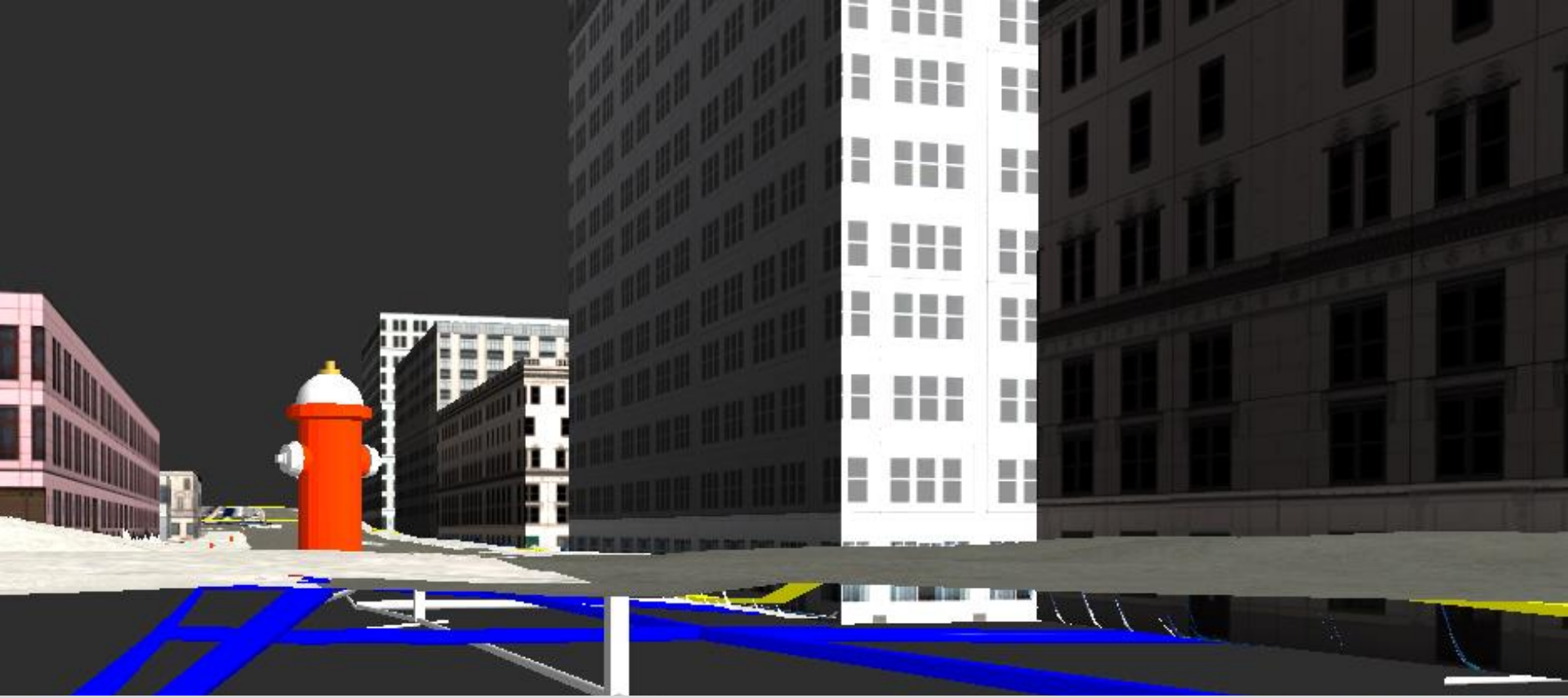

NYC 3D Underground Pilot and OGC MUDDI

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Overview

1. 3D Underground Project
   - Overview of 3D Underground POC
   - Agency Provided Data
   - Data Transformations
   - Lessons Learned

2. MUDDI
   - Approach
   - Identified Gaps
   - Demo
   - Next Steps

NYC Underground Data

- Decentralized data sources managed by city agencies, state authorities, and private utility companies
- Security concerns among data owners
- Strong business needs for mapping underground infrastructure

The Network of Pipes Under Manhattan's Streets

3D Underground Project

Mayor's Office of Operations contracted with DoITT to develop POC model using select City agency datasets.

