UNUM & UrbanARK Update

Dr. Debra F. Laefer
New York Univ.

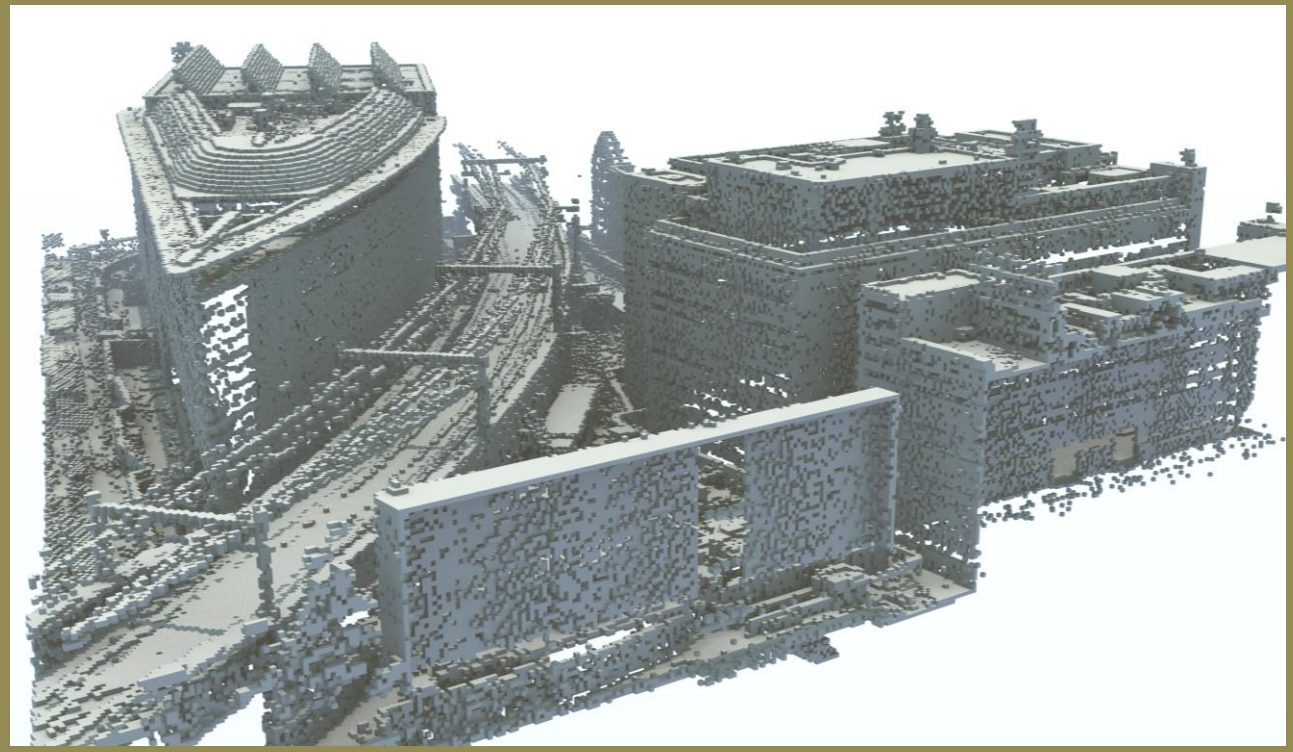
- 2022?
- 2012?
- 2002?
- 1992?

SWE-TRANS
www.swe-trans.com

PRET A MANGER
PRET A MANGER
PRET A MANGER
M101 via LEX AV

Today: unprecedented……

1. Robust, cheap, small, wireless sensors
2. Edge computing capabilities
3. Cloud computing availability
4. Machine learning & deep learning
5. Dense remote sensing



Yet…why not so smart?

1. **Lacking domain expertise**

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2. **Considering only half the problem**

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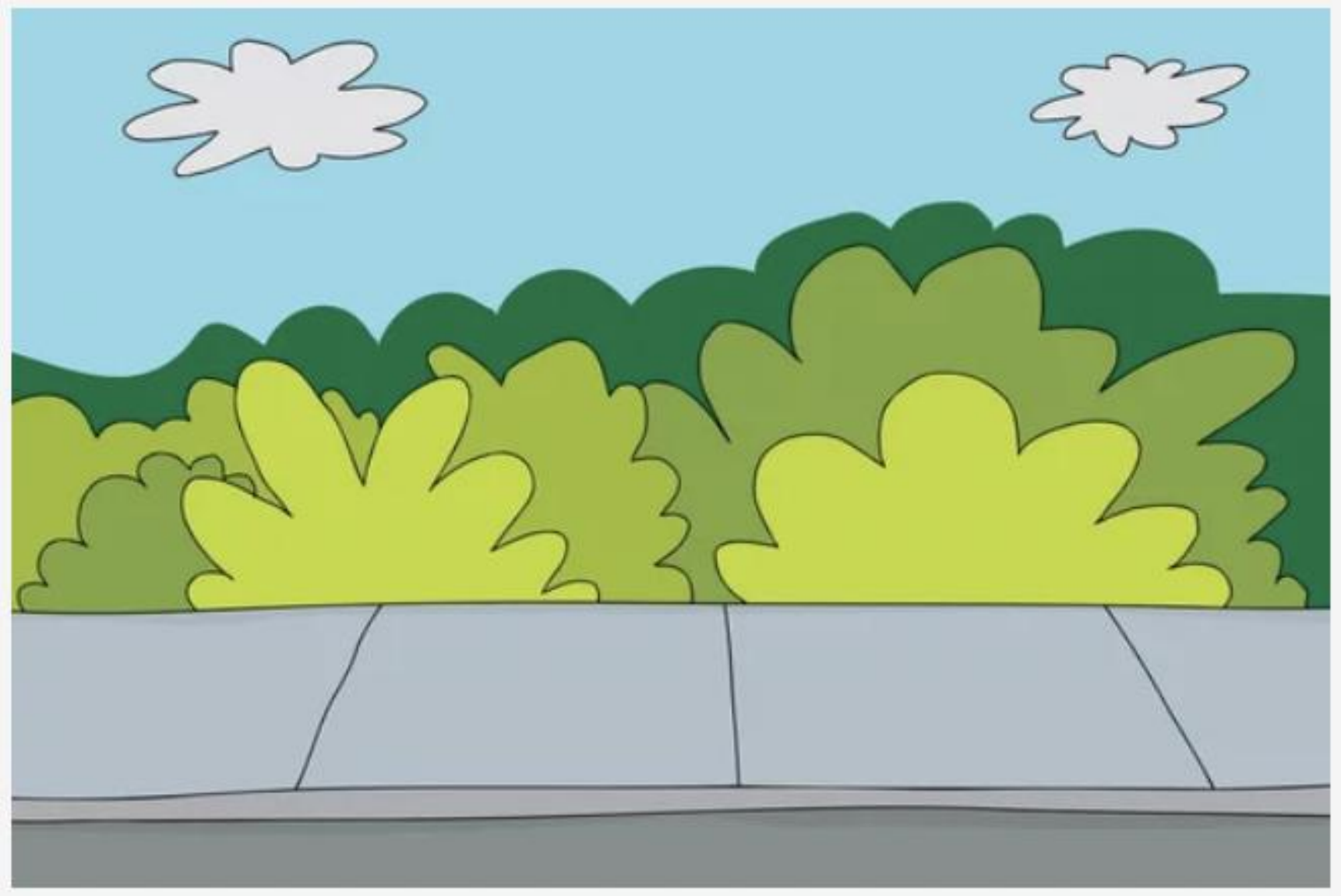
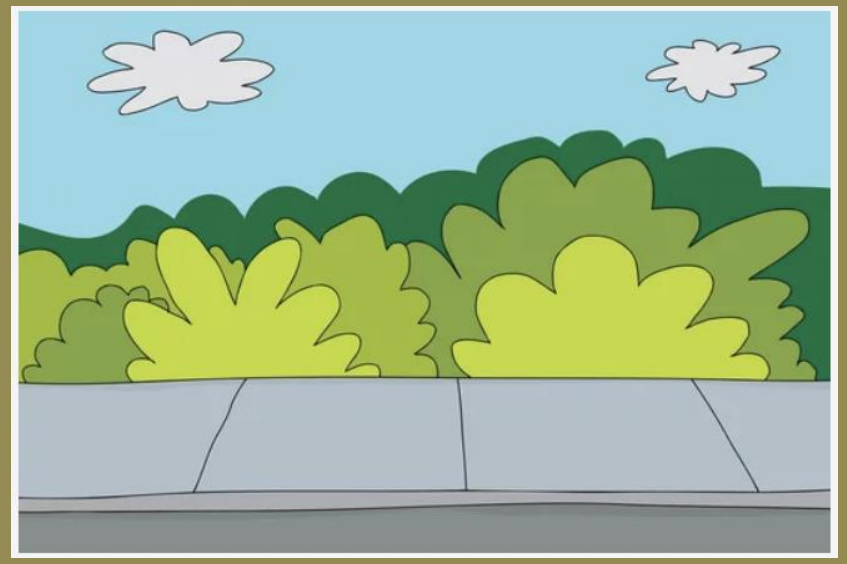
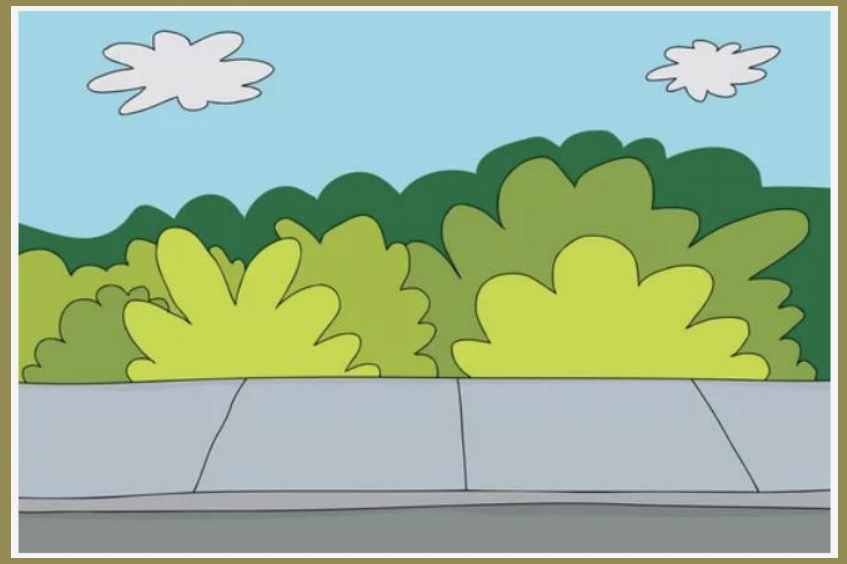
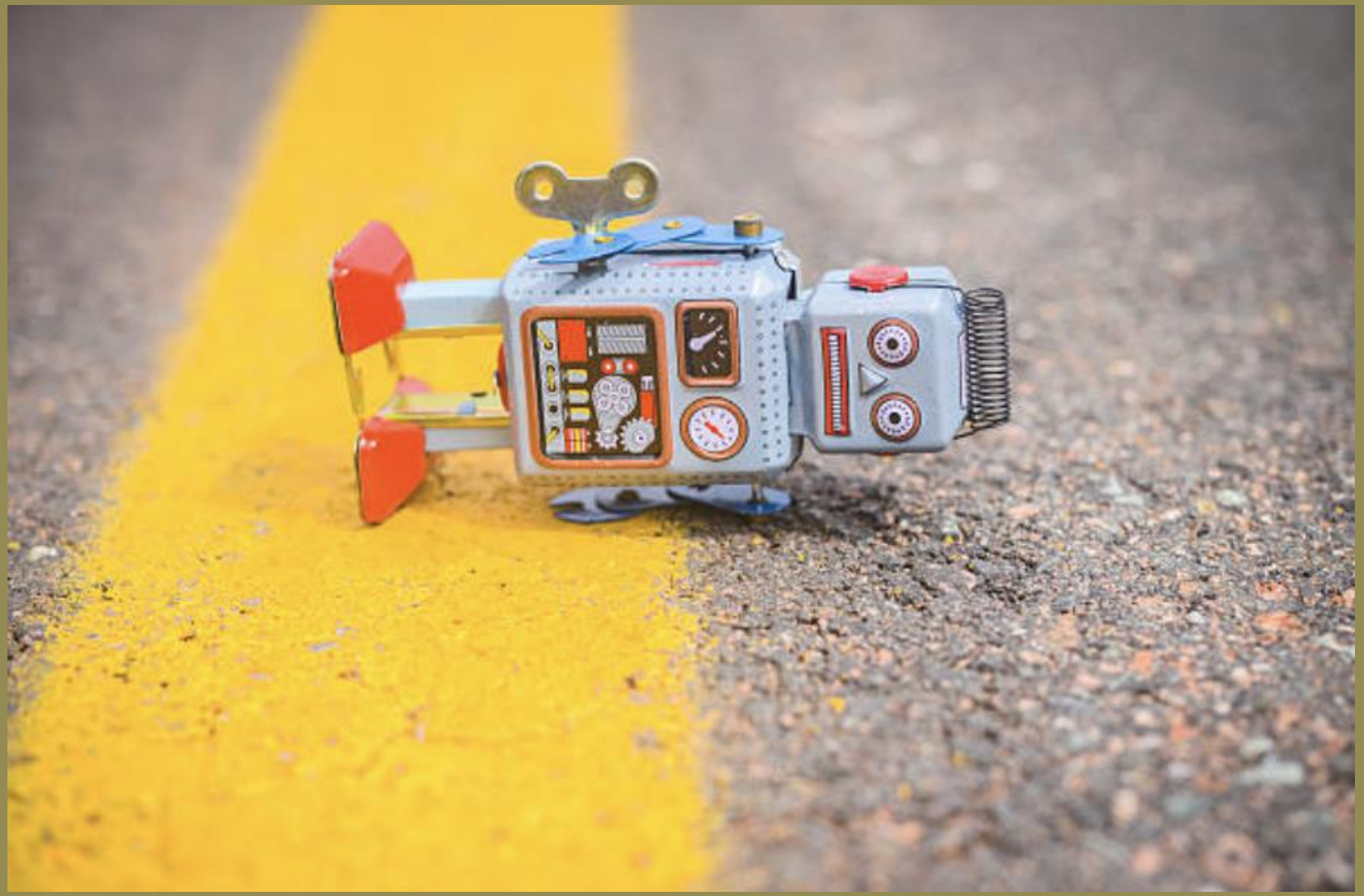
Digital twins



