HydroXC Workshop Session

HydroXC Schema 3.0: Sub-Schemas Preview

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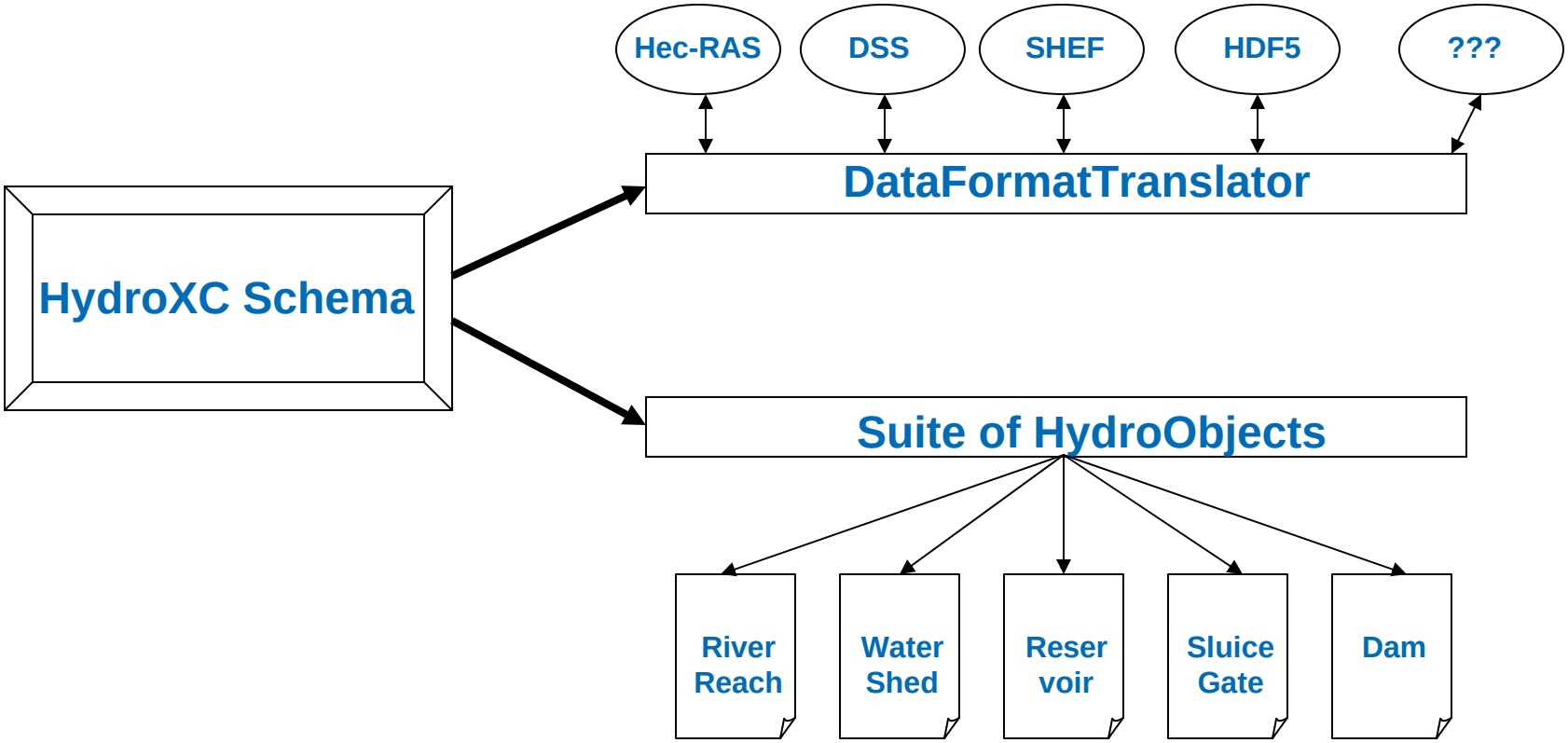
Meeting Agenda

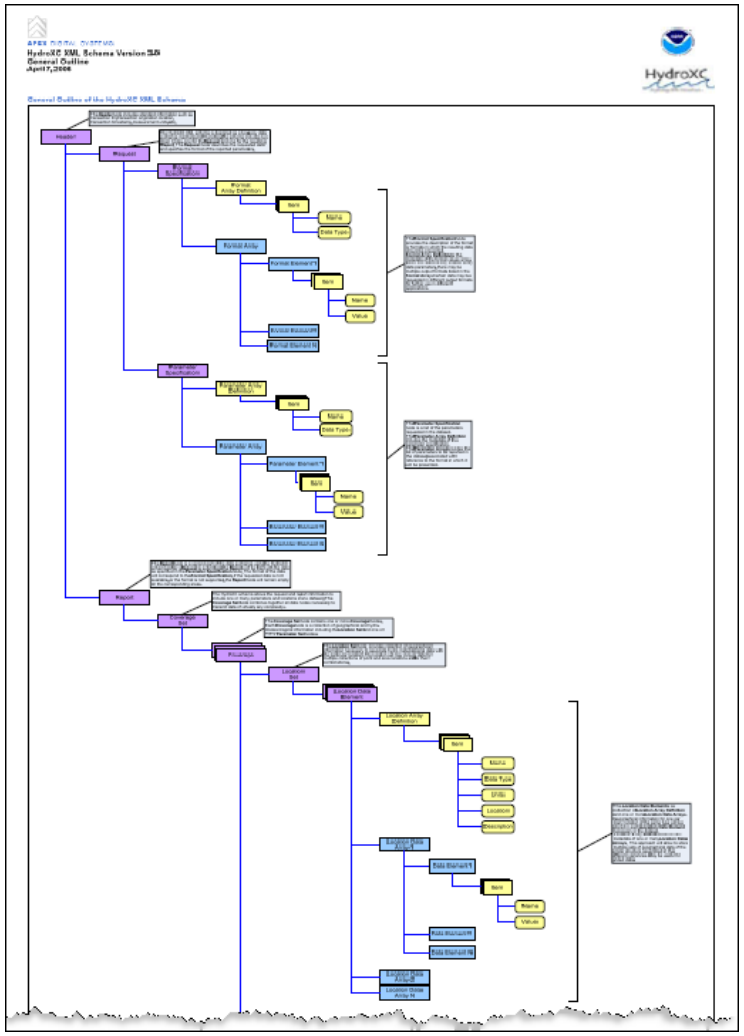
- Welcome
- HydroXC 3.0: Sub-schema Preview
  - HydroXC General Schema Objectives
  - Existing Schema Review
  - GeoReferencing: Geographic Markup Language (GML)
  - National Hydrography Dataset (NHD)
  - Sub-schemas
- Next Steps
  - Data Adapters
  - Website
- Open Discussion

HydroXC General Schema Objectives



Existing Schema Review: Schema 2.0

- General structure for basic hydrologic data
  - Generic data containers
  - Structured to allow for data format definitions paired with a set of data values
  - Meant to be able to support any type of hydrologic data, but with required thought to definition with every instance
    - No object-specific sub-schemas
- Documented only in Visio
  - No schema (.xsd) file
- Based on data samples provided by NOAA (OHD and RFCs), USGS, and Duke



Existing Schema Review: Limitations

- Need georeferencing structure
  - The schema does not contain a section that would relate the data collected or computed at a specific point to a coordinate system that in turn would be referenced to a vertical datum and specific projection.
- Need a link to the referencing system used by the National Hydrographic Dataset (NHD)
  - This is incorporated within the Geography Markup Language (GML) and in other schemas.
- Need more precise and standardized time referencing
  - Example: The existing version uses “the nearest year”, which works for NOAA’s SHEF format but is much too vague for most other applications. We suggest to incorporate a time reference standard like ISO 8601 conventions.

