Mapping Notes** |
| Complex Properties | Association | restriction | Relates an Observable Property with one or more Constraints | Object Property | restriction | Equivalent |
| Complex Properties | Association | statisticalMeasure | Relates an Observable Property with one or more Statistical Measures. | Object Property | statisticalMeasure | Equivalent |
| Complex Properties | Attribute | basePhenomemon | A value from a codelist of property types (temperature, wind, speed). | Class | Property | **A Property** is a characteristic of the Object Of Interest that is observed during the act of observation, for example: if the temperature of the water is measured, then the Property is Temperature.  **Object Of Interest** is the substance, taxon or other physical/chemical phenomenon of the feature that is being observed, for example: Waves, Rainfall, Calluna Vulgaris, Aluminium. |
| Complex Properties | Attribute | uom | O&M does not explain its use of Unit Of Measure, other than referencing Geographic Information - Conceptual schema language [ISO/TS 19101:2005]. | Class | UnitOfMeasure | **Promoting the UML attribute to an OWL class allows it become a subclass of skos:Concept, so that we can manage units in a SKOS thesaurus.** |
| Complex Properties | Class | AbstractObservableProperty | The complex properties extension to O&M allows the abstract class Abstract Observable Property to be implemented by two specialisations, see “Class: Observable Property” and “Class: Composite Observable Property”. | Class | AbstractObservableProperty | Equivalent |
| Complex Properties | Class | CompositeObservableProperty | Composite Observable Property is a class grouping together multiple Phenomena Observable Properties into one Composite Observable Property element e.g. a strongly linked pair of phenomena such wind speed and wind direction). | Class | CompositeObservableProperty | Equivalent |
| Complex Properties | Class | Constraint | A restriction acting to shrink the domain of a specific Observable Property to certain circumstances or restrictions. For example, if the Observable Property is “attenuance of light” then “of red wavelengths” might be a Constraint. | Class | Constraint | Equivalent |
| Complex Properties | Class | ObservableProperty | Observable Property is a class representing a reference to a phenomenon definition in a codelist with optional units of measure, which may be augmented using Constraints and/or Statistical Measures. | Class | ObservableProperty | Equivalent |
| Complex Properties | Class | Observation | Observation is a class representing the act of measuring or otherwise determining the value of a property | Not in scope |  | **Note that in this mapping, we are not directly concerned with actual observations – only with identifying the Datasets that contain Observation values.** |
| Complex Properties | Class | Statistical Measure | Some function over time or space which aggregates the values associated with Observable Properties, e.g. “daily maximum” | Class | StatisticalMeasure | Equivalent |
| Complex Properties | n/a | n/a | This concept is not included in the O&M model. | Class | Matrix | **Where a feature is a complex entity, the Matrix may be identified in order to clarify the particular component or aspect of the feature at, in, or on which the Object Of Interest was observed - for example: "Vegetation", "Soil", "Water", "Stream Sediment". A sample taken from a river could be either of the water or of the sediment.** |
| Complex Properties | n/a | n/a | This concept is not included in the O&M model. | Object Property | matrix | Observable Properties may be observed within a Matrix. |
| Environmental Monitoring Facilities | Association | belongsto | A link pointing to the Environmental Monitoring Networks this the Environmental Monitoring Facility pertains to. | Object Property | belongsTo | **owl:domain = UNION(EnvironmentalMonitoringFacility AND NetworkFacility) owl:range=UNION(EnvironmentalMonitoringNetwork AND NetworkFacility)** |
| Environmental Monitoring Facilities | Association | contains | A link pointing to the Environmental Monitoring Facilities included in the Environmental Monitoring Network. | Object Property | contains | **owl:domain = UNION(EnvironmentalMonitoringNetwork AND NetworkFacility) owl:range=UNION(EnvironmentalMonitoringFacility AND NetworkFacility)** |
| Environmental Monitoring Facilities | Association | triggers | Environmental Monitoring Activities triggered by the Environmental Monitoring Programme. | Object Property | triggers | Equivalent |
| Environmental Monitoring Facilities | Association | uses | The specific set of Abstract Monitoring Features involved in the Environmental Monitoring Activity. | Object Property | uses | Equivalent |