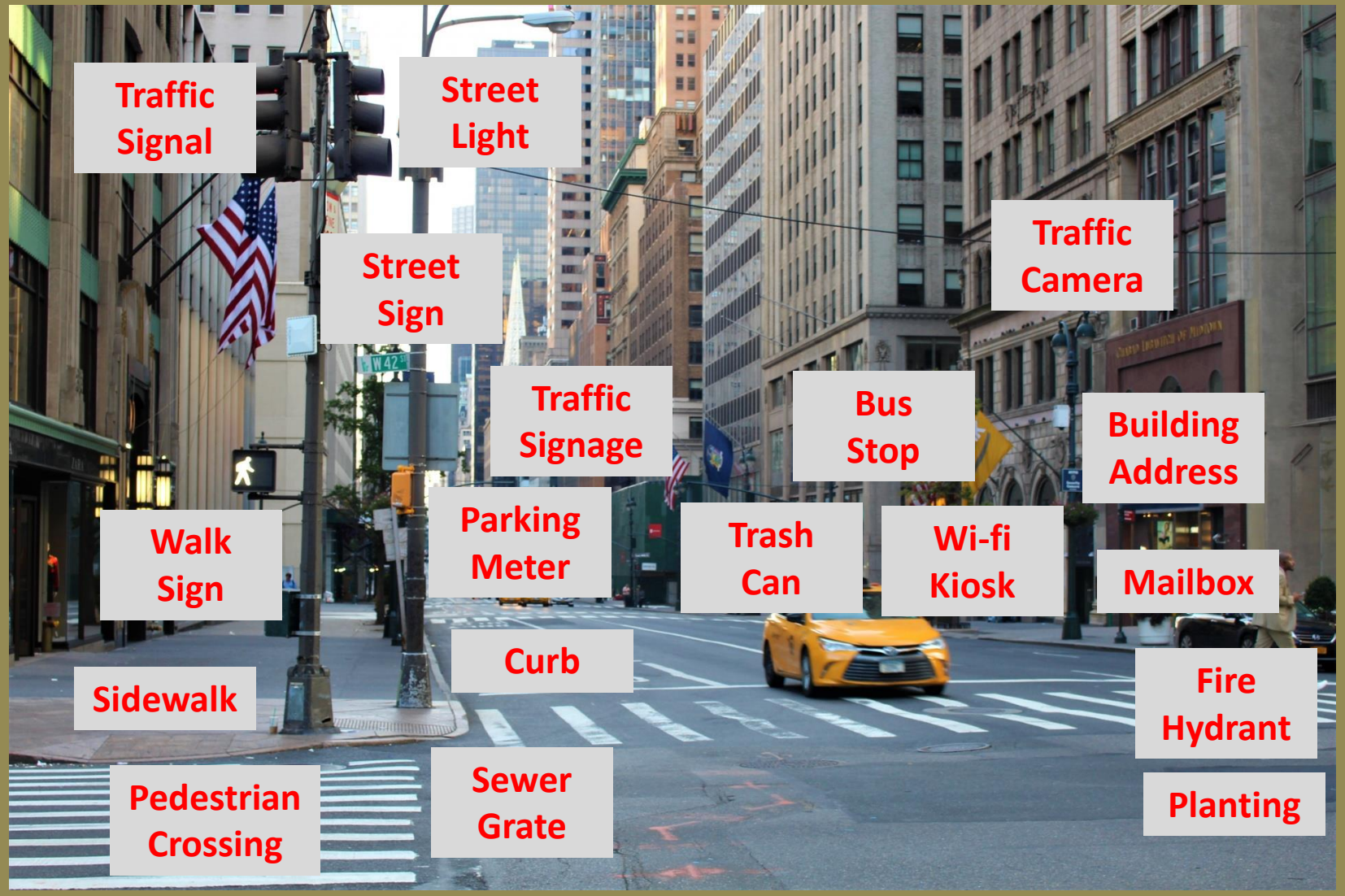




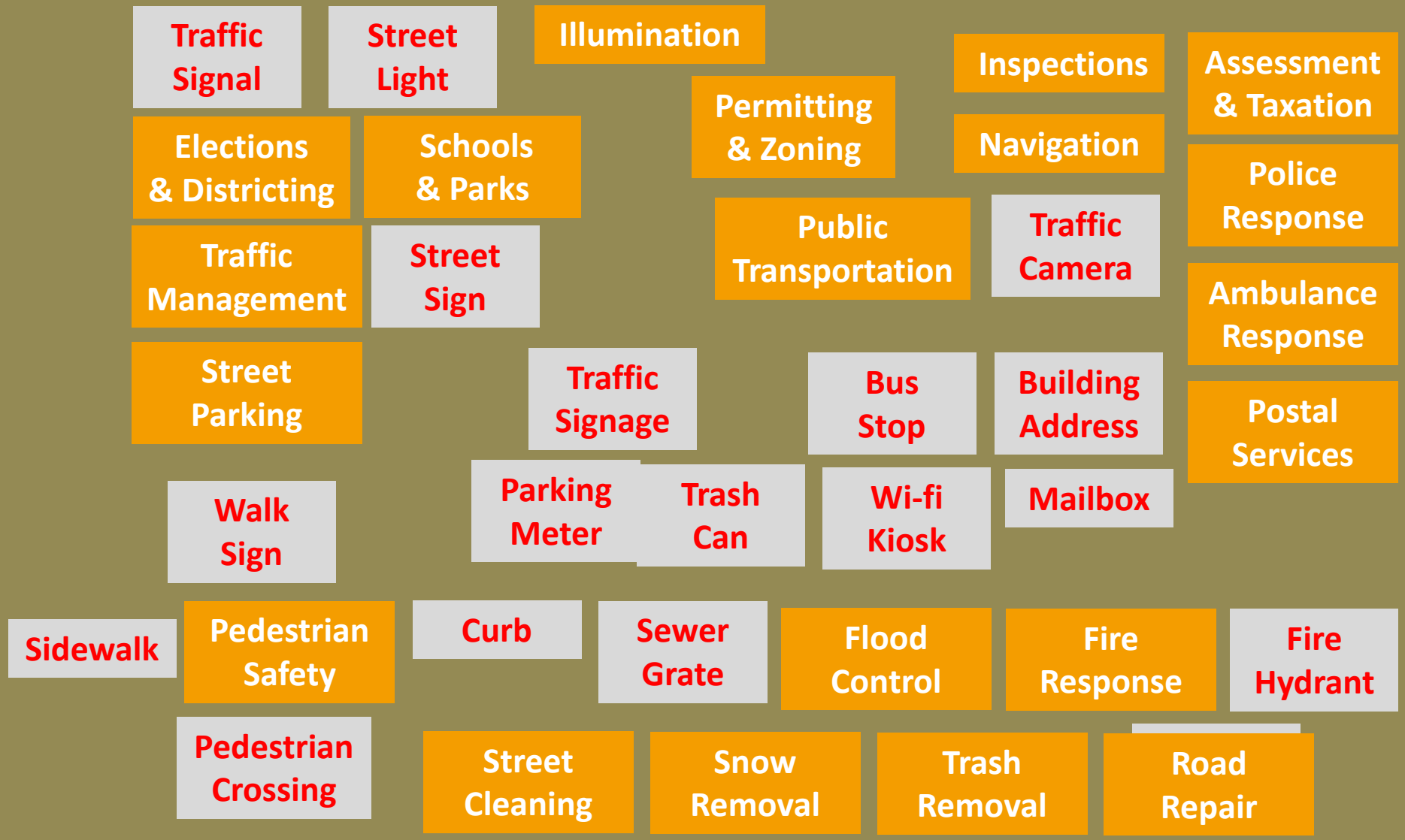


Above ground locational assumptions

Managed infrastructure



Essential services



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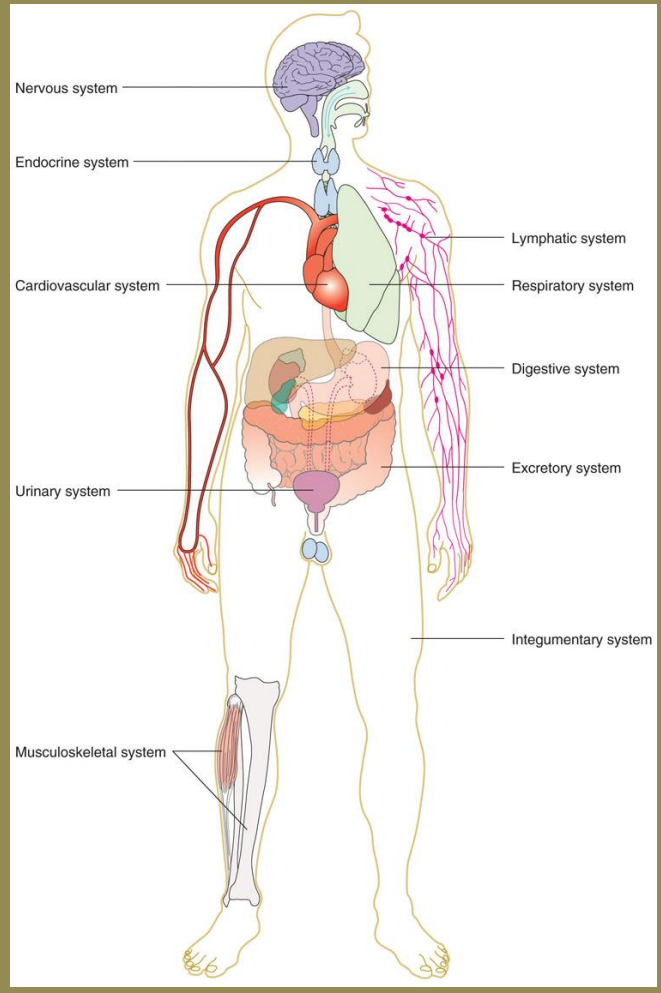