GeoReferencing: Geography Markup Language (GML)

- Need a Spatial Reference System (SRS)
- Several choices:
  - Latitude/Longitude, projection, vertical datum
  - Local Coordinate System (State Plane COS)
  - Universal Transverse Mercator (UTM), => X, Y [meters] plus Northing/Easting
- European Petroleum Survey Group (EPSG) code list. EPSG is now part of the Int'l Association of Oil and Gas Producers (OGP)
  - EPSG:4326 = WGS84 latitude/longitude coordinates in degrees with Greenwich as the central meridian.
  - EPSG:26917 = NAD83 UTM Zone 17
- Points, Line, Line String, Polygon

GeoReferencing: GML Examples

```
<gml:Point gml:id="point1" srsName="urn:ogc:def:crs:EPSG:6.6:4326">
    <gml:pos>45.67 88.56</gml:pos>
</gml:Point>
```

EPSG code for WGS 84

Point e.g. station

```
<gml:LineString gml:id=“line1" srsName="urn:ogc:def:crs:EPSG:6.6:4326">
    <gml:posList>45.67 88.56 55.56 89.44</gml:posList>
</gml:LineString >
```

Line e.g. river channel

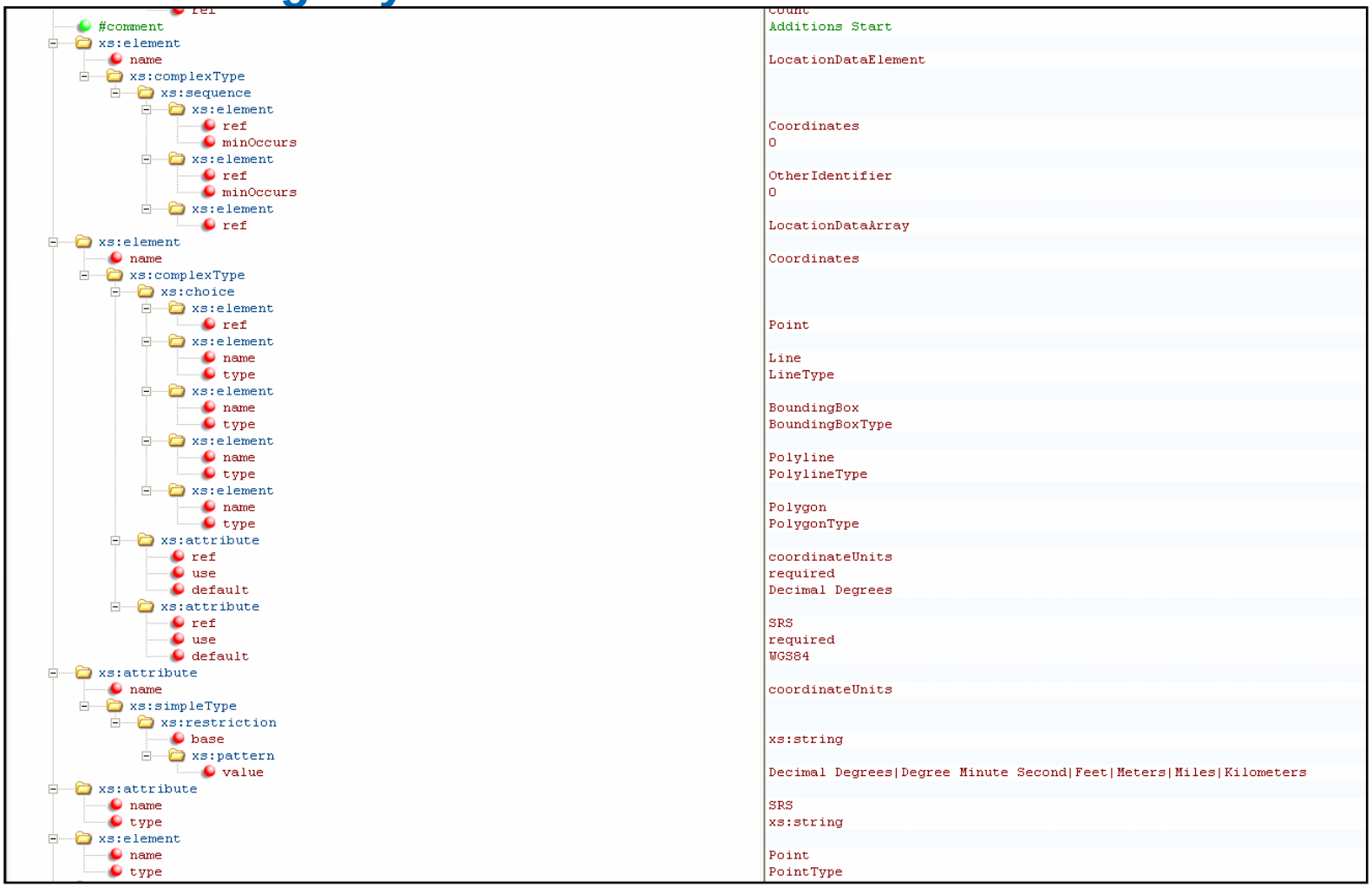
```
<gml:Polygon gml:id=“polygon1" srsName="urn:ogc:def:crs:EPSG:6.6:26986">
  <gml:exterior>
    <gml:LinearRing>
      <gml:posList> 45.256 -110.45 46.46 -109.48 43.84 -109.86 45.256 -110.45 </gml:posList>
    </gml:LinearRing>
  </gml:exterior>
</gml:Polygon>
```

