**Raw-water Supply Management domain**

# Entity: Channel (Reach)

Global description: **This entity contains a harmonised description of a generic channel (reach) made for raw-water supply management domain. This entity is primarily associated with the water management vertical and related IoT applications.**

## Channel Entity Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the channel.
* tag: An optional text used to assign the channel to a category, perhaps one based on age or the served area.
* length: The length of the channel. All units are accepted in CEFACT code.
* geometry: Description of the geometry of a channel. Text defining the geometry of a channel. Values restricted to “Trapezoidal” (for open channels) or “Circular” (for pressurized flow).
  + bottomSlope: A sub-property.
  + leftSideSlope: A sub-property.
  + rightSideSlope: A sub-property.
  + bottomWidth: A sub-property.
  + maxWaterDepth: A sub-property.
  + diameter: A sub-property.
* bottomSlope: The bottom slope of the channel in the case of “Trapezoidal” type. All units are accepted in CEFACT code.
* leftSideSlope: The slope of the left bank of the channel in the case of “Trapezoidal” type. All units are accepted in CEFACT code.
* rightSideSlope: The slope of the right bank of the channel in the case of “Trapezoidal” type. All units are accepted in CEFACT code.
* bottomWidth: The bottom width of the channel in the case of “Trapezoidal” type. All units are accepted in CEFACT code.
* maxWaterDepth: The maximum allowable water depth of the channel in the case of “Trapezoidal” type. All units are accepted in CEFACT code.
* diameter: The diameter of the channel in the case of “Circular” of the channel. All units are accepted in CEFACT code.
* roughness : The roughness coefficient of the channel. Manning’s coefficient for open channel flows or Surface roughness *k* for pipe flows.
* flowType : Text defining the type of flow in the channel. Values restricted to "free surface flow" or "pressure-driven flow" or "flow with steep controls".
* waterLoss (water leakages/losses - a flow number or a percentage of flow)

## Channel Entity Relationships

* downstreamNode: A relationship indicating the ID of the downstream node (junction, regulation structure) – where the channel ends.
* upstreamNode: A relationship indicating the ID of the upstream node ((junction, regulation structure) – where the channel begins.
* observedBy: A relationship to the device that provides the flow, velocity, depth, quality and waterOutflow property value. Reference to an entity of type Device.

|  |
| --- |
| {  "id": "urn:ngsi-ld:Channel:74azsty-70d4l-4da9-b7d0-3340ef655nnb",  "type": "Channel",  "createdAt": "2020-02-20T15:42:00Z",  "modifiedAt": "2020-02-20T15:45:00Z",  "length": {  "type": "Property",  "value": 52.90,  "unitCode": "MTR"  },  "geometry": [  {  "type": "Property",  “value”: “Trapezoidal”,  “bottomSlope”:{  "type": "Property",  “value”: “5%”,  }  “leftSideSlope”:{  "type": "Property",  “value”: “5%”,  }  “rightSideSlope”:{  "type": "Property",  “value”: “5%”,  }  “bottomWidth”:{  "type": "Property",  “value”: “5”,  }  “maxWaterDepth”:{  "type": "Property",  “value”: “10”,  }  }]  "roughness": {  "type": "Property",  "value": 72.4549,  "unitCode": "C62"  },  "flowType": {  "type": "Property",  "value": “free surface flow”,  },  "tag": {  "type": "Property",  "value": "Dafnoula"  },  "description": {  "type": "Property",  "value": "Free Text"  },  "startsAt": {  "type": "Relationship",  "object":"urn:ngsi-ld:Junction:63fe7d79-0d4c-4da9-b7d0-3340efa0656a"  },  "endsAt": {  "type": "Relationship",  "object":"urn:ngsi-ld:Reservoir:1863179e-3768-4480-9167 "  },  "vertices": {  "type": "GeoProperty",  "value": {  "type": "MultiPoint",  "coordinates": [  [24.40623, 60.17966],  [24.50623, 60.27966]  ]  }  },  } |

# Entity: CrossSection

Global description: **This entity contains a harmonised description of a generic cross-section made for raw-water supply management domain. This entity is primarily associated with the water management vertical and related IoT applications. Act as computation point.**

## CrossSection Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the cross section.
* tag: An optional text used to assign the cross section to a category, perhaps one based on age or the served area.