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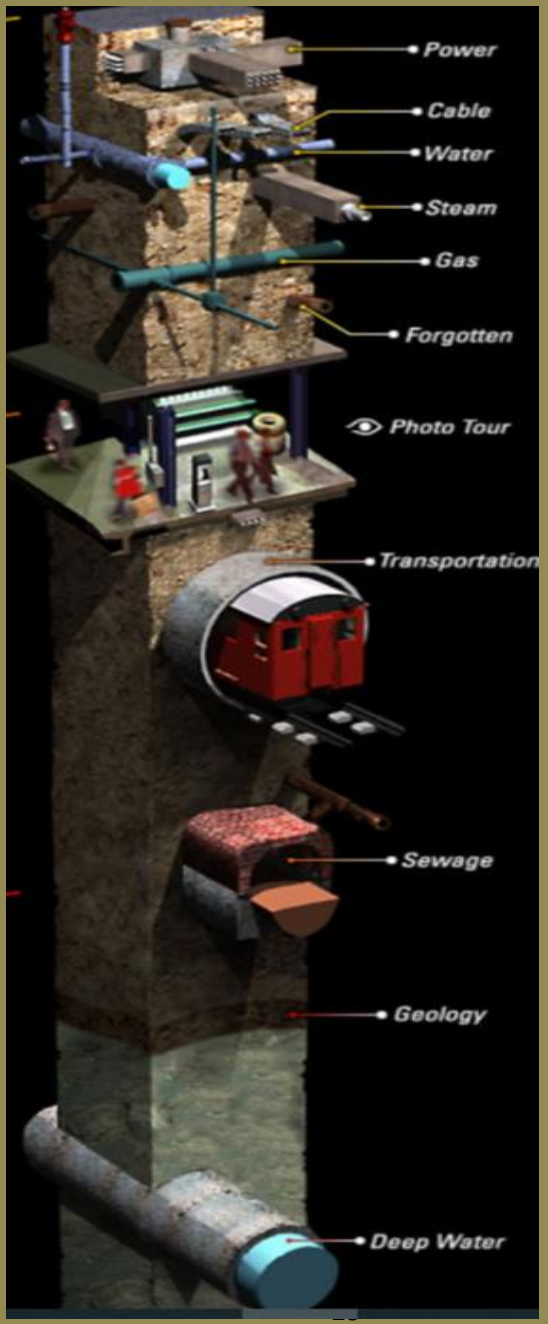
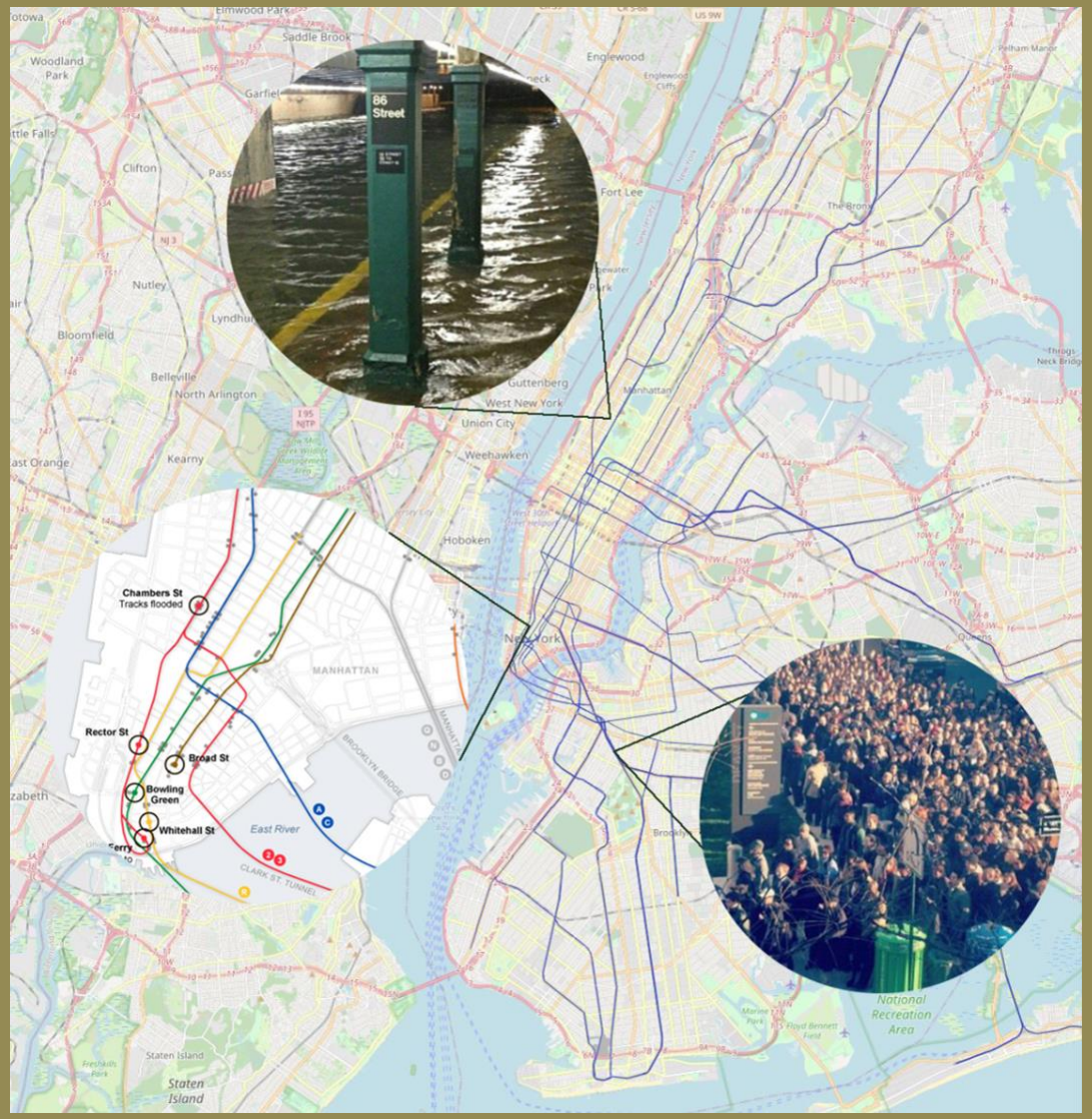