Polygon e.g. watershed

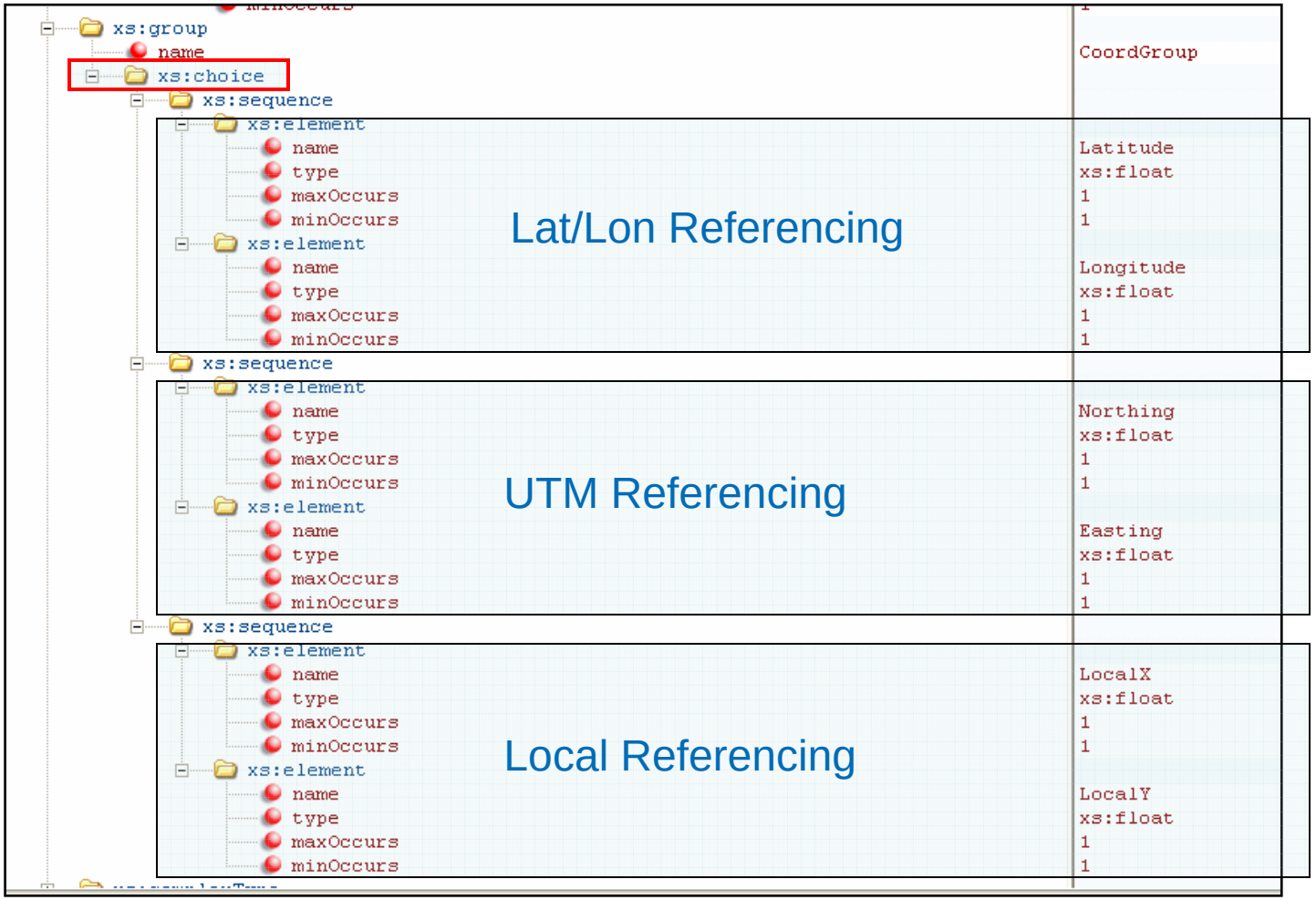
```
<gml:Envelope gml:id=“boundingBox1" srsName="urn:ogc:def:crs:EPSG:6.6:4326">
    <gml:lowerCorner>42.943 -71.032</gml:lowerCorner>
    <gml:upperCorner>43.039 -69.856</gml:upperCorner>
</gml:Envelope>
```

A bounding box

GeoReferencing: HydroXC Schema 3.0



GeoReferencing: HydroXC Schema 3.0



GeoReferencing: HydroXC Schema 3.0

GeoReferencing: Example of GML Conventions in HydroXC

```
- <Report Name="Perennial River" ID="0128071057" Count="1">
  - <CoverageSet Count="1">
-     <Coverage Count="1" ID="788012" Name="River Channel">
-       <LocationSet Count="1">
-         <LocationDataElement Count="1" ID="1345" Name="Channel Path">
-           <LocationArrayDefinition ID="9841" Name="Curve">
              <Item Name="latitude1" DataType="real" />
              <Item Name="latitude2" DataType="real" />
              <Item Name="latitude3" DataType="real" />
              <Item Name="longitude1" DataType="real" />
              <Item Name="longitude2" DataType="real" />
              <Item Name="longitude3" DataType="real" />
              <Item Name="srsName" DataType="String" />
            </LocationArrayDefinition>
-           <LocationDataArray Count="1">
-             <DataElement>
                <Item Name="latitude1" Value="45" />
                <Item Name="latitude2" Value="45.3" />
                <Item Name="latitude3" Value="46.1" />
                <Item Name="longitude1" Value="-83" />
                <Item Name="longitude2" Value="-82.2" />
                <Item Name="longitude3" Value="-82.7" />
                <Item Name="srsName" Value="urn:ogc:def:crs:EPSG:6.6:4326" />
```

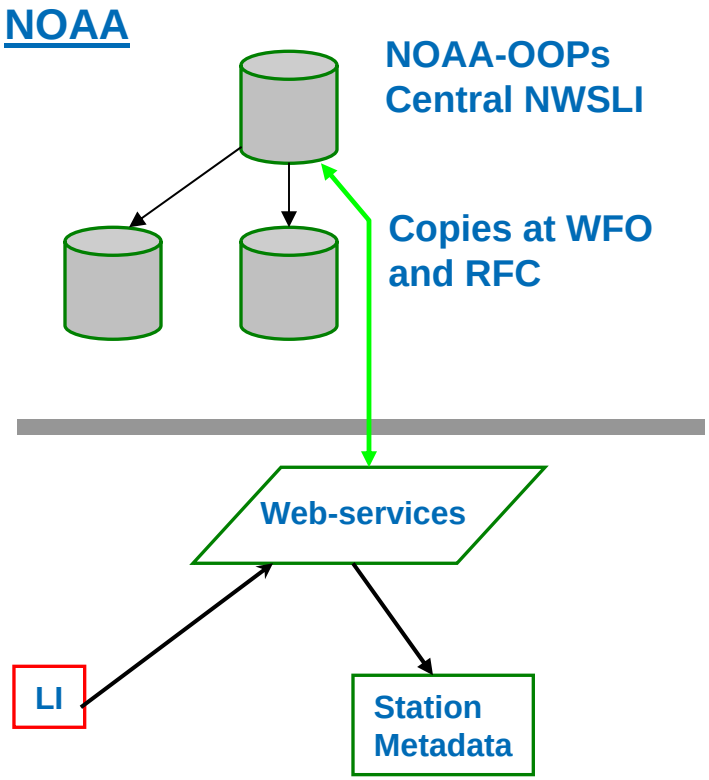
A Curve Section

GeoReferencing: Standard Hydrologic Exchange Format (SHEF)