Primary Goals:

1. Develop technical relationships with data providers
2. Understand city's ability to integrate underground infrastructure data
3. Identify opportunities for enhancing quality of underground data

Testbed 1 focused on providing a comprehensive underground information earlier in the project delivery process

NYC Agency Data

Dataset	Agency	Format
Water and Sewer Networks	Department of Environmental Protection	2D Feature Class
Telecommunications	Department of Information Technology and Telecommunications	3D Feature Class
Boreholes	Department of Buildings and Department of Design and Construction	PDF
Surveys/As-Builts	Department of Design and Construction	DWG, PDF, CAD
Potholes/Street Assessments	Department of Transportation	2D Feature Class

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NYC Agency Data

- Excluded sensitive data
- Unknown data quality for some features
- Created as 2D networks with Z attribute information, not 3D geometries
- Missing dimensions and Z values
- Varying data formats
- New York City coordinate reference systems
- No standard established for similar features from different agencies (ie Boreholes)

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Supplemental Data

Dataset	Purpose
2010 DEM	Used for interpolating 3D geometries as given depth below surface
Cyclomedia LiDAR	Reference for 3D scene. May be used for evaluating horizontal accuracy of surface features in model (hydrants, catchbasins, manholes)
2016 Orthoimagery	Reference for 3D scene
3D Buildings	Reference for 3D scene
Planimetrics	Roadbed, Street Centerline, Sidewalks, and Curb lines

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Supplemental Data

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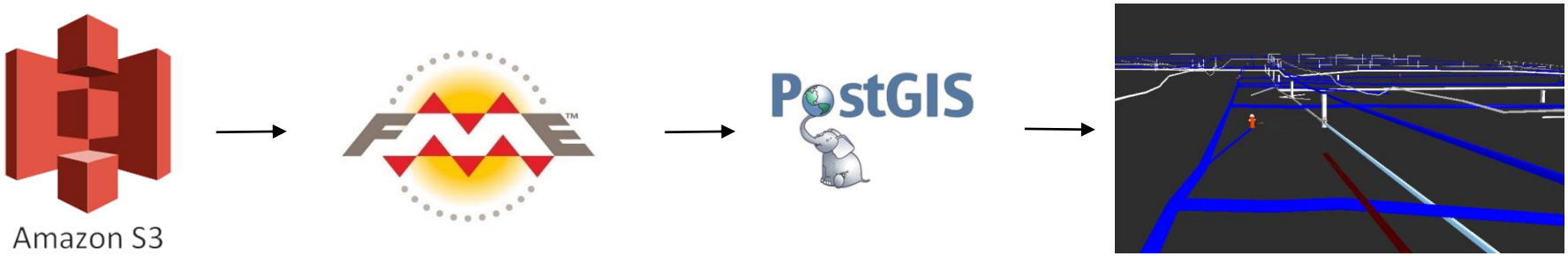
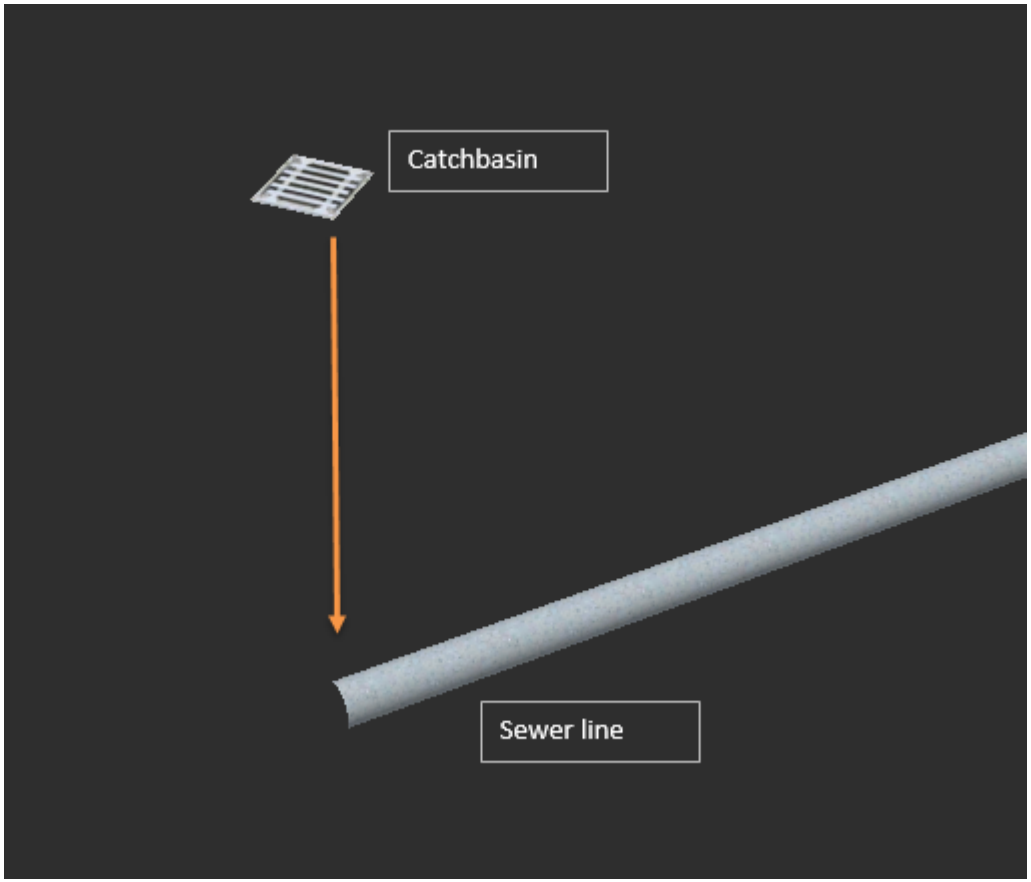
Data Transformations