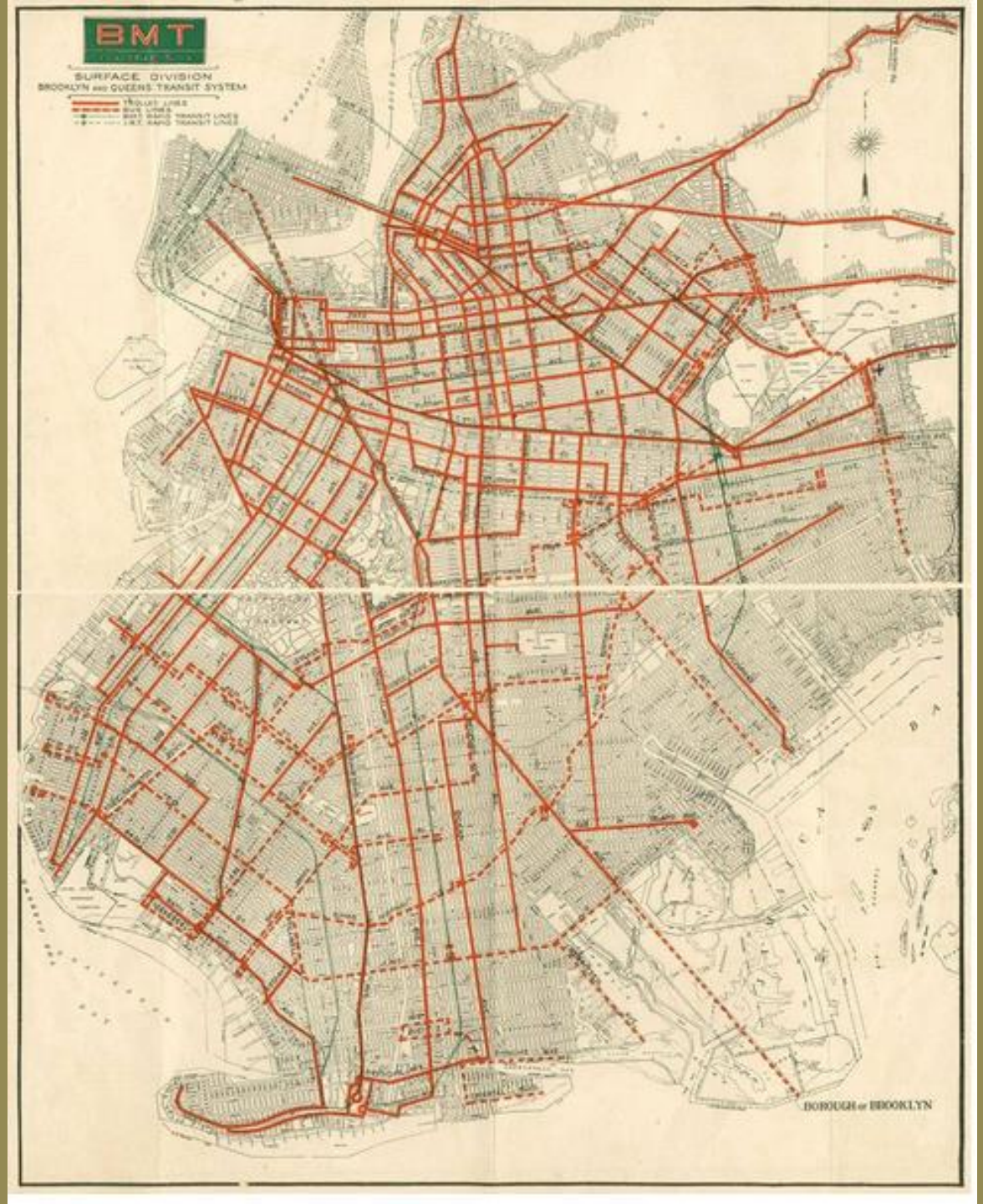
Underground utility vulnerabilities

Proximal

Spatial Extent



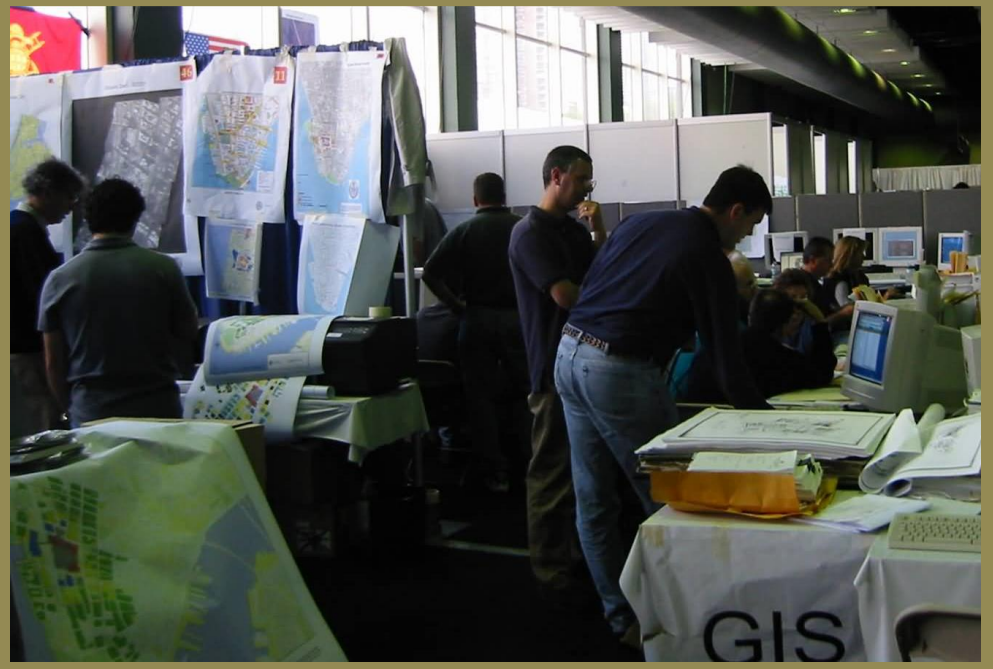
Abandoned lines



20+ Year struggle

Sep. 11 2001

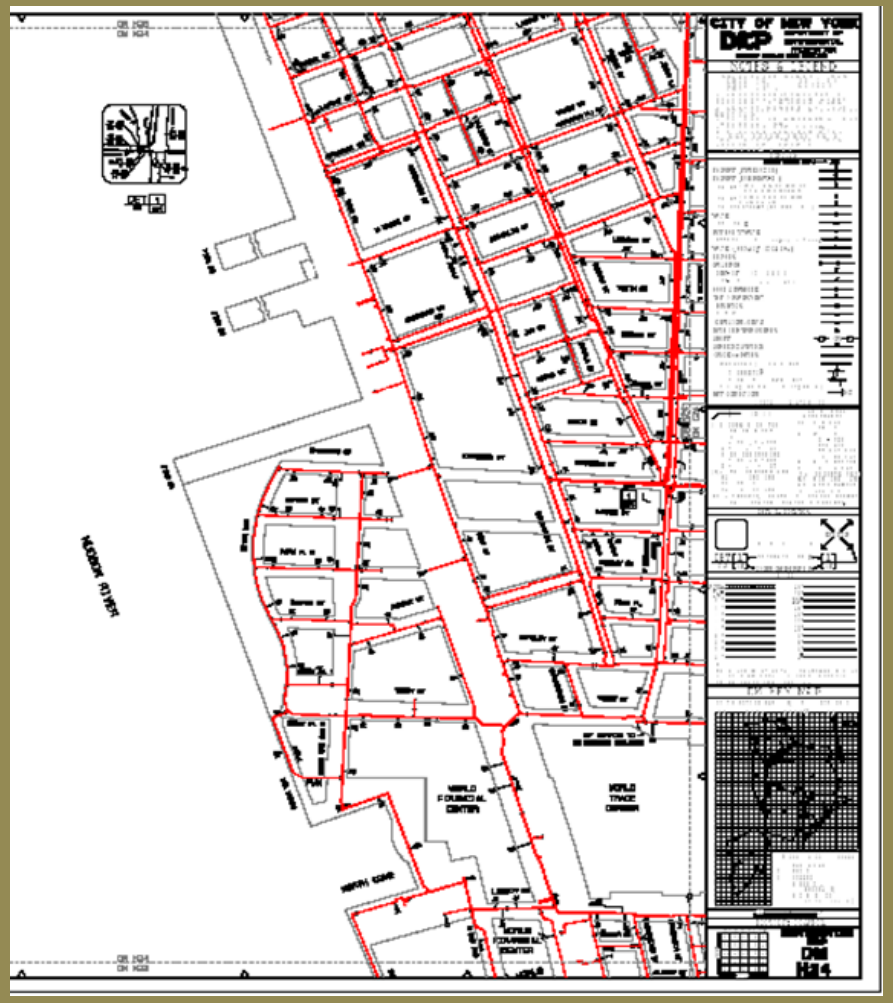
3 Weeks Later



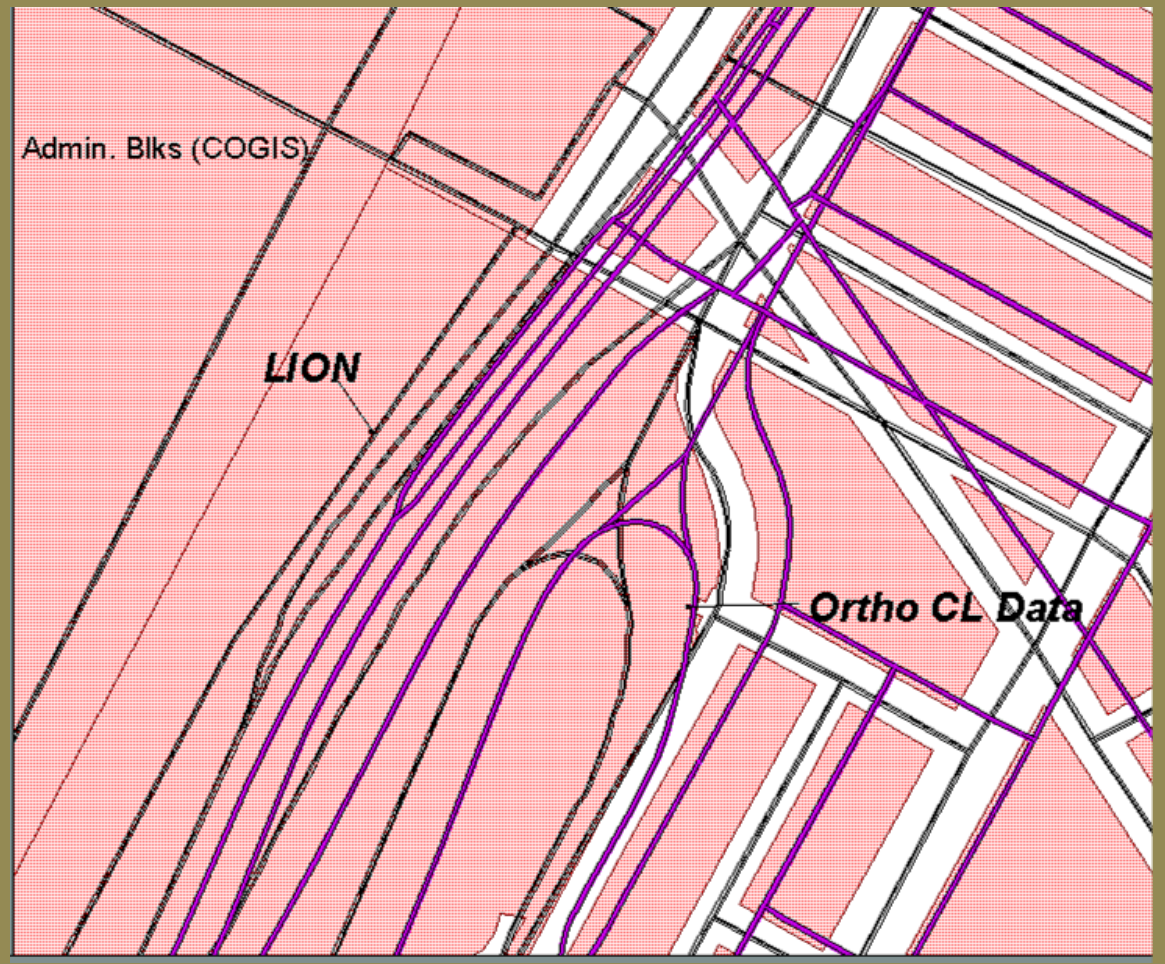
Real Threats

1990's

Multiple Incompatible NYC Digital Mapping Efforts

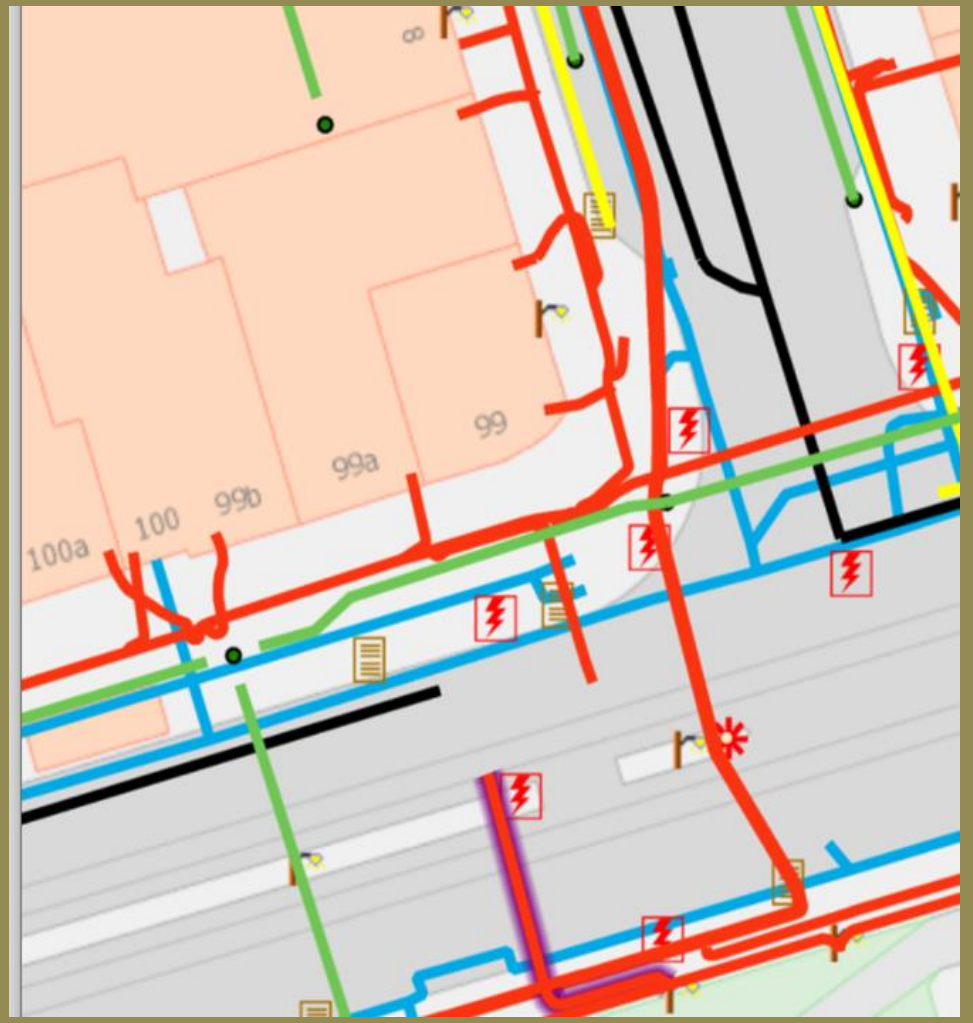


Street Centerline, Parcel Map, Water Map Did Not Align



NYC DEP: 7,000 Street Miles of Watermain Mapping, 1990

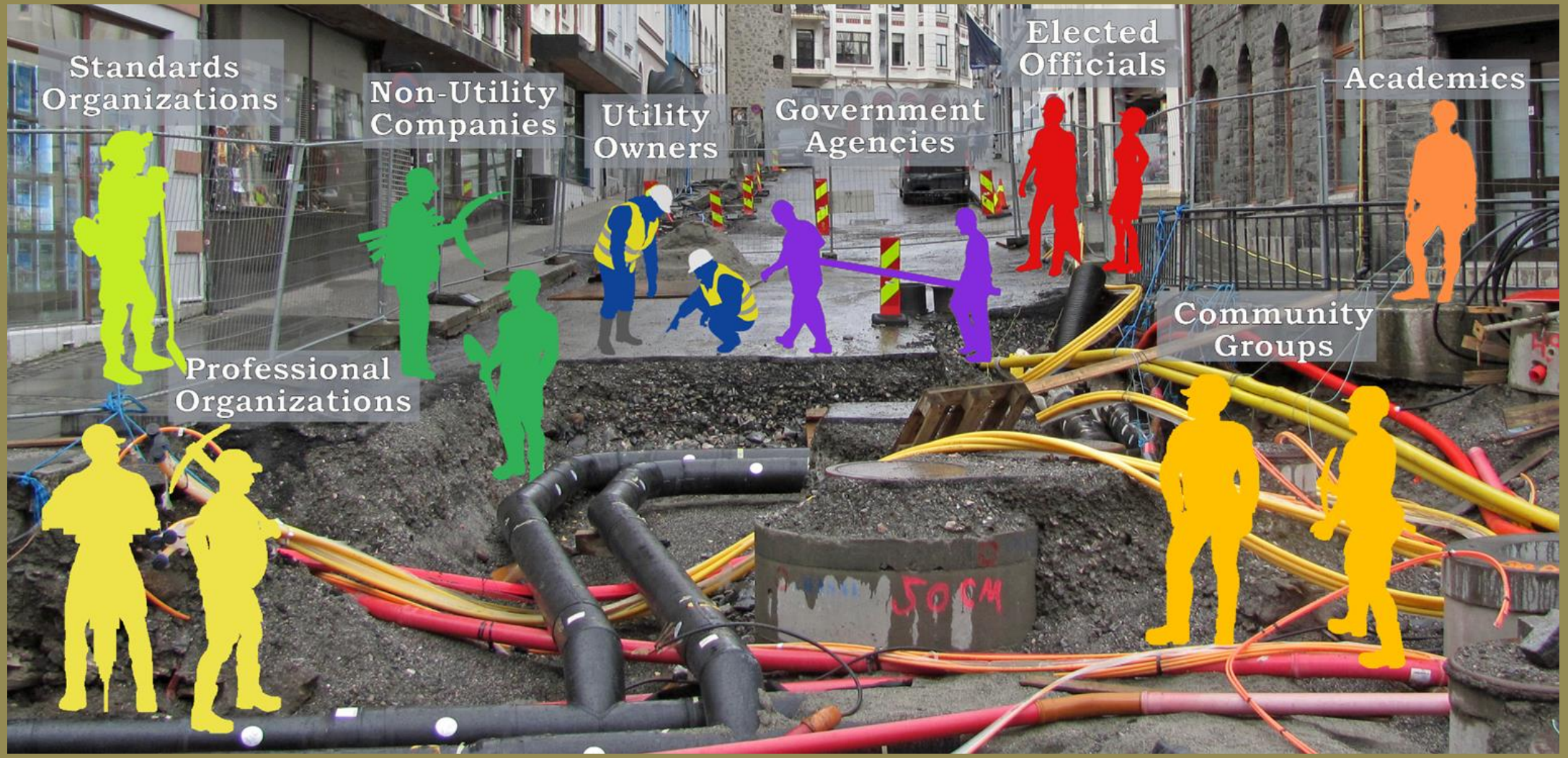
U.K., Flanders, Denmark, Netherlands



20 Year struggle

1. Dozens of data owners (private, city, & state)
2. Incomplete data
3. Undigitized data
4. Security concerns
5. Privacy concerns
6. Business concerns
7. Lack of money
8. Lack of integrated leadership

Today


Standards Organizations
Non-Utility Companies
Utility Owners
Government Agencies
Elected Officials
Academics
Professional Organizations
Community Groups