stationID
5(8) digit
location identifier

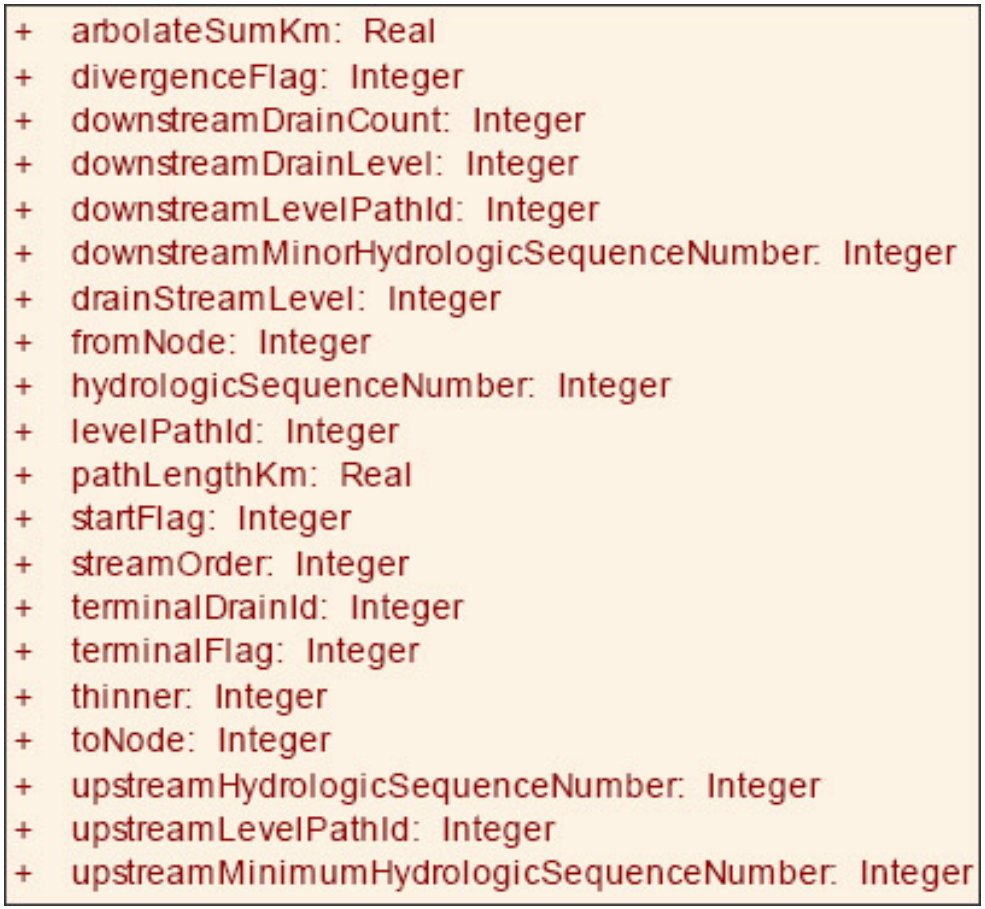
- Lat/lon
- stationName
- City
- County
- State
- Region
- Mileage
- Country
- Cooperative Program Area
- Hydrologic Service Area
- Electronic technician
- Country warning area
- River Forecast Center
- Comments

Coord Reference System?



National Hydrography Dataset (NHD) Referencing

Federal Geographic Data Committee (FGDC) Framework data model uses references to National Hydrography Dataset (NHD) to describe Stream-Reaches.



NHD: Elements

fromNode	Nationally unique ID for the "from" node (upstream node) endpoint
toNode	Nationally unique ID for the "to" node (downstream node) endpoint
hydrologicSequenceNumber	Nationally unique sequence number for the current reach
startFlag	Code to mark headwater features
terminalFlag	Code to mark features that terminate in the ocean, the Great Lakes, Canada, Mexico or in closed basins
terminalDrainId	Hydrologic sequence number for the terminal reach to which this drain flows
levelPathId	Hydrologic sequence number of the most downstream reach that is on the same level path
arbolateSumKm	Sum of the lengths, in kilometers, of all the reaches that drain to the downstream end of the current reach
pathLengthKm	Distance from this reach's downstream end to the terminal reach downstream end
thinner	Ordinal value to allow selection of progressively more dense networks; least dense network is where thinner = 1
divergenceFlag	Code signifying if reach is part of a flow divergence

drainStreamLevel	Current stream level; supports upstream mainstream navigation
downstreamDrainLevel	Stream level of downstream mainstem reach; supports downstream navigation
streamOrder	Strahler stream order number for the reach
upstreamLevelPathId	Level path identifier of the immediately upstream mainstem reach; supports navigation traversals through SQL queries
upstreamHydrologicSequenceNumber	Hydrologic sequence number of the immediately upstream mainstem
upstreamMinimumHydrologicSequenceNumber	Minimum hydrologic sequence number of all immediately upstream reaches
downstreamLevelPathId	Level path identifier of downstream reach
downstreamDrainCount	Number of drains immediately downstream
downstreamMinorHydrologicSequenceNumber	At a divergence, the Hydrologic Sequence Number of the immediately downstream minor path reach

Sub-schemas/HydroObjects

- Standard Hydrologic Exchange Format (SHEF - NOAA data format)
- StreamReach (GML based)
- Reservoir (GML based)
- More to come!

HydroObjects: GML HydroFeatures as a first start

HydroFeature Types in DHS model

Why no WaterShed?

Department of Homeland Security (DHS)
Geospatial Data Model
Federal Geographic Data Committee (FGDC)
Framework

