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**INFORMED
INFRASTRUCTURE**
The magazine for civil & structural engineers

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Advancing AEC Industry Through Digital Twins

May 11, 2023



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Introduction



Andy Lovell
Solution Engineer Manager, AEC
Esri



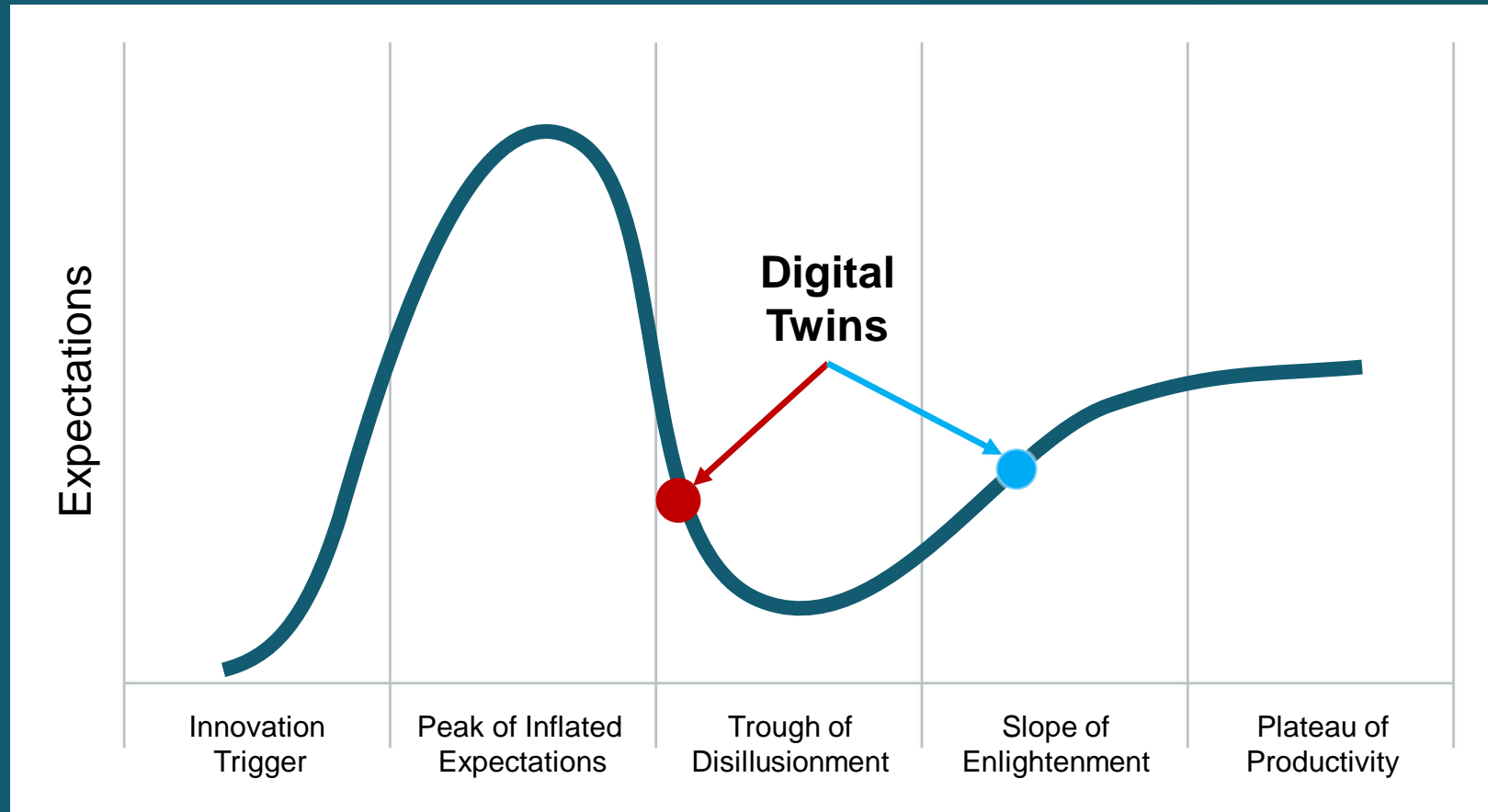
Christine Ma
Urban Planning Practice Lead,
Built Environment
Esri

Digital Twins are virtual representations of the real world . . .
. . . including physical objects, processes, relationships and behaviors.

GIS creates digital twins of the social, natural and built environment . . .
. . . and uniquely integrates many types of digital models.

Gartner Hype Curve

We're entering the 'Trough of Disillusionment'



Adapted from "Spatial Digital Twins: Global Status, Opportunities, and the Way Forward", WGIC 2022, pg 12.

Infrastructure Investments

United States example Infrastructure Investment and Jobs Act (IIJA)



Roads & Bridges
\$110B



Electric Grid Upgrade
\$73B



Passenger & Freight Rail
\$66B



Broadband
\$65B



Improved Water Quality
\$55B



Climate Change Protection
\$50B



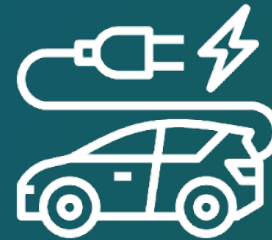
Airports & Ports
\$42B



Public Transit
\$39B



Environmental Clean-Up
\$21B



Electric Vehicles
\$15B



Transportation Safety
\$11B



Reconnecting Communities
\$1B

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\$12.7B

Estimated Total Industry
Value

2021

\$8B

Market for the
Geospatial Industry

\$48B

Estimated Total Industry
Value

2026

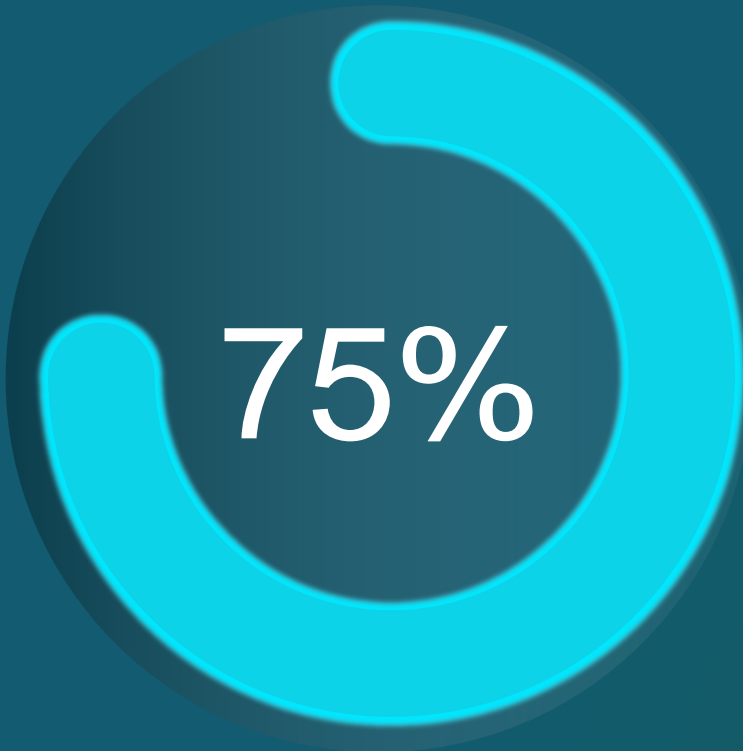
\$25B

Market for the
Geospatial Industry

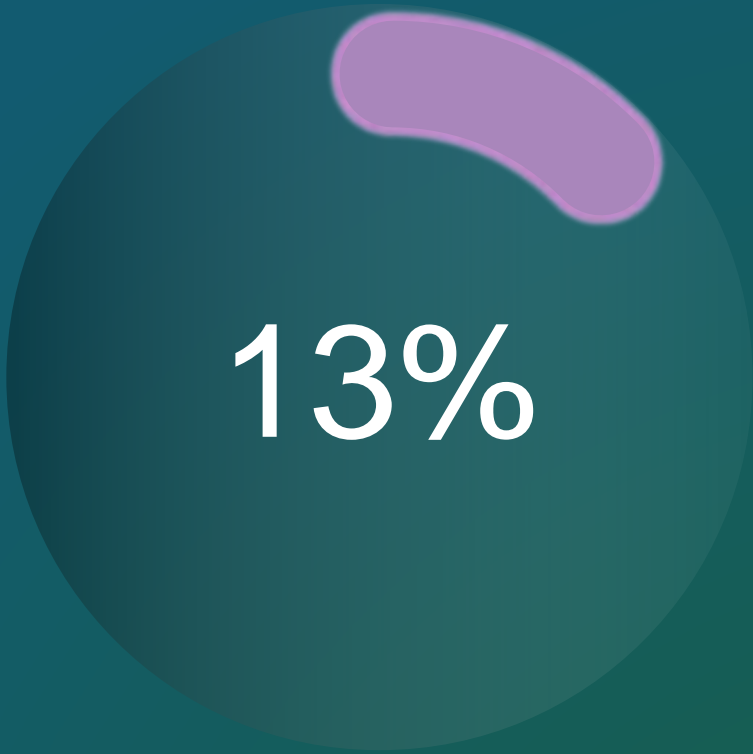
Gartner[®]

WGIC
World Geospatial Industry Council

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Use or Plan to use
Digital Twins



Are Using a Type
of Digital Twin



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Building from Existing Approaches

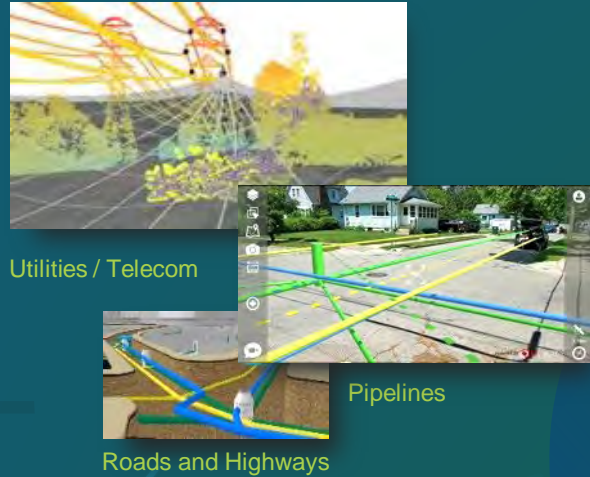
Twins are Abstracting and Modeling Everything

Facilities or Buildings (BIM)



Facilities / Indoors

Networks (NIM)