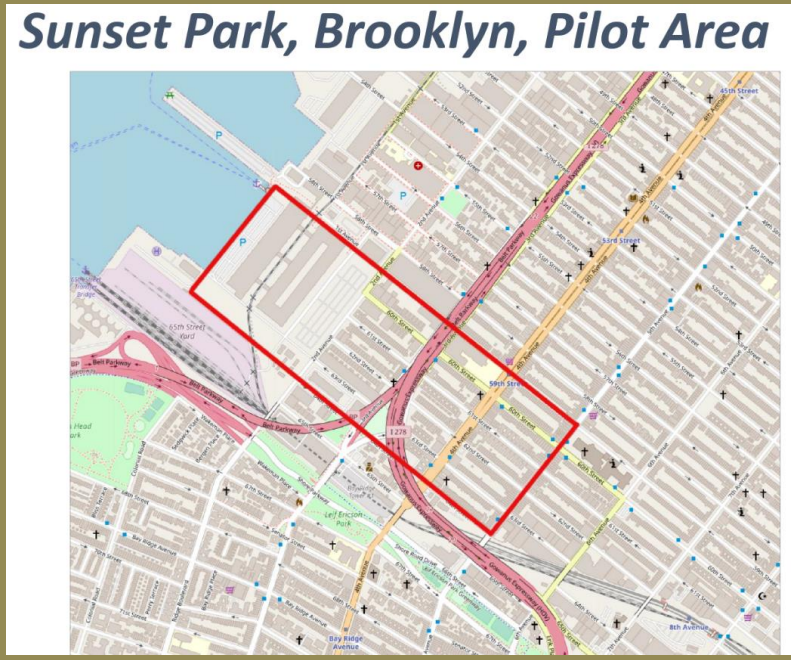
Aug. 2021

Utility Network	Data in Digital Form	Registered to NYC Basemap	Is Data Shared
Water	Yes	Yes	Limited: Within Selected City Agencies
Sewer	Yes	Yes	Limited: Within Selected City Agencies
Electric	No	No	No -811 Street Markups Only
Gas	Partial - Early	Unknown	No - 811 Street Markups Only
Telecom	Partial - Early	Unknown	No - 811 Street Markups Only
Transit	Yes	Yes	Limited: Within Selected City Agencies
Steam	No	Unknown	No - 811 Street Markups Only
Streets and Sidewalks	Yes	Yes	Yes

Pilot study areas

Midtown East (Manhattan)

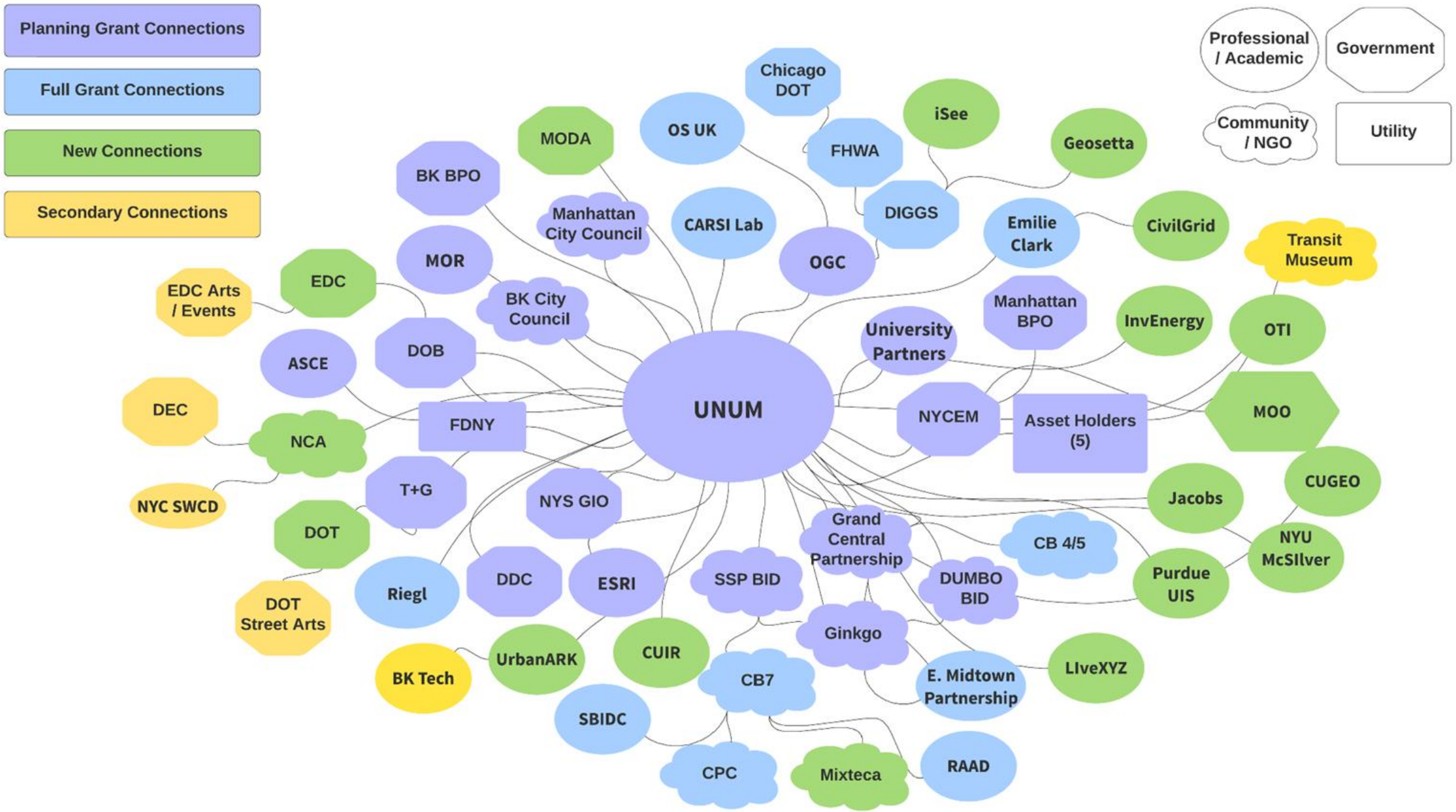
Sunset Park (Brooklyn)



Understanding subsurface utility vulnerabilities to natural hazards

Stakeholders		Asset Holders (+OEM,FDNY,NYPD)
Improve community understanding		**Facilitate asset holder involvement**
Open data	≠	Secured data
1. Student aggregation of open data 2. Community-driven digital twin 3. Art installation 4. Scavenger hunt		1. Streamline data model 2. Transform data 3. Interoperability check 4. Explore natural hazard vulnerabilities

Stakeholder & Asset Holder Network



Participating Organizations

KEY ACTIVITIES

1. Local Stakeholder ID ((BID, CB, NYC Council)
1. Customer Discovery (Problems, Use Cases)
1. Education And Training (Workshops, Field Work, Community-wide Events)

