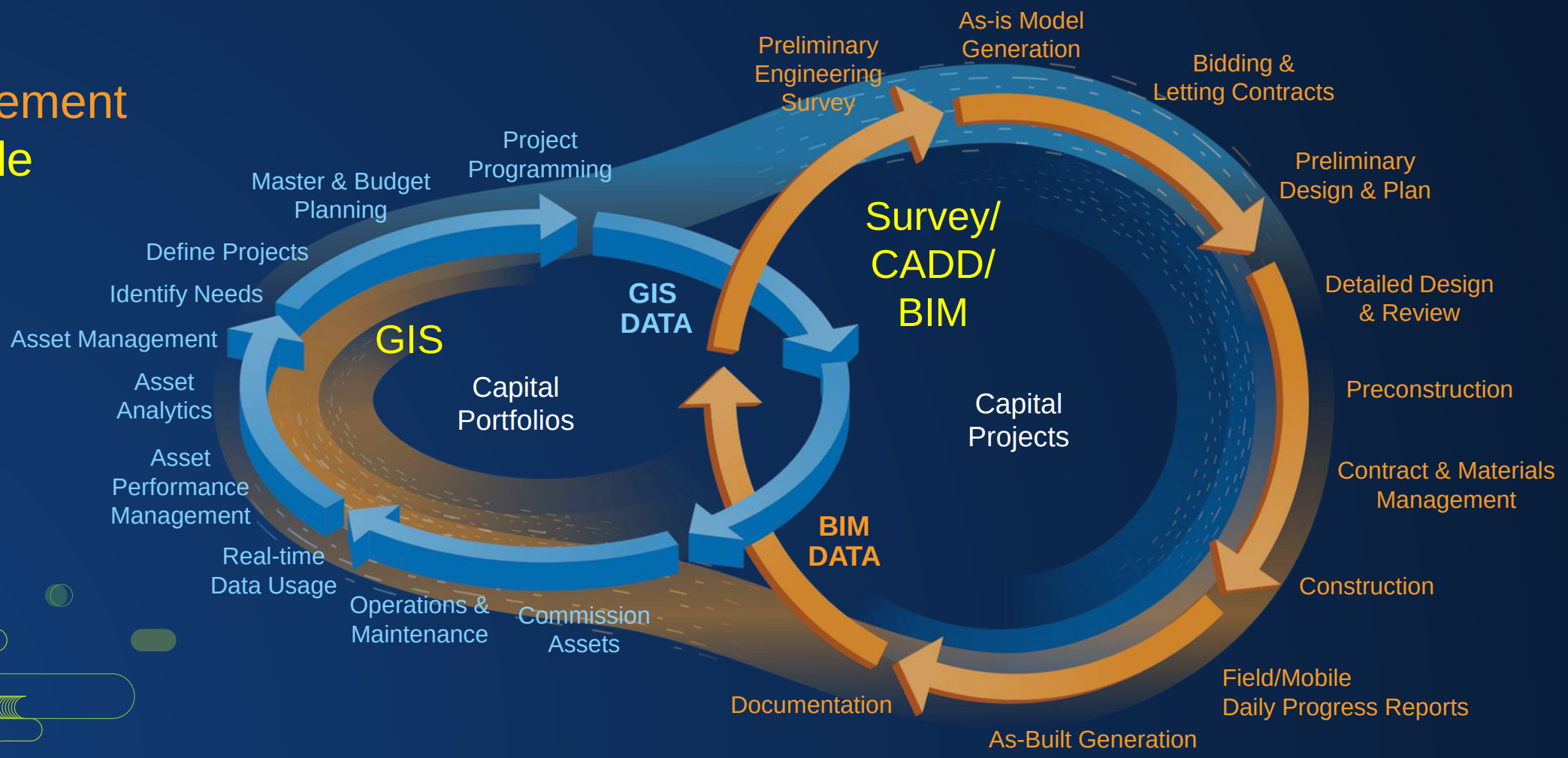
Digital Delivery

Moving Asset Location and Descriptive Data Seamlessly with Zero Loss Throughout Its Lifecycle