Utilities / Telecom

Pipelines

Roads and Highways

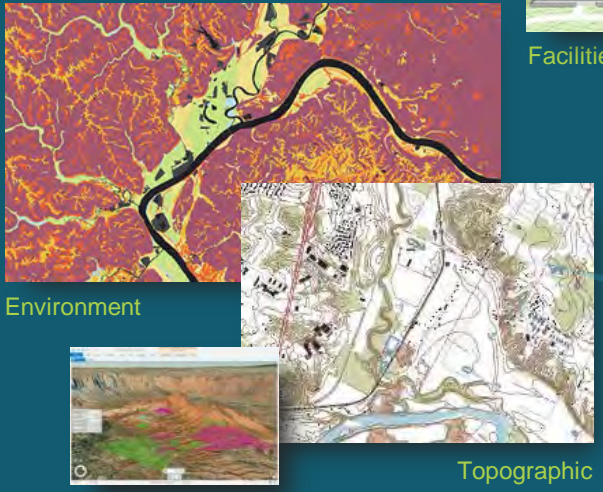
Cities (CIM)



Smart City

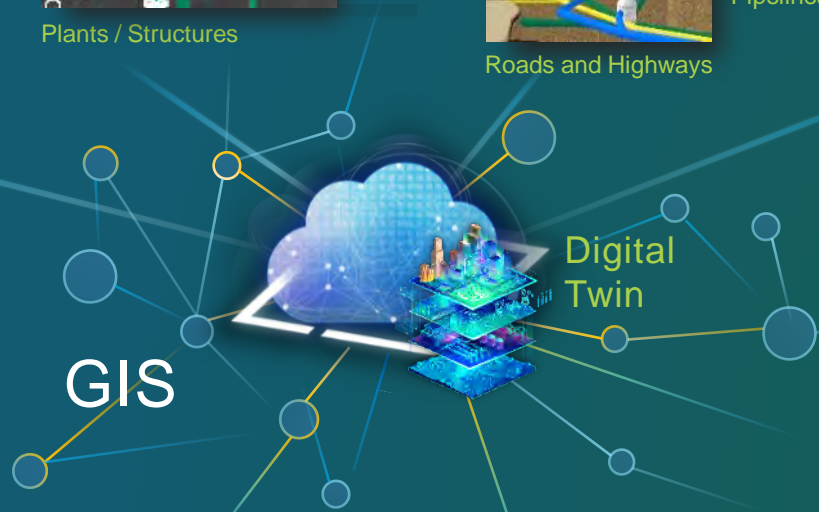
Planning

Landscapes (LIM)



Environment

Topographic



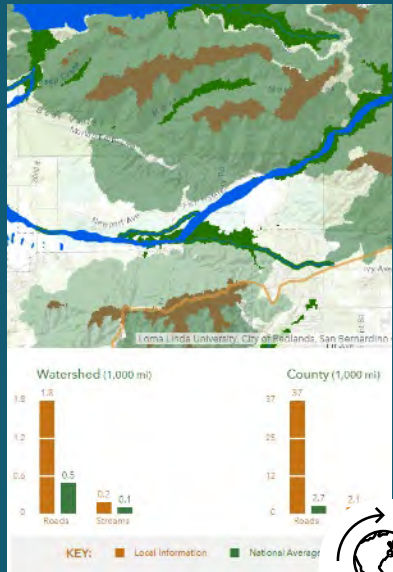
*GIS is the framework for . . .
. . . Creating & Integrating Twins*

ArcGIS

A Foundation for Digital Twins



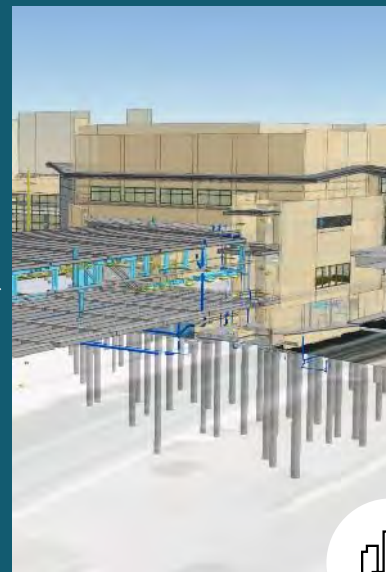
Esri's Digital Twin Platform



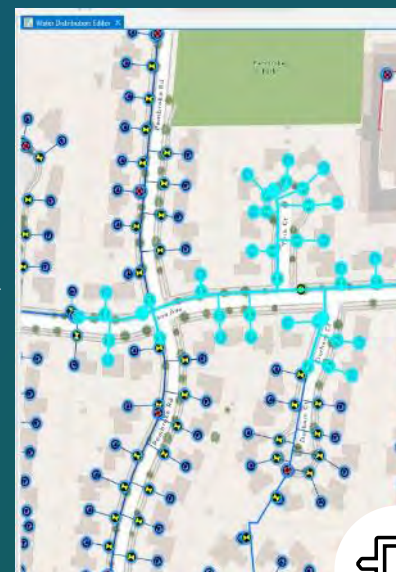
Environmental



Spatial
Planning



Design /
Construction



Network

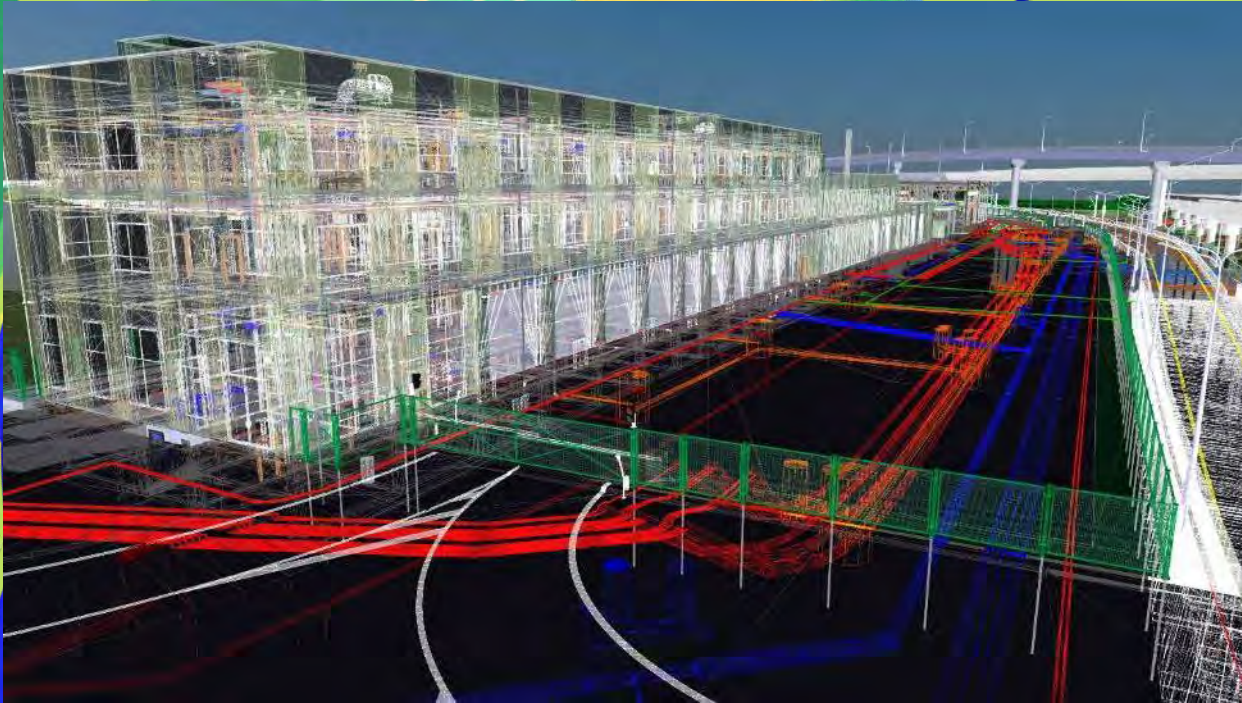


Operations



Reality Capture & Data Integration





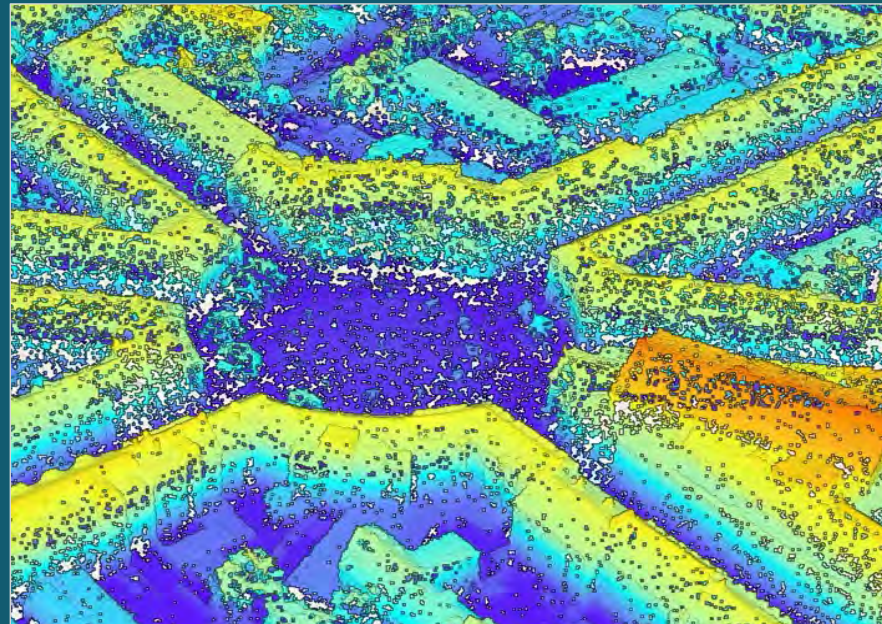
Reality Capture



Reality Capture

- Provide an aggregated overview of original captures and their metadata (airborne or drone imagery and LiDAR captures)
- Quickly create flight plans that are relevant to type of site or asset being captured
- Cloud Processing to generate 3D Meshes (SLPK), True Ortho, DIM PointClouds

Primary applications:



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1 Reality Capture Video.mp4

ArcGIS

Enables Outcome-Driven
Digital Twins





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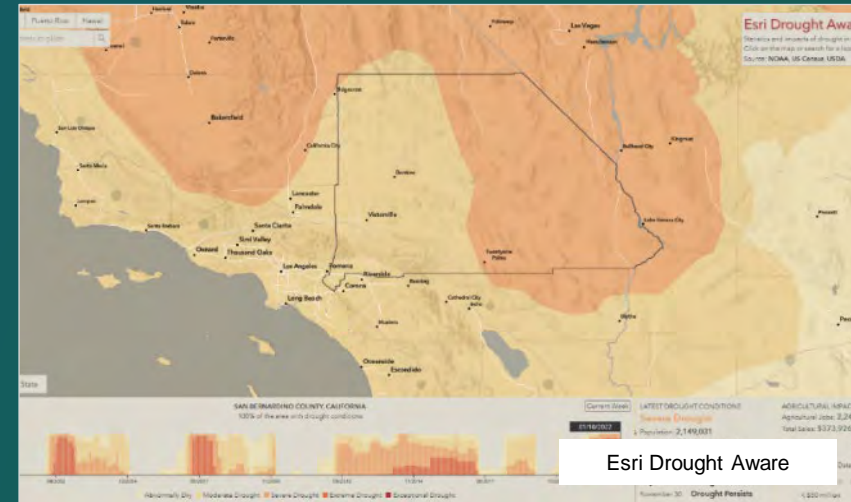
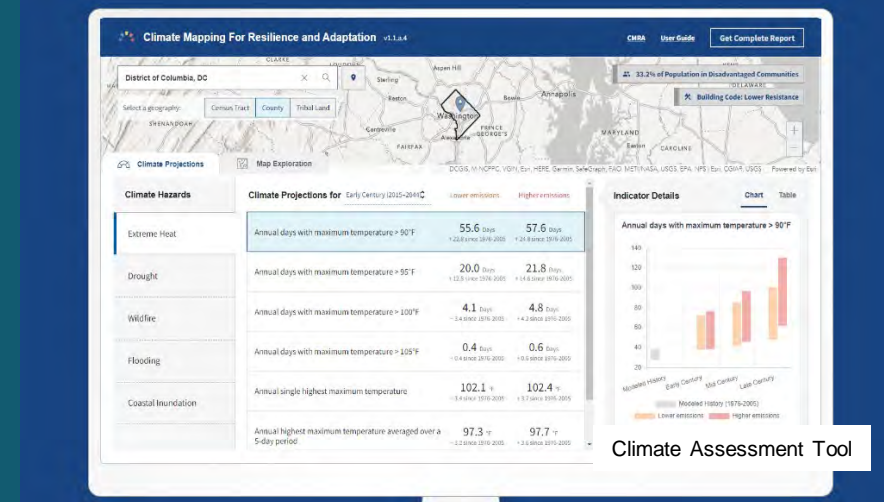
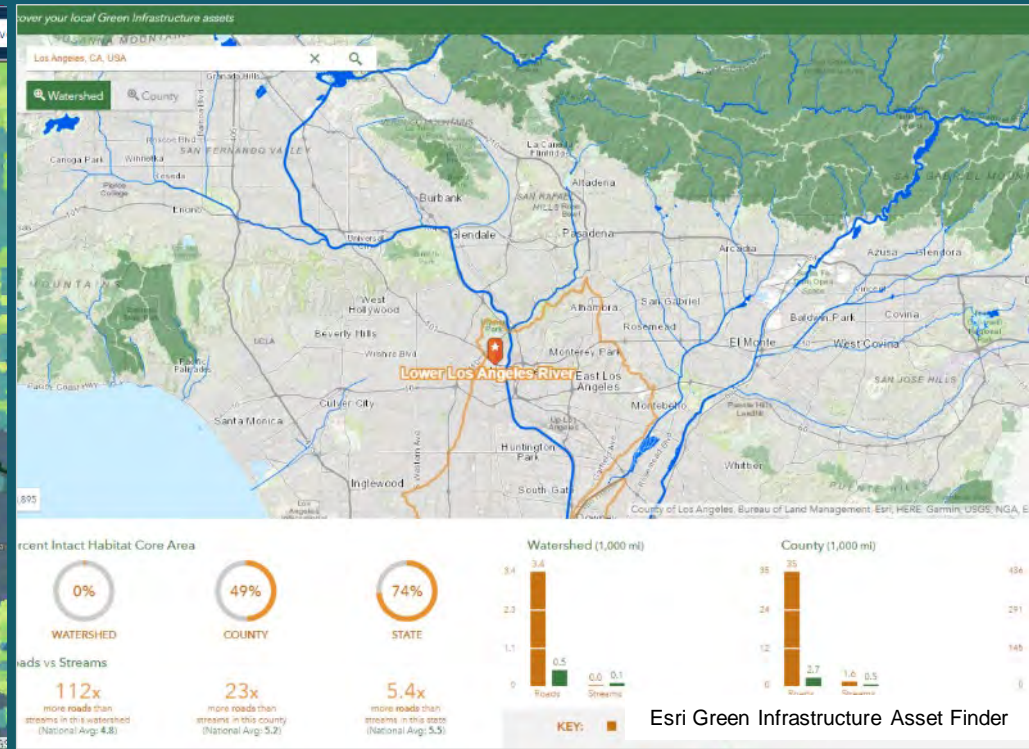
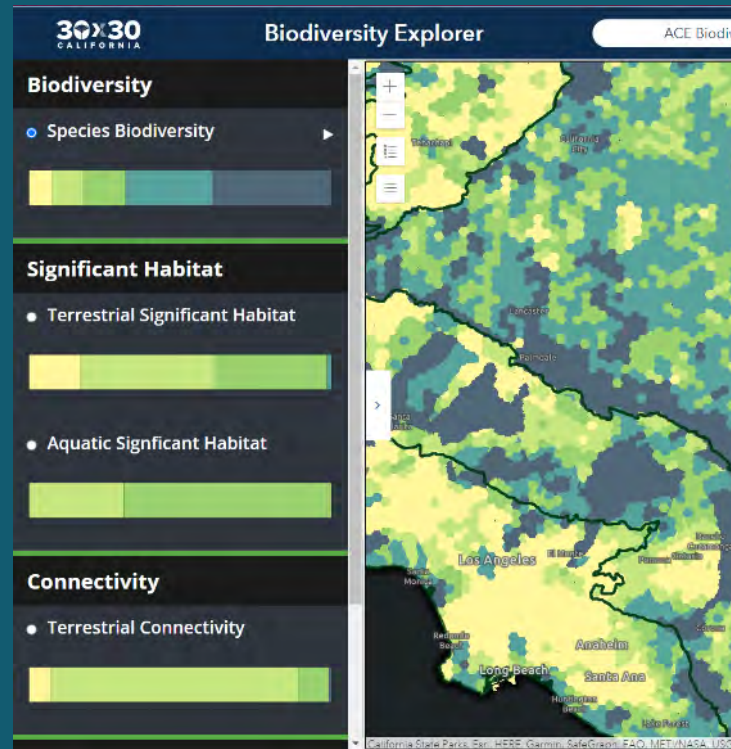
Environmental Digital Twin



Environmental Digital Twin

- Visualize local climate trends / extremes
- Summarize and score environmental vulnerability on Noise, Heat, and Pollution (air, water quality)
- Establish indicators for hazard risk evaluation that show the impacts for ongoing plans and projects
- Measure Sustainability Performance

Primary applications:

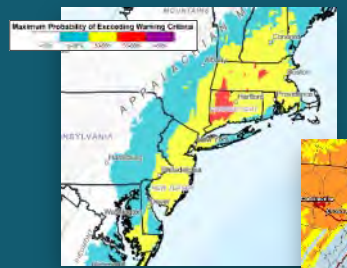




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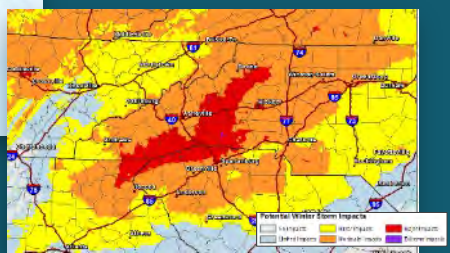
Environmental Digital Twin

Winter Storm
Forecasting



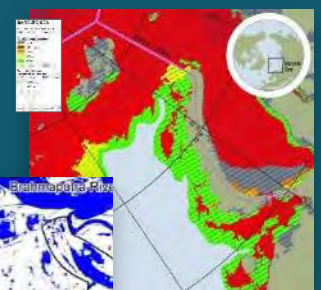
NOAA
Eastern US

Impact Assessment



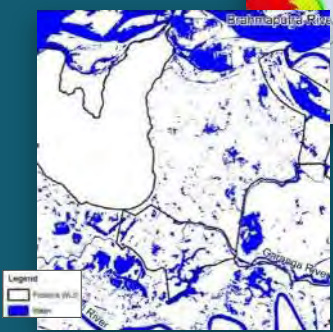
North & South Carolina

Sea Ice Monitoring



US National
Ice Center
Barents Sea

Monitoring
Waterbodies
& Grasslands



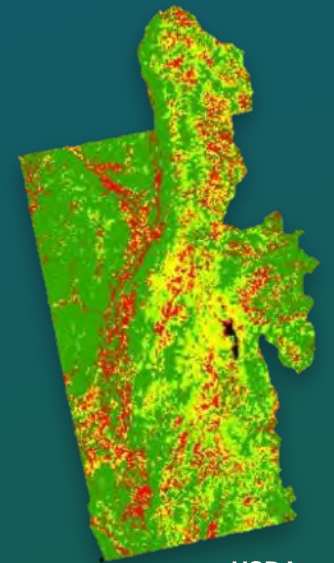
WWF India
India

Managing Safe Water Access



Indian Health Service
Navajo Nation

Modeling
Soil Drainage



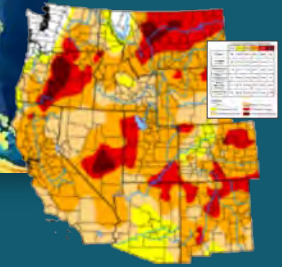
USDA
Green Mountain
National Forest,
Vermont