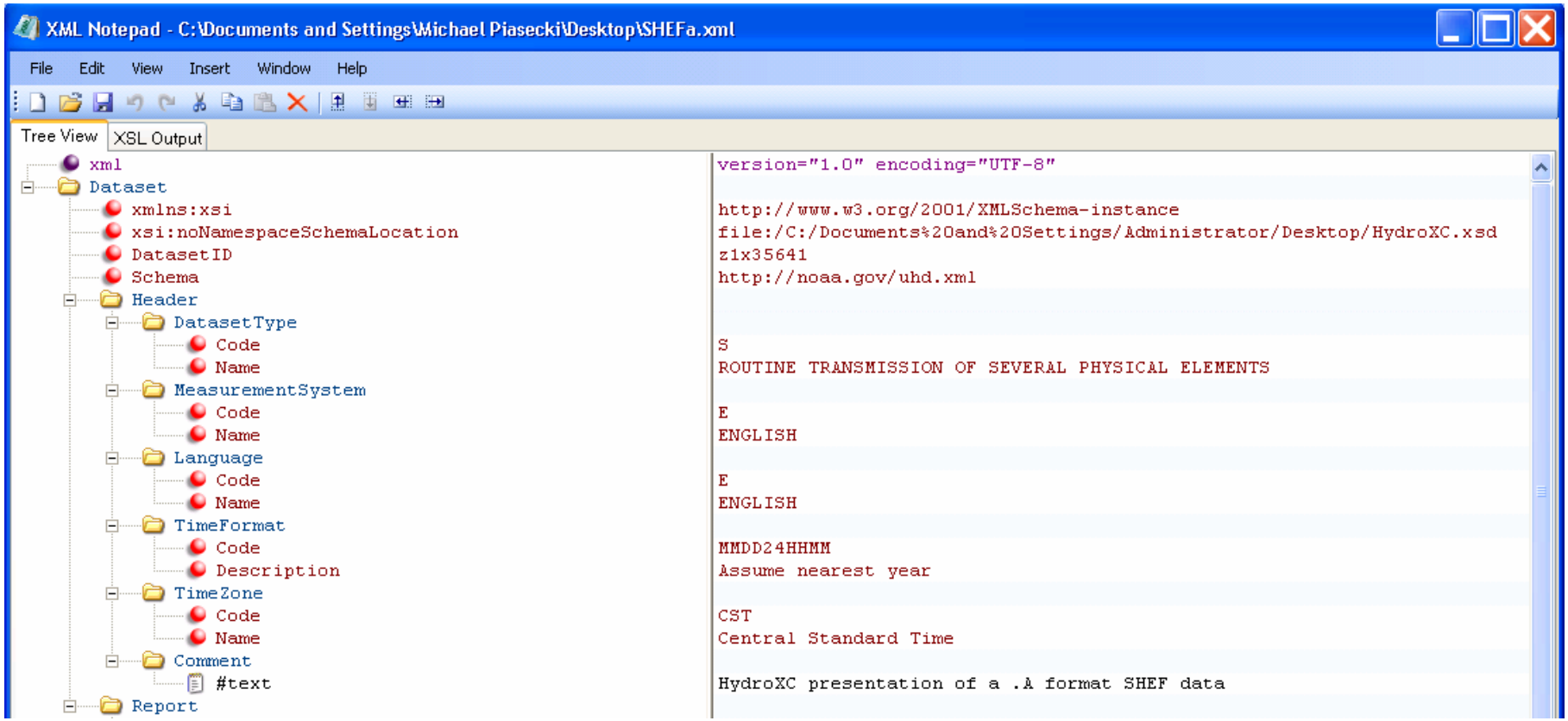
ANSI Geographic Information Framework Data Content Standard

Part 6: Hydrography

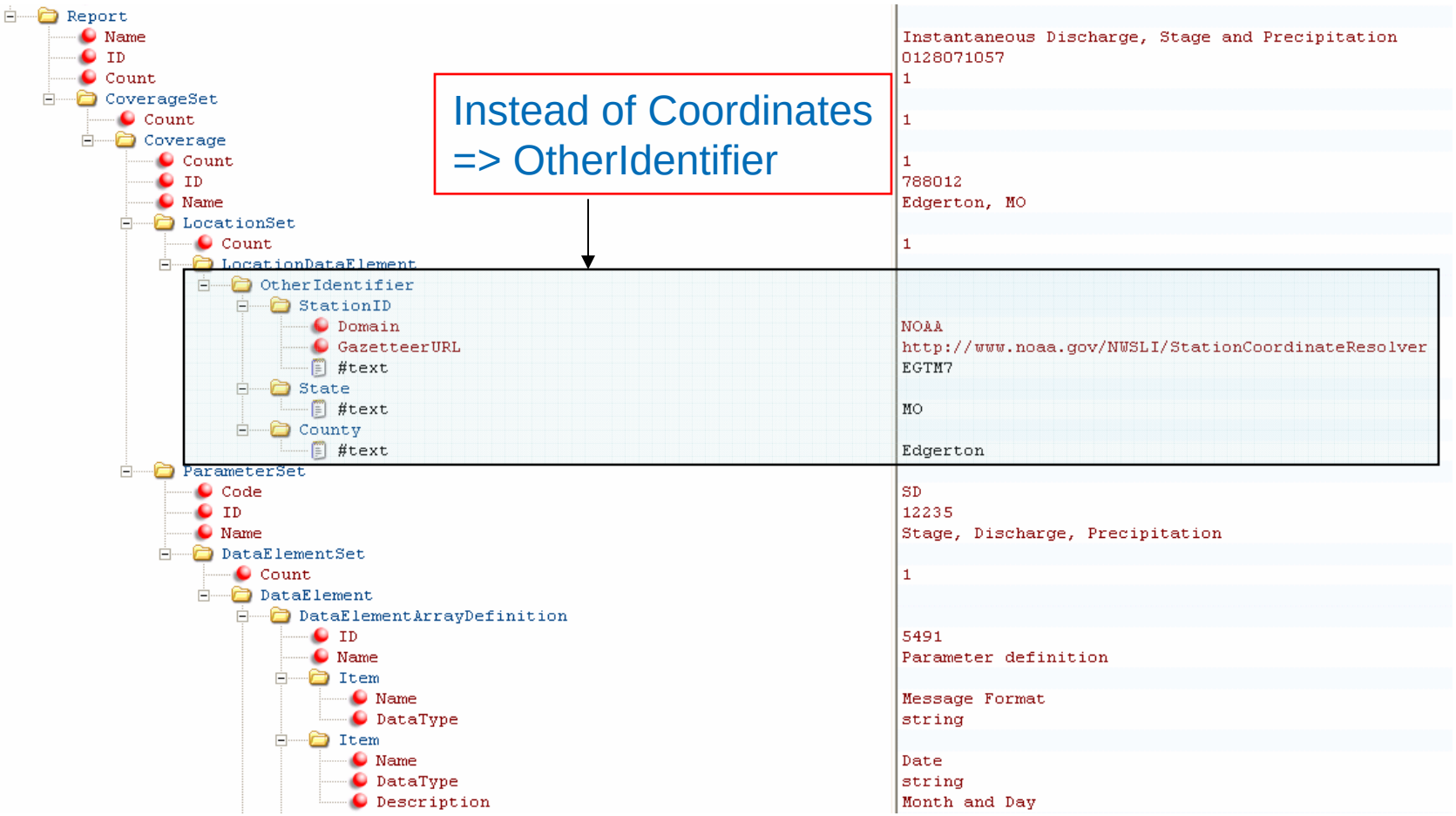
GML Application Schema (Features)

