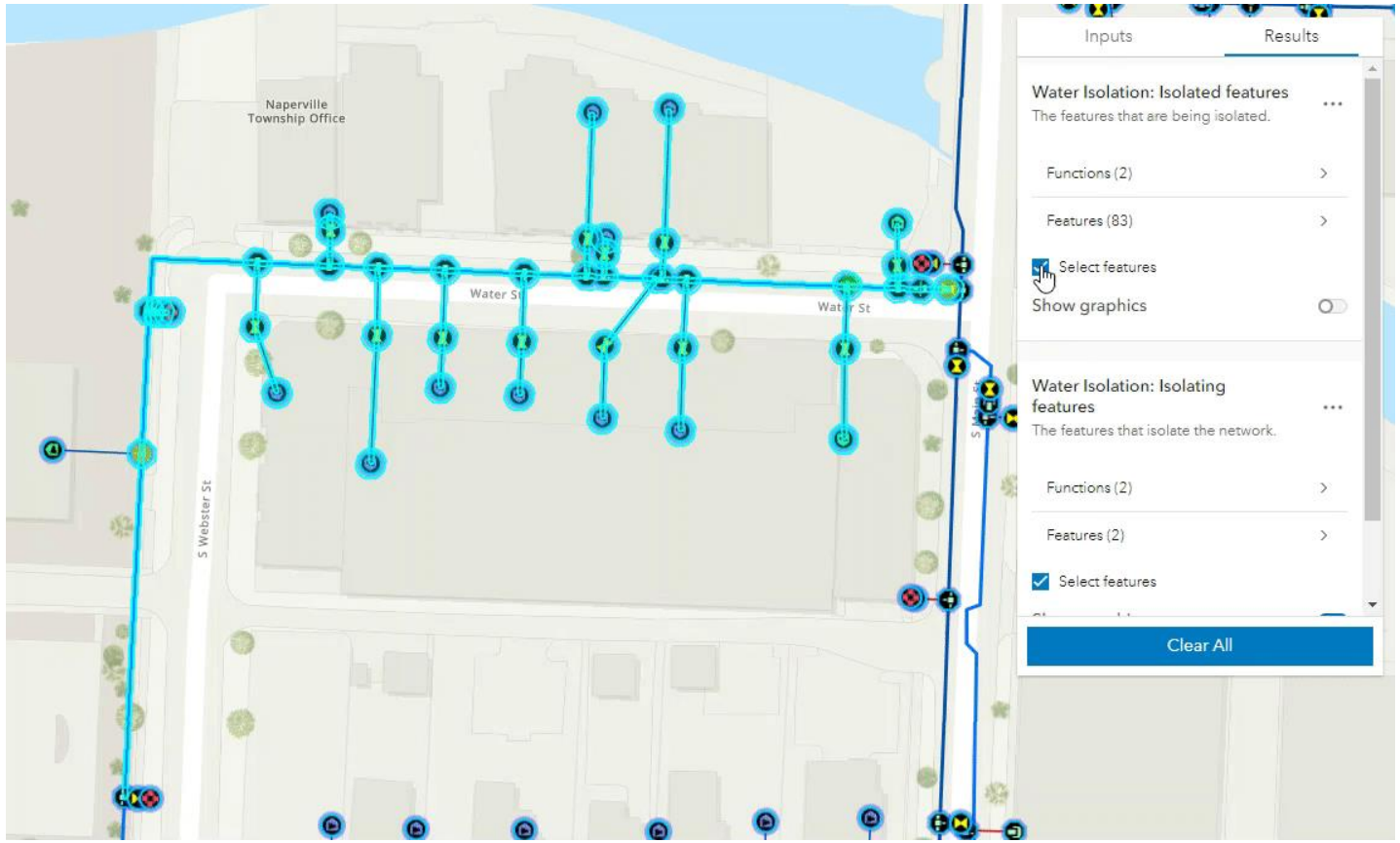
GIS Mapping at Utilities



Gregg Rotundo
GIS Specialist – Aurora Water
CECTI School – November 8th, 2024

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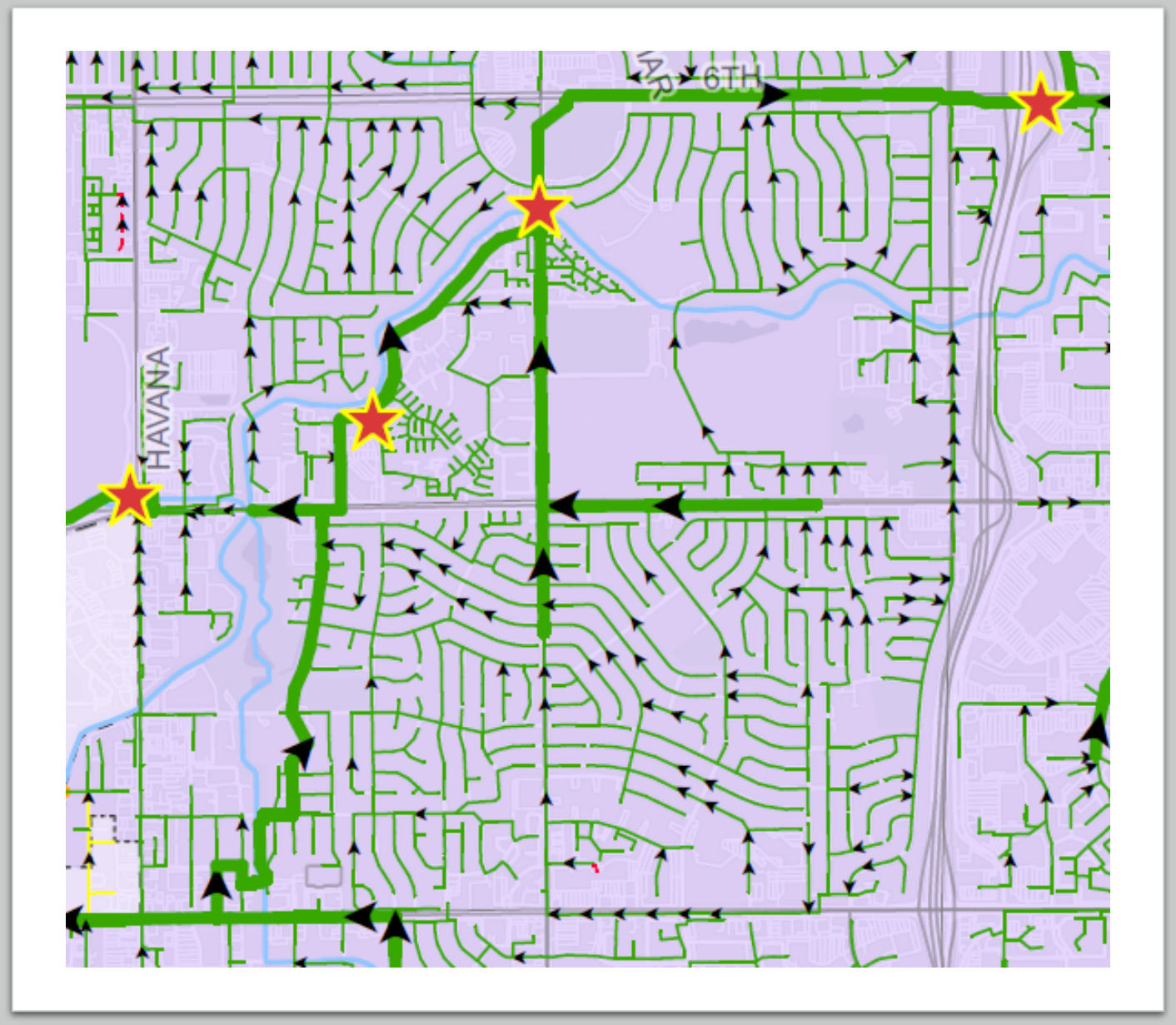
Overview

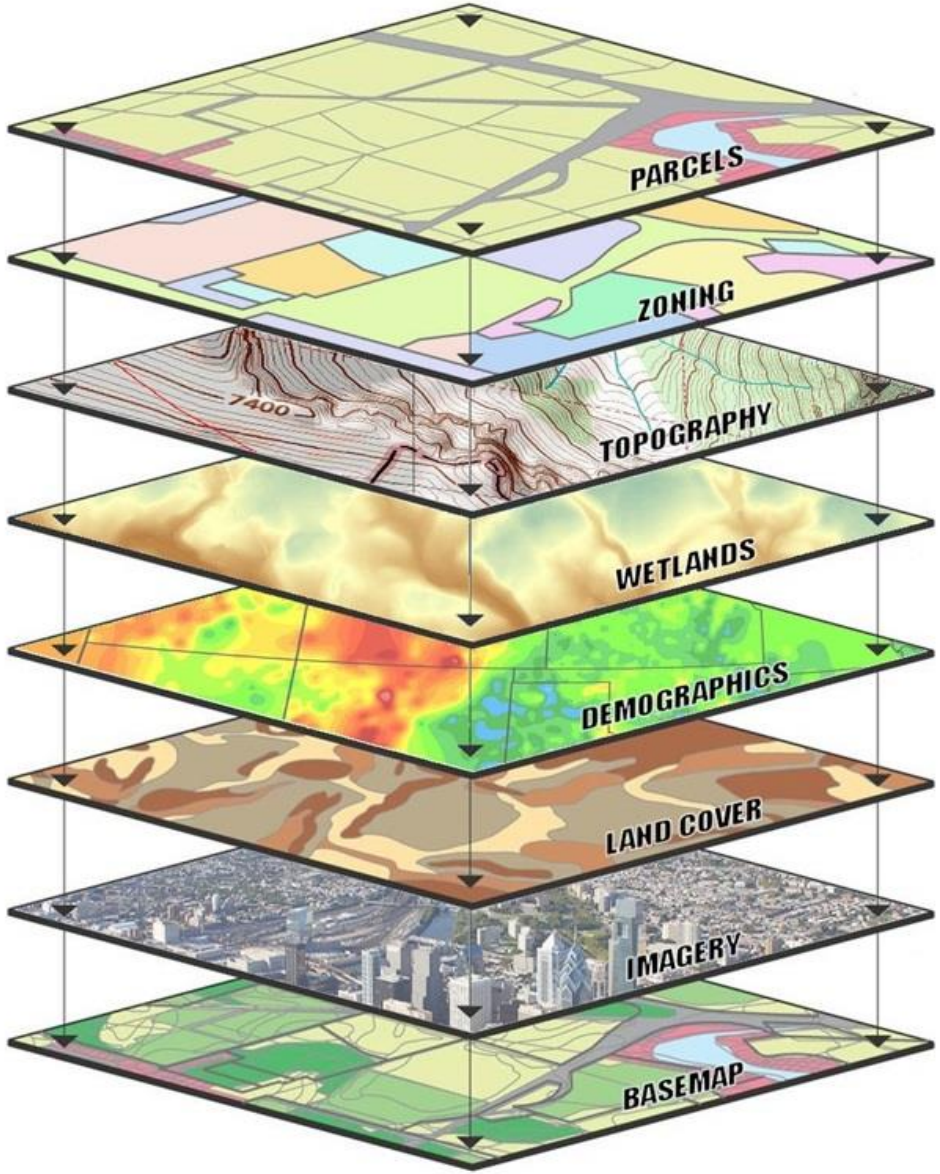
- What is GIS?
- Current Software
- Digital Asset Record
- Networks and Models
- Mobile and Web Solutions
- What's next in GIS?



What is GIS?

GIS = Geographic Information Systems

- Spatial database
- “Integrating location data (where things are) with all types of descriptive information (what things are like there)”
- Adopted by utilities starting in the 90s



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Why GIS?