ESRI AUTODESK AASHTOWARE TRIMBLE BENTLEY LEICA

Asset
Management
Lifecycle

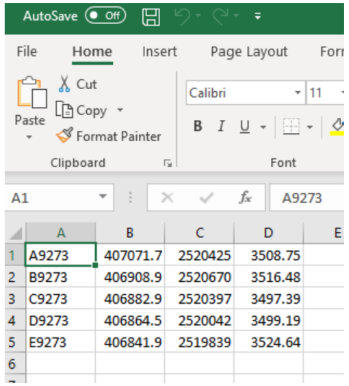


Prior to Digital Delivery

Spatial Representation (graphics) and Attributes often separated between toolsets & manually linked

Feature Codes linked to survey spatial representations

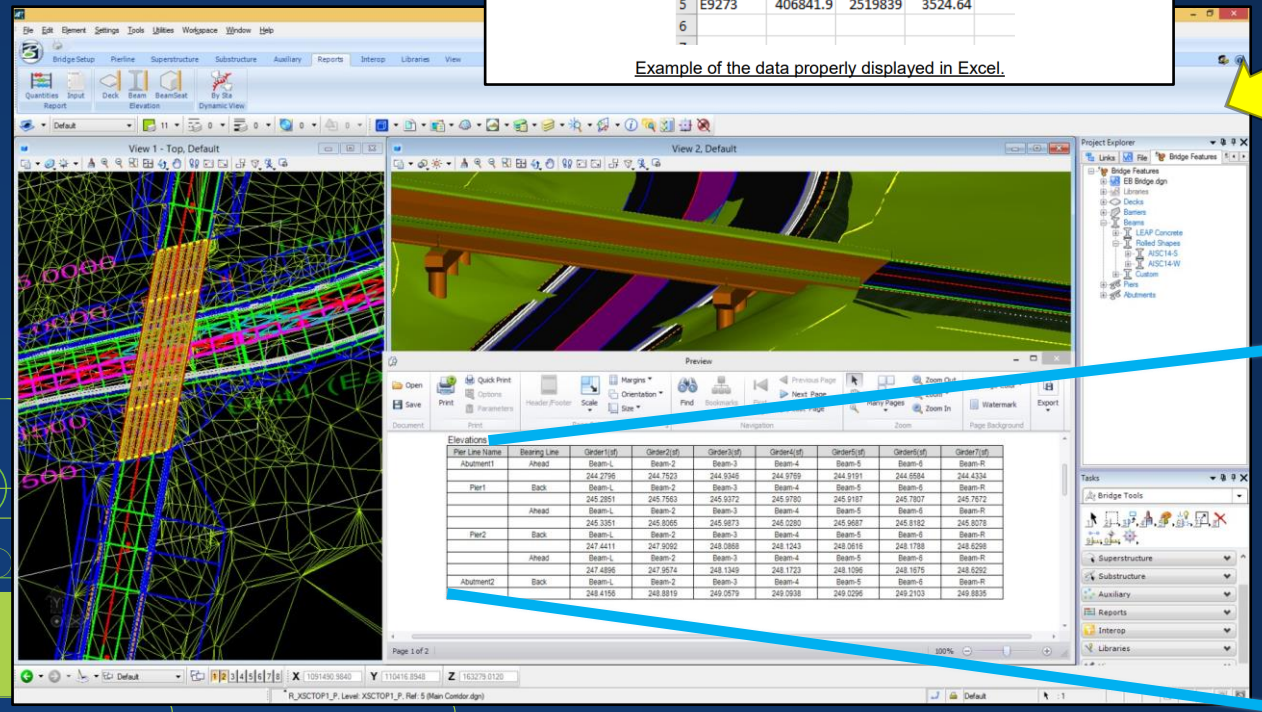
7. Save the file by clicking the **Save As** button and navigating to the proper location. In the file type drop-down window, select **CSV (comma delimited).csv** and click **Save**.