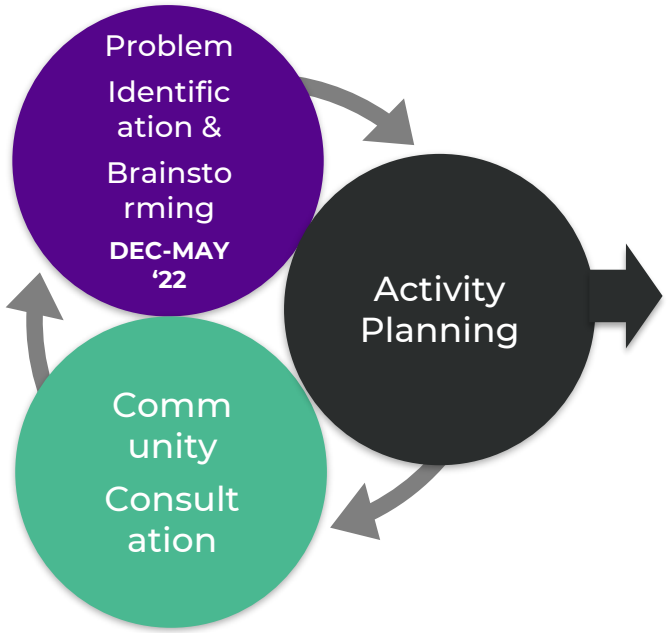
COMMUNITY PARTNER IDENTIFICATION

Ginkgo → S. Childs

SUNSET PARK → D. Estrada

NYC Brooklyn Community Board 7 → J. Laufer

華人策劃協會 CPC → S. Mei



CPC Workshops

APR-MAY '22

Field Work

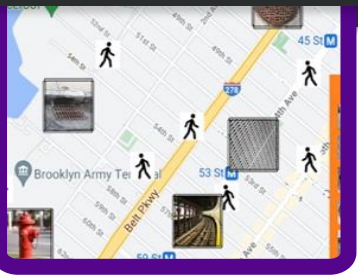
MAY '22

Training

JUL-AUG '22

Community Wide Event

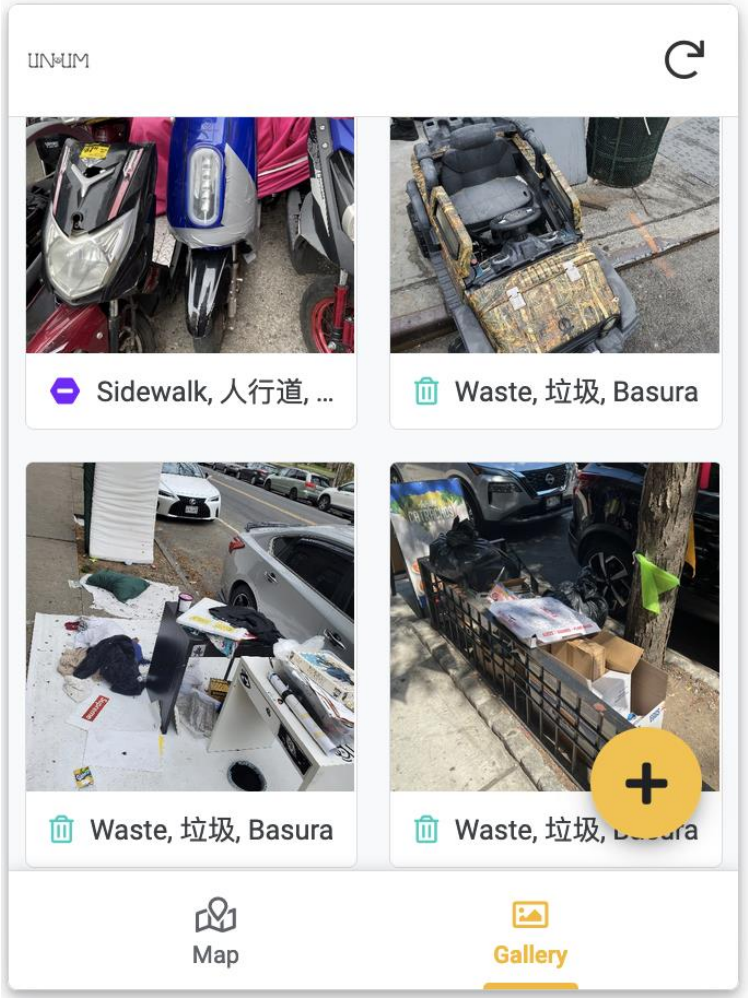
OCT '22

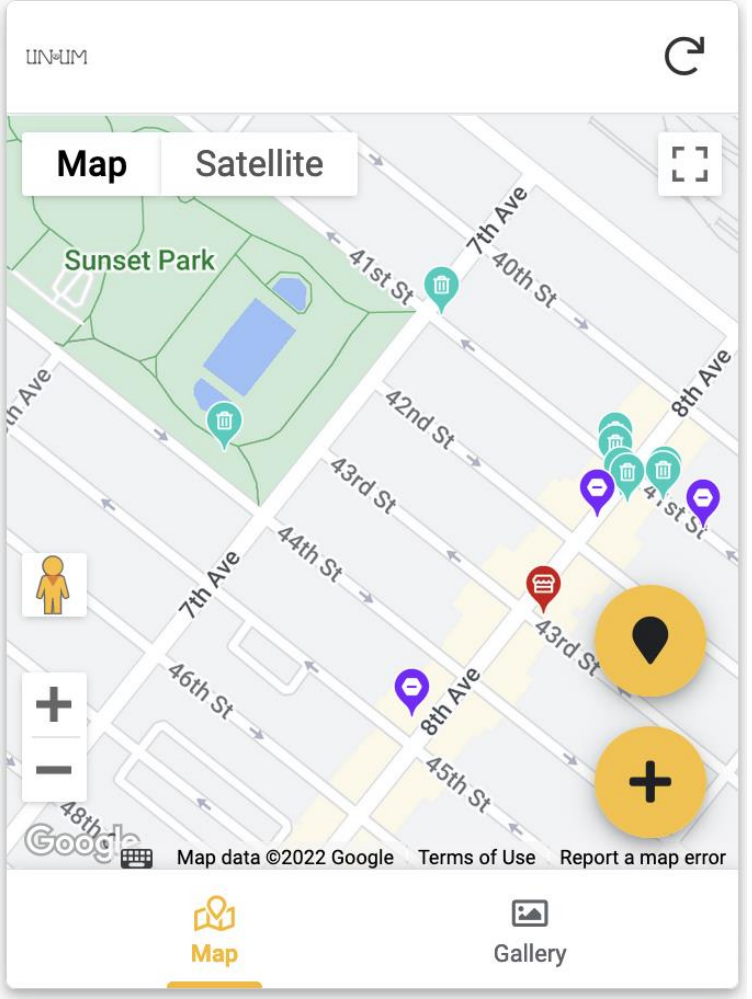


Transferable Community Tools

Teaching Materials

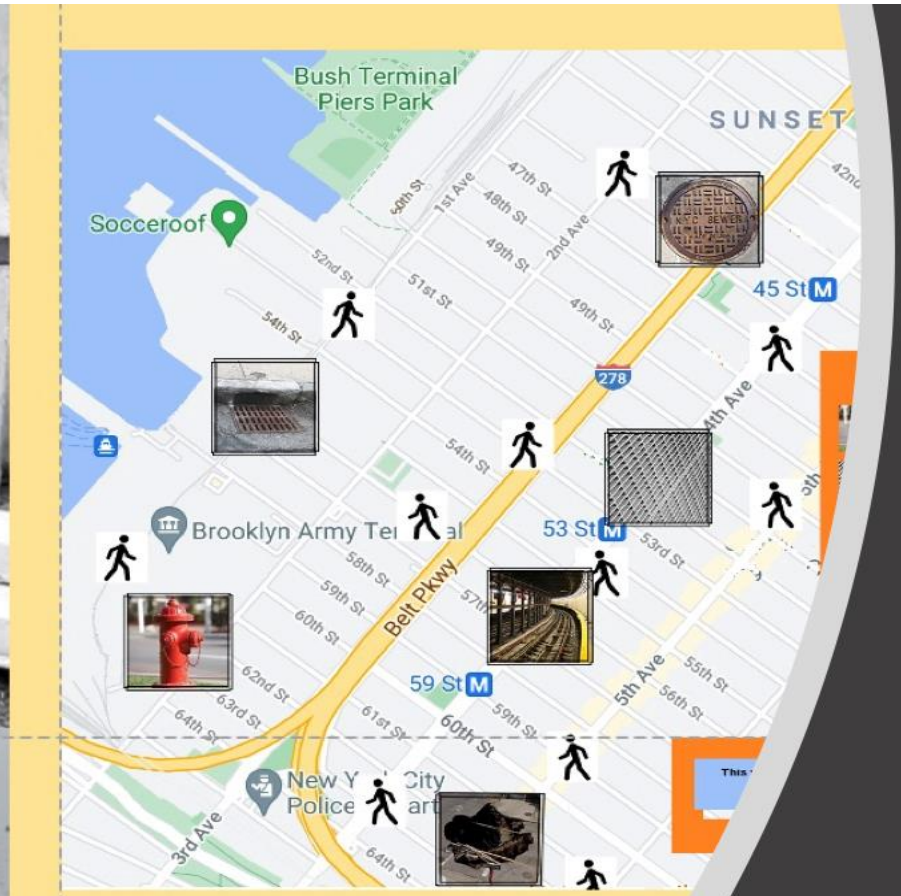
Digital Twin





CITY AS ORGANISM

After the "Dig Around" Workshop in June 2019, I was struck by how the conceptual disconnect in visualizing the underground was similar to how we imagine the insides of our bodies. That if we were to look inside, everything would be in its proper place and be legible and discreet, when in fact, the opposite is quite true. The Interstitial embedding of the organs amidst the layers of facia, fat, muscles and veins, resemble nothing of the classroom anatomical model. The underground seems to be the same. Everything is entwined and overlapping, layered, hidden. Interpreting the subsurface as a living organism with its own systems, I began making drawings imagining a lens through which we see what lies beneath the surface: intentional excavation, transportation, rock, soil, anthropogenic deposits, human artifacts, vermin, sewage, water, utilities and much more.



I will be creating an interactive outdoor research station in a repurposed catch basin, installed on the sidewalk in front of the Chinese-American Planning Council on 4th avenue in Sunset Park, for a month in late spring 2022. The station will provide a full immersive experience for the visitor allowing for contemplation of what lies beneath. The catch basin will contain a conceptual video and be lined with printed aluminum of interpretive drawings, maps, and information in English, Spanish, and Chinese. A weekend community event is being planned that will include a scavenger hunt throughout Sunset Park, for objects connected to the underground. On these objects will be a QR code that will allowed visitors to learn more about the city beneath their feet.

KEY ACTIVITIES

1. Key Contact ID
2. Customer Discovery (Focus Groups, Roundtables, Surveys)
3. Security And Privacy Protocols (Legal Agreements)
4. Data Transformation And Integration (MUDDI)
5. Risk Analysis And Resiliency

ASSET HOLDER IDENTIFICATION

GISMO — NYC Geospatial Information System and Mapping Organization

NYC Emergency Management

Open Geospatial Consortium

esri

ASSET HOLDERS

FIRE DEPARTMENT CITY OF NEW YORK

conEdison

MTA

nationalgrid

verizon

POLICE DEPARTMENT CITY OF NEW YORK

NYC Environmental Protection

Draft Storage System & Security Protocol

JAN-MAY '22

Engage with asset holders to ID security needs

Design secure data exchange platform through Esri

Data Sharing Agreement Creation)

MAY '22

NYU and NYCEM coauthor agreements

Distribute and pursue signatures with asset holders

Data Transfer & Transformation

FALL '22

Receive data through secure Esri environment

Begin MUDDI transformation

Run QA / QC

Data Visualization

WINTER '22

2D visualizations (NYU)

3D visualizations (NYCEM)

Risk Analysis & Resiliency Agreement

SPRING '23

Meet with asset holders and risk decision makers to run assessment and analysis

Understand city-wide scalability

MUDDI (OGC)

UTILITIES: Concerned about other systems impacting their systems during a failure

Type of Infrastructure	Very concerned or Most Concerned
Water supply	75%
Sewer systems	75%
Electric power	50%
Steam	25%
Natural gas	50%
Transportation (tunnels)	50%
Public transit (subway or rail)	75%
Telecommunications	*100%*

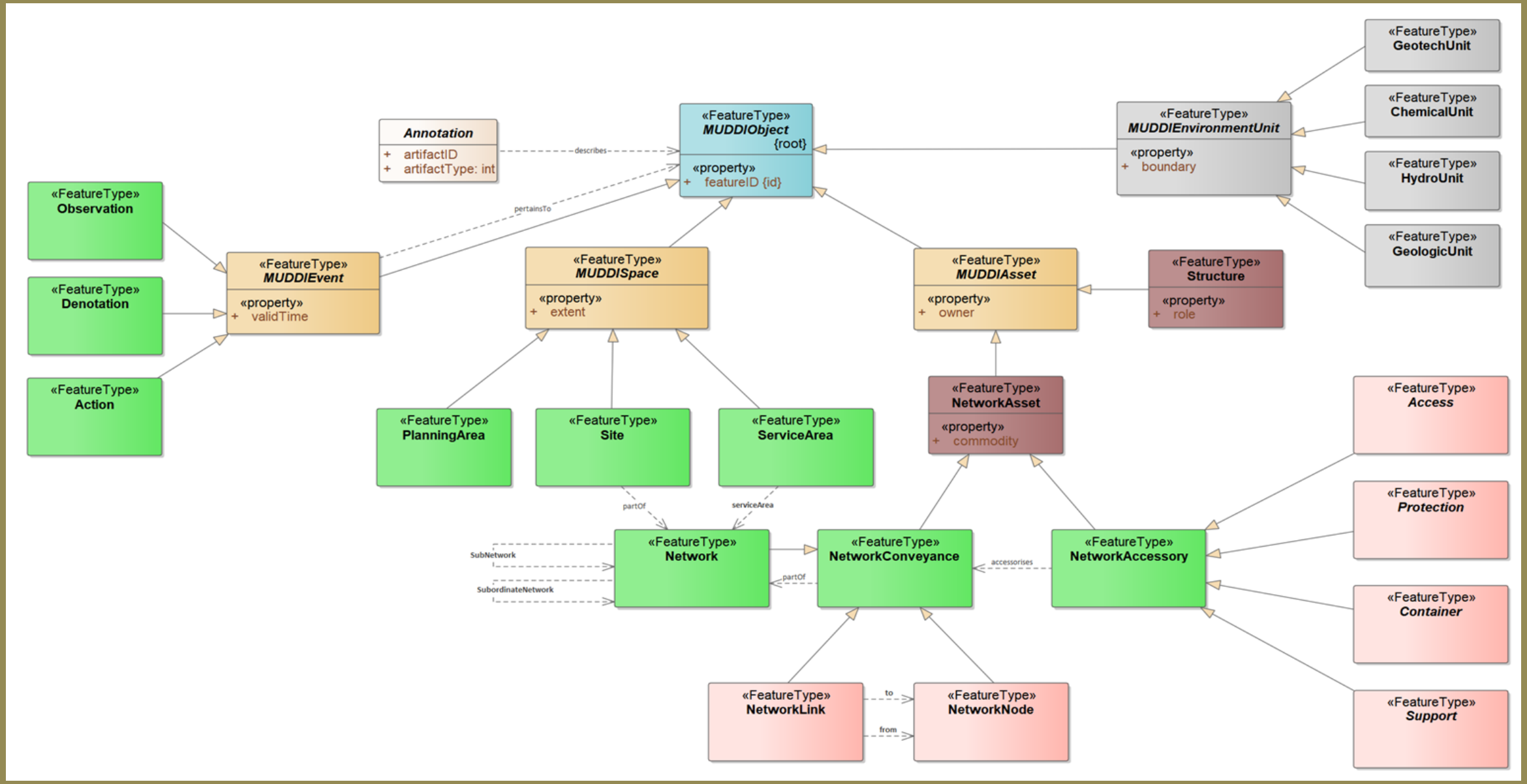
OTHER STAKEHOLDERS: Concerned about infrastructure impacting them

Type of Infrastructure	Very concerned or Most concerned
Water supply	62%
Sewer system	*69%*
Electric power	62%
Steam	38%
Natural gas	54%
Transportation (tunnels)	46%
Public transit (subway or rail)	62%
Telecommunications	*69%*

Other Stakeholders

"What do you see as the major obstacles to long-term collaboration in the area of underground infrastructure resiliency?"

MUDDI (OGC)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«FeatureType» ChemicalUnit
«FeatureType» HydroUnit
«FeatureType» GeologicUnit
«FeatureType» MUDDIEnvironmentUnit
«property» + boundary
Annotation
+ artifactID
+ artifactType: int
describes
«FeatureType» MUDDIObject {root}
«property» + featureID {id}
pertainsTo
«FeatureType» Observation
«FeatureType» Denotation
«FeatureType» Action
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serviceArea
SubNetwork
SubordinateNetwork
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partOf
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accessorises
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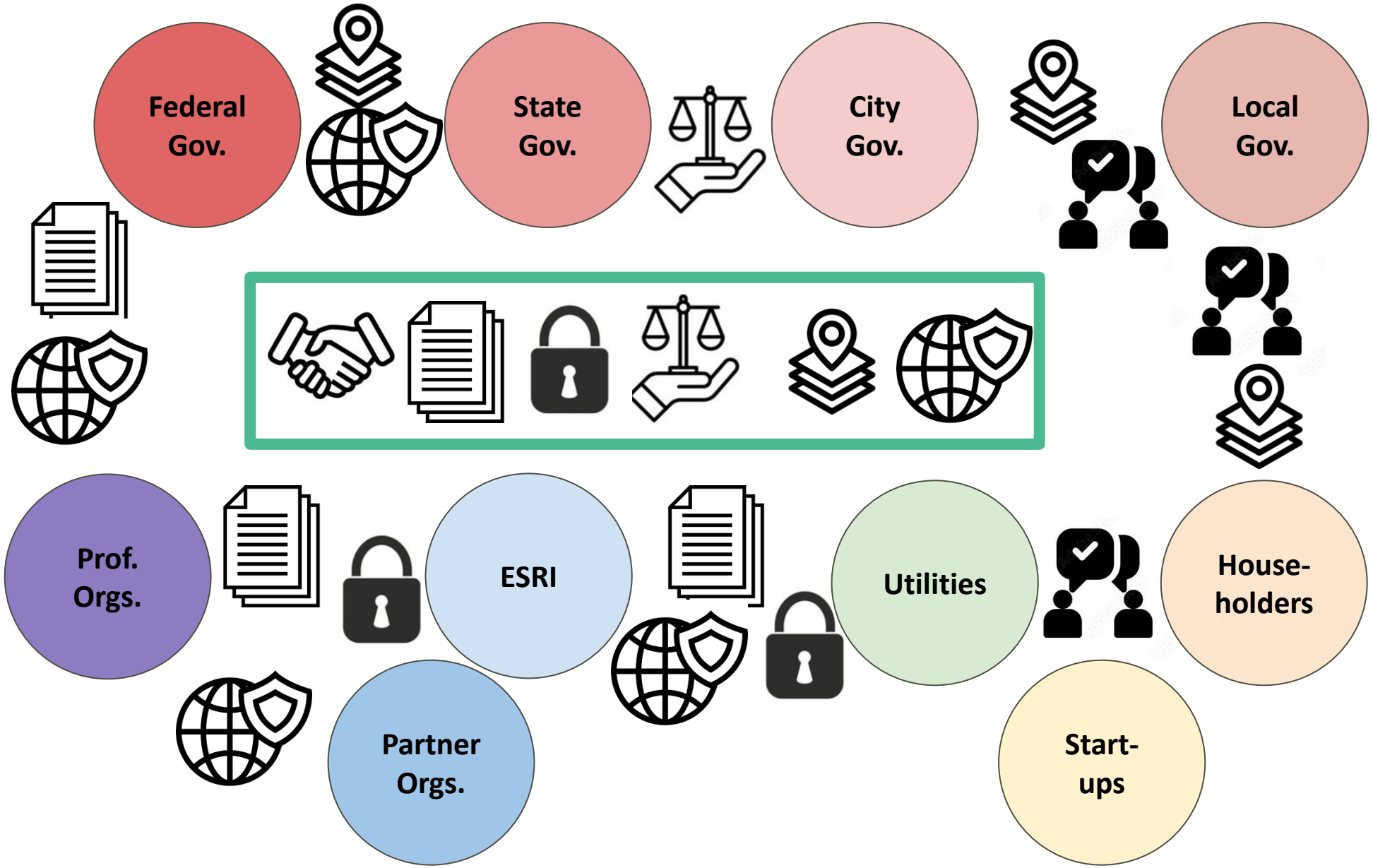
«FeatureType» NetworkLink
to
from
«FeatureType» NetworkNode