1. Clean and standardize agency provided data
   - Ensure consistent unit measurements for 2D mapping
   - Reproject data as needed
   - Text/numeric/date field standardization
2. Transform 2D features to 3D geometries
   - Utilize attribute information for 3D geometry creation
   - Assumptions on data connections where needed
3. Write to PostGIS database
4. Visualize in 3D environment

Data Transformations



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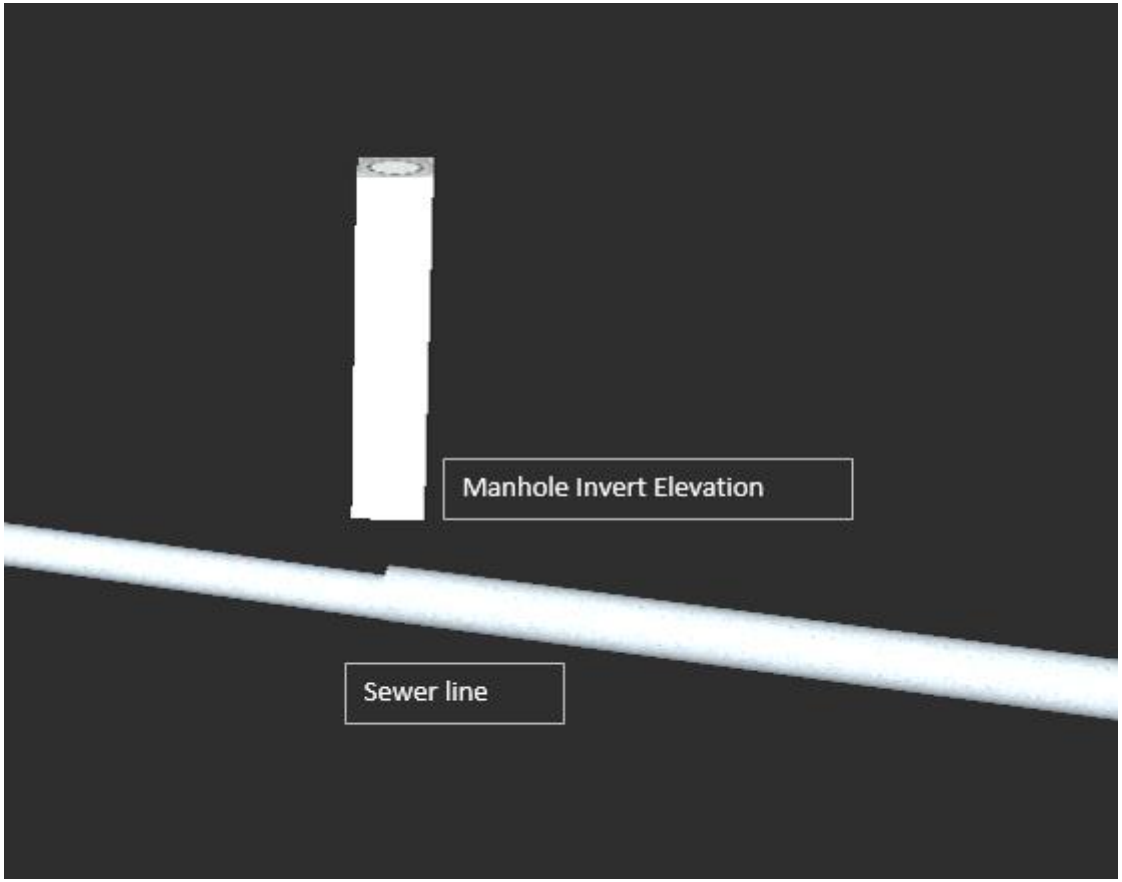
Data Transformations