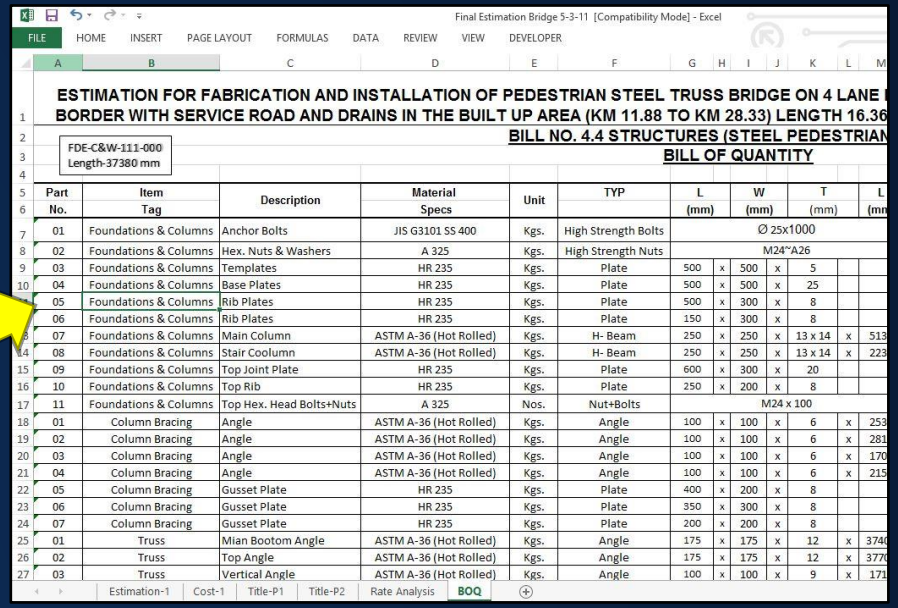
	A	B	C	D
1	A9273	407071.7	2520425	3508.75
2	B9273	406908.9	2520670	3516.48
3	C9273	406882.9	2520397	3497.39
4	D9273	406864.5	2520042	3499.19
5	E9273	406841.9	2519839	3524.64
6				

Example of the data properly displayed in Excel.

Design Environment storing spatial representation



Pay/Bid Items linked manually to spatial representation or used just in tabular form



ESTIMATION FOR FABRICATION AND INSTALLATION OF PEDESTRIAN STEEL TRUSS BRIDGE ON 4 LANE
BORDER WITH SERVICE ROAD AND DRAINS IN THE BUILT UP AREA (KM 11.88 TO KM 28.33) LENGTH 16.36
BILL NO. 4.4 STRUCTURES (STEEL PEDESTRIAN
BILL OF QUANTITY

FDE-C&W-111-000
Length-37380 mm

Part No.	Item Tag	Description	Material Specs	Unit	TYP	L (mm)		W (mm)		T (mm)		L (mm
01	Foundations & Columns	Anchor Bolts	JIS G3101 SS 400	Kgs.	High Strength Bolts	Ø 25x1000						
02	Foundations & Columns	Hex. Nuts & Washers	A 325	Kgs.	High Strength Nuts	M24"A26						
03	Foundations & Columns	Templates	HR 235	Kgs.	Plate	500	x	500	x	5		
04	Foundations & Columns	Base Plates	HR 235	Kgs.	Plate	500	x	500	x	25		
05	Foundations & Columns	Rib Plates	HR 235	Kgs.	Plate	500	x	300	x	8		
06	Foundations & Columns	Rib Plates	HR 235	Kgs.	Plate	150	x	300	x	8		
07	Foundations & Columns	Main Column	ASTM A-36 (Hot Rolled)	Kgs.	H- Beam	250	x	250	x	13 x 14	x	513
08	Foundations & Columns	Stair Coolumn	ASTM A-36 (Hot Rolled)	Kgs.	H- Beam	250	x	250	x	13 x 14	x	223
09	Foundations & Columns	Top Joint Plate	HR 235	Kgs.	Plate	600	x	300	x	20		
10	Foundations & Columns	Top Rib	HR 235	Kgs.	Plate	250	x	200	x	8		
11	Foundations & Columns	Top Hex. Head Bolts+Nuts	A 325	Nos.	Nut+Bolts	M24 x 100						
01	Column Bracing	Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	100	x	100	x	6	x	253
02	Column Bracing	Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	100	x	100	x	6	x	281
03	Column Bracing	Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	100	x	100	x	6	x	170
04	Column Bracing	Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	100	x	100	x	6	x	215
05	Column Bracing	Gusset Plate	HR 235	Kgs.	Plate	400	x	200	x	8		
06	Column Bracing	Gusset Plate	HR 235	Kgs.	Plate	350	x	300	x	8		
07	Column Bracing	Gusset Plate	HR 235	Kgs.	Plate	200	x	200	x	8		
01	Truss	Mian Bootom Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	175	x	175	x	12	x	3740
02	Truss	Top Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	175	x	175	x	12	x	3770
03	Truss	Vertical Angle	ASTM A-36 (Hot Rolled)	Kgs.	Angle	100	x	100	x	9	x	171