To describe HydroFeatures

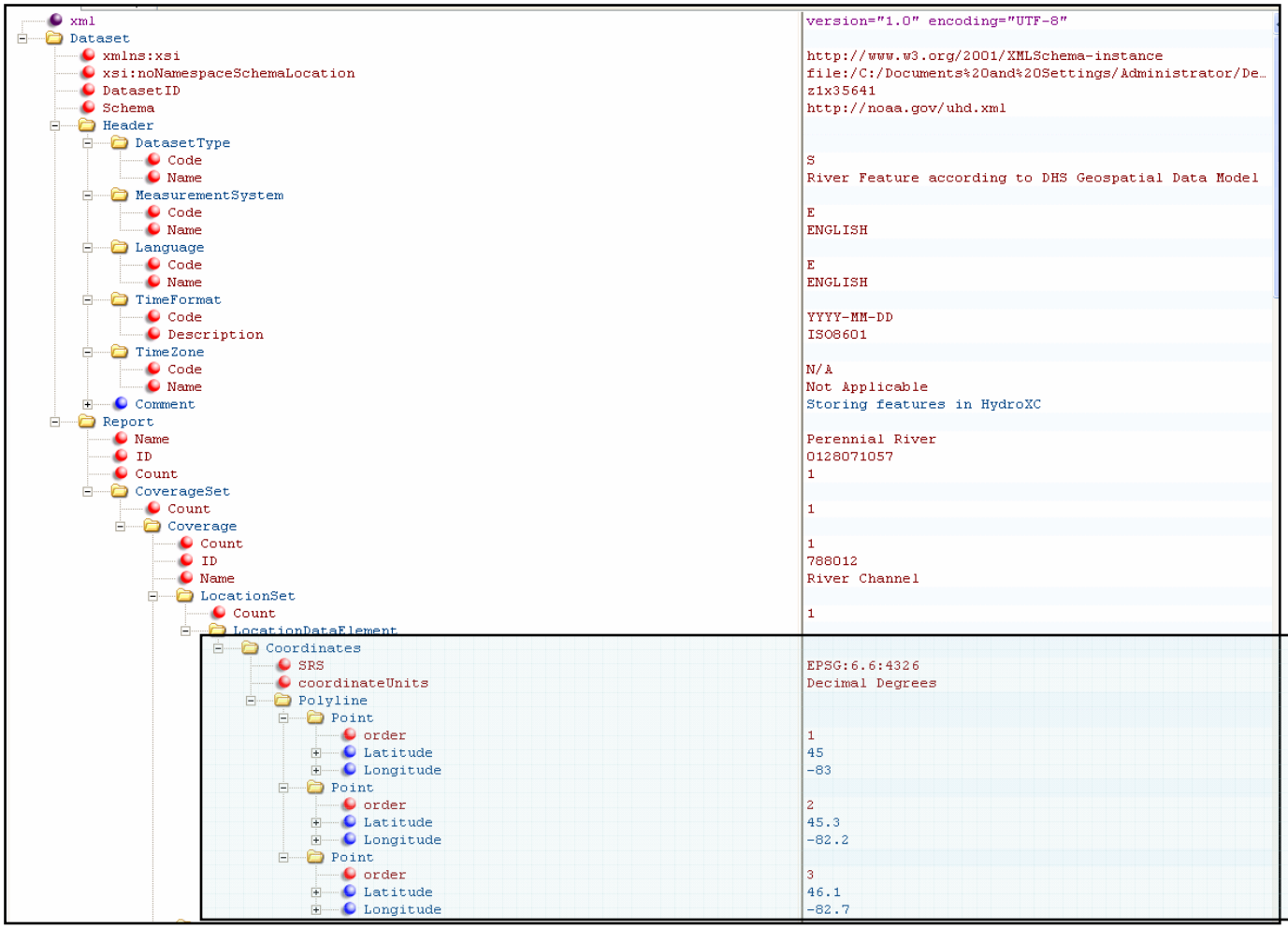
Sample Sub-Schema for SHEF



SHEF (cont)