| Environmental Monitoring Facilities | Attribute | boundingBox | A representation of the area in which the Environmental Monitoring Activity takes place. | Data Property | boundingBox | Equivalent |
| Environmental Monitoring Facilities | Attribute | name | A plain text denotation of the Abstract Monitoring Object. | Data Property | monitoringObject.name | **Note that because names are local in UML, we must qualify it for it to be unique in OWL.** |
| Environmental Monitoring Facilities | Attribute | representativePoint | A representative point location for the Environmental Monitoring Facility. | Data Property | representativePoint | Equivalent |
| Environmental Monitoring Facilities | Class | AbstractMonitoringFeature | An abstract base class for the environmental monitoring features in the real world (Environmental Monitoring Facility, and Environmental Monitoring Network) | Class | AbstractMonitoringFeature | Equivalent |
| Environmental Monitoring Facilities | Class | AbstractMonitoringObject | An abstract base class for environmental monitoring objects. | Class | AbstractMonitoringObject | Equivalent |
| Environmental Monitoring Facilities | Class | EnvironmentalMonitoringActivity | The specific set of Abstract Monitoring Features used for a given domain in a coherent and concise timeframe, area and purpose. Examples of instances of this class include: “A research vessel cruise such as Royal Research Ship James Clark Ross 20080221”, “Geochemical Baseline Survey of the Environment (G-BASE)”, “Long-term Monitoring e.g. the Cumbrian lakes environmental research (CLEAR)”. | Class | EnvironmentalMonitoringActivity | Equivalent |
| Environmental Monitoring Facilities | Class | EnvironmentalMonitoringFacility | A geo-referenced object directly collecting or processing data about objects whose properties (e.g. physical, chemical, biological or other aspects of environmental conditions) are repeatedly observed or measured. Examples include: “RRS James Clark Ross”, “Rothamsted Agricultural Research Station”, “BILSAT-1 Earth Observation Satellite”. | Class | Environmental Monitoring Facility | Equivalent |
| Environmental Monitoring Facilities | Class | EnvironmentalMonitoringNetwork | An administrative or organisational grouping of Environmental Monitoring Facilities managed the same way for a specific purpose, targeting a specific area. Each network respects common measurement protocols. | Class | EnvironmentalMonitoringNetwork | Equivalent |
| Environmental Monitoring Facilities | Class | EnvironmentalMonitoringProgramme | A framework based on policy relevant documents defining the target of a collection of observations and/or the deployment of Abstract Monitoring Features on the field. | Class | EnvironmentalMonitoringProgramme | Equivalent |
| Monitoring Properties | Association | monitoredFeature | Relates a Monitored Property to the geographic feature (the class Monitored Feature) which manifests an Observable Property. | Object Property | monitoredFeature | Equivalent |
| Monitoring Properties | Association | monitoredObservableProperty | Relates a Monitored Property to the Observable Property (from the Complex Properties ontology) which describes the result values stored in the Monitoring Dataset. | Object Property | monitoredObservableProperty | Equivalent |
| Monitoring Properties | Association | monitoringProcedure | Relates a Monitored Property to the Process that was involved in gathering the data values which are stored within the Monitoring Dataset. | Object Property | monitoringProceure | Equivalent |
| Monitoring Properties | Association | storesValuesfor | A Monitoring Dataset stores the result values arising from observations of Monitored Properties. | Object Property | storesValuesFor | Equivalent |
| Monitoring Properties | Association | wasGeneratedBy | A Monitoring Dataset is related to the Data Origin (typically instantiated as an Environmental Monitoring Activity) that caused it come into existence. An association is required to make the connection between a dataset and its originating activity. | Object Property | wasGeneratedBy | Equivalent |
| Monitoring Properties | Attribute | label | Ideally Monitored Features would be already described in a feature registry, but this may not always be the case. This attribute is included for convenience in the situation where feature URIs and labels cannot be readily imported from another source. | Data Property | monitoredFeature.label | **Note that because names are local in UML, we must qualify it for it to be unique in OWL.** |