Drought Forecasting



Argonne National Laboratory
US

Drought
Monitoring



US Bureau of
Reclamation
Western US

Flow Prediction



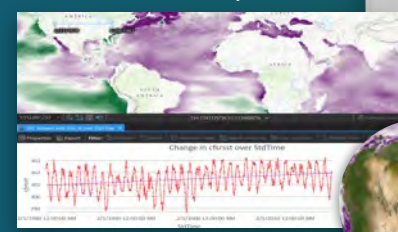
NOAA
US

Flood Forecasting



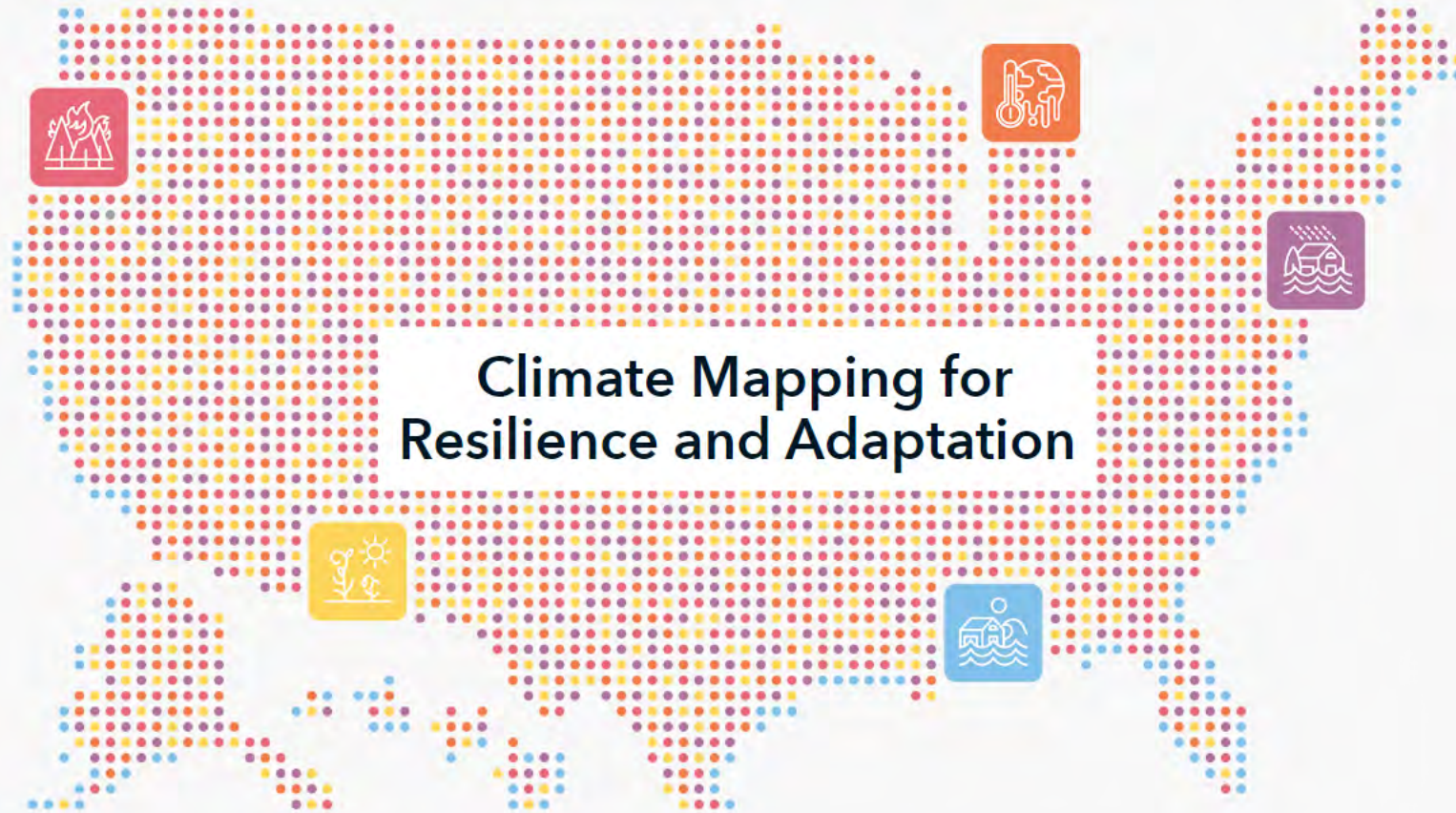
Texas

Sea Surface Temperature



NOAA | NASA
Global





Climate Mapping for Resilience and Adaptation

Knowing which hazards could harm the things you care about is the first step in protecting them. This portal can help you understand what climate-related hazards you face, now and in the future.

- View real-time maps showing where climate-related hazards are occurring today
- Check how your exposure to five common climate-related hazards is projected to change over time
- Learn more about climate-related hazards and federal policies relevant to climate adaptation
- Find federal funding opportunities that can help pay for climate resilience projects, including those available through the Bipartisan Infrastructure Law



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Planning Twin



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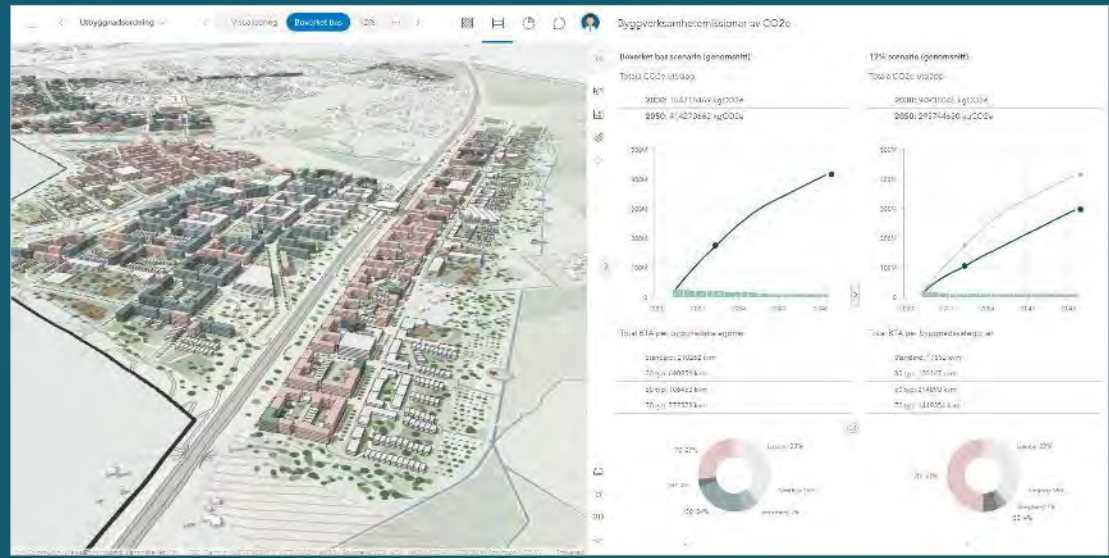
Planning Twin

- Overlay major plans and projects on the citywide mesh basemap
- Design and iterate master plan scenarios based on defined strategies
- Establish KPI dashboards for evaluation (accessibility, financial performance, tax revenue, etc.)
- Create a walkthrough of proposals with Unreal Engine / XR

Primary applications:



ArcGIS Urban, CityEngine, Unreal Engine





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Planning Twin Solutions



PLAN



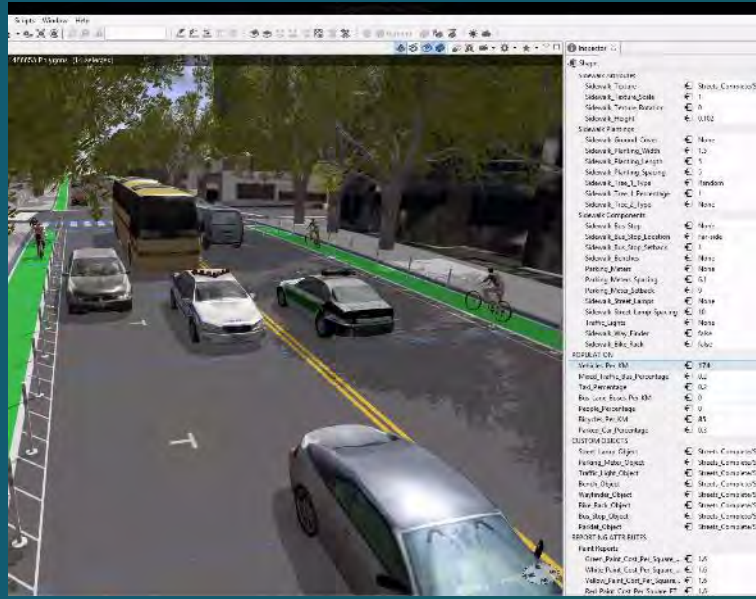
DESIGN



ENGAGE



Designation of uses
Regulation and policy
Impact of development



Design with advanced tools
New streetscaping
Integrate through plugins (New Rhino)



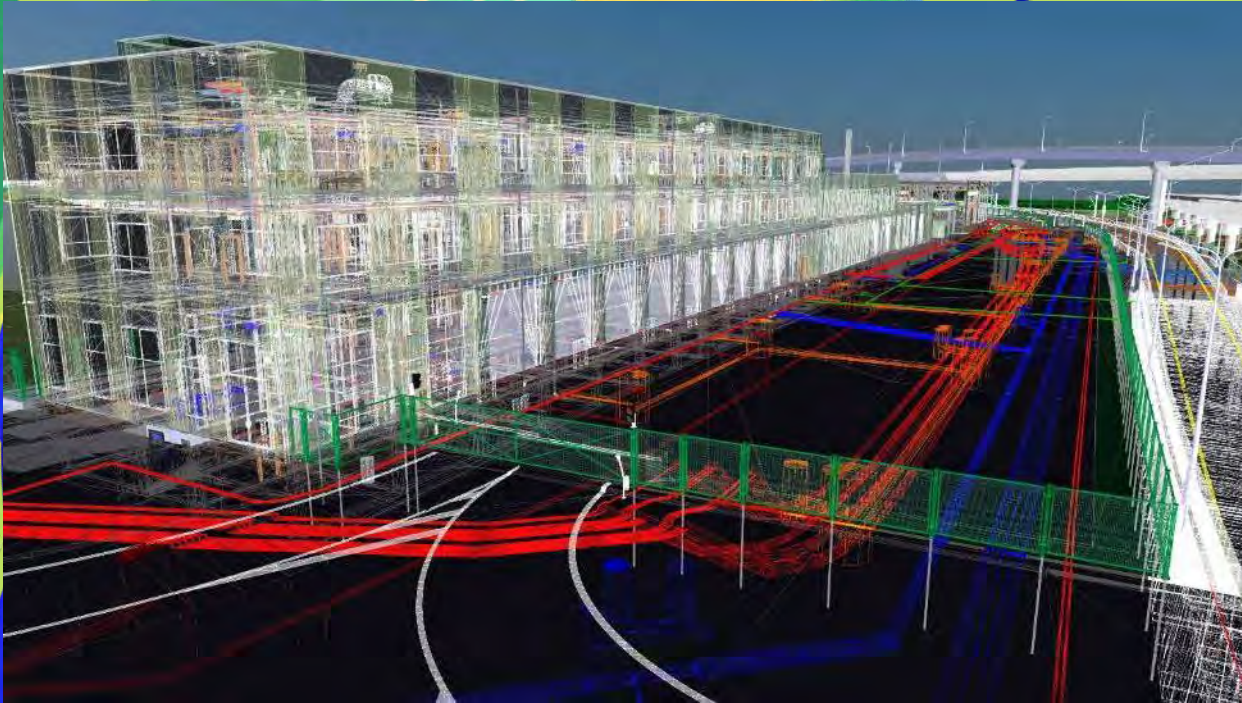
Render photo-realistic images
Produce videos with simulations
Create interactive game engine experiences