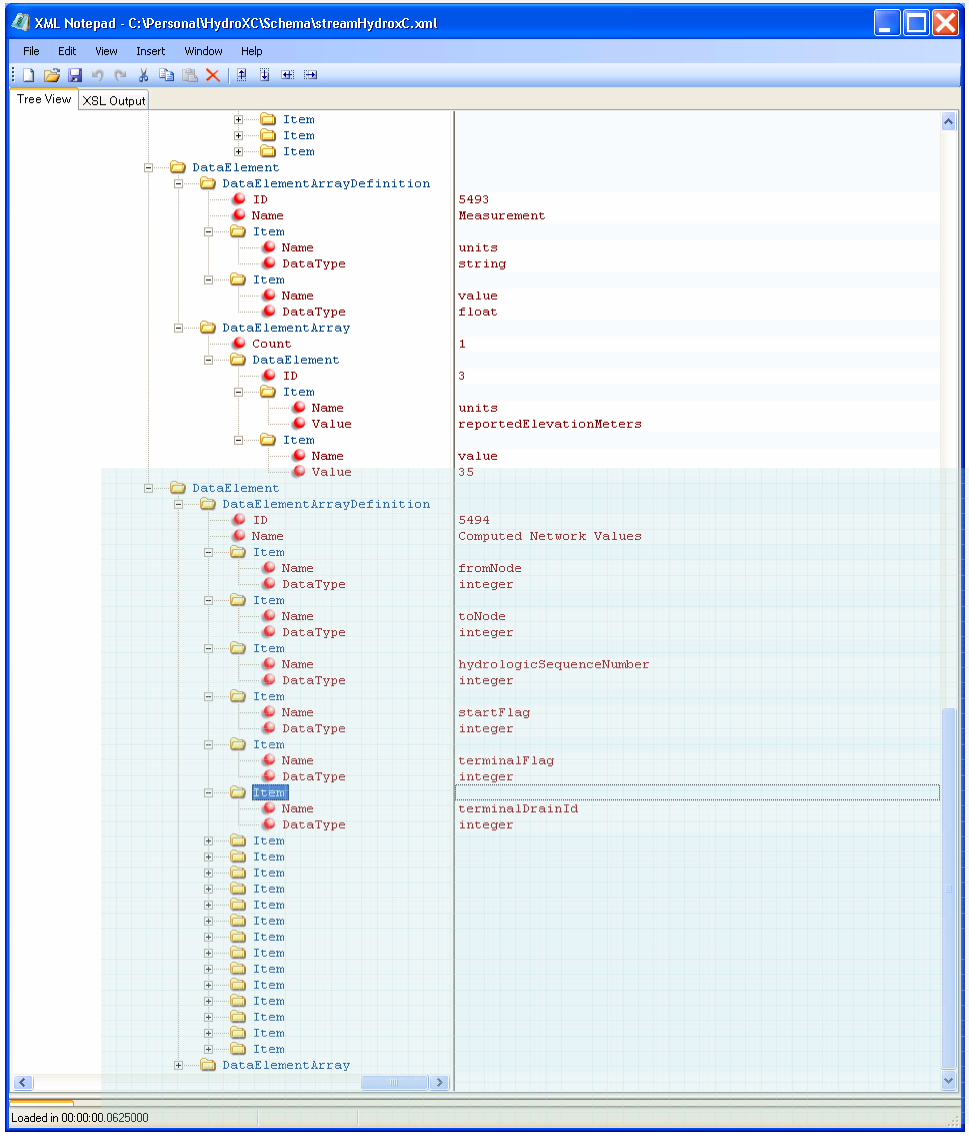

Instead of Coordinates
=> OtherIdentifier
Report
Instantaneous Discharge, Stage and Precipitation
Name
ID
0128071057
Count
1
CoverageSet
Count
1
Coverage
Count
1
ID
788012
Name
Edgerton, MO
LocationSet
Count
1
LocationDataElement
OtherIdentifier
StationID
Domain
NOAA
GazetteerURL
http://www.noaa.gov/NWSLI/StationCoordinateResolver
#text
EGTM7
State
#text
MO
County
#text
Edgerton
ParameterSet
Code
SD
ID
12235
Name
Stage, Discharge, Precipitation
DataElementSet
Count
1
DataElement
DataElementArrayDefinition
ID
5491
Name
Parameter definition
Item
Name
Message Format
DataType
string
Item
Name
Date
DataType
string
Description
Month and Day

Sample Sub-Schema for StreamReach



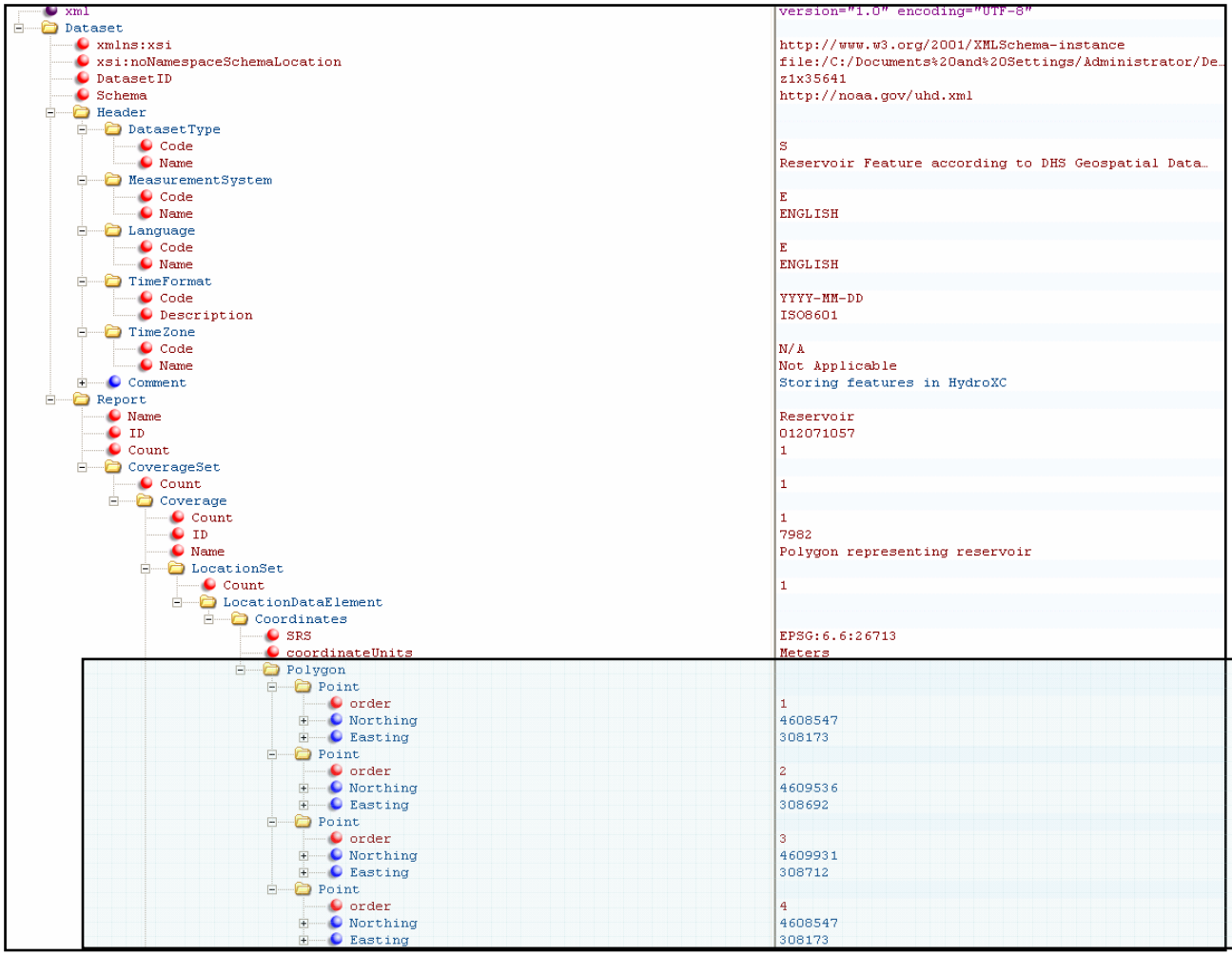
Lat/Lon ordered

StreamReach (cont)