- System of Record
  - Modeling, Asset Management, Customer Information System, and Machine Learning
- Location intelligence
- Knowledge management
- Coordination and Integration
- Engage public

Smarter decisions

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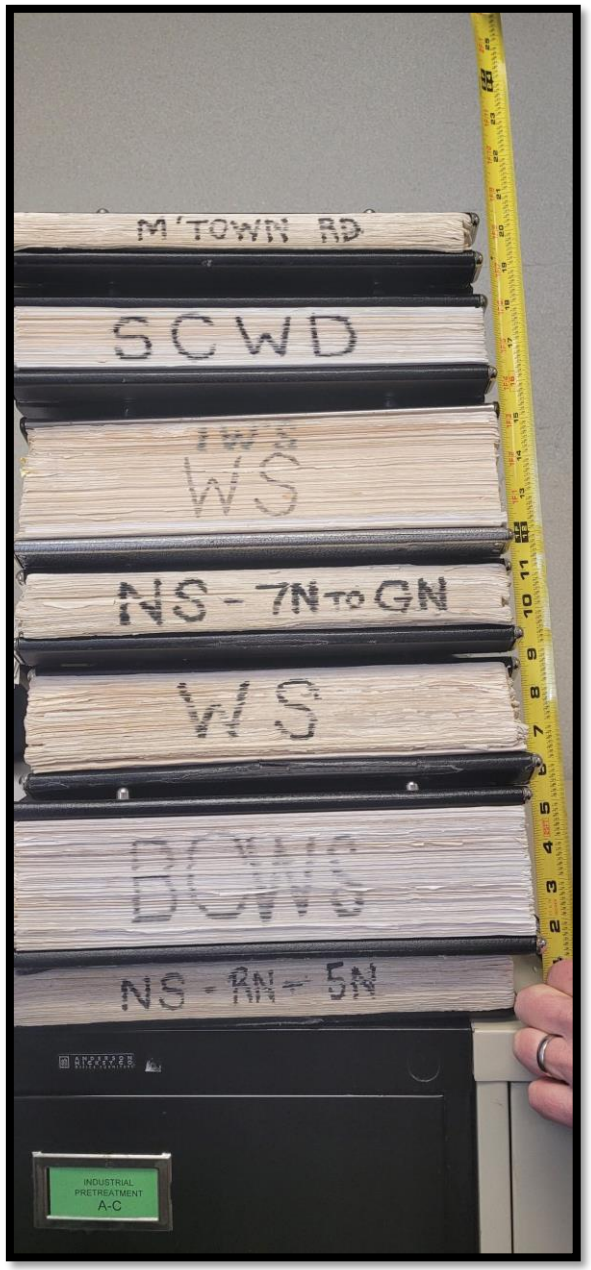

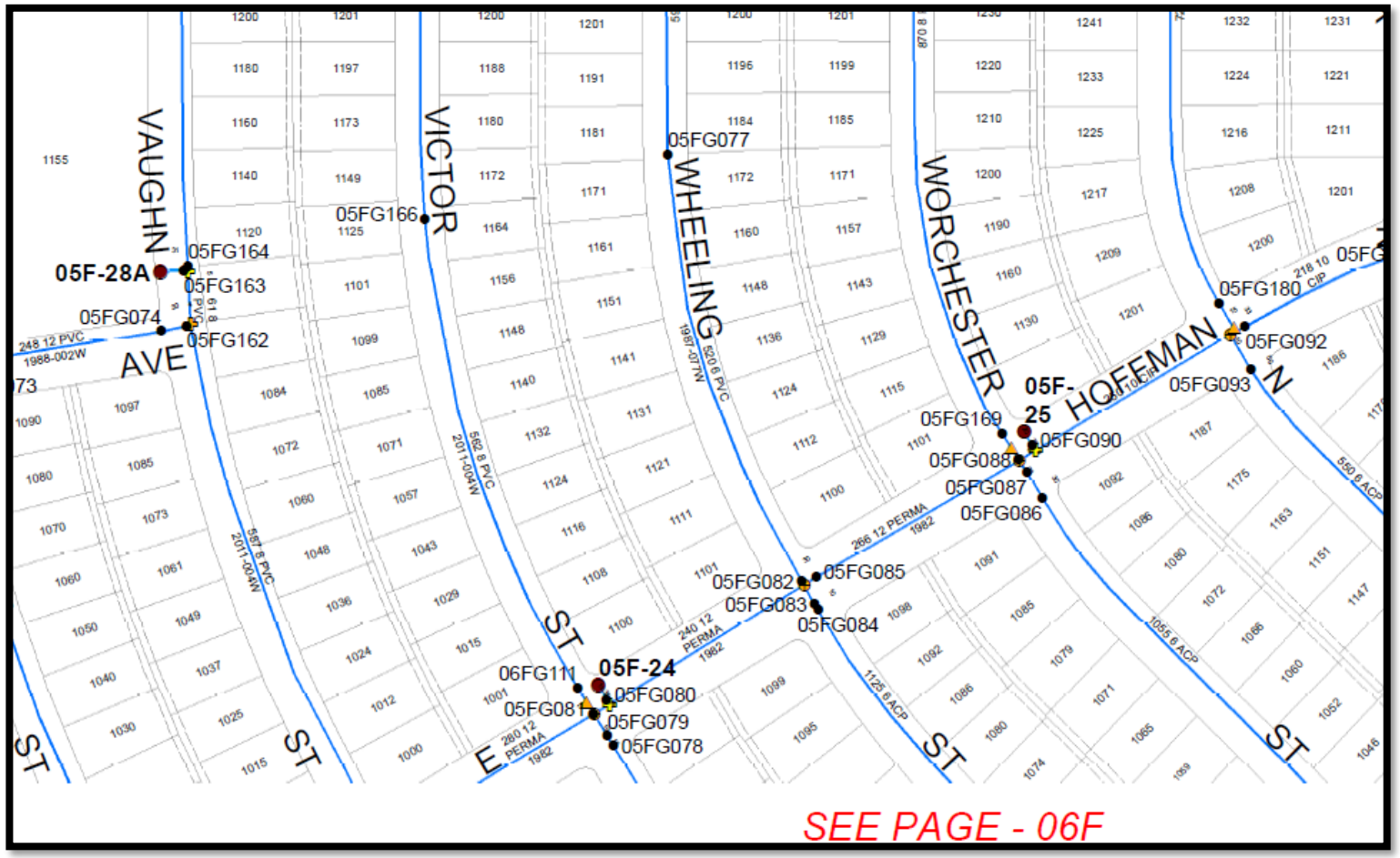

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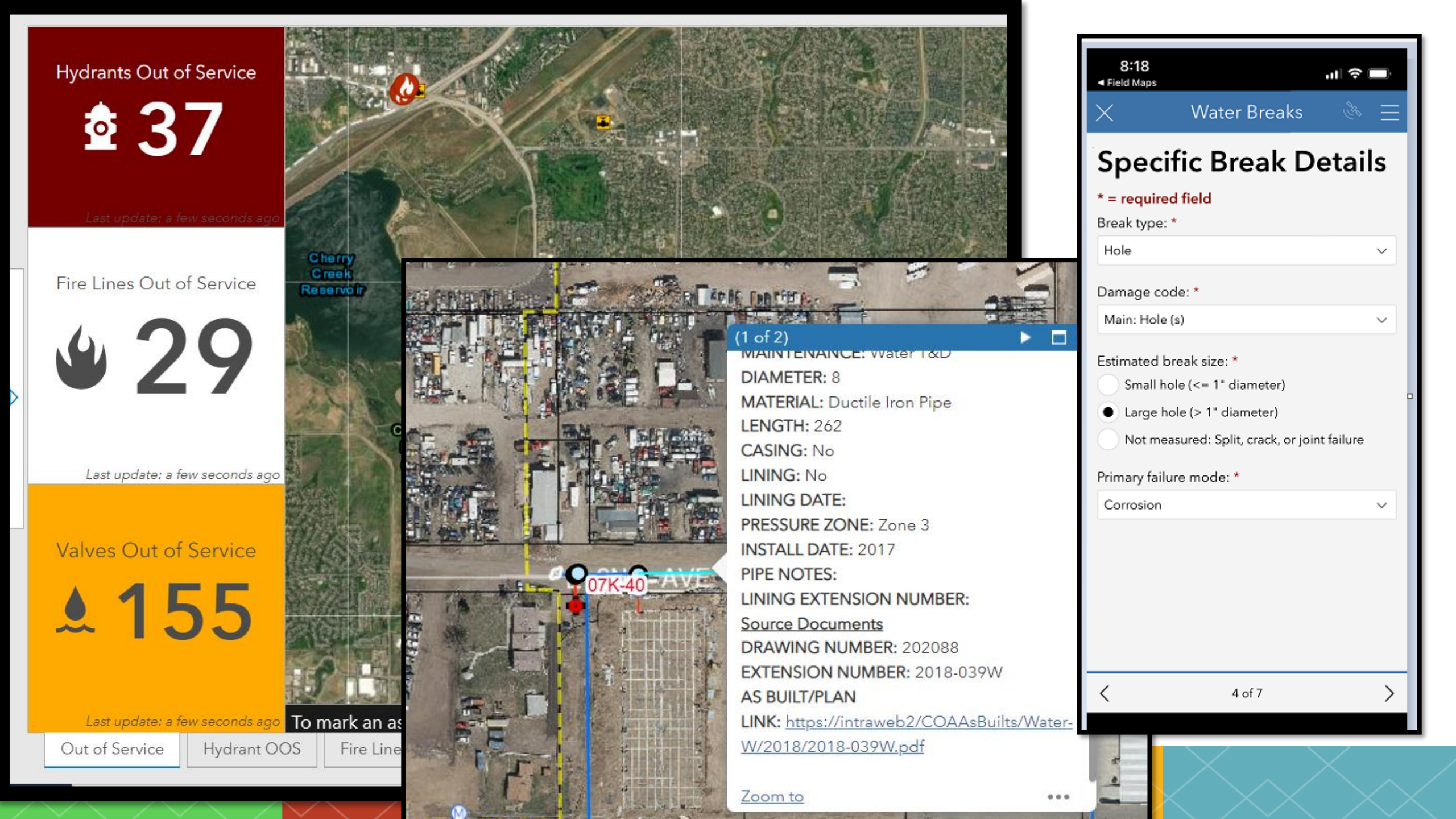
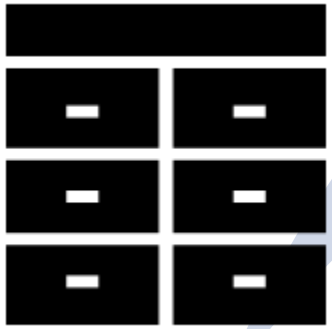
Source: https://eos-gnss.com/


Hydrants Out of Service
37
Last update: a few seconds ago
Fire Lines Out of Service
29
Last update: a few seconds ago
Valves Out of Service
155
Last update: a few seconds ago
Cherry Creek Reservoir
To mark an as
Out of Service
Hydrant OOS
Fire Line
07K-40
(1 of 2)
DIAMETER: 8
MATERIAL: Ductile Iron Pipe
LENGTH: 262
CASING: No
LINING: No
LINING DATE:
PRESSURE ZONE: Zone 3
INSTALL DATE: 2017
PIPE NOTES:
LINING EXTENSION NUMBER:
Source Documents
DRAWING NUMBER: 202088
EXTENSION NUMBER: 2018-039W
AS BUILT/PLAN
LINK: https://intraweb2/COAAsBuilts/Water-W/2018/2018-039W.pdf
Zoom to
8:18
Field Maps
Water Breaks
Specific Break Details
* = required field
Break type: *
Hole
Damage code: *
Main: Hole (s)
Estimated break size: *
Small hole (<= 1" diameter)
Large hole (> 1" diameter)
Not measured: Split, crack, or joint failure
Primary failure mode: *
Corrosion
4 of 7

GIS Evolution Timeline



Paper civils in filing cabinets

Map books

Digital Field Maps

Custom solutions

3D, Analytics, Connected Systems, Digital Twin

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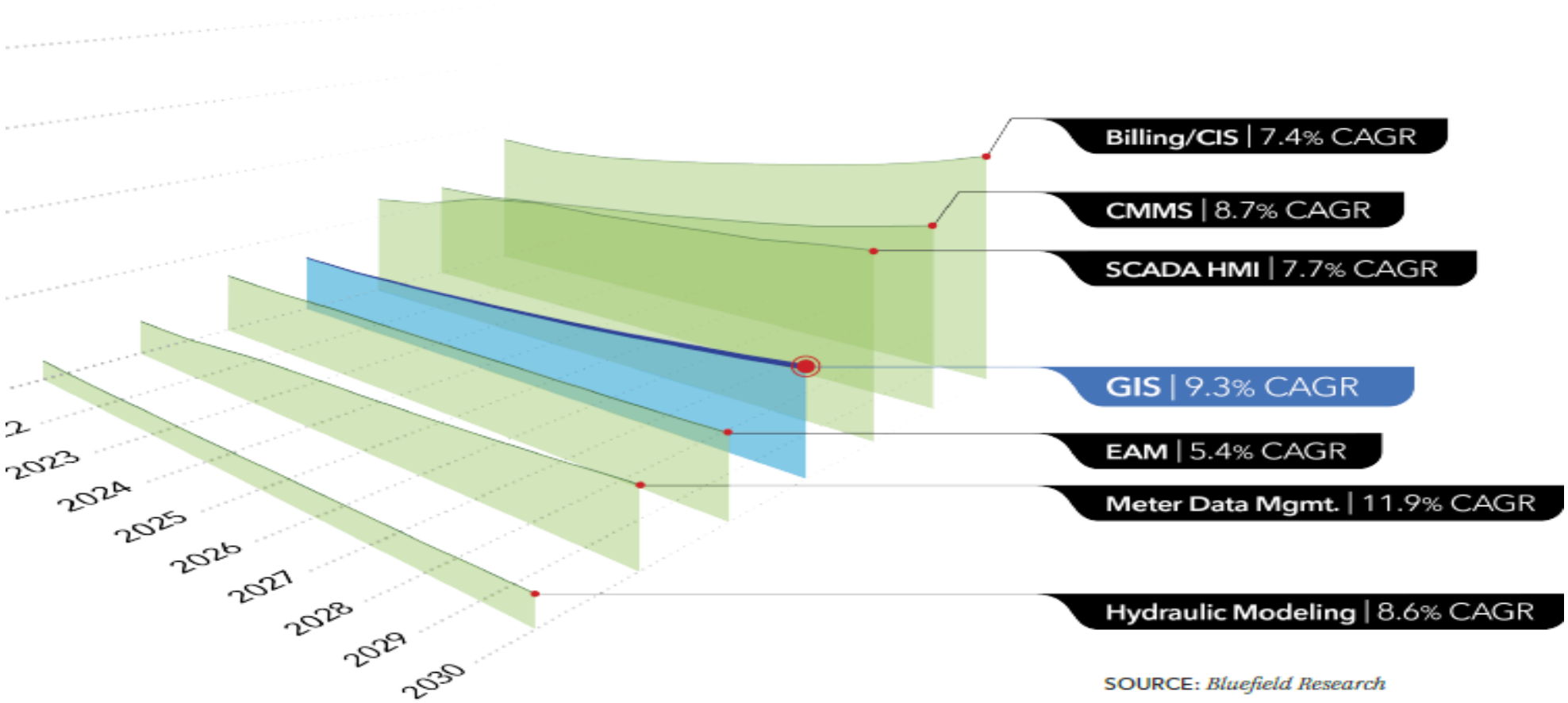
US UTILITIES' PROJECTED DIGITAL WATER SOFTWARE INVESTMENTS BY PRODUCT TYPE