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2 Planning Twin Video.mp4



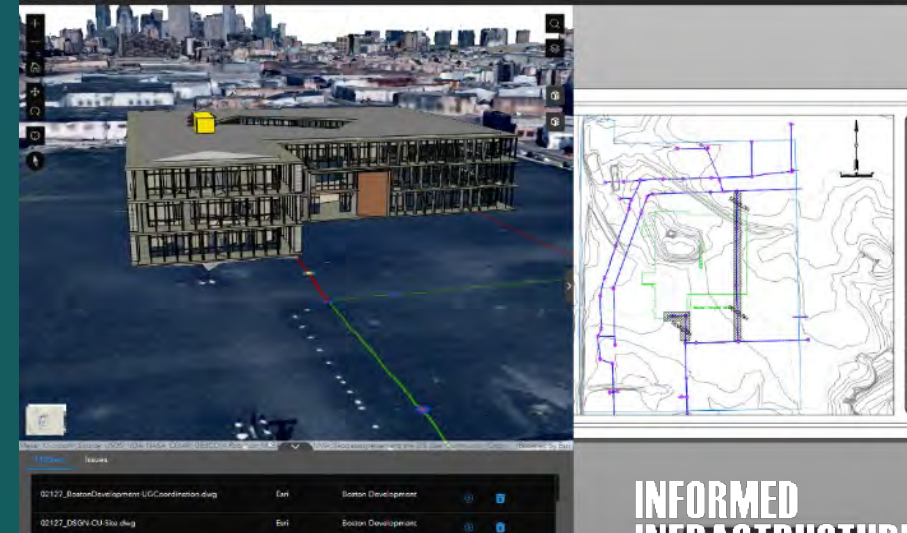
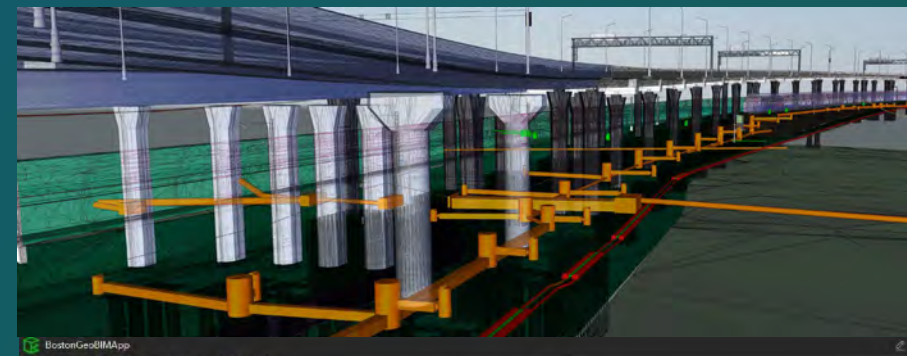
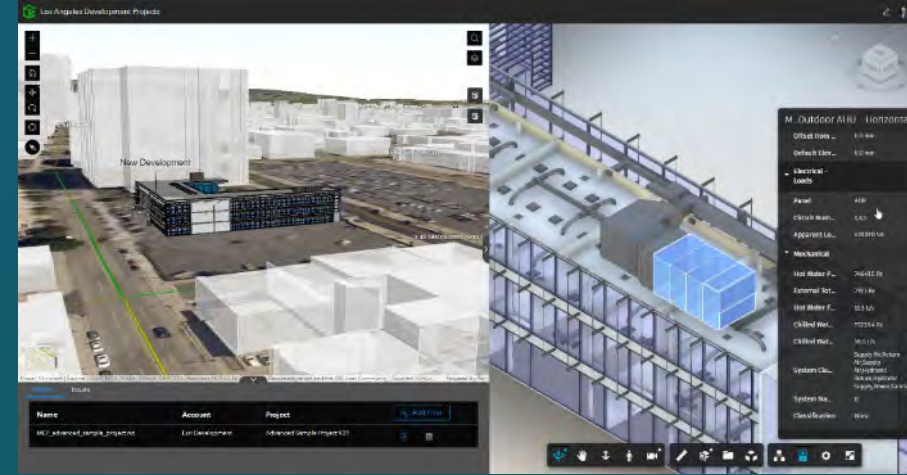
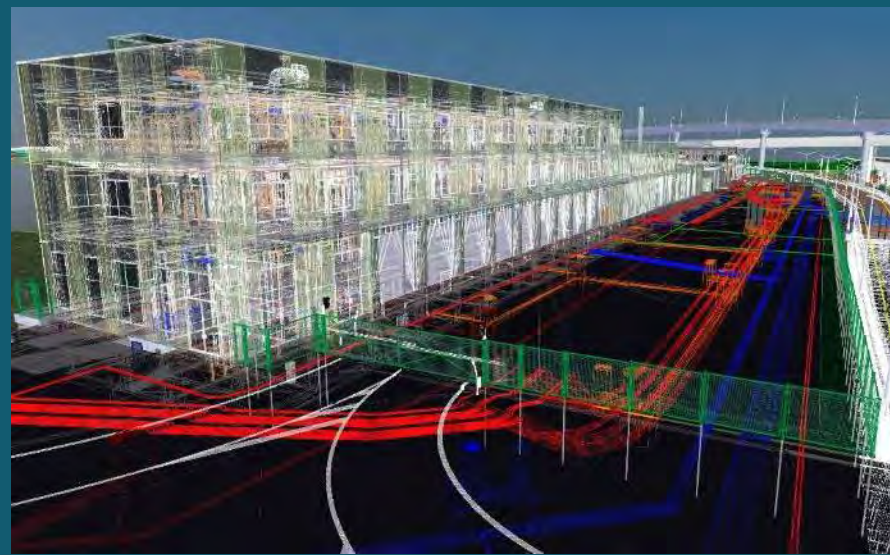
Construction Digital Twin



Design & Construction Digital Twin

- Zoom into a Building Scene Layer within the citywide mesh
- Connect to Autodesk Construction Cloud and BIM 360
- Support an integrated visualization and query of assets in context
- Share project status and issues through a common dashboard

Primary applications:



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3 BIM and GIS Video.mp4

Digitize your site with ArcGIS Reality

From sensor to accurate derived products

- Focused Capture for Use
- Progress Tracking and Analysis



Digital Elevation Models



Orthomosaics



360° Panoramas



Inspection Oriented Imagery
& FMV



3D Point Clouds & Meshes



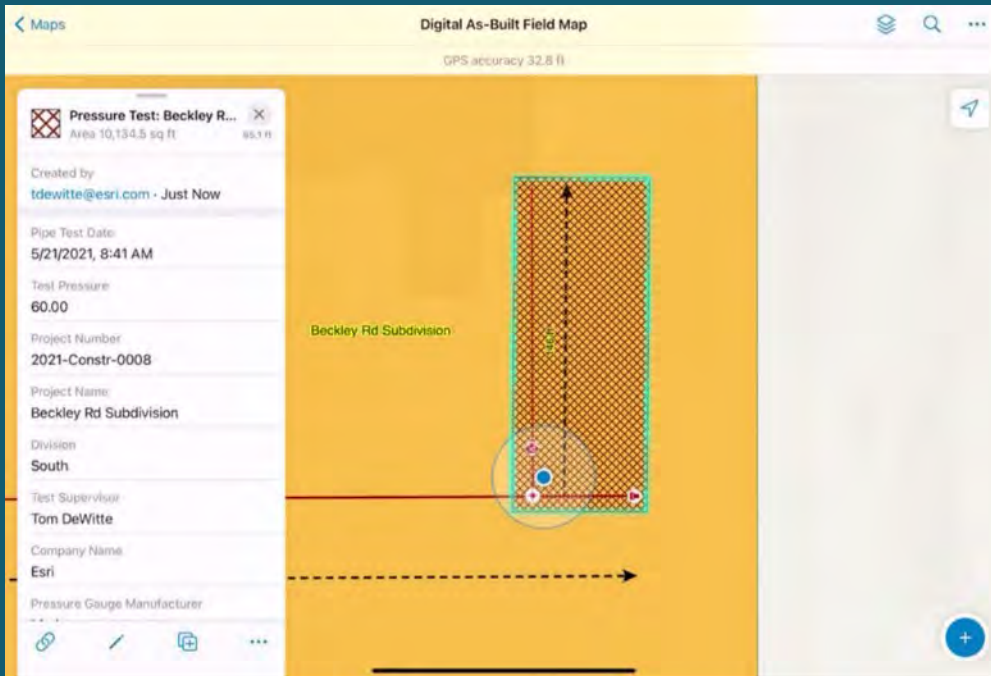


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Field Operations

Keeping field teams informed

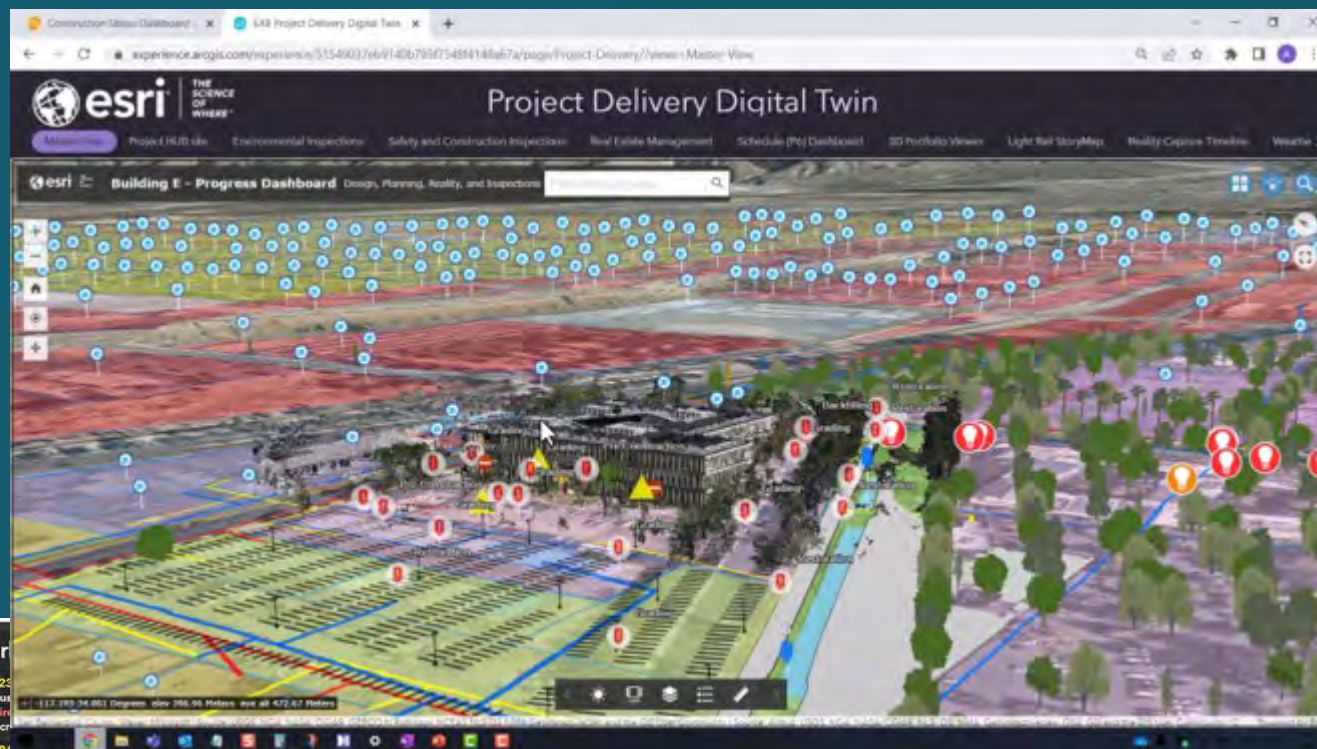
- Connected people, workflows and data
- Staying aware, staying safe