* position: Description of relevant position of a cross section from a reference point.
  + Attribute type: Property. Number.
  + withReferenceTo: A sub-Relationship to the ID of a node (e.g., Junction, Sluice gate, Reservoir) from which the relevant position of the cross section is measured.
* location: the geographic point of the cross-section.

"location": {

"type": "Point",

"coordinates": [

24.30623,

60.07966

]

}

* crossSectionGeometry: Description of the geometry of a cross-section. Text defining the geometry of a channel. Values restricted to “Trapezoidal” (for open channels) or “Circular” (for pressurized flow) or “Irregular”.
  + leftSideSlope: A sub-property.
  + rightSideSlope: A sub-property.
  + bottomWidth: A sub-property.
  + maxWaterDepth: A sub-property.
  + diameter: A sub-property.
  + cross\_section\_Coordinates: An array describing [station, elevation].
  + targetURI: A sub-relationship. URI of a “channel” component from which the value of a property is obtained.
* flow: Rate of flow in the cross-section.
* velocity: Velocity in the cross-section.
* quality: Quality parameter (temperature, turbidity, conductivity) in the cross-section.
* depth: Water depth in the cross-section.
* EnergyHead: the energy head in the cross-section.
* PressureHead: for pressurized flow

## CrossSection Relationships

* attachedTo: A relationship to the ID of the channel where the cross-section “lives in”. Reference to an entity of type Channel.
* observedBy: A relationship to the device that provides the flow, velocity, depth, quality and waterOutflow property value. Reference to an entity of type Device.
* withReferenceTo: A sub-Relationship to the ID of a node (e.g., Junction, Sluice gate, Reservoir) from which the relevant position of the cross section is measured.

# Entity: Junction

**Global description: This entity contains a harmonised description of a generic junction made for raw-water supply management domain. Junctions are defined as locations where the characteristics of the channel changes, two or more channels (or reaches) come together or split apart, amounts of water are abstracted or inserted to the system.**

## Junction Entity Properties

* uniqueName: the name of the junction.
* id: Unique identifier (required).
* description: An optional text that describes other significant information about the junction.
* tag: An optional text used to assign the junction to a category, perhaps one based on age or the served area.
* location: the geographic point of the junction.

"location": {

"type": "Point",

"coordinates": [

24.30623,

60.07966

]

}

* position: Description of relevant position of a cross section or junction from a reference point.
  + Attribute type: Property. Number.
  + withReferenceTo: A sub-Relationship to the ID of a node (e.g., Junction, Sluice gate, Reservoir) from which the relevant position of the cross section is measured.
* waterOutflow: Water abstracted (or diverted) from the junction to another source (m3/s).
* waterInflow: Water inserted to the junction from another source (m3/s).

## Junction Entity Relationships

* downstream: A relationship indicating the ID of the downstream entity (channel, junction, spillway, sluice gate).
* upstream: A relationship indicating the ID of the upstream entity (channel, junction, spillway, sluice gate).
* observedBy: A relationship to the device that provides the flow, velocity, depth, quality and waterOutflow property value. Reference to an entity of type Device.

# Entity: RegulationStructure

**Global description: This entity contains a harmonised description of a generic “regulation structure” made for raw-water supply management domain. Regulation structure consists a junction type object, controlling flow in a channel.**

## RegulationStructure Entity Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the regulation structure.
* tag: An optional text used to assign the regulation structure to a category, perhaps on its type. E.g., “L-gate” or “E-gate”.
* location: the geographic point of the junction.