Specific Engineering Data from the Design Environment

Elevations

Pier Line Name	Bearing Line	Girder1(sf)	Girder2(sf)	Girder3(sf)	Girder4(sf)	Girder5(sf)	Girder6(sf)	Girder7(sf)
Abutment1	Ahead	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		244.2796	244.7523	244.9346	244.9769	244.9191	244.6584	244.4334
Pier1	Back	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		245.2851	245.7563	245.9372	245.9780	245.9187	245.7807	245.7672
	Ahead	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		245.3351	245.8065	245.9873	246.0280	245.9687	245.8182	245.8078
Pier2	Back	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		247.4411	247.9092	248.0868	248.1243	248.0616	248.1788	248.6298
	Ahead	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		247.4896	247.9574	248.1349	248.1723	248.1096	248.1675	248.6292
Abutment2	Back	Beam-L	Beam-2	Beam-3	Beam-4	Beam-5	Beam-6	Beam-R
		248.4156	248.8819	249.0579	249.0938	249.0296	249.2103	249.8835

Digital Delivery Foundation

GIS = Database, Integration Tools, Support of All Data Types & Models, Apps

GIS Centric

GIS Supported

Link Pay items to Design Elements	Define and Automate Data Workflows	Build & Maintain a Data Warehouse	Deploy Construction Inspection App Suite at Survey Grade	Design in 3D
Define Design Standards	Align GIS and Design Symbology	Develop a Design Submission Portal	Create Data Loop between Design & Construction	Support Underground Utility Database
Contractually Enforce Design Standards	Conduct Change Management	Provide Access to a Common Data Environment	Integrate Material & Other Testing & Geotechnical Work	Ingest 3D Point Clouds (360 photos Lidar, Drone Data)
Deploy a CADD to GIS Data Transfer Platform/Approach	Develop a CADD Data Viewer in GIS (Web Map or App)	Establish Asset Data Standards	Integrate Contract Management & e-Ticketing Systems	Create Digital As-Builts in GIS

Establish Early → **Establish Later**

Digital Delivery Workflow

Tools for Designers

UDOT Keeping Utah Moving

HORROCKS ENGINEERS

HDR

esri THE SCIENCE OF WHERE

SAFE SOFTWARE

Bentley Advancing Infrastructure

aurigo

Microsoft

You will need Portal Access to use these tools

Digital Delivery

Documentation and Tools Map

TOOLS FOR DESIGNERS

STEP 1 — Digital Delivery Workspace

LAUNCH TOOL

Generate design using updated CADD standards

NOTE: Existing UDOT assets can be extracted using the Asset Extraction Tool.

STEP 2 — Validate the Design

LAUNCH TOOL

Upload the DGN to the CADD Validation Tool at completion milestones and before the conversion to GIS.

NOTE: All UDOT projects (digital and traditional) should complete up through this step. This is step is critical prior to running step 6.

STEP 3 — Generate Item Type Report

LAUNCH TOOL

Generate Item Type Report in Excel.

NOTE: This data preparation is critical for field tools.

STEP 4 — Run Pay Item Validation

LAUNCH TOOL

Verify MasterWorks and the Item Type Report align before creating the Pay Item DGN and providing it to the contractor.