Solving Complex Problems

Project oversight and coordination

- Packaged interfaces
- Deliver to the Marketplace



Trench Inspections

Trench Inspection Date: **Status: Not Filled**
Inspector:

Trench Inspection Date: 4/28/2022, 9:30 AM
Status: Filled
Inspector: N/A

Trench Inspection Date: 4/19/2022, 1:30 PM
Status: Filled
Inspector: Daniel Chantios

Trench Inspection Date: 4/22/2022, 2:00 PM
Last update: 11 minutes ago

Trench Status

● Filled 4 ● Not Filled 1

Construction Logistics Dashboard

Esri Community Maps Contributors, Loma Linda University, City of Redlands, County of Riverside, County of San Bernardino, California St... Powered by Esri

Workforce

WF122
Status: Expired
Expires: 4/27/2022, 8:30 AM
Description: Check utility connections for exposed lines

WF784
Status: Completed
Expires: 4/27/2022, 8:30 AM
Description: Check utility connections for exposed lines

WF358 - Critical
Status: Completed
Expires: 4/20/2022, 8:15 AM
Description: Inspect Utilities

WF984 - Critical
Status: Canceled
Expires: 5/12/2021, 8:00 AM
Description: Check exposed utilities in trench

W3478 - Critical
Status: Canceled
Expires: 5/1/2022, 8:15 AM
Last update: 11 minutes ago

Priority

| Priority | Count |
|----------|-------|
| Low | 2 |
| Medium | 4 |
| High | 5 |
| Critical | 5 |

Bar Chart Pie chart



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4 Project Dashboard Video.mp4

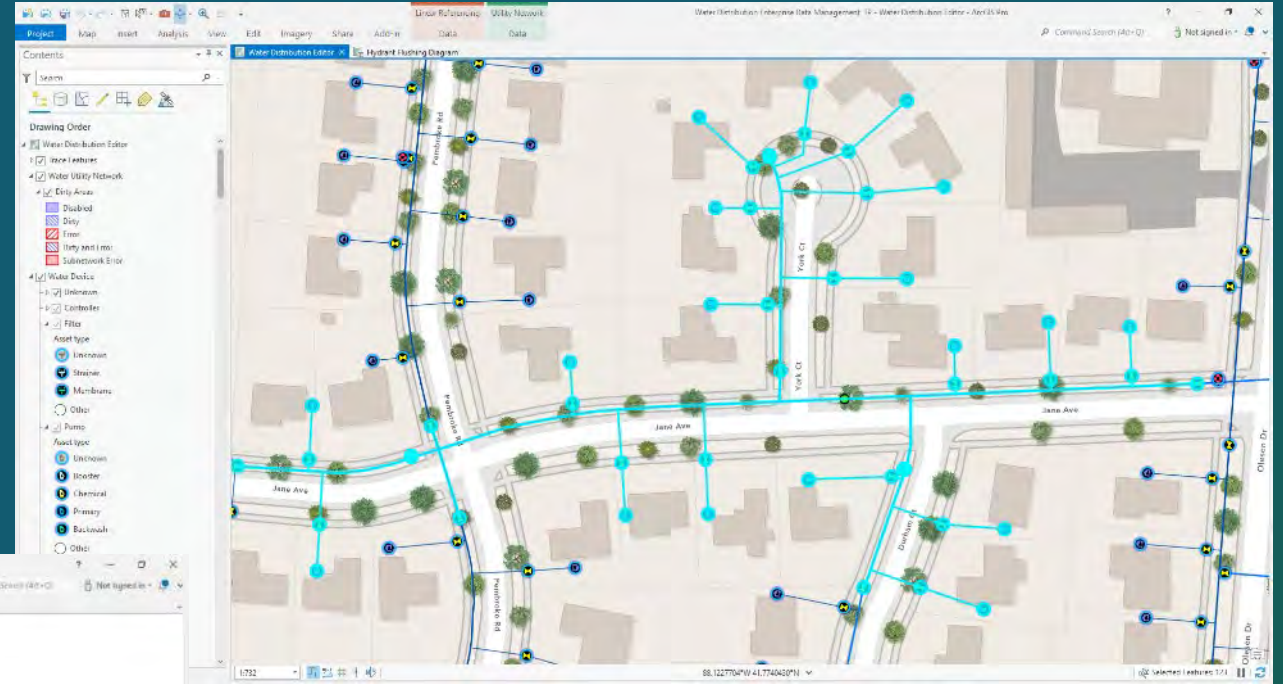
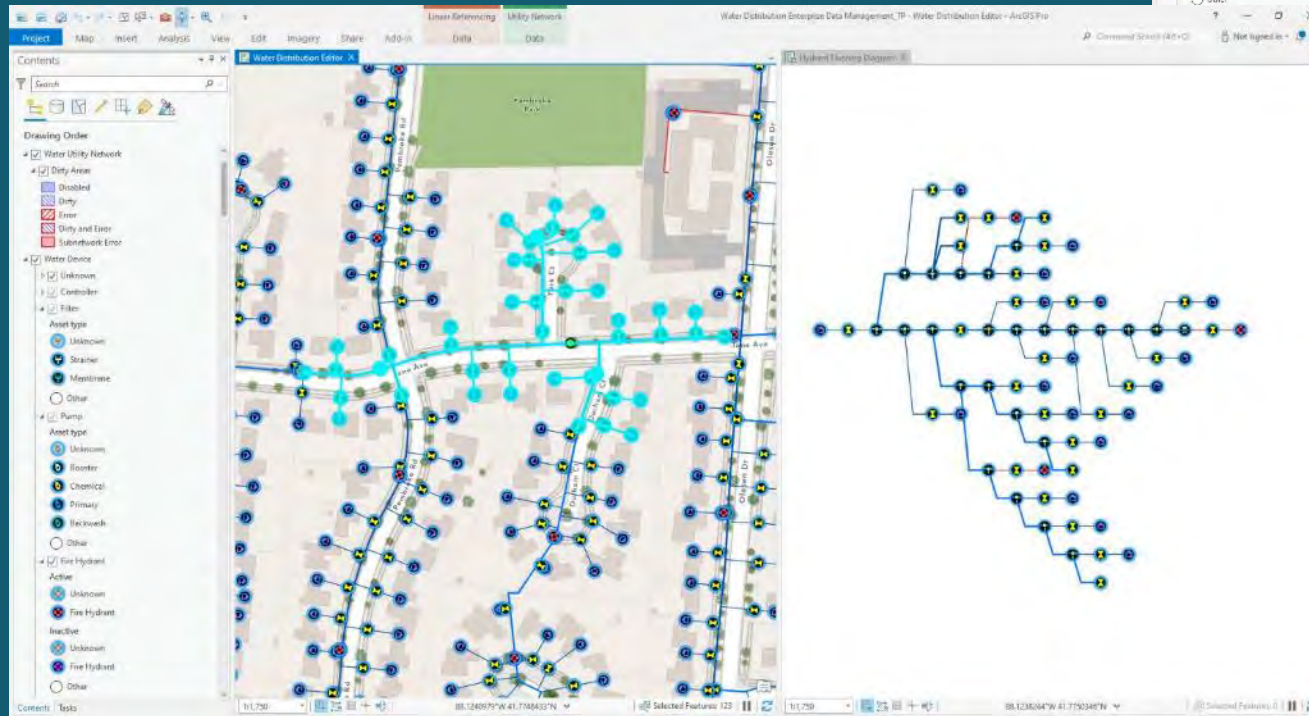