2021–2030



SOURCE: *Bluefield Research*

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SOFTWARE LANDSCAPE

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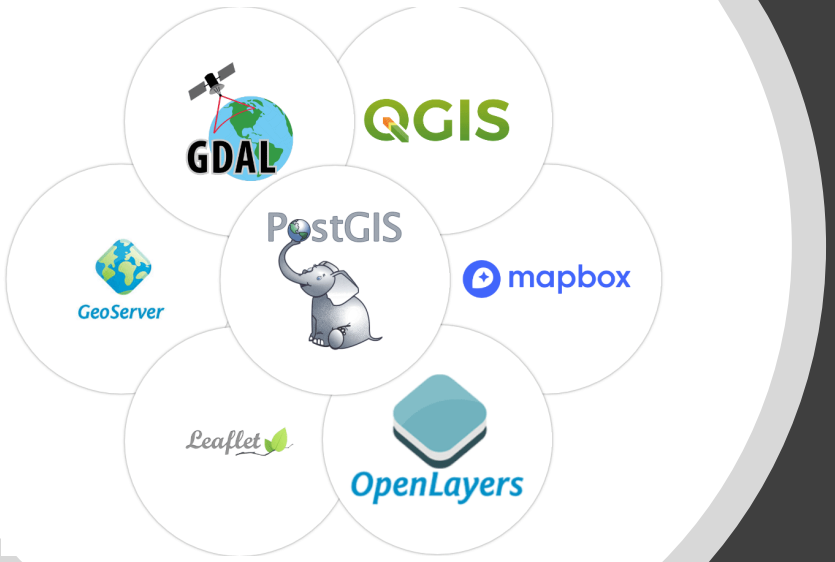

Bentley

AUTODESK

esri

Software Landscape

- ESRI (ArcGIS, SDE)
- Autodesk (AutoCAD, CAD, Tandem)
- Bentley (CAD)
- Open Source (QGIS, Atlas.co, Google Earth Pro)

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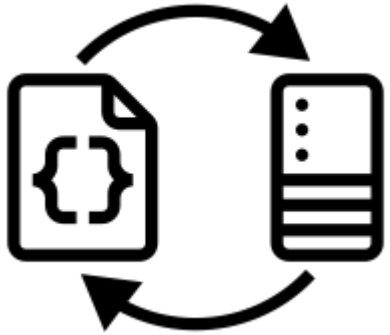
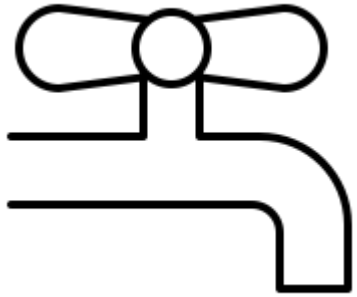
Software Relationship





Vendor

Utilities

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But where do we start if ESRI isn't an option?

Do you have technical personnel?

- Open-Source GIS like QGIS

Can you hire a consultant?

- They can create a one-time dataset which you can maintain from the field with cheaper software

Can you work on mapping a little bit at a time?

- Research ESRI alternatives like GIS Cloud and Juniper Uinta

Do you have engineers on staff?

- Think about using CAD
- Think about a small on call contract with an engineering firm

Caution: Protect your data! It represents critical infrastructure.

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DIGITAL ASSET RECORD

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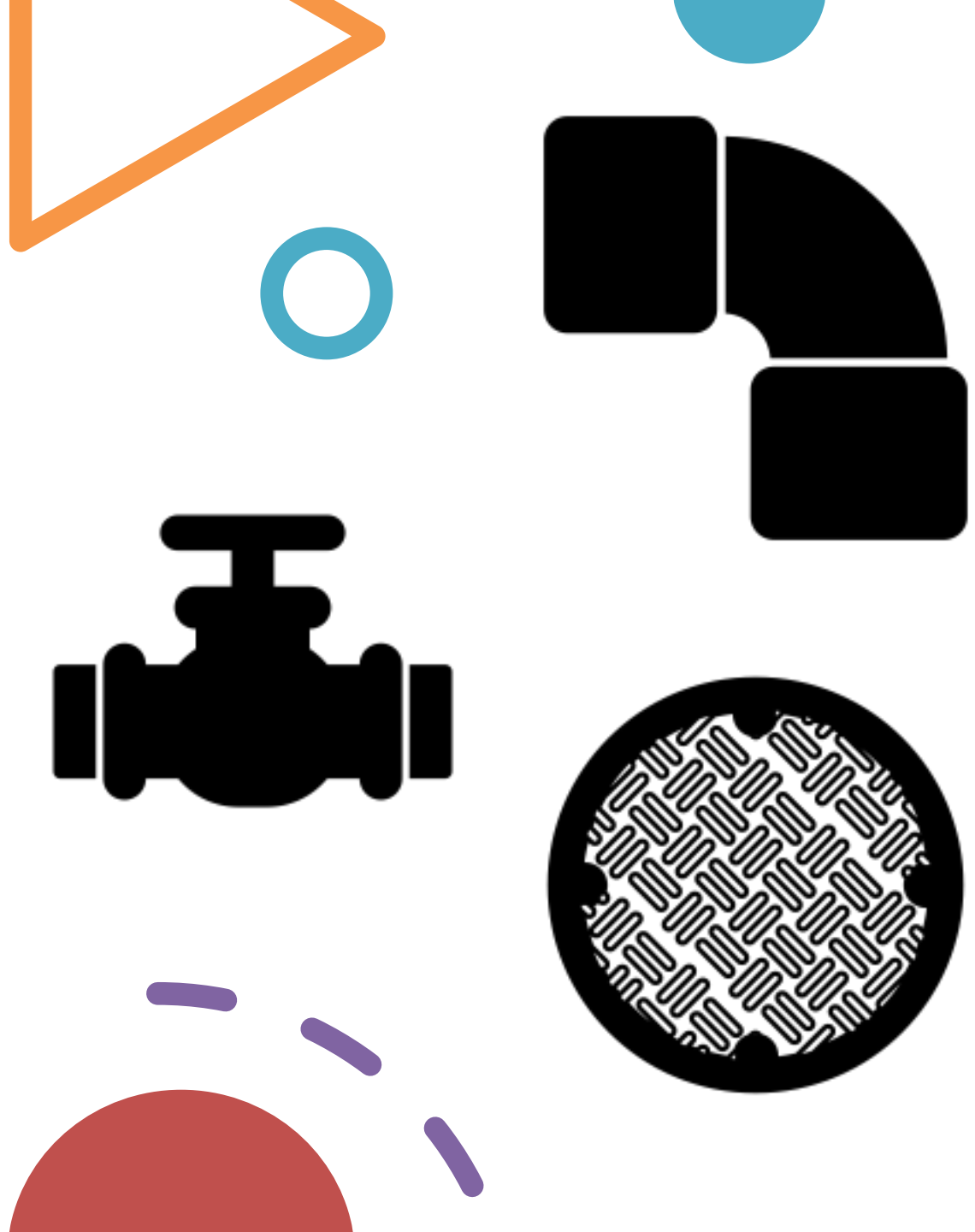
Asset =

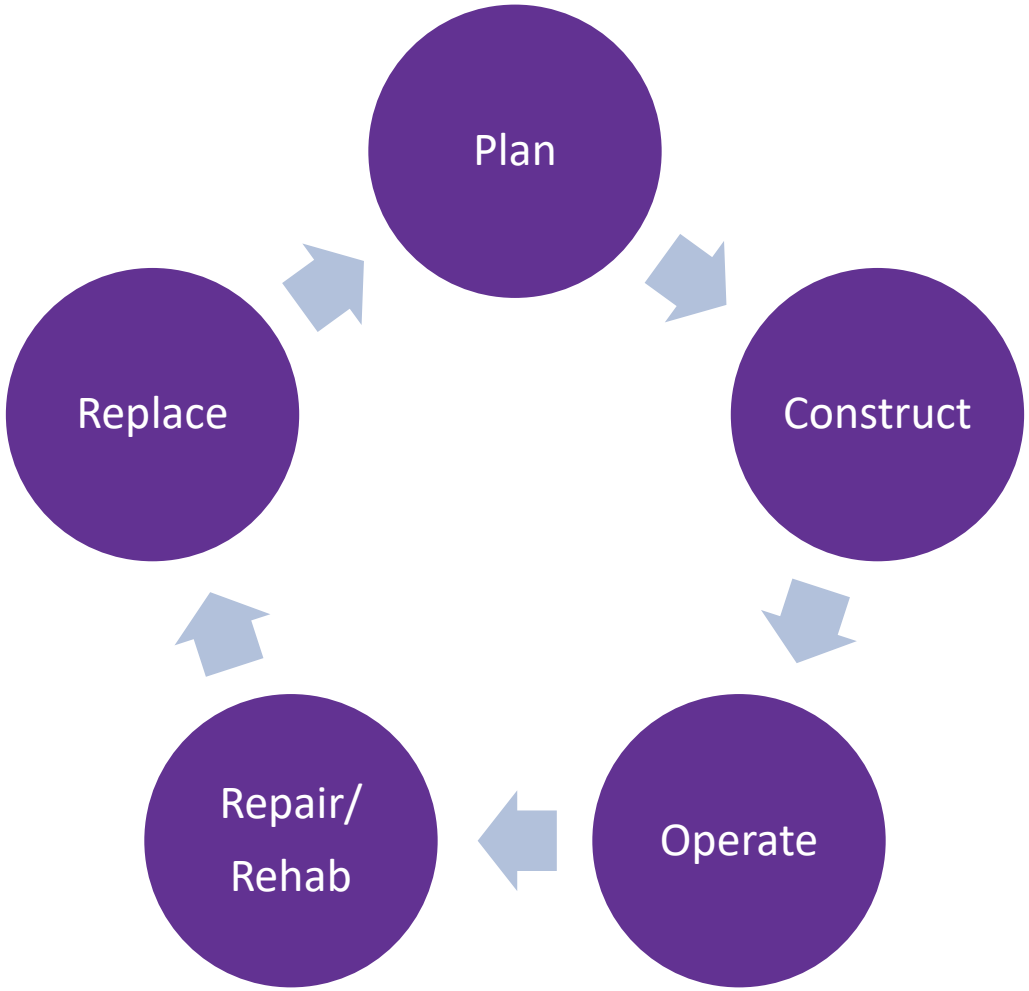
Plant, equipment, buildings, property, pipelines, infrastructure and other items that have potential or actual value to the organization.

- Typically broken into Qualifying and Non-Qualifying
- Includes non-physical items such as water rights, easements, and data



AWWA Asset Management Definitions Guidebook 2018

Asset Lifecycle



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Types of Assets

Horizontal

- Distribution and Collection Systems
  - Wastewater pipes, manholes, valves, meters, etc.

Vertical

- Treatment and Pump/Lift Stations
  - Motors, MCCs, SCADA, etc.