STEP 5 — Pay Item DGN Creator

LAUNCH TOOL

Prepare DGN output of Pay Items for contractor to view items by location.

» SEND PAY ITEM DGN TO CONTRACTOR

STEP 6 — GIS Conversion Tools

Convert DGNs to GIS using one or all tools available. The end user determines which tool is used.

Tool #1 Supports construction and asset management

There are two conversion options available, choose one:

- **Single File Conversion Tool** *(Portal)*
- **Batch Conversion** *(requires access to UDOT ProjectWise)*

NOTE: Steps 1-5 must be completed prior.

Tool #2 Supports online platforms (ie: Story Maps)

Tool is currently in development.

NOTE: Steps 1 & 2 must be completed prior.

Tool #3 Supports UDOT ROW

- **ROW Conversion Tool** *(Portal)*

NOTE: Steps 1-5 must be completed prior.

STEP 7 — M&P / A&D Pay Item Details

LAUNCH TOOL

Run tool to include Pay Item Details Table in GIS database.

It is the responsibility of the Designers to run these tools at standard completion milestones:

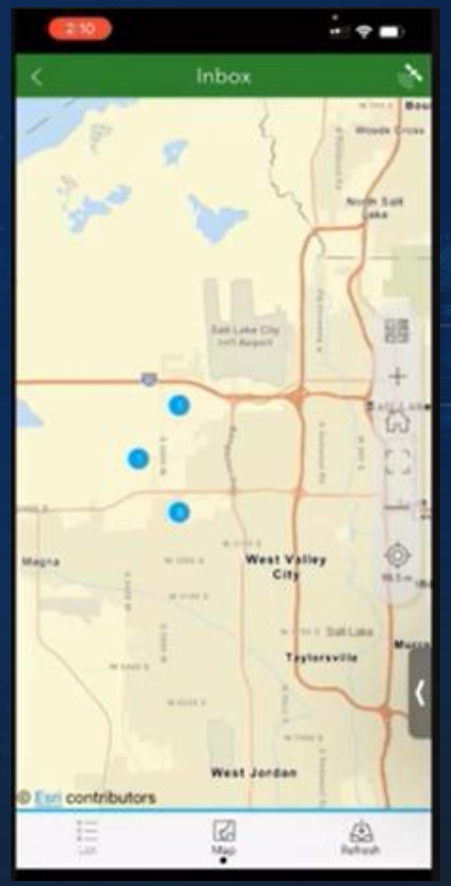
- 30%
- 60%
- 90%
- 100%

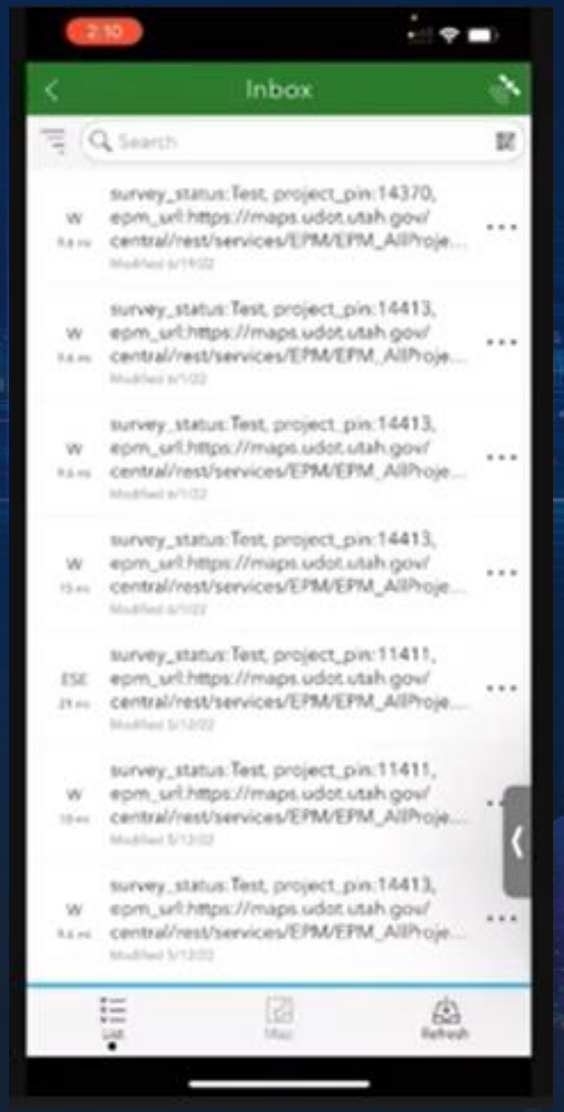
Whenever an update is made to the design or pay item information, the tools will need to be rerun starting with Step 2.