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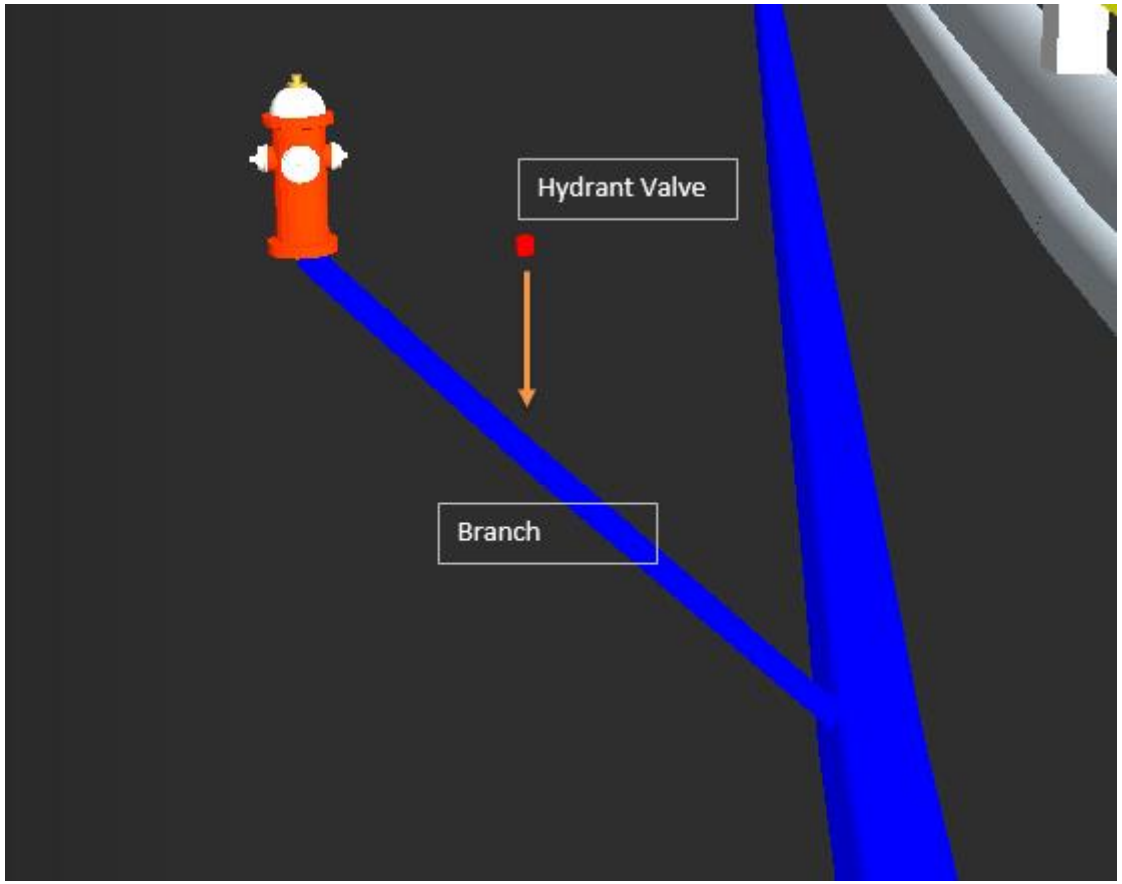
Data Transformations