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Network Analytics

Smart Networks

- Leverage ArcGIS Enterprise and ArcGIS Network Management Capabilities



Water Quality Assessment and Alerting at Household Level

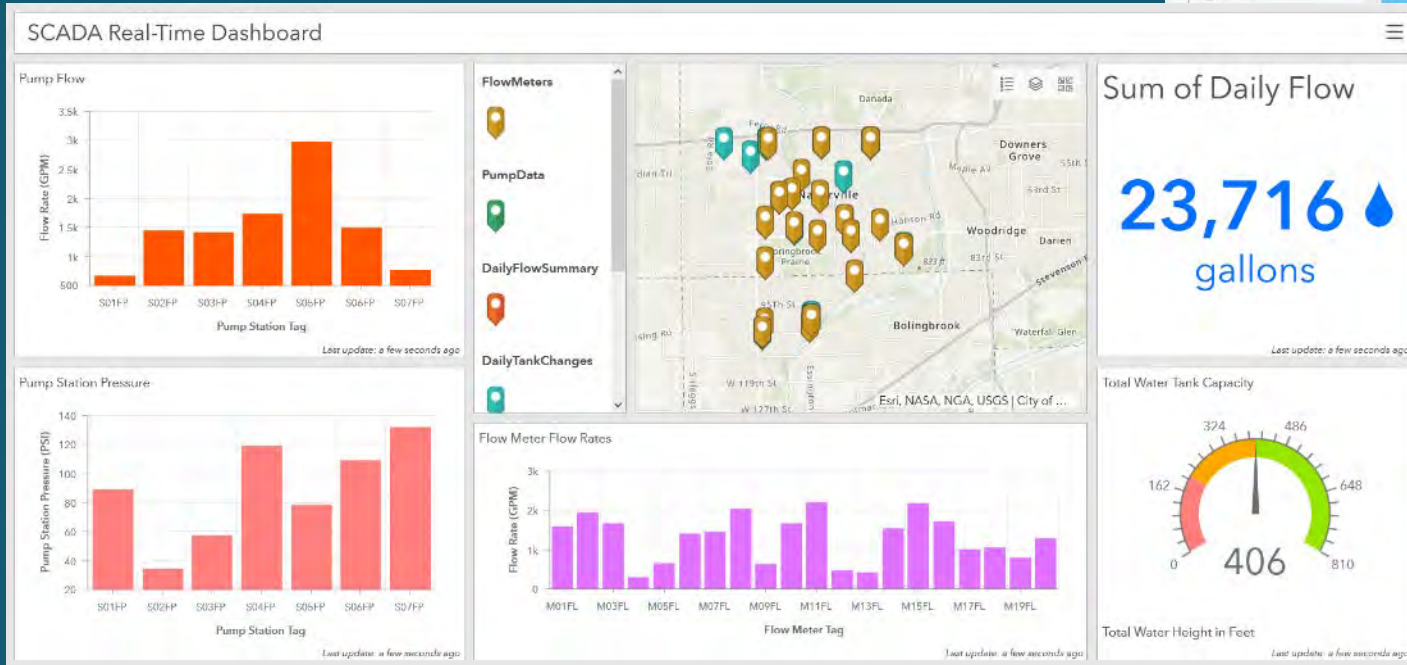
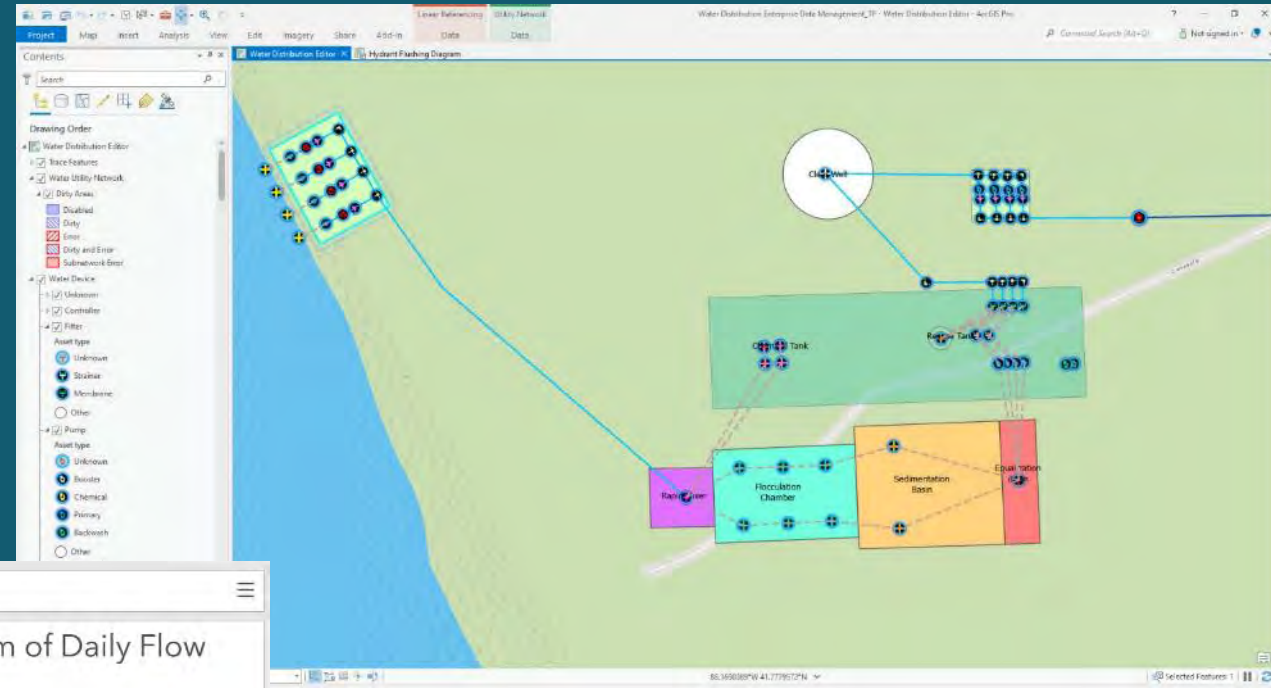


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Asset Modeling & Simulation

Connections to other business systems

- Leverage Dashboards and automation tools like Python and Notebooks

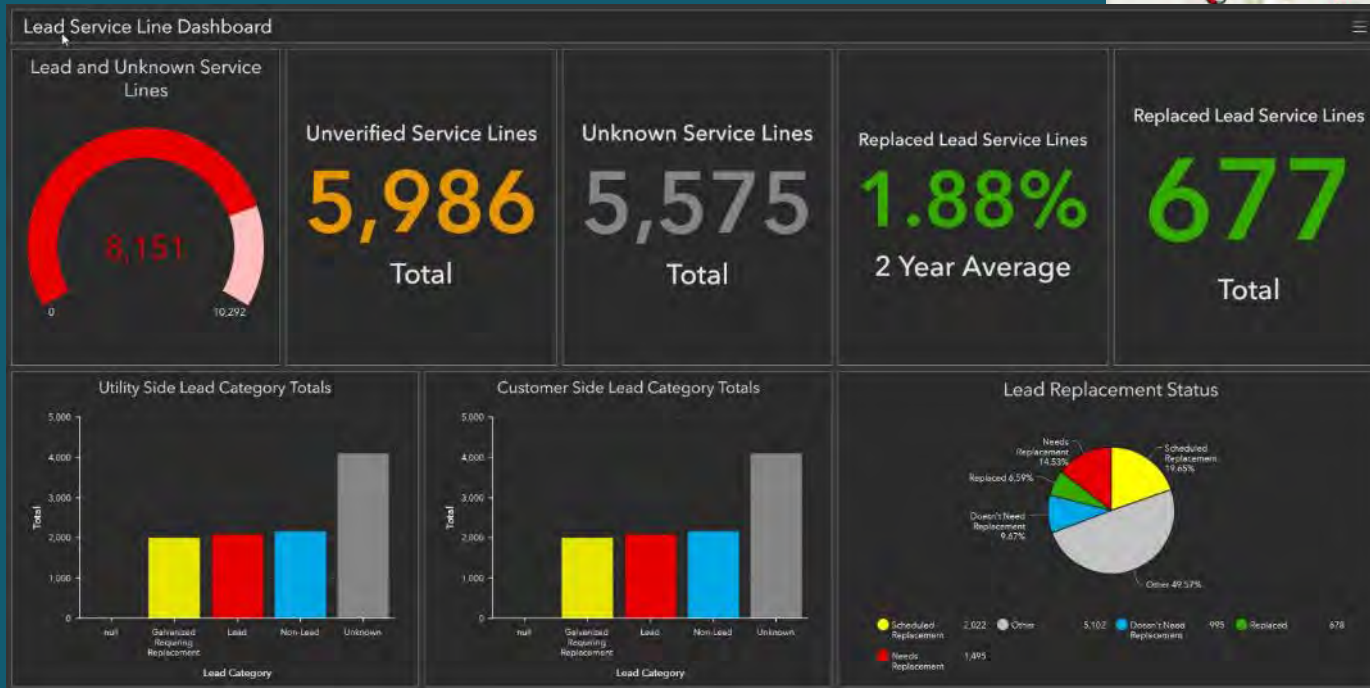
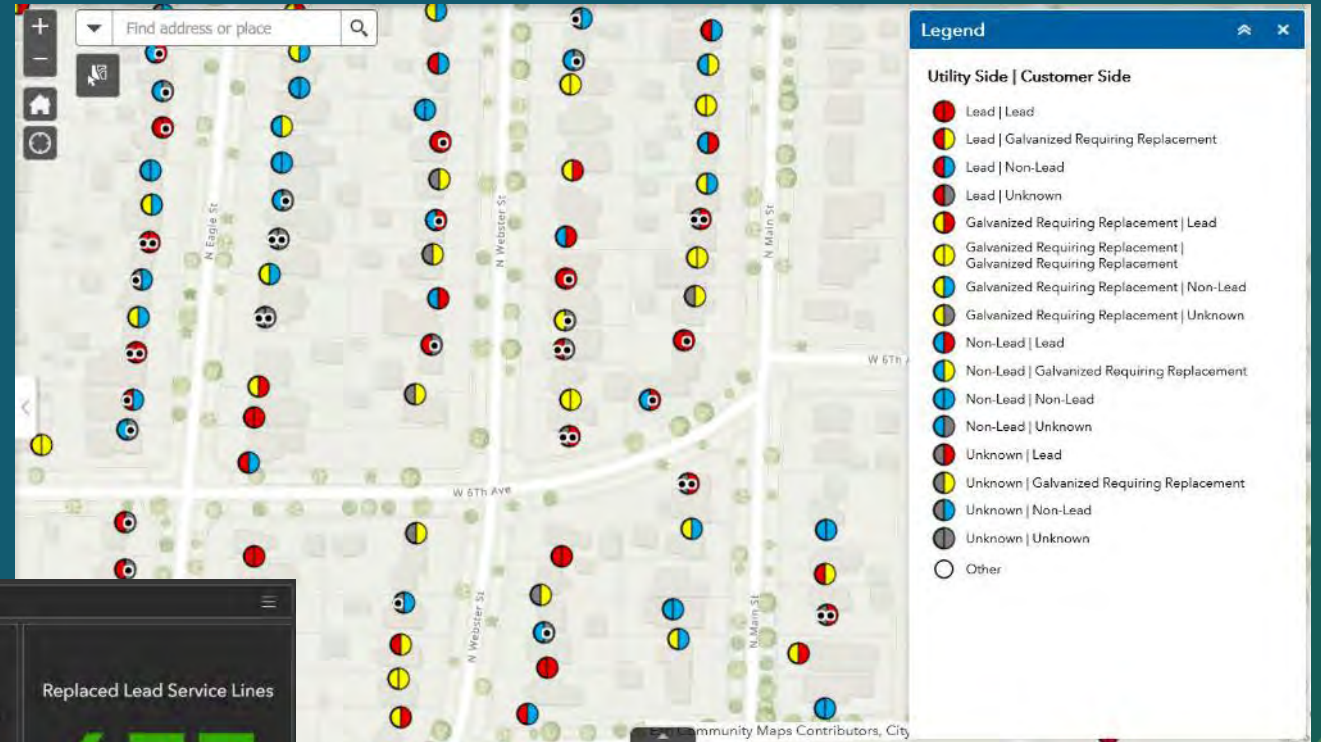