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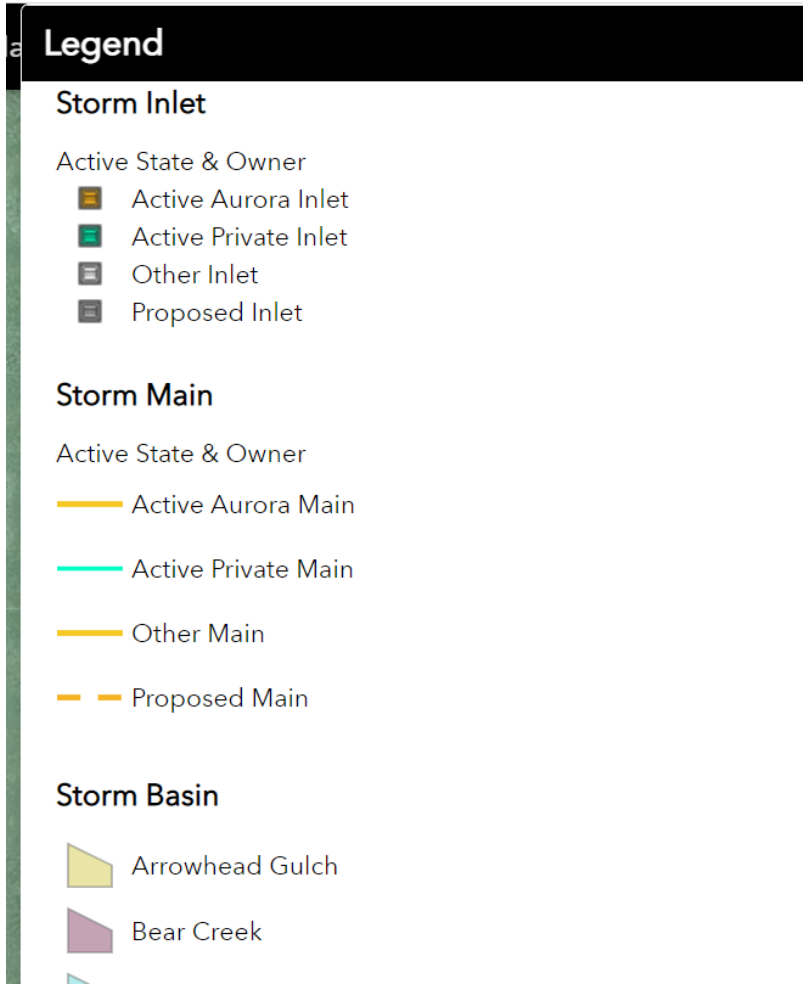
GIS Data for Digital Asset Record

- Spatial Reference
  - Coordinates
  - Projection
- Shapes
  - Points
  - Lines
  - Polygons



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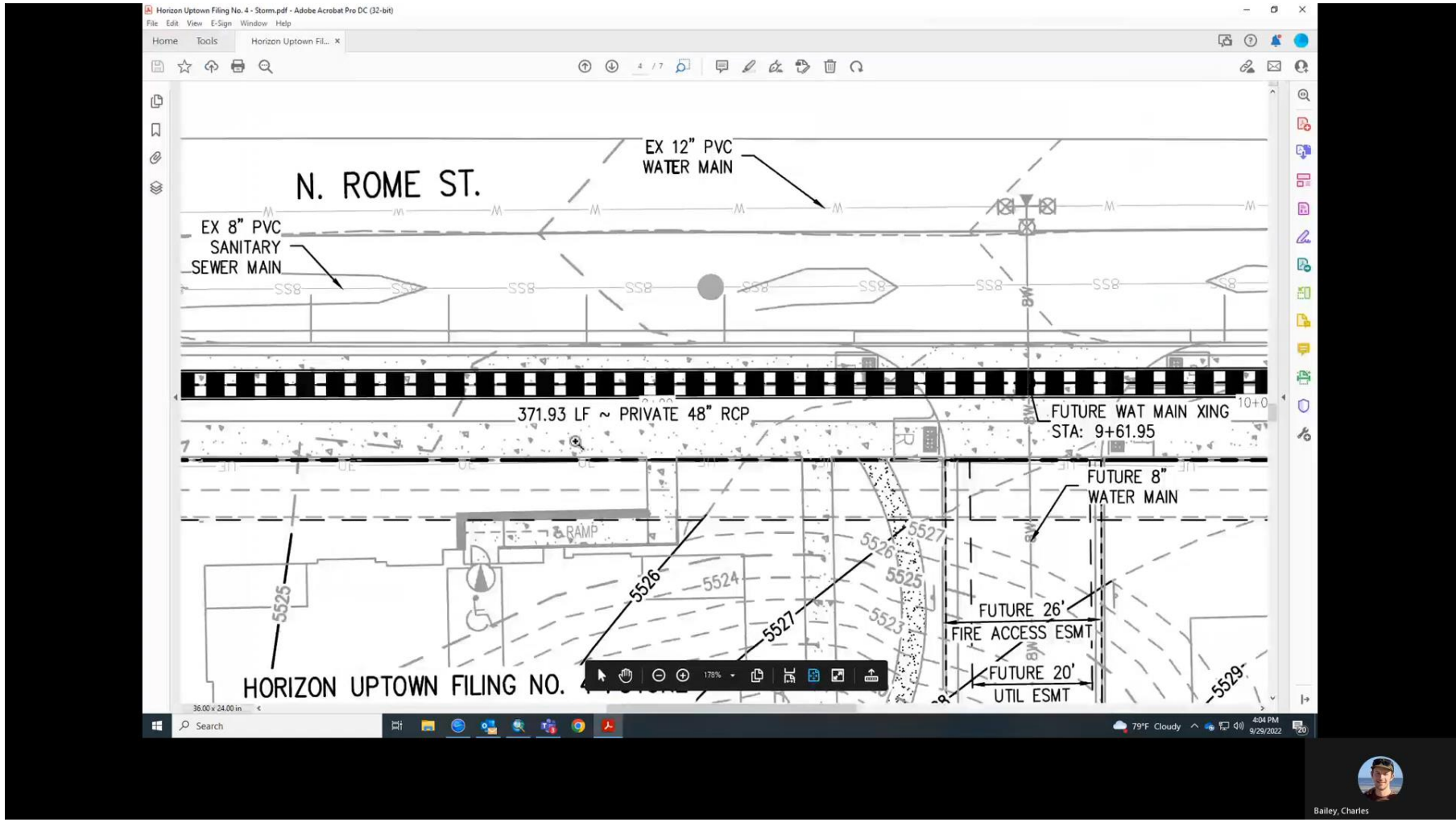
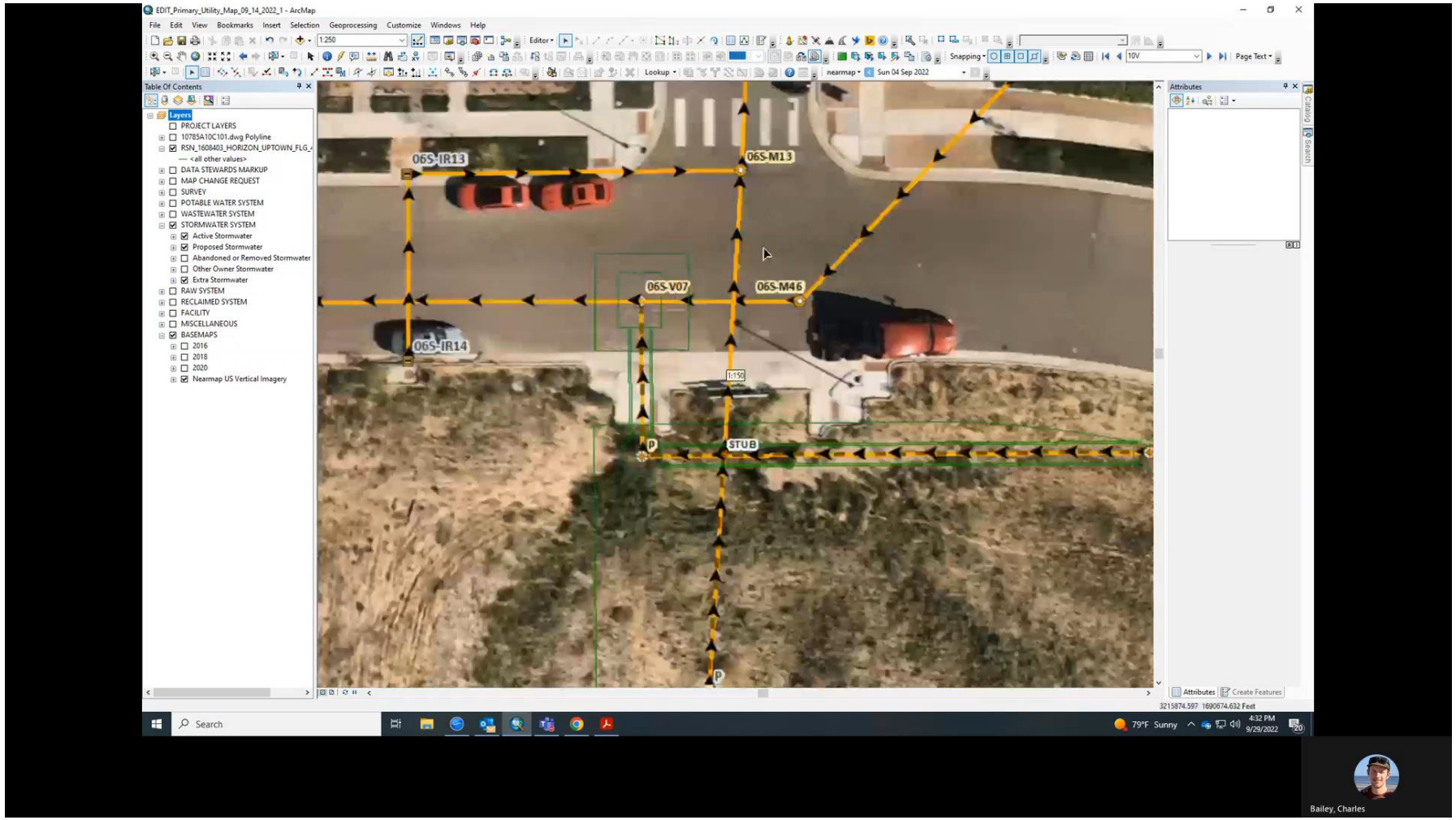
Creating Digital Asset Record in GIS