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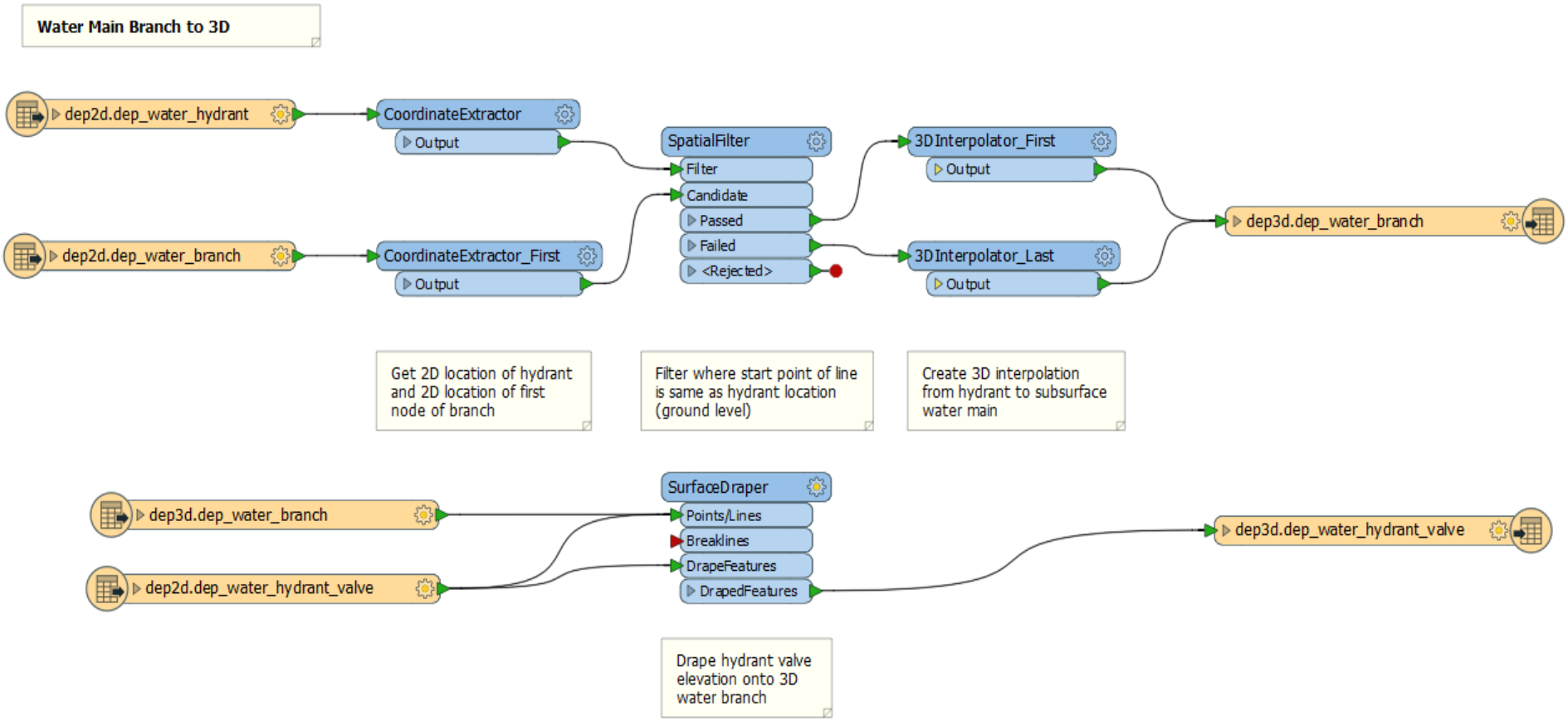
Data Transformations