| Monitoring Properties | Attribute | MonitoringProcessResource | It is unlikely that the detail of a specific Monitoring Process is available in a structured, linked-data format, since there exists no common logical model for such things. This attribute facilitates linking to an external web resource (such as an HTML or PDF document) that can provide a narrative description of the process. | Data Property | monitoringProcessResource | Equivalent |
| Monitoring Properties | Attribute | name | A Data Origin has a label by which the activity is commonly known. This data property is required because Environmental Monitoring Activity as defined in the INSPIRE Environmental Monitoring Facilities context is primarily an associative concept linking programmes with the facilities or networks of facilities that those programmes utilise - it does not carry any human meaningful label. Becasue | Data Property | dataOrigin.name | **Note that because names are local in UML, we must qualify it for it to be unique in OWL.** |
| Monitoring Properties | Class | DataOrigin | Data Origins are activity documentation objects. Instances are the subset of Environmental Monitoring Activities which have actually generated data - and where that data has been collected together and catalogued as one or more Monitoring Datasets. This class is a subtype of Activity as defined in the PROV-O ontology (Lebo, Sahoo and McGuinness, 2013). | Class | DataOrigin | Equivalent |
| Monitoring Properties | Class | MonitoredFeature | A Monitored Feature is a representation of a real world thing which carries the property that is being observed. It is the thing from which the observation/measurement is taken. It may be a sampling feature. | Class | MonitoredFeature | Equivalent |
| Monitoring Properties | Class | MonitoredProperty | A Monitored Property is an Observable Property that was observed/measured/estimated of a Monitoring Feature using a specified Monitoring Process. The class Monitored Property is related to the INSPIRE EF class "Observing Capability" - however, whereas an Observing Capability represents a period of time during which it was, is, or will be, possible to observe something, a Monitored Property classifies a set of observations which have definitely happened, and for which there exists a metadata record describing the associated collection of result values. | Class | MonitoredProperty | Equivalent |
| Monitoring Properties | Class | MonitoringDataset | Monitoring Datasets are dataset documentation objects. Instances are those datasets which are known to have originated from a particular environmental monitoring activity. Example instances include: “Chemical contaminants in White-tailed sea eagle eggs - Predatory Bird Monitoring Scheme (PBMS)”, “United Kingdom Butterfly Monitoring Scheme: collated indices 2011”, “Regional geochemistry of north-east England (1996)”. | Class | MonitoringDataset | Equivalent |
| Monitoring Properties | Class | MonitoringProcess | The Monitoring Process is the process or methodology used during the monitoring which generated the dataset. | Class | MonitoringProcess | Equivalent |

# Appendix B – Mapping to INSPIRE Feature Concepts

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| **Model** | Concept | **Mapping** | **INSPIRE Feature Concept** |
| Environmental Monitoring Facilities | Abstract Monitoring Feature | Same As | http://inspire.ec.europa.eu/featureconcept/AbstractMonitoringFeature/ |
| Environmental Monitoring Facilities | Abstract Monitoring Object | Same As | http://inspire.ec.europa.eu/featureconcept/AbstractMonitoringObject |
| Environmental Monitoring Facilities | Environmental Monitoring Activity | Same As | http://inspire.ec.europa.eu/featureconcept/EnvironmentalMonitoringActivity |
| Environmental Monitoring Facilities | Environmental Monitoring Facility | Same As | http://inspire.ec.europa.eu/featureconcept/EnvironmentalMonitoringFacility |
| Environmental Monitoring Facilities | Environmental Monitoring Network | Same As | http://inspire.ec.europa.eu/featureconcept/EnvironmentalMonitoringNetwork |
| Environmental Monitoring Facilities | Environmental Monitoring Programme | Same As | http://inspire.ec.europa.eu/featureconcept/EnvironmentalMonitoringProgramme |
| Complex Properties | Application Schema | Adapted From | http://inspire.ec.europa.eu/featureconcept/ObservableProperties/ |
| Monitoring Properties | Process | Subclass Of | http://inspire.ec.europa.eu/featureconcept/Process/ |
| Monitoring Properties | Monitoring Dataset | Subclass Of | http://inspire.ec.europa.eu/glossary/DataSet/ |
| Monitoring Properties | Monitored Feature | Subclass Of | http://inspire.ec.europa.eu/glossary/Feature/ |
| Monitoring Properties | Monitored Property | Patterned On | http://inspire.ec.europa.eu/featureconcept/ObservingCapability/ |