- North Easting
- CAD
- Survey
  - Professional
  - GNSS



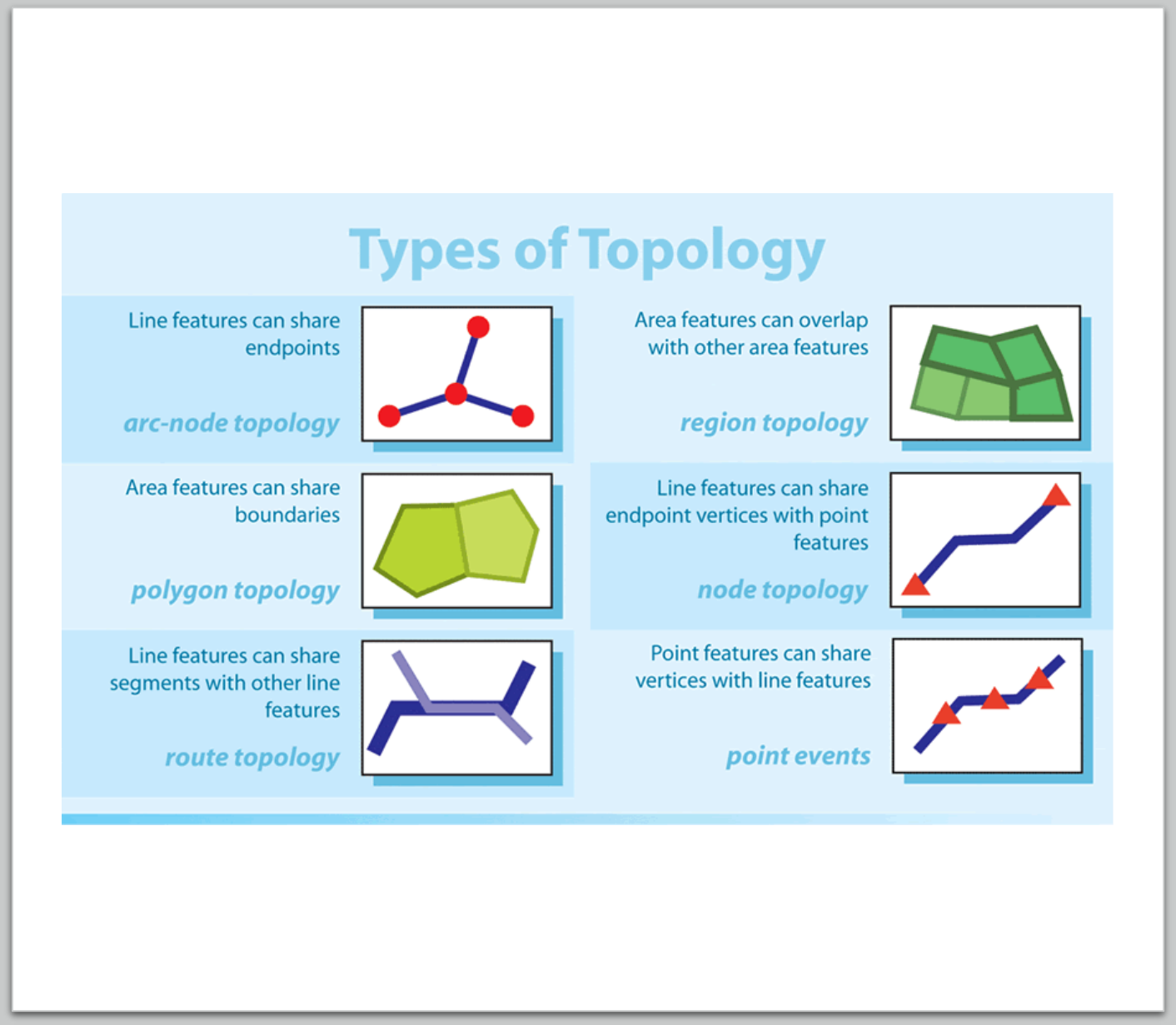
Creating Digital Asset Record in GIS

- Attributes
  - Diameter
  - Material
  - Install Date
  - Inverts



Creating GIS Data

- Topology
  - Connection
  - Direction
  - Alignment

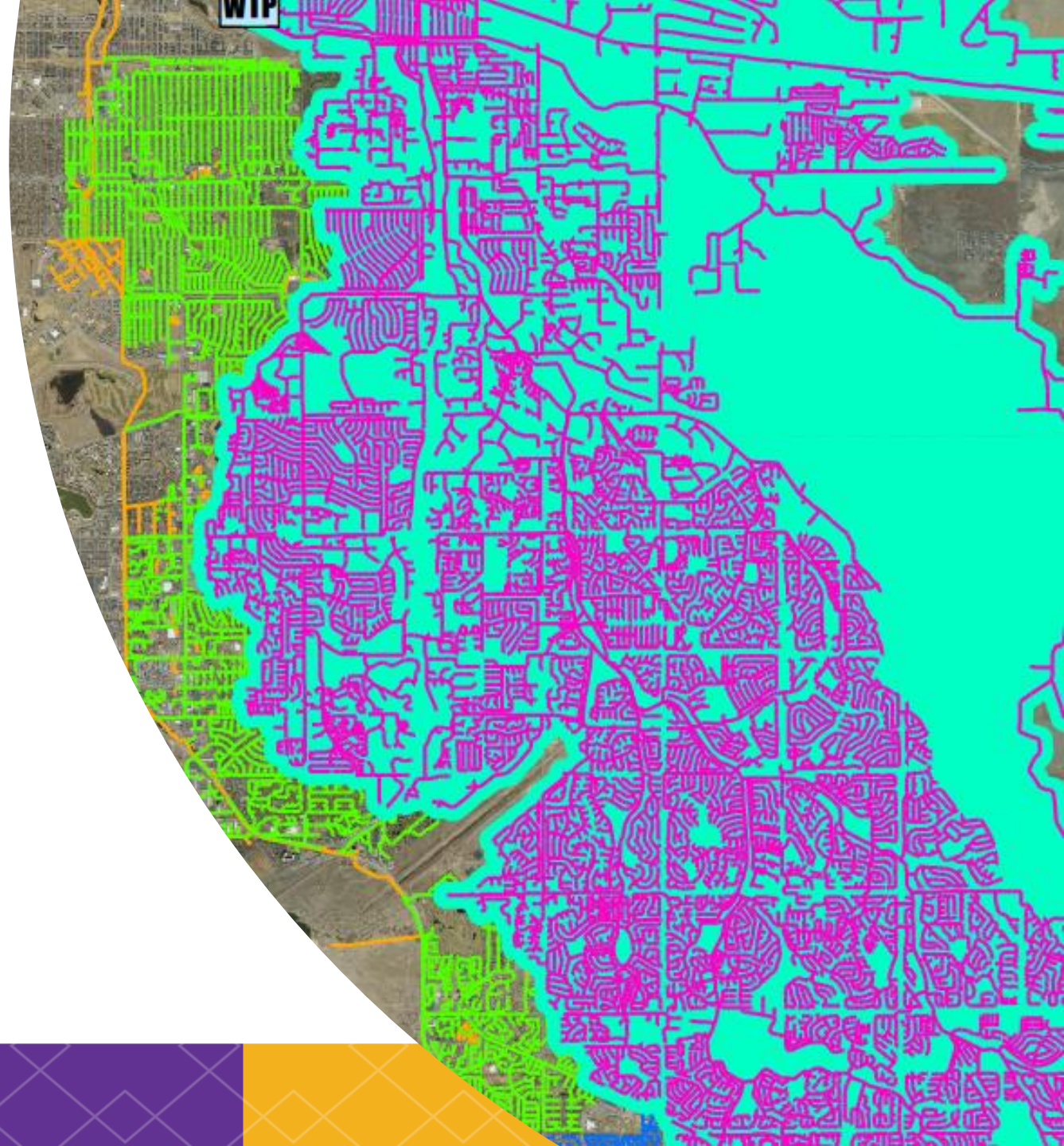


Source: ESRI

NETWORKS AND MODELING

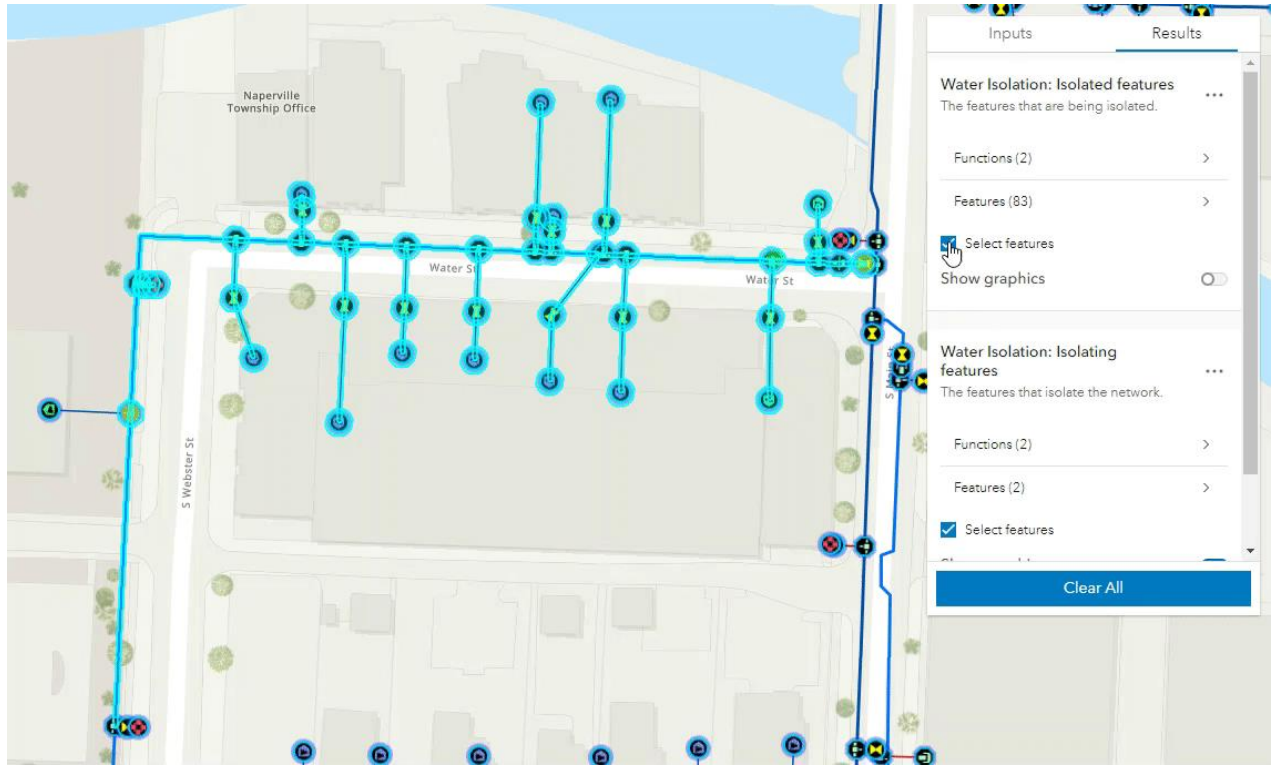
Geometric Network

- Topology + Network Rules
- Allows real world understanding and tracing
  - What is upstream of SSO?
  - How many people rely on this lift station?
- Requires GIS license and hefty computer



Utility Network

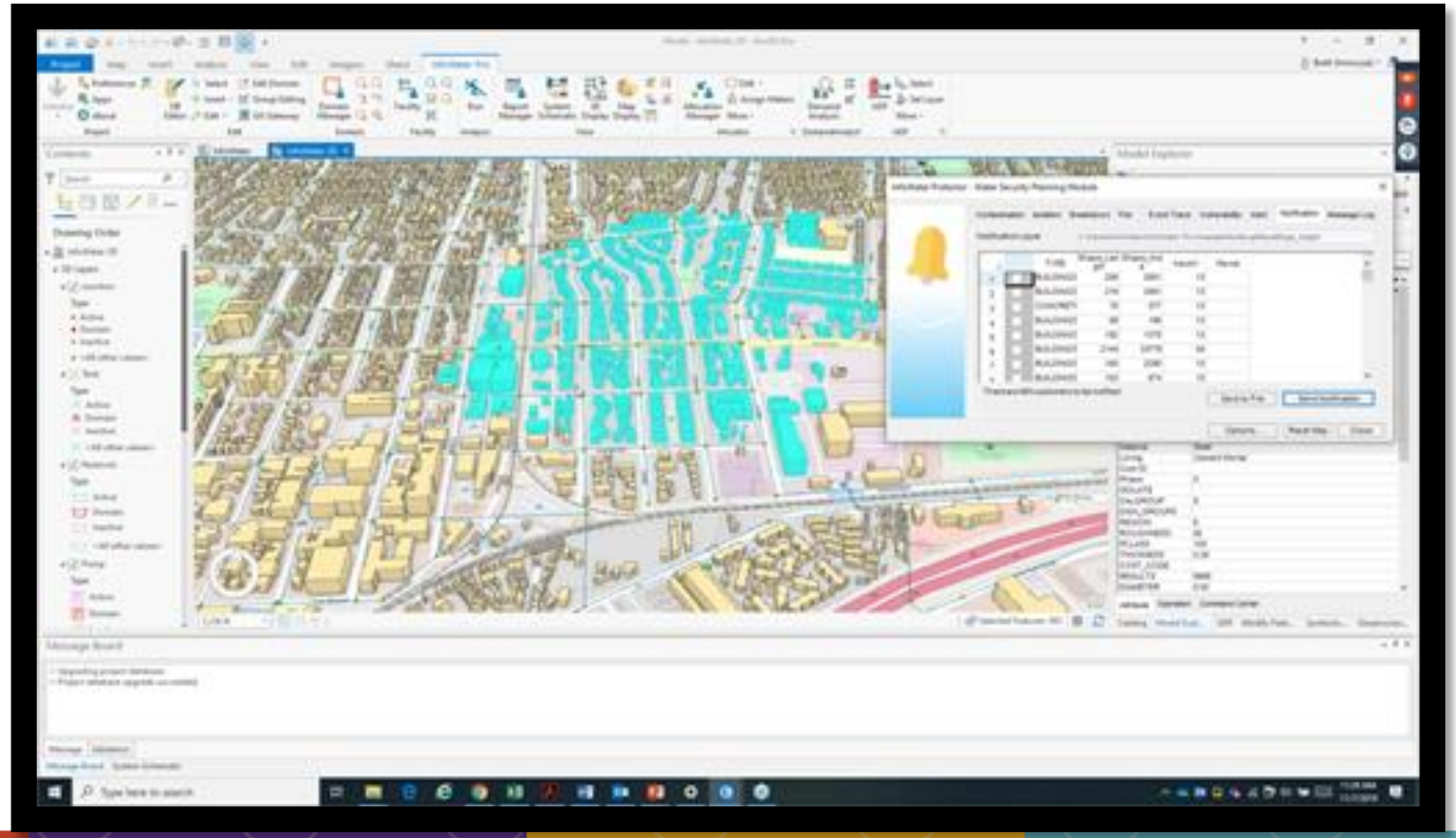
- New
- Light hydraulic model based on geometric network framework
- Anyone can run a trace on any device, including mobile, quickly
  - What customers are out of service?
  - What valves do I need to close to isolate this pipe segment?