"location": {

"type": "Point",

"coordinates": [

24.30623,

60.07966

]

}

* position: Description of relevant position of the regulation structure from a reference point.
  + Attribute type: Property. Number.
  + withReferenceTo: A sub-Relationship to the ID of a node (e.g., Junction, Sluice gate, Reservoir) from which the relevant position of the cross section is measured.
* telecommand: Define whether the regulation structure is controlled remotely or manually. True/False value.
* structureType: Determine the type of the structure. It takes specific values e.g., “Sluice Gates”.
* numberOfGates: An integer value defining the number of gates attached to the regulation structures.
* numberOfSpillways: An integer value defining the number of spillways attached to the regulation structure.

## RegulationStructure Entity Relationships

* hasGate: A relationship to the ID label of the gate.
* hasSpillway: A relationship to the ID label of the spillway.
* upstreamTo:
* downstreamTo:

# Entity: RegulationGate

**Global description: This entity contains a harmonised description of a generic “RegulationGate” made for raw-water supply management domain. Regulation structure consists a junction type object, controlling flow in a channel.**

## RegulationGate Entity Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the regulation gate.
* tag: An optional text used to assign the regulation gate to a category, perhaps one based on age or the served area.
* gateType: The type of the gate: specific values “SLUICE-GATE” or “RADIAL-GATE”.
* gateWidth: the width of the sluice gate (m).
* gateOpening: the height of gate opening (in meters or percentage).
* gateBottomElevation: Elevation of the bottom (crest) of the gate.
* flowType: It defines the flow conditions in the gate. It takes the values: “OVERFLOW” (upstream water level exceeds the weir crest level), “FREE-FLOW” (water level is lower than gate edge),”SUBMERGED FLOW” (the rate of flow passing through the gate is regulated by the opening of the gate).
* gateDischargeCoefficient: Gate discharge coefficient (m0.5/s) accounts for energy losses as water passes under the gate.
* orificeDischargeCoefficient: Orifice discharge coefficient (m0.5/s) accounts for energy losses as water passes under the gate and the downstream tailwater increases to the point at which the gate is no longer flowing freely (downstream submergence is causing a greater upstream headwater for a given flow).
* waterDischarge: the discharge that passes the weir (Q).
* headDifference: the difference between the upstream depth and the depth just downstream.
* upstreamControlPoint: Description of cross section just upstream of the sluice weir which controls the flow.
  + depth: A sub-property: the water depth just upstream of the sluice gate.
  + hasCrossSection: A sub-relationship indicating the ID of the cross section.

" upstreamControlCrossSection ": [

{

"type": "Property",

"value": "upstreamControlCrossSection",

" upstreamDepth": {

"type": "Property",

"value": 11.2

},

" hasCrossSection": {

"type": "Relationship",

"object": " urn:ngis-ld:CrossSection:CS01 "

},

}]

* justDownstreamControlPoint: Description of cross section just downstream of the sluice weir which controls the flow.
  + depth: A sub-property: the water depth just downstream of the sluice gate.
  + hasCrossSection: A sub-relationship indicating the ID of the cross section.
* downstreamControlPoint: Description of cross section downstream of the sluice weir where the flow conditions become permanent.
  + depth: A sub-property: the water depth just downstream of the sluice gate.
  + hasCrossSection: A sub-relationship indicating the ID of the cross section.

## RegulationGate Entity Relationships

* observedBy: A relationship to the device that provides the gateOpening, upstreamDepth, downstreamDepth, flowRate. Reference to an entity of type Device.
* hasCrossSection: A sub-relationship indicating the ID of the cross section.
* curveDischargeCoefficient: A relationship to the ID label of the curve that represents the discharge Coefficient as a function of relative weir opening (weir opening over upstream depth), Cd over a/H1..
* attachedTo: A relationship to the ID of the channel or the junction where the cross-section is attached to. Reference to an entity of type Channel.

