

# Assessing the Underworld: **Infrastructure Asset Ontologies**



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## **ATU Infrastructure Asset Ontologies**

An ontology defines a *common vocabulary* for people who need to share information in a domain. It includes *machine-interpretable definitions* of basic concepts in a domain and relations among them. It provides a way of integrating data from multiple sources.

The ATU infrastructure asset ontologies define *main concepts* describing utilities (e.g. pipes), soil, roads, as well as their relationships with the natural environment (e.g. rain) and human activities (e.g. maintenance).



The ATU infrastructure asset ontologies reuse the top-level concepts from the SWEET ontology (https://sweet.jpl.nasa.gov) developed by NASA and specify them for different infrastructure assets.



ATU infrastructure asset The ontologies are used together in decision support ATU the system to help users understand

- how different assets affect each other;
- how asset properties and processes affect each other;
- possible causes and effects of asset defects or failures:
- possible consequences of maintenance/repair activities.

## **An Ontology of Soil Properties and Processes (OSP)**

The OSP ontology mainly describes

- different kinds of soil properties and processes;
- how of soil properties and processes affect each other. E.g. the strength of soil is influenced by the water content of it.

The first version of the OSP ontology is openly available from the University of Leeds data repository: http://doi.org/10.5518/54. The second version is under development.

SoilPhysics (http://imash.leeds.ac.uk/ontologies/atu/SoilPhysics.owl) : [C	:\Users\scshd\Downloads\SoilPhysics.owl]	
File Edit View Reasoner Tools Refactor Window Help		
SoilPhysics (http://imash.leeds.ac.uk/ontologies/atu/SoilPhysics)	ics.owl)	▼ Search
Active Ontology × Entities × Individuals by class × DL Query ×		
Class hierarchy:	DL query:	
🐮 🕼 🐹 Asserted 👻	Query (class expression)	
	(hasImpactOn some SoilStrength) and Phenomena	
HumanActivity		
LandUse	Execute Add to ontology	
SoilManagement	Query results	
► ● Traffic	Subclasses (15)	Direct superclasses
Phenomena	Evapotranspiration	Superclasses
PlanetaryPhenomena	Flood	Direct subclasses
SoilPhenomena	FluxControlledWaterInfiltration	⑦ ☑ Subclasses
Process	Inundation	🧃 🗌 Instances
Force		0
	ProfileControlledWaterInfiltration	0
		0
	Rain	
SoilPhysicalProcess	SoilCracking	
Property	SoilHydrophobicity	•
AirProperty	SoilMoistureHysteresis	0
GeneralProperty	SoilOxygenDeficiency	0
► ● Meteorological Property	SoilWaterEvaporation	0
SoilProperty	SoilWaterInfiltration	0
SoilChemicalProperty	SoilWaterPapelloney	0
SoilPhysicalProperty		
SoilSpatialProperty	I ranspiration	



#### **Structures of Different Types of Road** Source: New Roads and Street Works Act 1991 Specification for the Reinstatement of Openings in Highways

The road/pipe ontology mainly describes

- different kinds of roads/pipes, their properties and components;
- road/pipe defects, factors influencing or influenced by them, as well as possible causes and effects of defects;
- road/pipe maintenance and repair activities.

As shown in the figure above, different types of road have different structures/layers. The road ontology defines different types of roads and describes the properties of roads regarding different road layers.

## **Ontologies describing Roads and Pipes**



### Visualization of the OSP ontology using Protégé

The concepts and relation statements are created based on

EPSRC

Engineering and Physical Sciences

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the knowledge of domain experts, •

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the SWEET ontology developed by NASA •

Similarly, the pipe ontology classifies pipes into different categories based on their functions/usages, materials and diameters. The current version focuses on describing water pipes.