Water Quality Measurement and Assessment at a Community Level

Solving Complex Problems

Building Solutions

- Leverage ArcGIS Solutions
- Deliver to the Marketplace



Bringing it all together to solve real challenges



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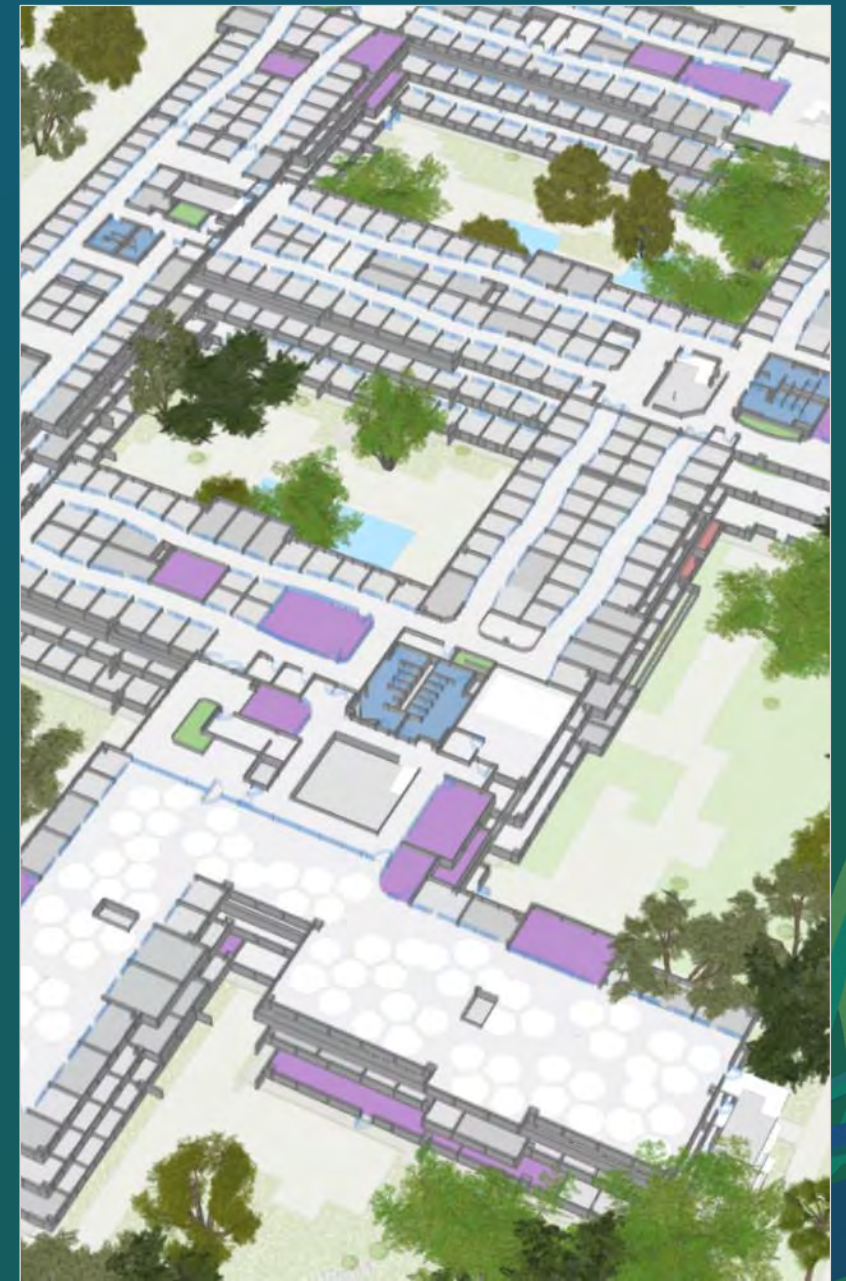
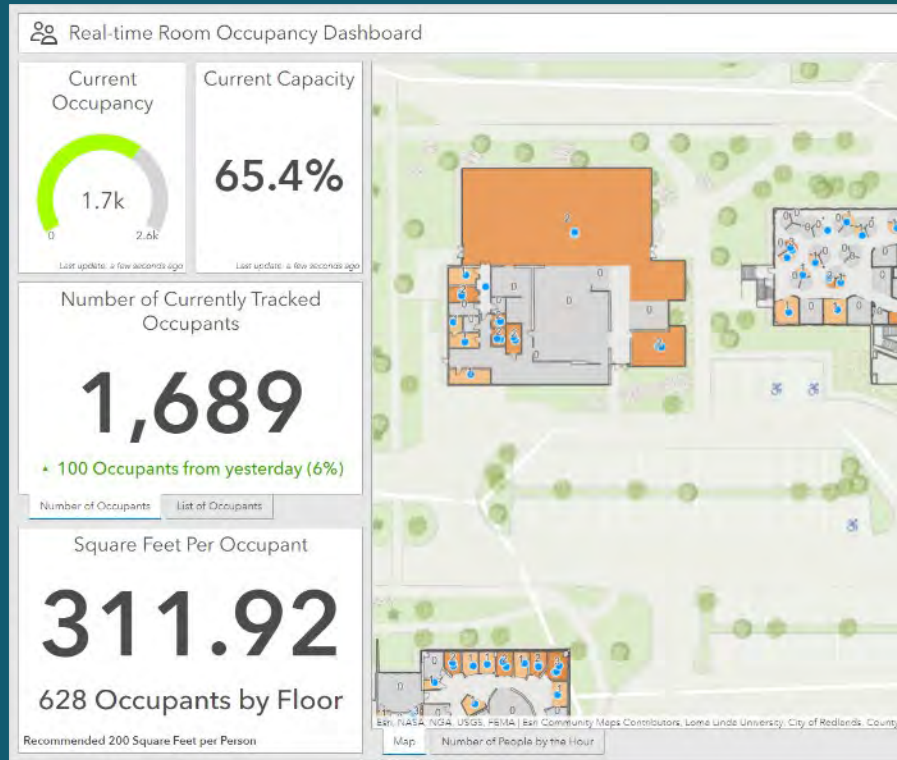
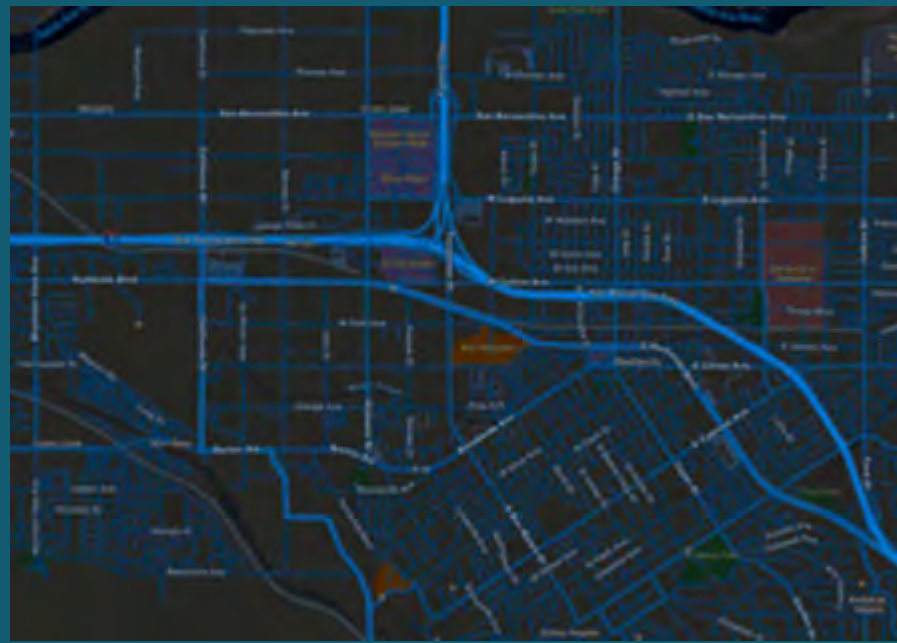
Operations Digital Twin



Operations Digital Twin

- Facility Management
- Wayfinding
- Asset Management
- Transportation Management
- IoT Integration
- Predictive Analysis

Primary applications:



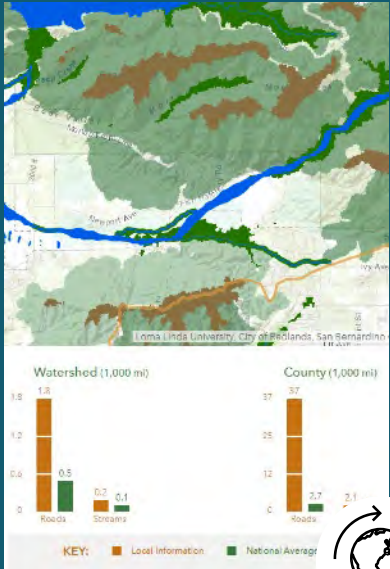
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5 Operations Twin Video.mp4

Esri's Digital Twin Platform



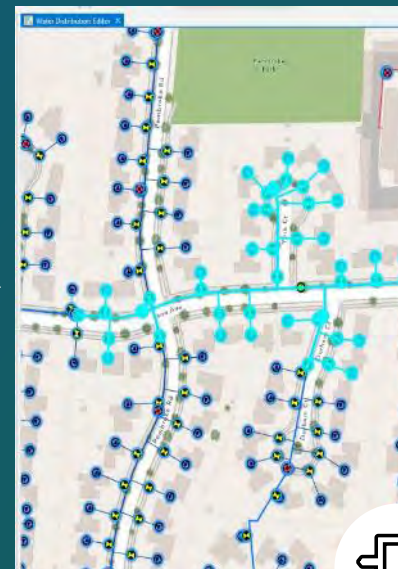
Environmental



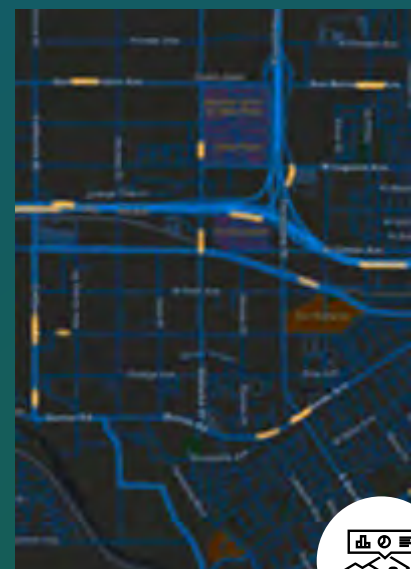
Spatial
Planning



Design /
Construction



Network



Operations



Reality Capture & Data Integration



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Start with your Business Problems!



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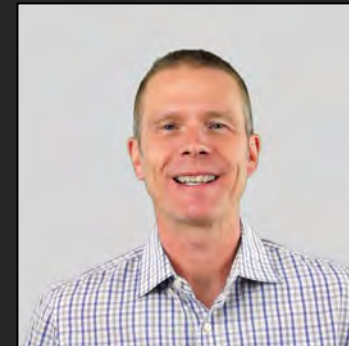
Questions and Answers with:



Andy Lovell
Solution Engineer Manager, AEC
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Christine Ma
Urban Planning Practice Lead, Built Environment
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Todd Danielson
Editorial Director
Informed Infrastructure



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