# Entity: Spillway

## Spillway Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the spillway.
* tag: An optional text used to assign the spillway to a category, perhaps one based on age or the served area.
* spillwayType: The type of the spillway (the methods for computing outflow): It defines the type of the spillway. It takes specific values: “BROAD-CRESTED”, “OGEE”, ”SHARP-CRESTED” or “SPECIFIED SPILLWAY”. In the case of “SPECIFIED SPILLWAY”, only “elevation (m) – discharge (m3/s)” curve is required.
* crestElevation: The crest elevation of the spillway (m). Required only for “BROAD-CRESTED”, “OGEE” and ”SHARP-CRESTED”.
* crestLength: The length of the spillway (m) equal to the total length through which water passes. Required only for “BROAD-CRESTED”, “OGEE” and ”SHARP-CRESTED”.
* spillwayWidth: The width of the spillway (m). Only for “BROAD-CRESTED”.
* numberAbutments: The number of abutments of an ogee spillway. Only for “OGEE”.
* abutmentType: The type of abutments of an ogee spillway. Restricted values to “Concrete” or ”Earth”. Only for “OGEE”.
* apronElevation: The elevation at the bottom of the ogee spillway structure (P, just upstream of the spillway).
* apronLength: The total length of the spillway bottom (m).
* dischargeCoefficient: the discharge coefficient (m0.5/s) accounts for energy losses as water enters the spillway, flows through the spillway, and eventually exits the spillway.
* designHead: The design head is the total upstream energy head, measured above the spillway crest, for which the spillway is designed (Ho) for “Ogee Spillway”.
* designDischarge: The design discharge of the spillway (m3/s). Only for “OGEE”.
* designDischargeCoefficient: the discharge coefficient (Co) for the design discharge (Ho).
* maxFloodElevation: The maximum elevation of water that can passes the spillway.
* waterDischarge: the discharge that passes the spillway (Q).
* upstreamVelocity: the flow velocity upstream of the spillway.
* upstreamHead: the total upstream energy head.
* upstreamDepth: the water depth upstream of the spillway, above the crest (H).

## Spillway Relationships

* curveElevationDischarge: A relationship to the ID label of the curve that represents the elevation as a function of discharge.
* curveDischargeCoefficient: A relationship to the ID label of the curve that represents the discharge coefficient as a function of upstream head/depth and spillway geometry. For “BROAD-CRESTED”, discharge coefficient as a function of upstream head over spillway width. For “OGEE”, C/Co over H/Ho.
* curveDesignDischargeCoefficient: A relationship to the ID label of the curve that represents the design discharge coefficient as a function of apron Elevation over design upstream head. Only for “OGEE” (Co over P/ Ho).

# Entity: Curve

Global description: **This entity contains a harmonised description of a generic curve made for raw-water supply management domain.**

## Curve Properties

* id: Unique identifier (required).
* description: An optional text that describes other significant information about the curve.
* tag: An optional text used to assign the channel to a category, perhaps one based on age or the served area.
* curveType: The curve type. Values restricted to “DischargeCoefficient - RelativeOpening”, “ELEVATION - DISCHARGE”, “C/Co - H/Ho”,” P/ Ho”, “C – h/width of spillway”.
* xData : X data points for the curve
* yData : Y data points for the curve

# Entity: WaterSystem

Global description: **This entity contains a harmonised description of a generic water system made for raw-water supply management domain. This entity is primarily associated with the water management vertical and related IoT applications.**

## WaterSystem Properties

* id (e.g., "urn:ngsi-ld: RawWaterSystem: L7-L11")
* type
* description (A free text description for the system)
* mostUpstreamPoint
* mostDownstreamPoint

## WaterSystem Relationships

* isComposedOf: Reference to the ID of an entity of type Channel, cross-section, Junction, Regulation structure, Regulation gate, Spillway.
* hasSubSystem: Reference to the ID of a sub-system - an entity of type “Water\_System”.

# HydraulicSimulationScenario

This entity contains an harmonised description of Simulation Scenarios made for the Raw-water Supply Management domain.