Source: ESRI

Hydraulic Models

- Mathematical model that allows for the simulation of real-world situations
  - New Developments
  - Pipe breaks
- Requires Hydraulic Modeling license and hefty computer



Source: Innovyze

MOBILE AND WEB SOLUTIONS

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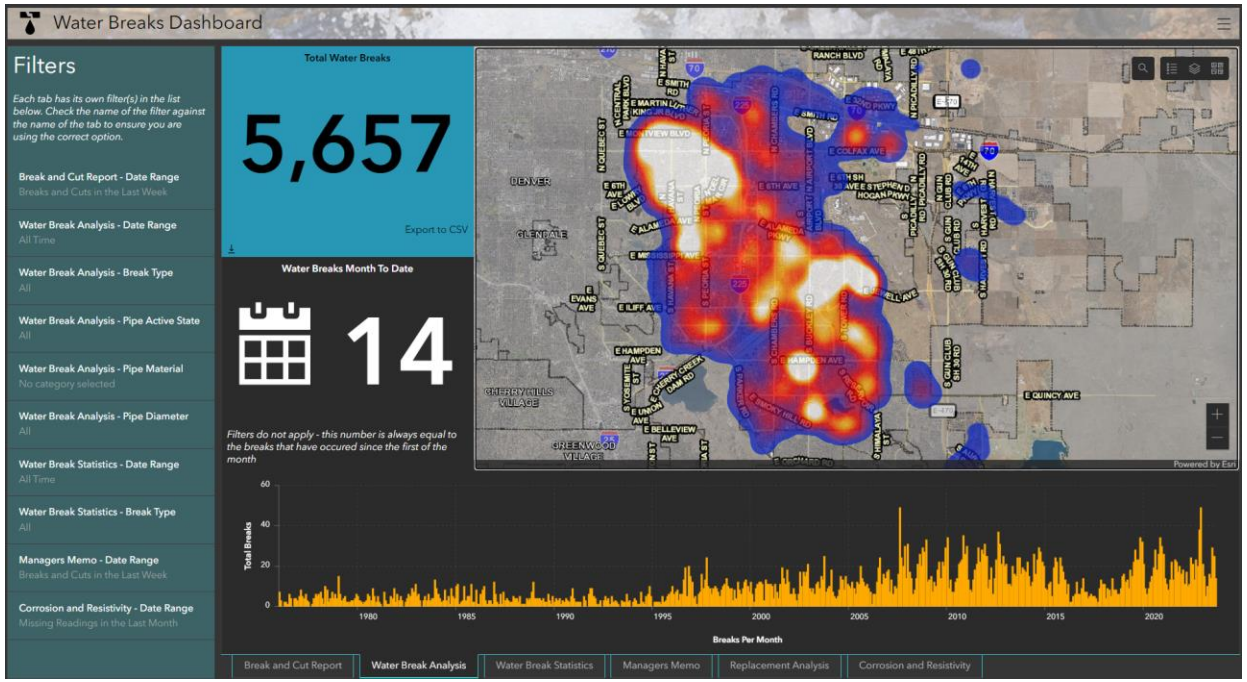
Mobile and Web Solutions



GIS provides a foundation to quickly create and deploy mobile solutions to help utilities

- Out of Service
- Water Breaks
- Inspections
  - Hydrants
  - Manholes
- Planning Coordination

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WHAT'S NEXT?

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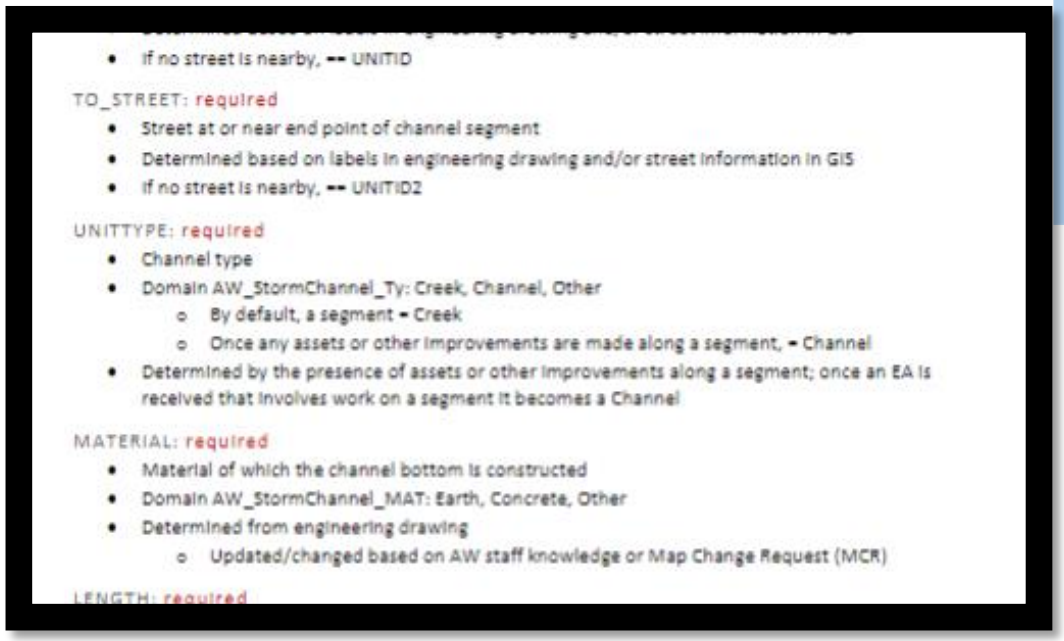
Data Standardization

- Quick to spin up solutions
- Low tech background



- If no street is nearby, == UNITID

TO_STREET: required

- Street at or near end point of channel segment
- Determined based on labels in engineering drawing and/or street information in GIS
- If no street is nearby, == UNITID2

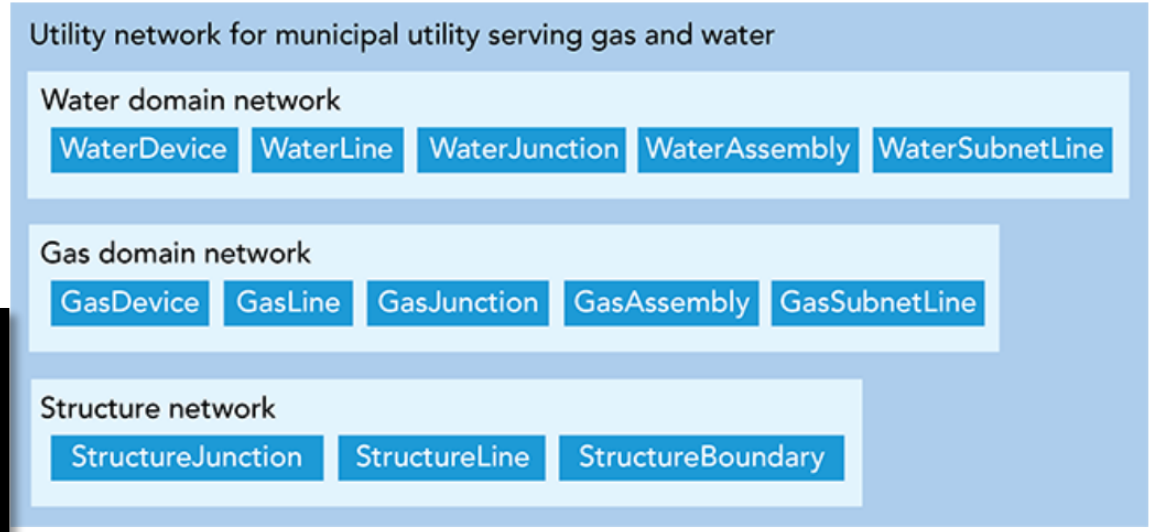
UNITTYPE: required

- Channel type
- Domain AW_StormChannel_Ty: Creek, Channel, Other
  - By default, a segment = Creek
  - Once any assets or other improvements are made along a segment, = Channel
- Determined by the presence of assets or other improvements along a segment; once an EA is received that involves work on a segment it becomes a Channel

MATERIAL: required

- Material of which the channel bottom is constructed
- Domain AW_StormChannel_MAT: Earth, Concrete, Other
- Determined from engineering drawing
  - Updated/changed based on AW staff knowledge or Map Change Request (MCR)

LENGTH: required



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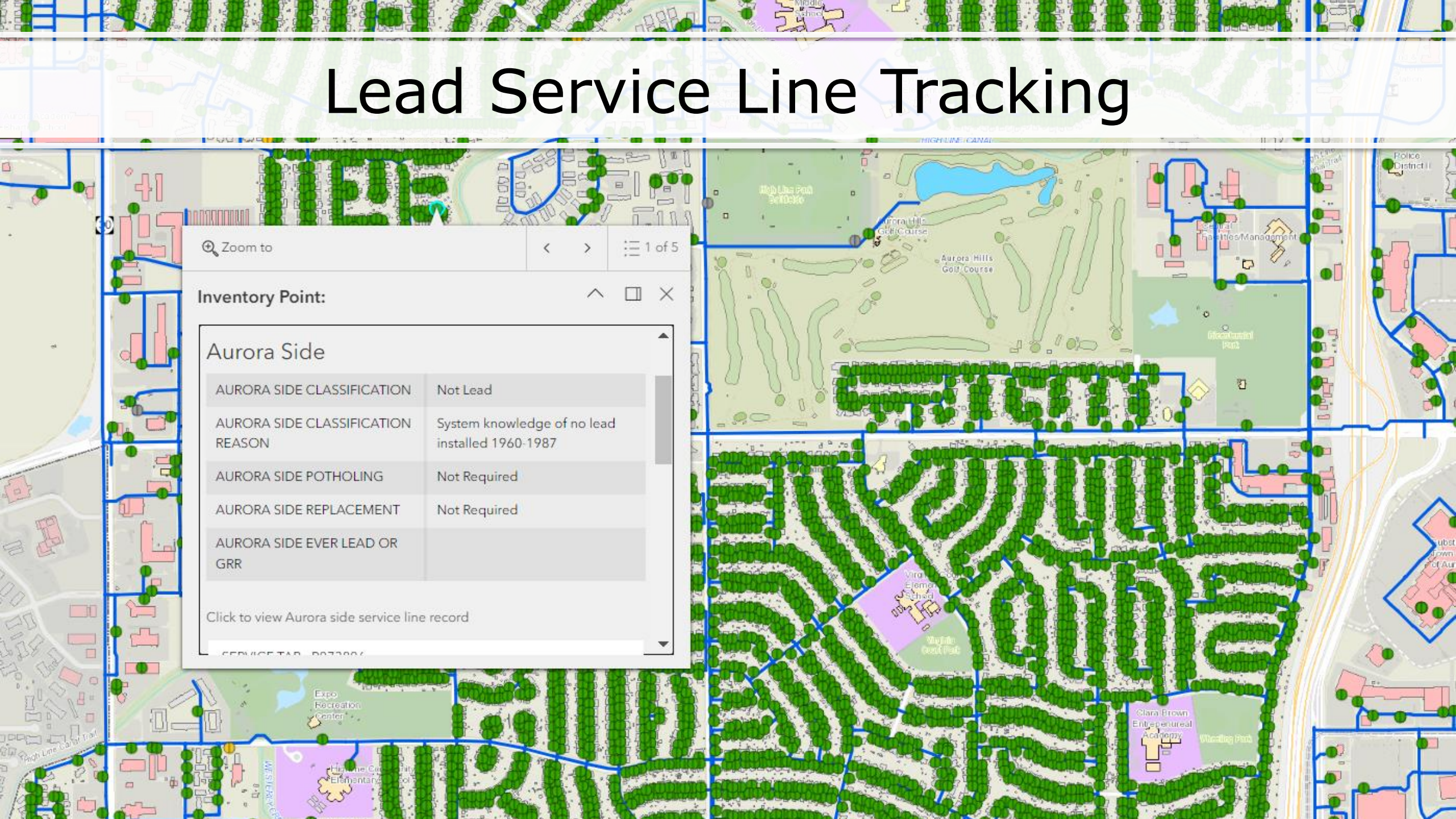
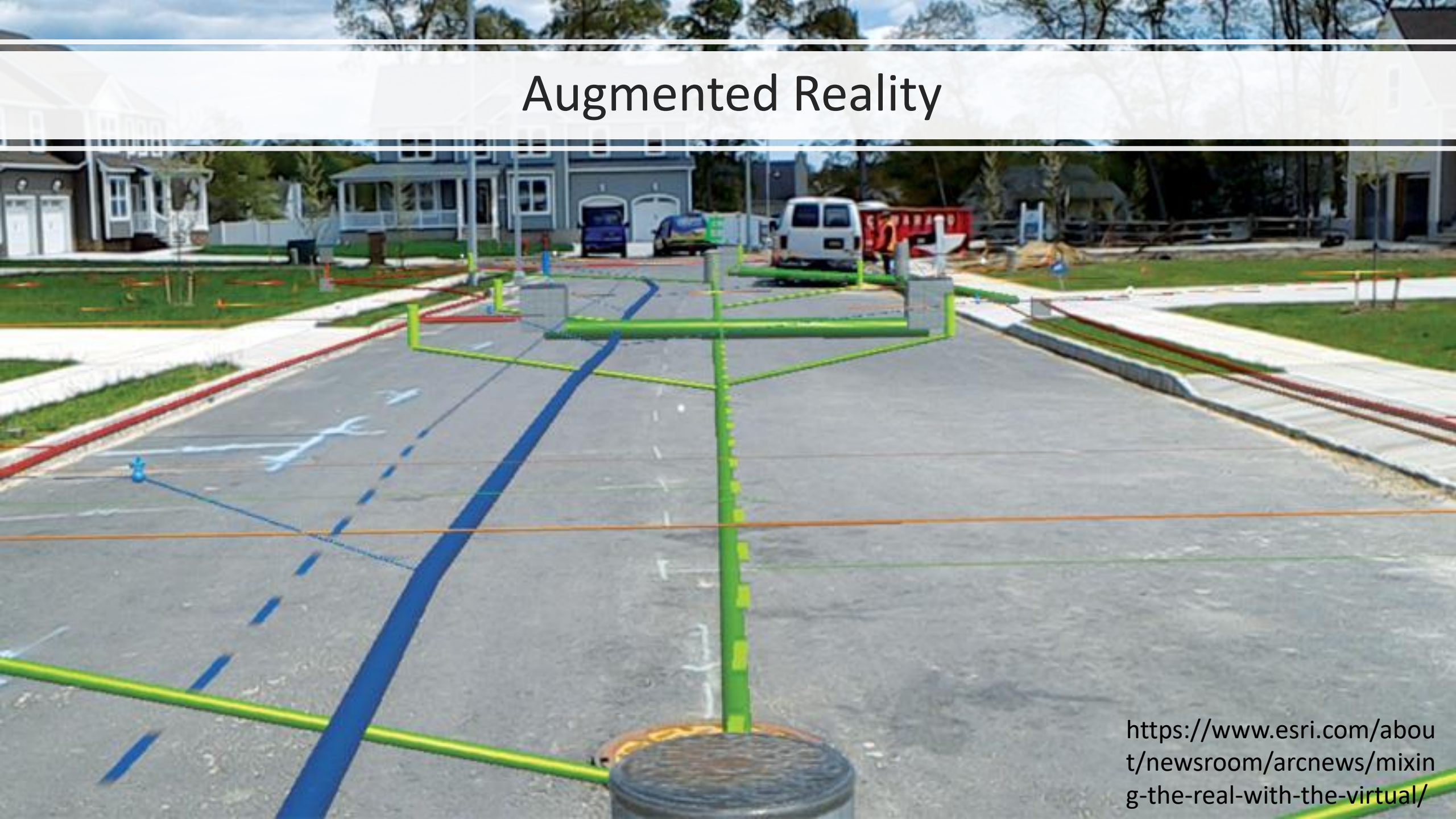
Source: ESRI