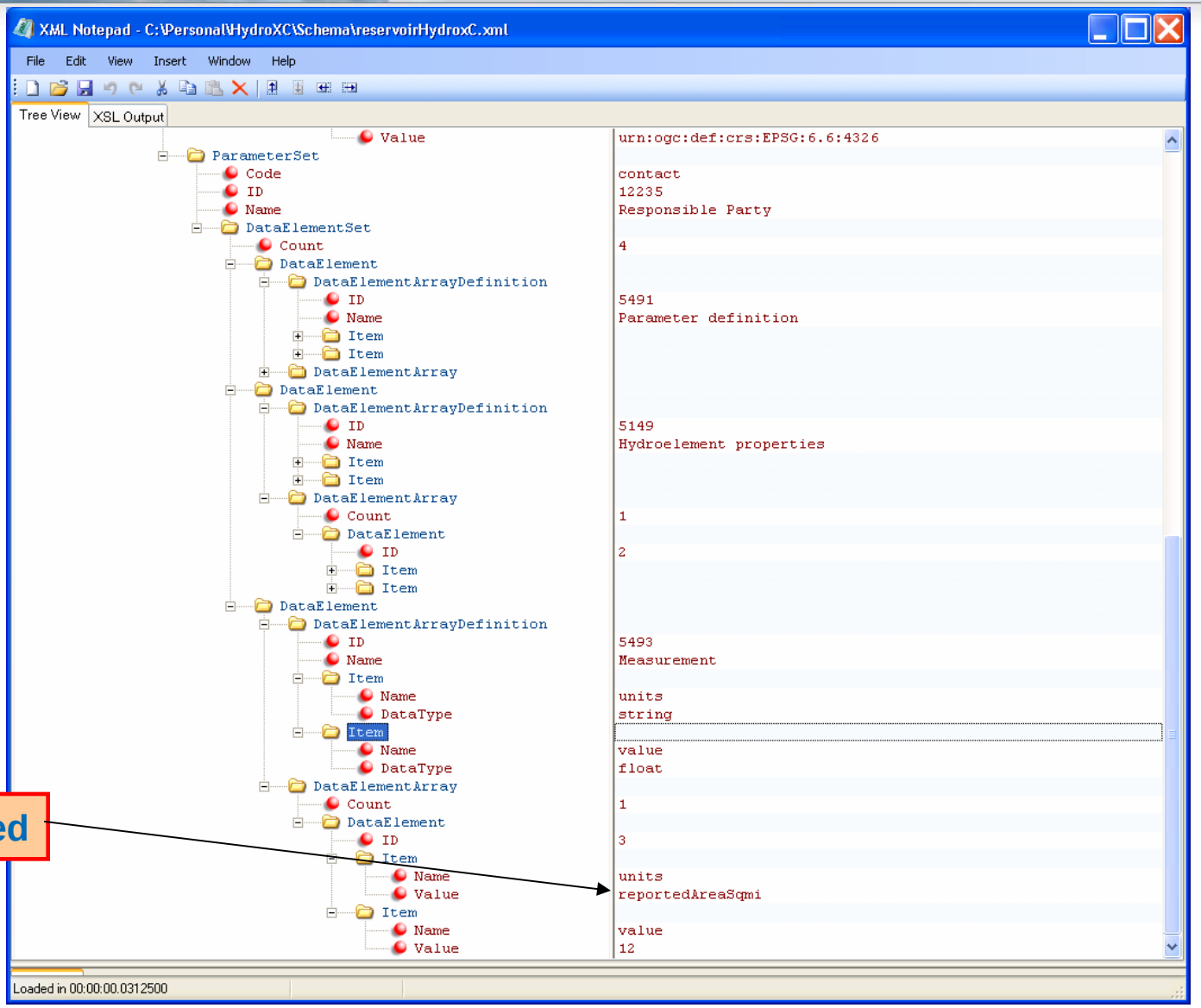
NHD elements

Sample Sub-Schema for Reservoir



UTM ordered

Reservoir (cont)

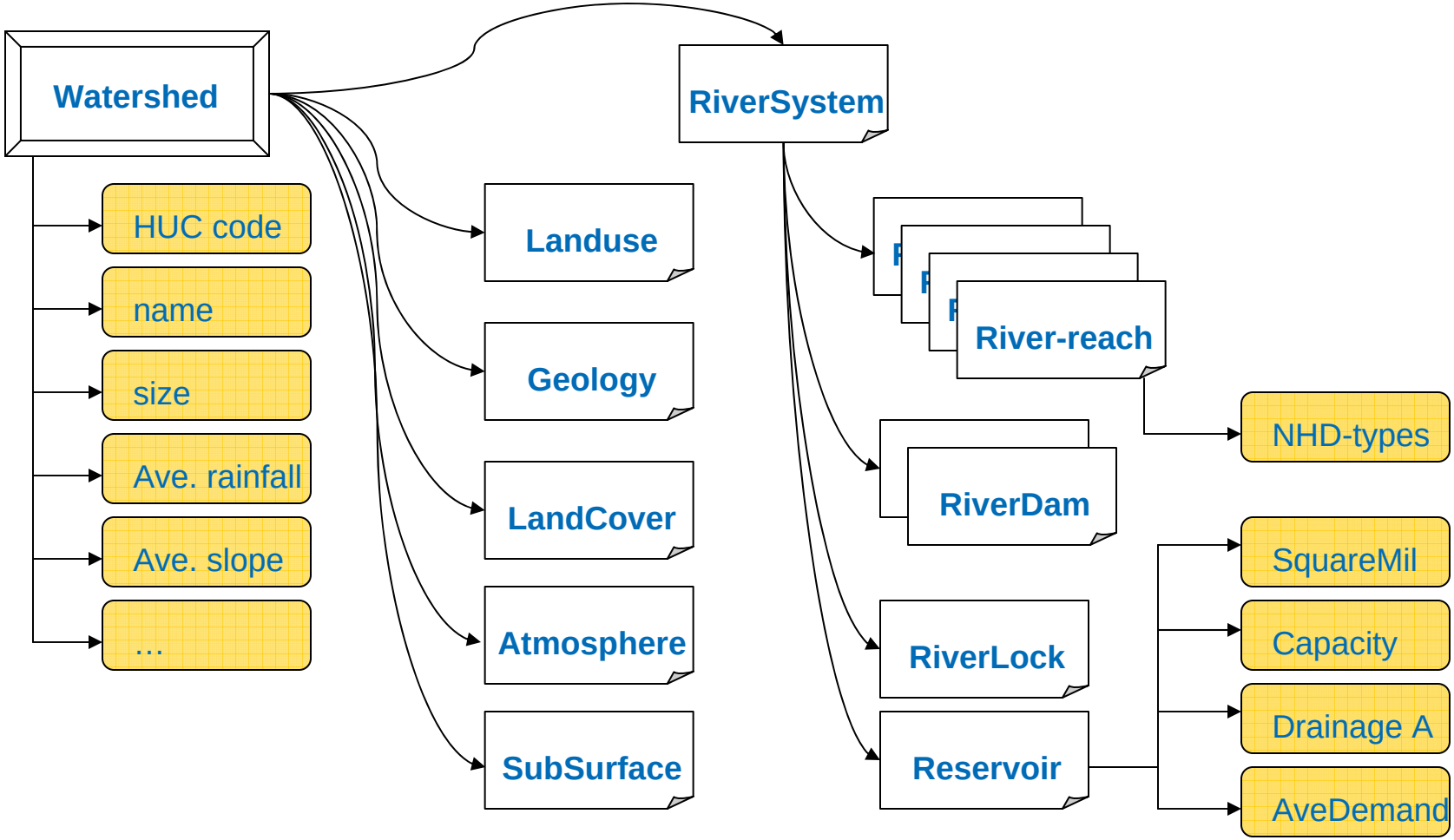


Only attribute recorded

Next Steps: Sub-schemas

- HydroObjects
  - Need to take a look at the GML based features, and possibly expand the descriptive scope (see Reservoir). Also, possible creation of new objects, like a WaterShed object, or a geoVolume object.
  - Need to develop a framework such that hydro-objects can be linked in the context of a digital watershed (DW) representation.
  - This may need to culminate in the development of a formal representation of a digital watershed and how hydro-objects can aid in forming a DW.
  - Next on the list: Watershed
    - quite complex because it is one of the fundamental core objects that need to be described.

Next Steps: Sub-schemas (cont.)
Thoughts on Future HydroObjects Framework



Next Steps: Data Adapters and Website

- Data Adapters
  - Creation of first example data adapter to translate HydroXC and SHEF formats
  - Will highlight in next workshop meeting
- Website
  - Launches at end of March at www.hydroxc.org

Open Discussion

- Thank you!