## HydraulicSimulationScenario Properties

* id (e.g., "urn:ngsi-ld: HydraulicSimulationScenario: 01")
* type
* description (A free text description for the system)
* inputParameter: Description of the set of modifications to be applied to the water system for the simulation.
  + water attribute: A sub-property. A water attribute issued from the above data models. It follows fully this data model and it could be a property or a relationship. It contains the results of the simulation.
  + targetURI:A sub-Relationship of the water attribute. It presents the target water node or link that will handle the modification.

|  |
| --- |
| "inputParameters": [ |
|  | { |
|  | "type": "Property", |
|  | "value": "Property 1", |
|  | "setting": { |
|  | "type": " roughness", |
|  | "value": 5, |
|  | "targetURI": { |
|  | "type": "Property", |
|  | "value": " urn:ngis-ld:Channel:C01" |
|  | } |
|  | }, |
|  | "datasetId": "urn:ngsi-ld:Dataset:ValveSetting" |
|  | }, |
|  | { "type": "Property", |
|  | "value": "Property 1", |
|  | " openingCurve": { |
|  | "type": "Relationship", |
|  | "object": "urn:ngsi-ld:Curve:C1", |
|  | "targetURI": { |
|  | "type": "Relationship", |
|  | "object": " urn:ngis-ld:Sluice\_Weir:SW01" |
|  | } |
|  | }, |
|  | "datasetId": "urn:ngsi-ld:Dataset:PumpCurve" |
|  | } |

* targetValues/targetFlow: Description of the set of target values defined by the user before the simulation.
  + water attribute: A sub-property (e.g., flow). A water attribute issued from the above data models. It follows fully this data model and it could be a property or a relationship. It contains the results of the simulation.
  + targetURI:A sub-Relationship of the water attribute. It presents the target water node or link that will handle the modification.

## HydraulicSimulationScenario Relationships

* createdBy: The ID of who created/triggered the simulation.
* hasWaterSystem: Reference to an entity of type “WaterSystem”. Reference to the ID of the “WaterSystem” system used in the simulation.
* hasSimulationResult: Reference to the ID of Simulation Results - an entity of type “HydraulicSimulationResult”.

# HydraulicSimulationResult

## HydraulicSimulationResult Properties

* id (e.g., "urn:ngsi-ld: HydraulicSimulationScenario: 01")
* type
* description (A free text description for the system).
* dateCreated: Entity creation timestamp. This will usually be allocated by the storage platform.
* simulatedProperties : Description of the set of results from a simulation applied to a water system.
  + water attribute: A sub-property. A water attribute issued from the above data models. It follows fully this data model and it could be a property or a relationship. It contains the results of the simulation.

|  |  |
| --- | --- |
| "simulatedProperties":[ |  |
|  |  | { |
|  |  | "type": "Property", |
|  |  | "value": "output parameter 1", |
|  |  | "gateOpening": { |
|  |  | "type": "Property", |
|  |  | "value": 50, |
|  |  | "targetURI": { |
|  |  | "type": "Property", |
|  |  | "value": " urn:ngis-ld:SluiceGate:SG1" |
|  |  | } |
|  |  | }, |
|  |  | "datasetId": "urn:ngsi-ld:Dataset:ValveSetting" |
|  |  | }, |
|  |  | { |
|  |  | "type": "Property", |
|  |  | "value": "output parameter 2", |
|  |  | "depth": { |
|  |  | "type": "Property", |
|  |  | "value": 3.5, |
|  |  | "targetURI": { |
|  |  | "type": "Relationship", |
|  |  | "value": " urn:ngis-ld:Junction:J01" |
|  |  | } |
|  |  | }, |
|  |  | "datasetId": "urn:ngsi-ld:Dataset:TankInitialQuality" |
|  |  | } |
|  |  | ] |

## HydraulicSimulationResult Relationships

* createdBy: The ID of who created/triggered the simulation.
* hasWaterSystem: Reference to an entity of type “WaterSystem”. Reference to the ID of the “WaterSystem” system used in the simulation.
* refHydraulicSimulationScenario: Reference to an entity of type “HydraulicSimulationScenario”. Reference to the ID of the Hydraulic simulation scenario.
* targetURI : URI of network component with a simulated property value. A sub-relationship of the water attribute Property
  + Attribute type: Relationship
  + Mandatory

# Key questions

1. How to transfer/inherit properties from one entity to another? E.g. how to assign values to geometry property from channel, if cross-section’s geometry is the same with that of channel?
2. Do we need to define the reference point that defines the position of each cross-section?