UNUM Exchange Processes + Products



Transfer & Sustain 2022 (21 years later)
HUD Disaster Recovery Community Development

Partner

NYC Office of the Mayor

NYC Mayor's Office of Operations

NYC Emergency Management

UNHUM

Transfer

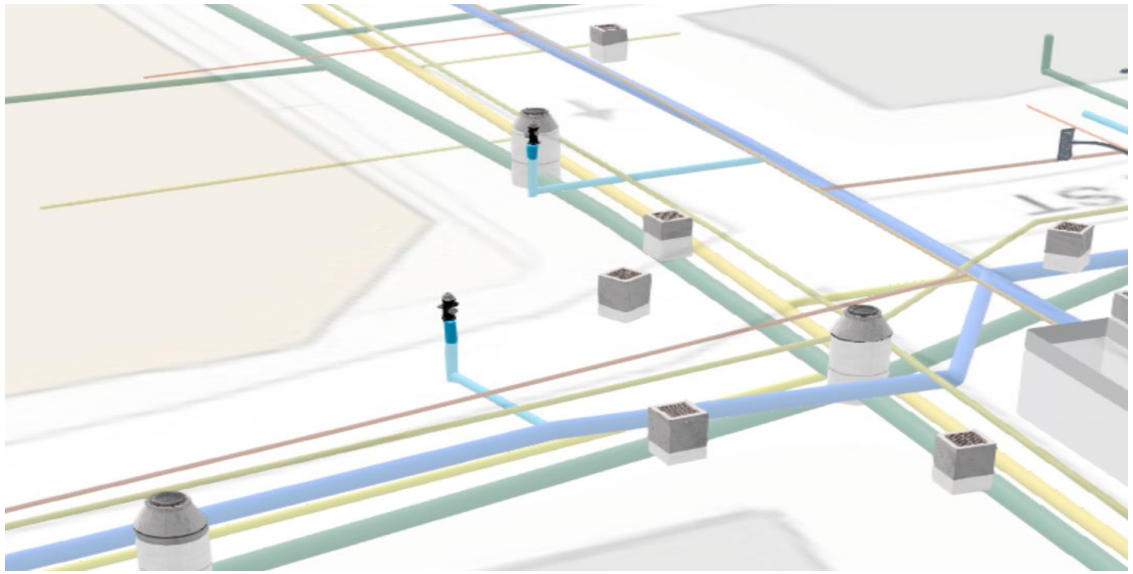
Sustain

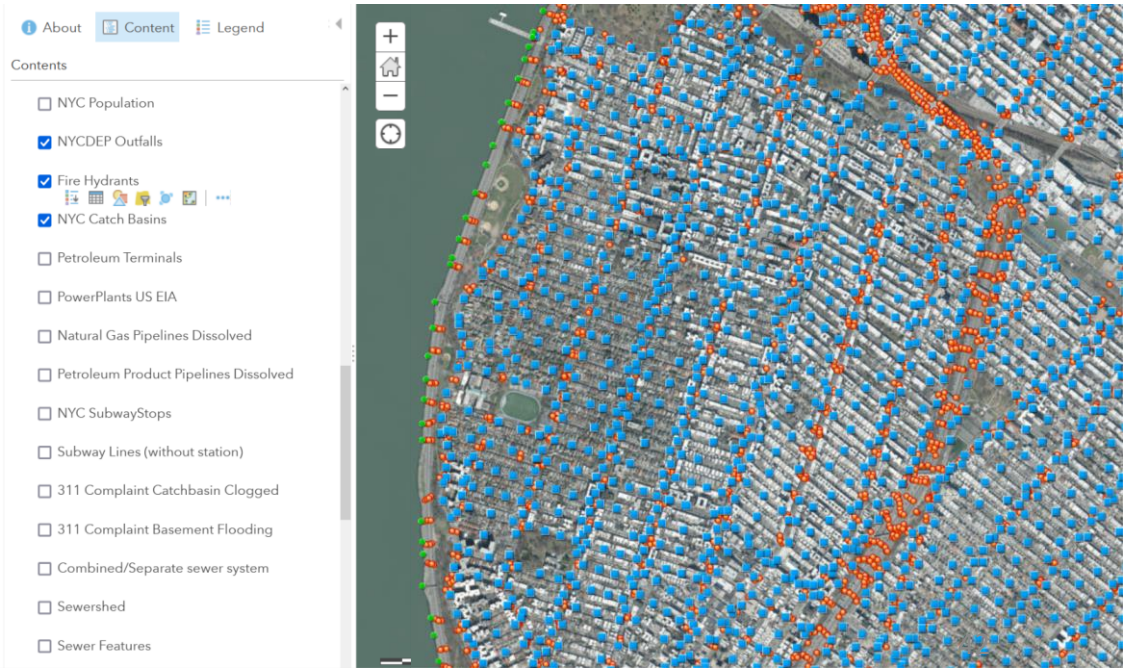
Initiative	Proposed Budget
Resiliency in Basement Apartment Conversions	$400,000
Evacuation Modeling	$1,000,000
Geothermal Feasibility Study	$400,000
Post-Disaster Housing Recovery Program Analysis	$1,069,000
3DUnderground Database	$10,000,000
Future and Real Time Impact Assessments	$1,000,000
Canvassing Operations Study	$1,000,000
Disaster Recovery IT System	$1,500,000
Neighborhood Studies	$4,000,000
Total	**$20,369,000**

Link to publicly available doc

Transferable Asset Holder Tools

- Consortium Building Processes & Materials
- ROI Information
- Best Practice Documents & Cases
- Security Protocols
- NDA
- Data Standards - OGC MUDDI
- Data Transformation Techniques
- Open Data (64 layers)





Looking forward

1. Subsurface zoning
2. Higher standards for utility as-builts
3. Interoperable, federated systems (ideally nationally)
4. Utilidors

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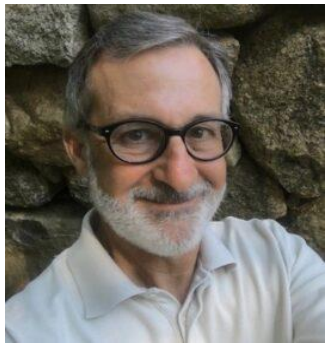
Debra Laefer – PI

Wendy Dorf - Senior Personnel

Alan Leidner - Senior Personnel



Josh Lieberman - Senior Personnel

Rae Zimmerman - Co-PI

Star Childs - Senior Personnel

Sean Ahearn - Senior Personnel

Carlos Restrepo - Associate Research Scientist

Emilie Clark - Project Artist

Peter Gmelch - Project Manager

Kim Hertz - PhD Student

Karnik Panchal - Masters Student

Kshitij Chandna - Masters Student

Low Cost Flood Risk Viewer

COSTCO
Legend
Worst case Inundation
Sandy inundation zone
Estimated SLR 2050

Data processing (Part 1)

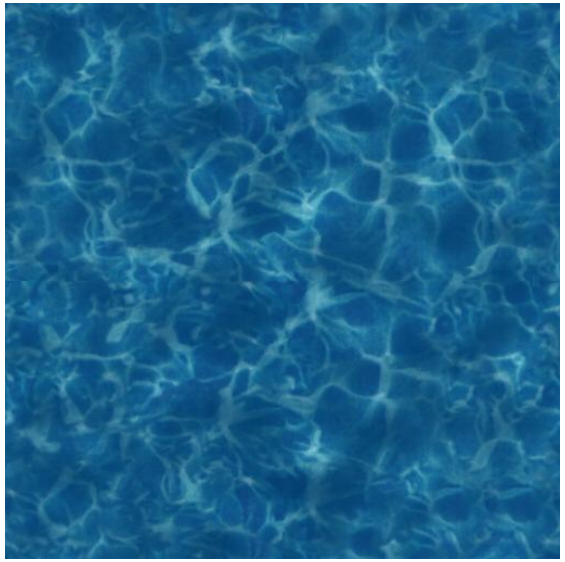
- Take multiple LiDAR scans
- Merge/Clean data using CloudCompare
- Covert to Potree format

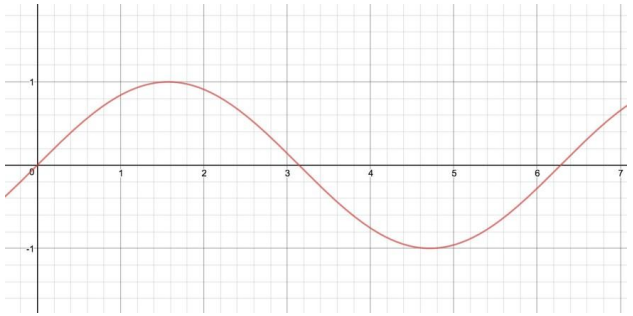
Flood creation (Part 2)

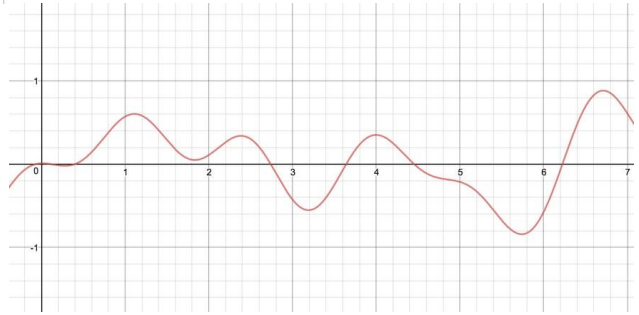
- Collect images of floods
- Extract textures using InkSkape
- Use compound sin function to create wave like patterns
- Increase wave height dynamically

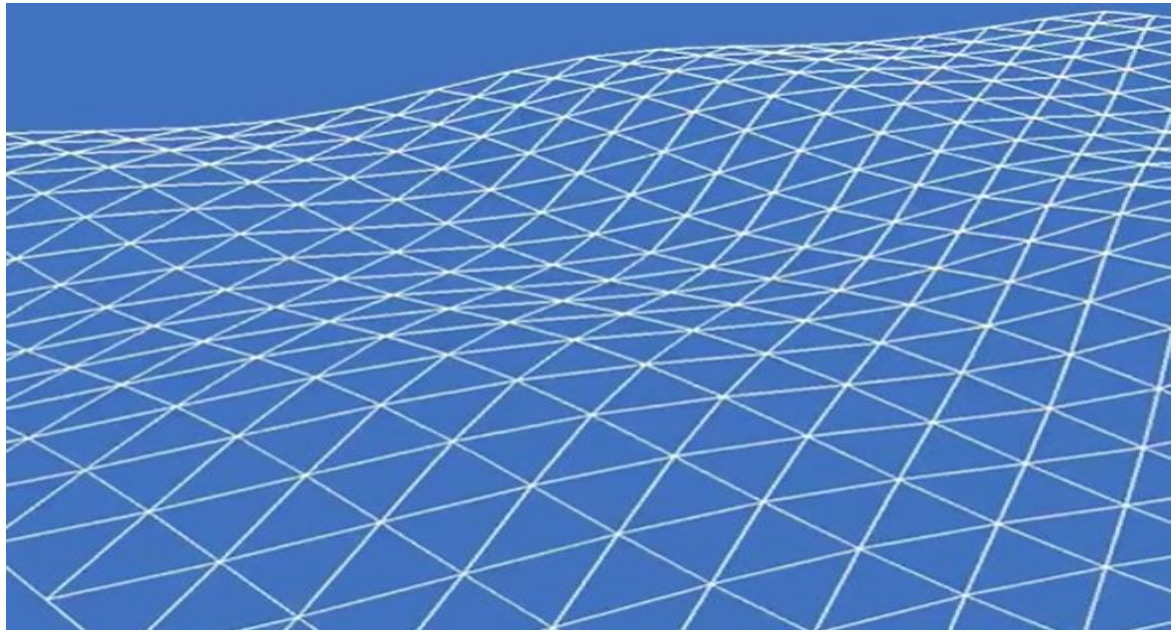
Visualization (Part 3)