Lead Service Line Tracking

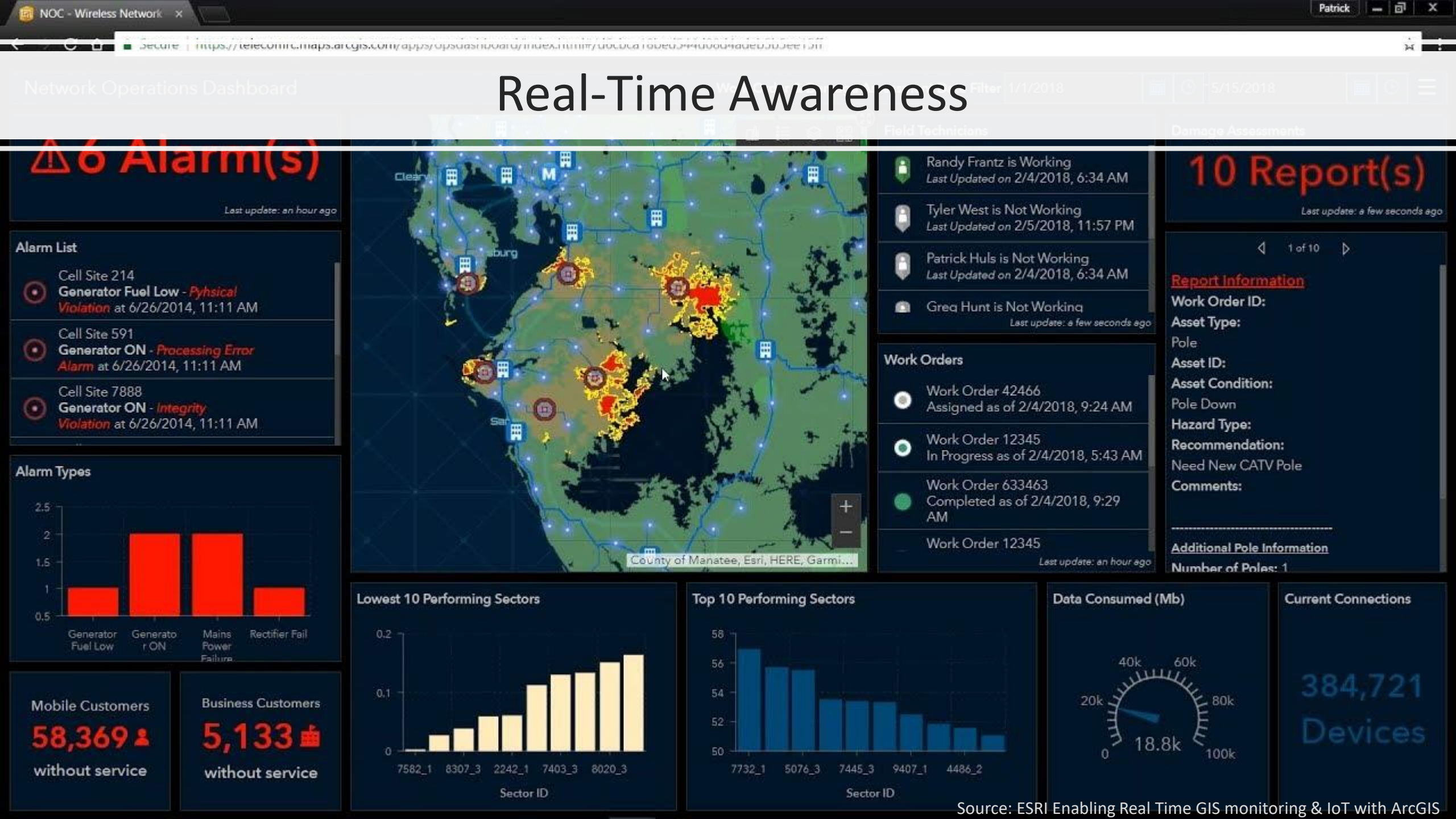


Augmented Reality

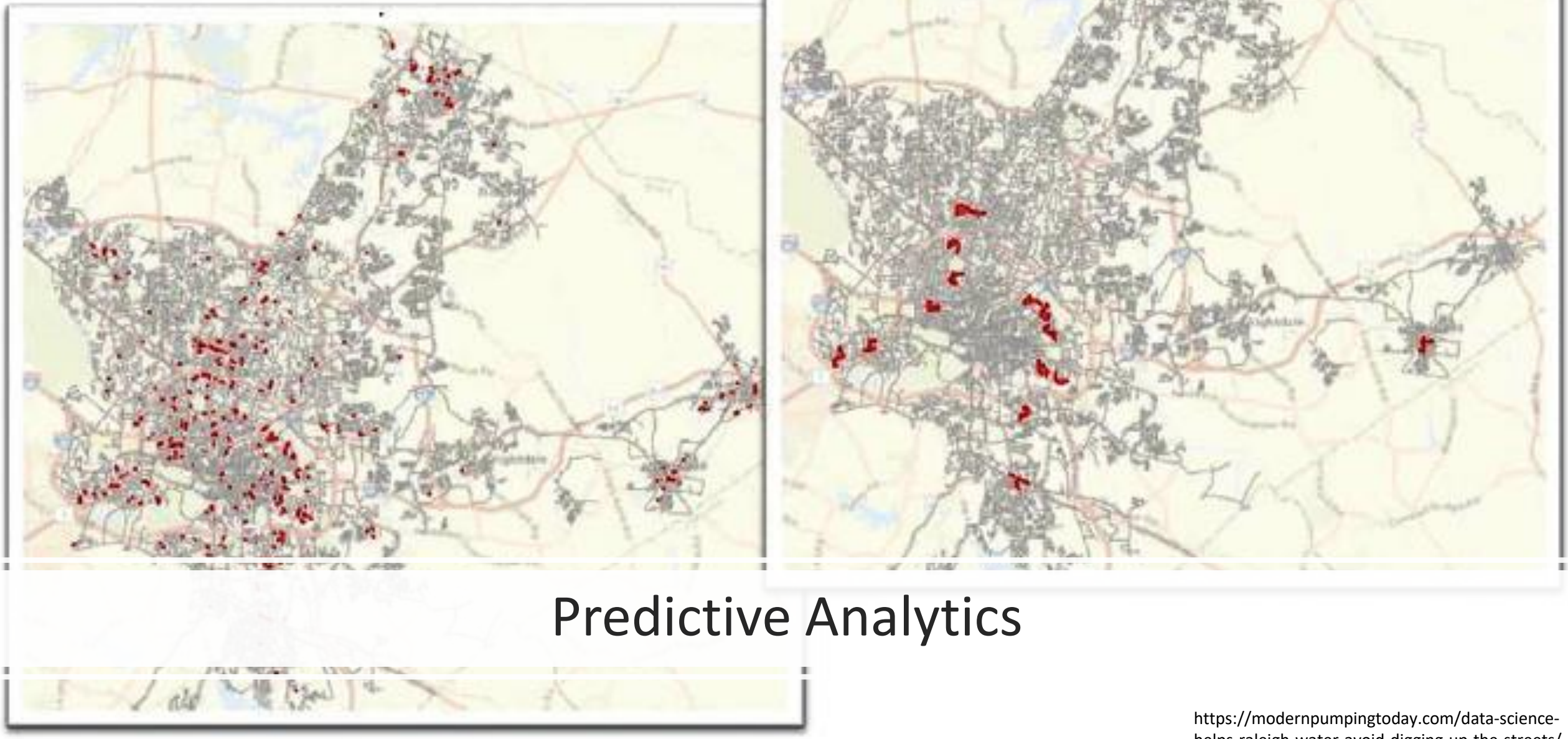


https://www.esri.com/about/newsroom/arcnews/mixing-the-real-with-the-virtual/

Real-Time Awareness

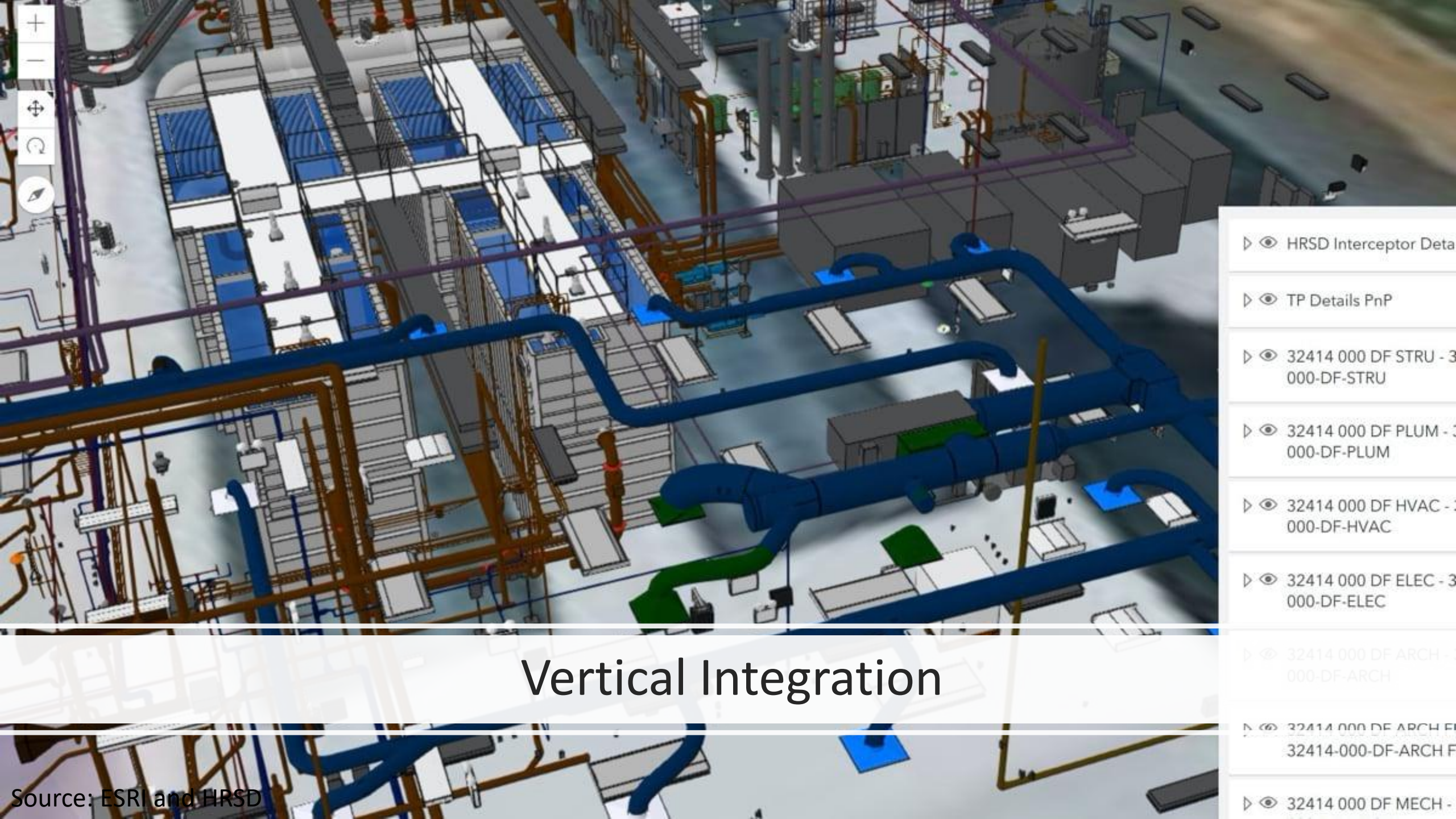


Source: ESRI Enabling Real Time GIS monitoring & IoT with ArcGIS



Predictive Analytics

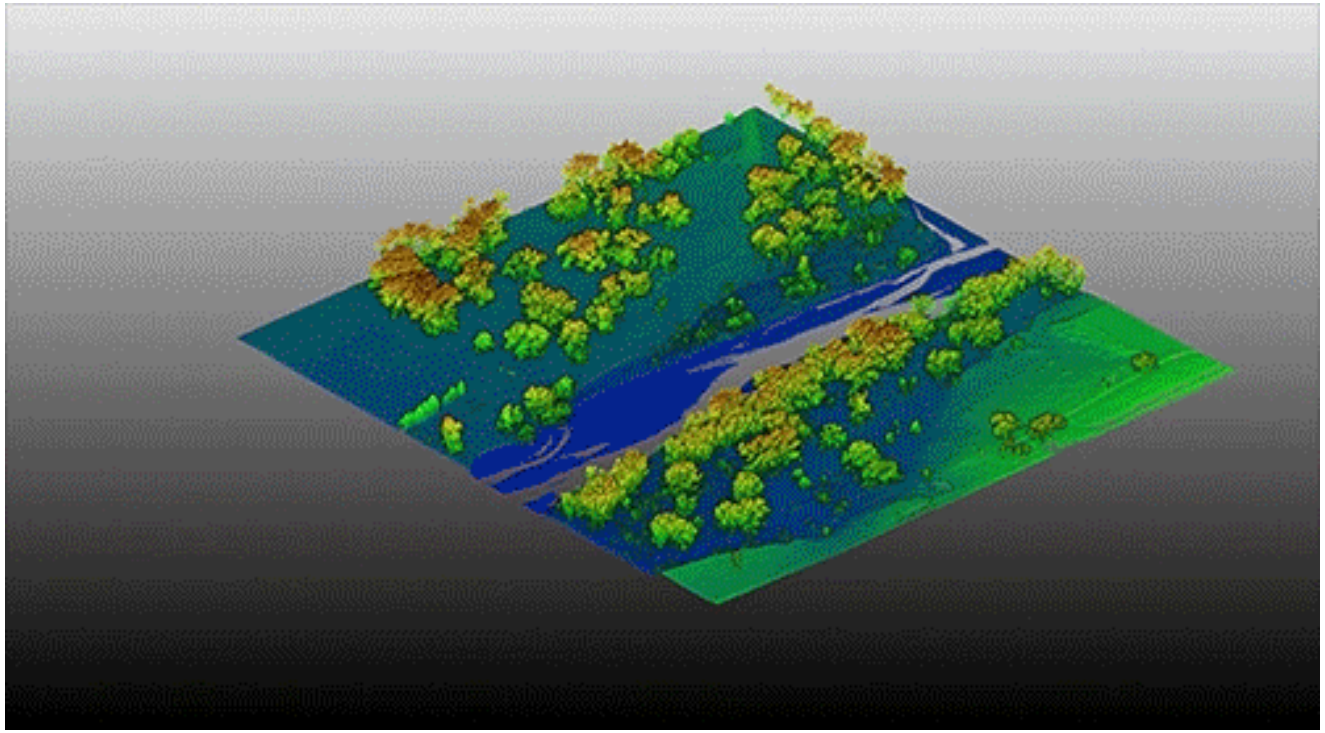
https://modernpumpingtoday.com/data-science-helps-raleigh-water-avoid-digging-up-the-streets/



Vertical Integration

Source: ESRI and HRSD

Drones



USGS + Colorado Springs Utilities Case Study

<u>Old way</u>

9 days of work → 3,000 survey points