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3DUp Lessons Learned

1. Data domain owners need to be involved in implementation of underground model

2. Standards should be established in model for data and metadata

3. Model should track changes to infrastructure. How do we maintain network topology when transforming 2D geometries?

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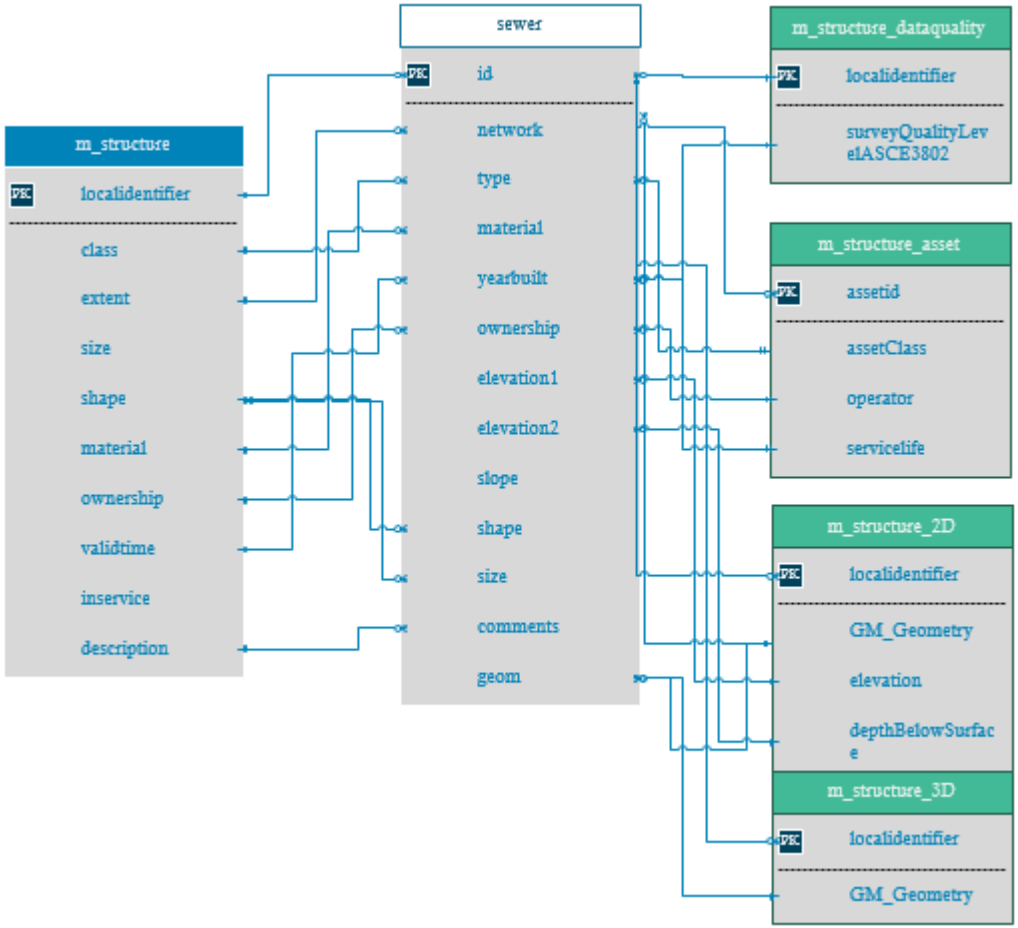
MUDDI Approach

Agency Dataset	Network	Elements	Interfaces
Catchbasin	Sewer	Structure NetworkObject: NetworkNode	IAsset IDataQuality IRendered
Connections	Sewer	Structure NetworkObject: NetworkNode	IAsset I2D IDataQuality
Manhole	Sewer	Structure ContainerObject: Access	IAsset I2D IDataQuality IRendered
Outfalls	Sewer	Structure NetworkObject: NetworkNode	IAsset IDataQuality
Sewer	Sewer	Structure NetworkObject: NetworkLink	IAsset IDataQuality I2D
Sewer Structure	Sewer	Structure NetworkObject: NetworkNode	IAsset IDataQuality I2D

MUDDI Approach

MUDDI element | Source data* | MUDDI interfaces



1. Map source data to MUDDI element and interface tables

2. Perform transformations to populate MUDDI model

3. Identify potential gaps in model

**some attribute names have been excluded/modified*

MUDDI Enhancements

Element/Interface	Attribute	Purpose
I2D	Rotation	Degree rotation of object used in mapping applications
IAsset	Height/Width	Account for structures with multiple size attributes
IAsset	Unit	Unit of measurement of size attributes
IDataQuality	last edit last edited by	Documentation for last time feature was edited
ISurveyed or IAsset	ContractNo	Would serve as a lookup resource for source information
ISurveyed or IAsset	SurveyLink	Would serve as a lookup resource for source information
ISurveyed	Date	Specifically for survey data such as boreholes

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Next Steps

Refine MUDDI Implementation

- Soil cores for borehole data (need more samples)
- Map remaining elements to MUDDI

Review and test model with City data editors

- Identify additional gaps or requirements for model
- What methods can be used to classify data quality for ASCE in MUDDI
- Review Network and IGraph implementation with subject matter experts
- Standardize metadata collection
- How do we ensure that data becomes more accurate over time?
- How to maintain network links during editing?
- How do we implement a process to track changes while also maintaining original topology of the network model?