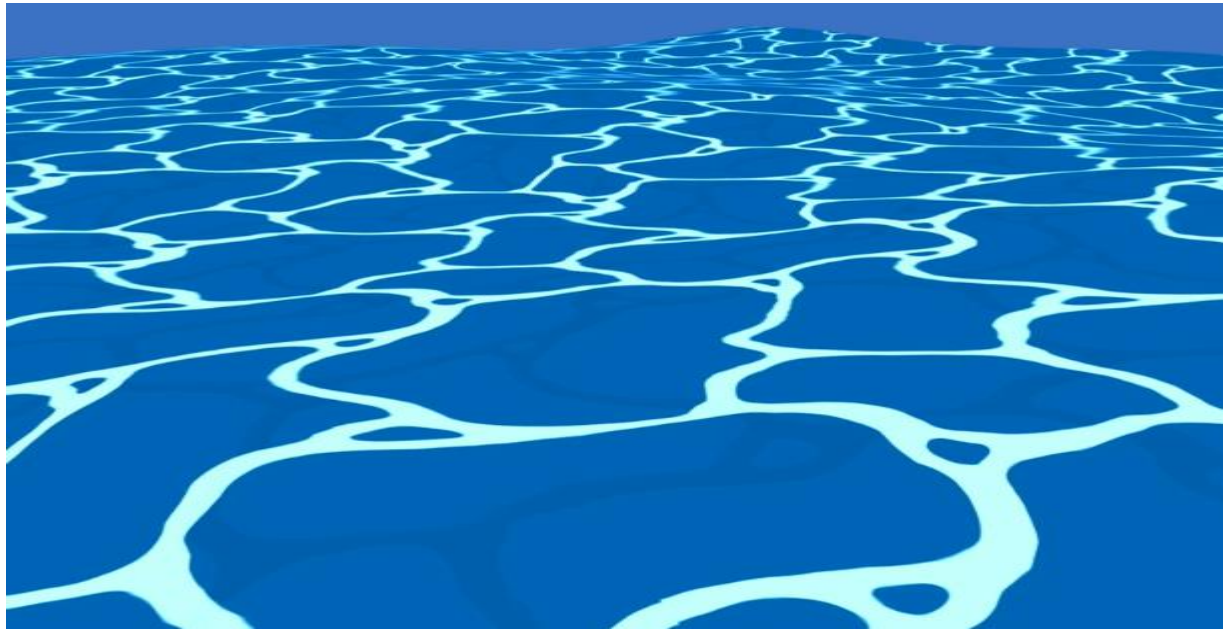
- Set a viewpoint position
- Load the viewer on web browser

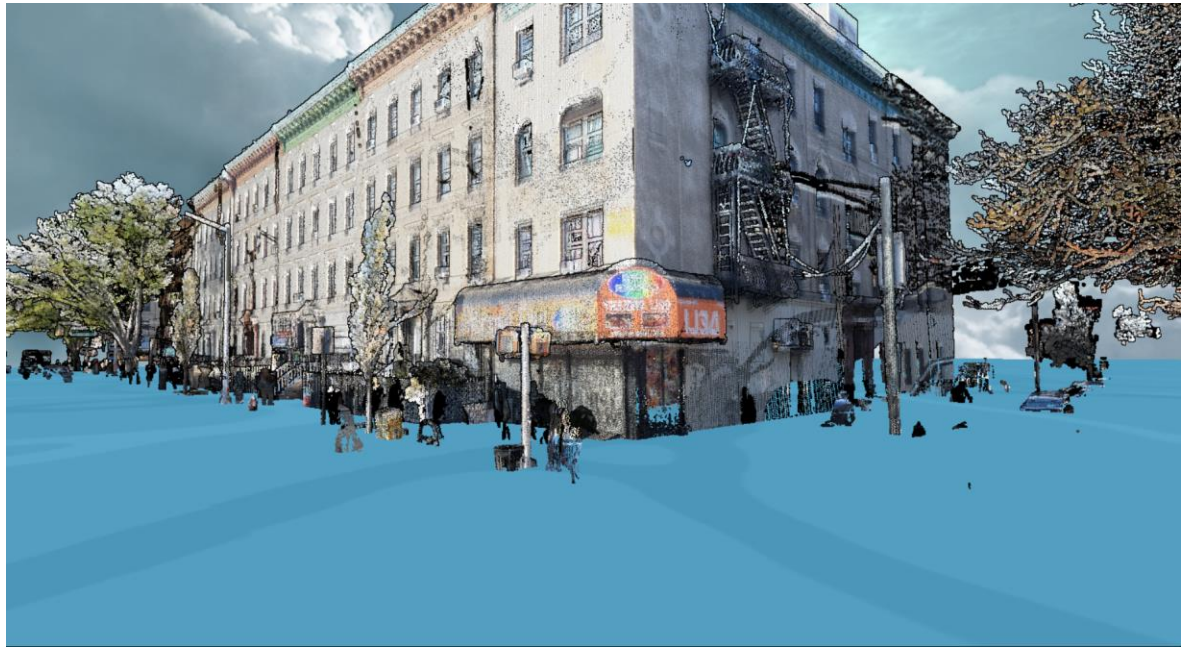


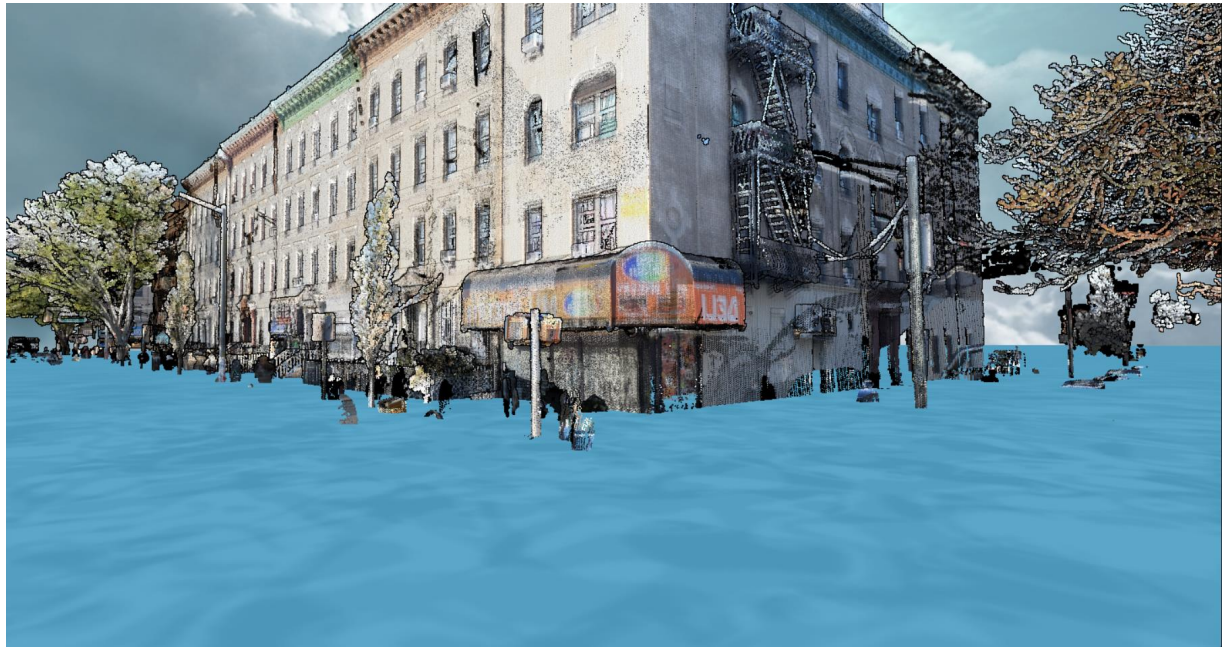


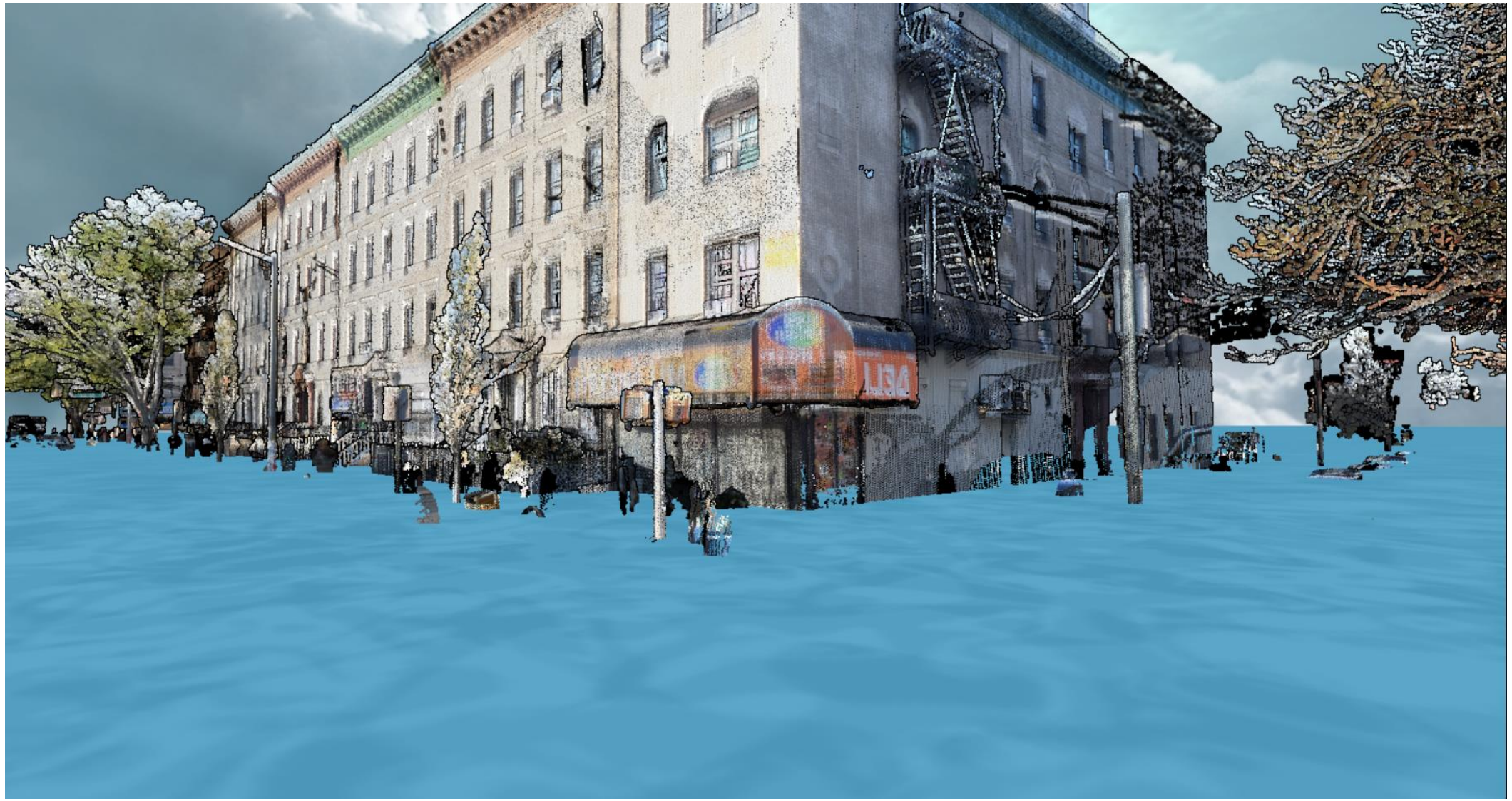








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Thank You

debra.laefer@nyu.edu