<u>Drone way</u>

20 minutes of work → 46 million survey points

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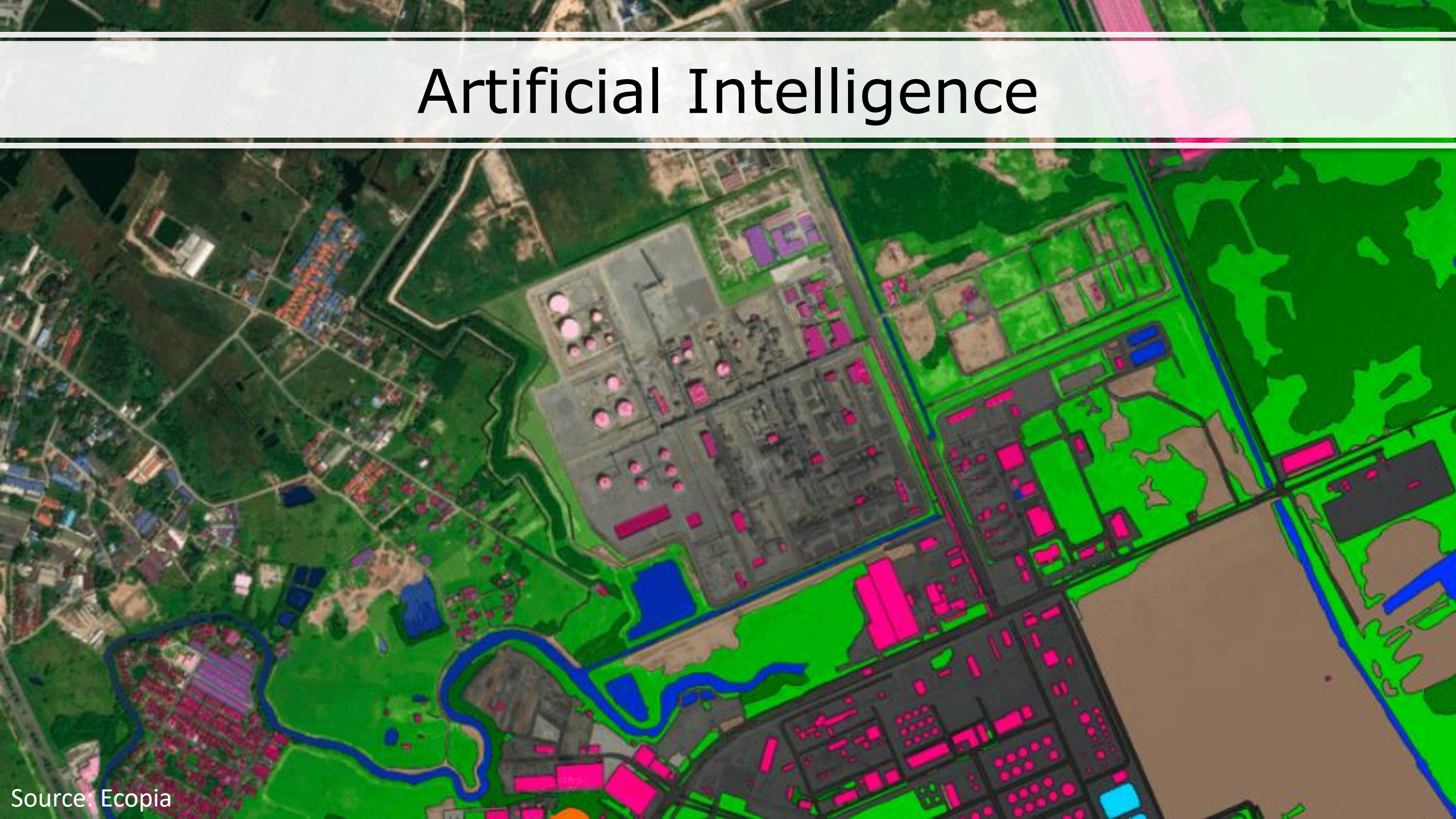
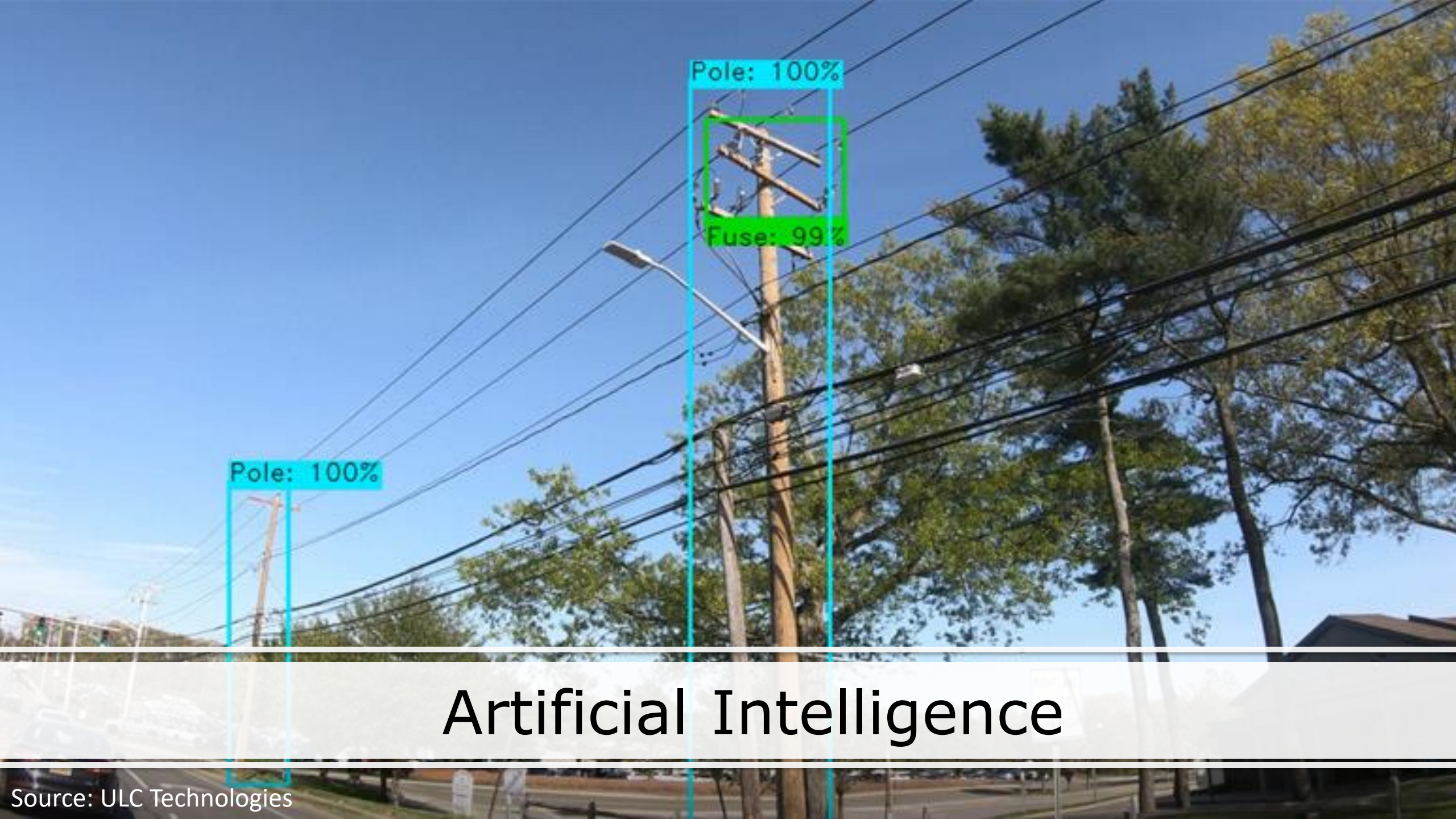
Source: USGS

Artificial Intelligence



Source: Ecopia



Artificial Intelligence

Source: ULC Technologies

REVIEW

- We use GIS every day
- GIS data is critical to water utilities for managing assets
- GIS is an important investment for utilities.
- Modeling is critical in planning
- AI and Drones are the future!

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QUESTIONS?

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