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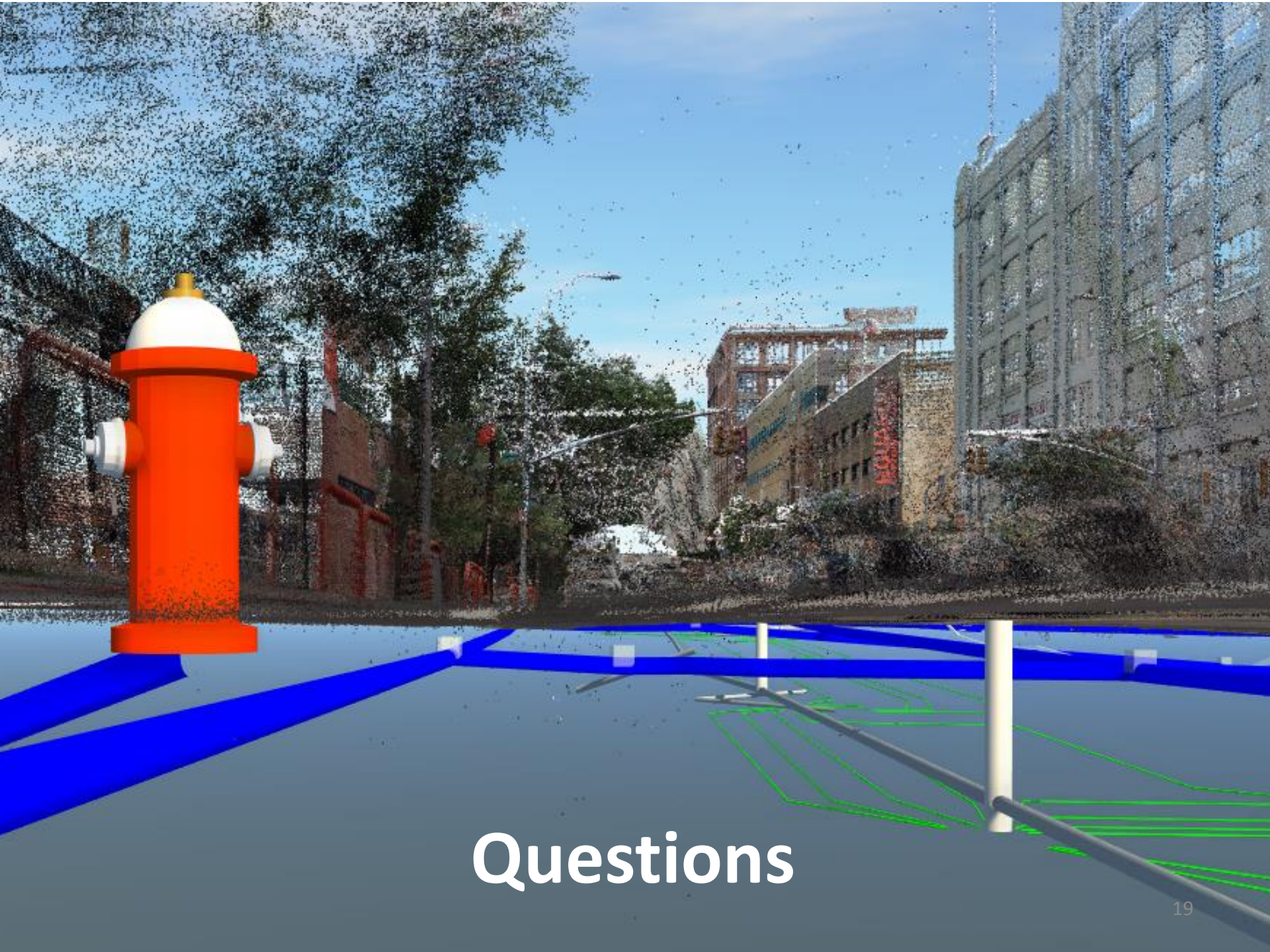
Questions