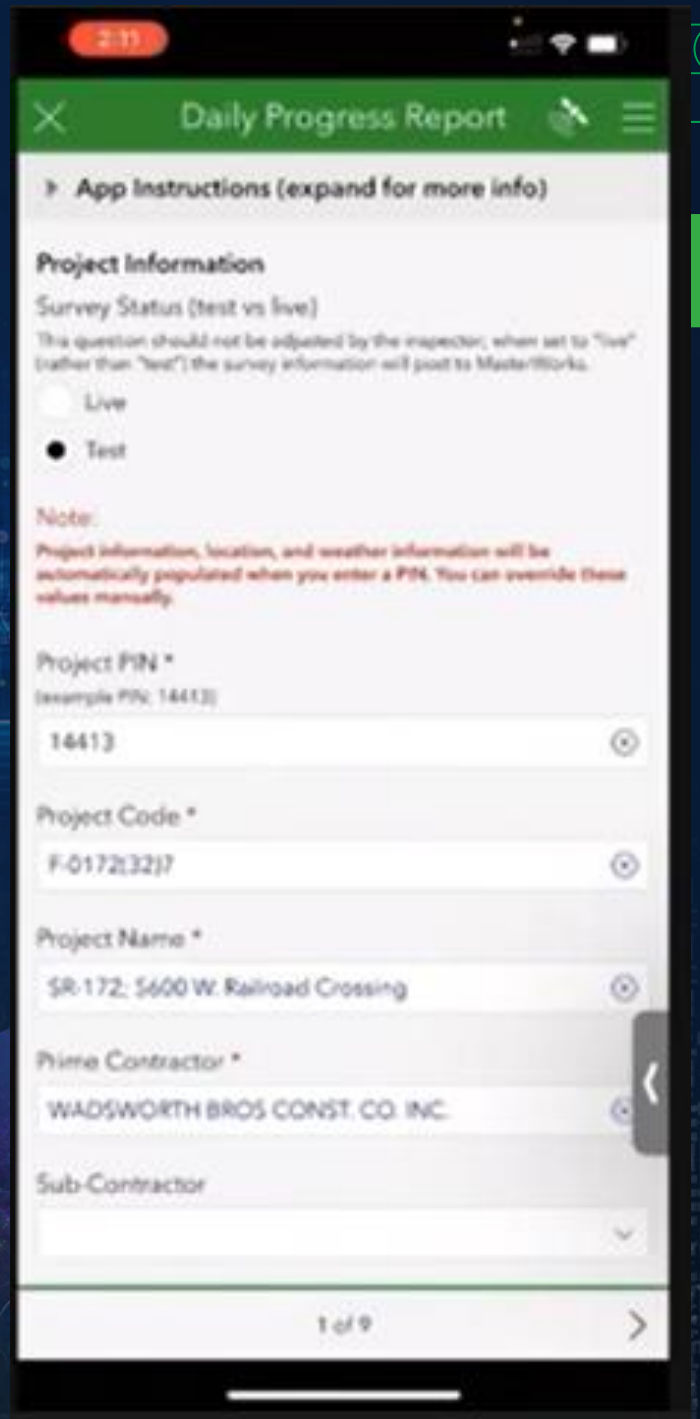
Field Tools for Construction Progress Inspections

Capturing construction data to support digitalization of the entire workflow

Daily Progress Report (DPR)







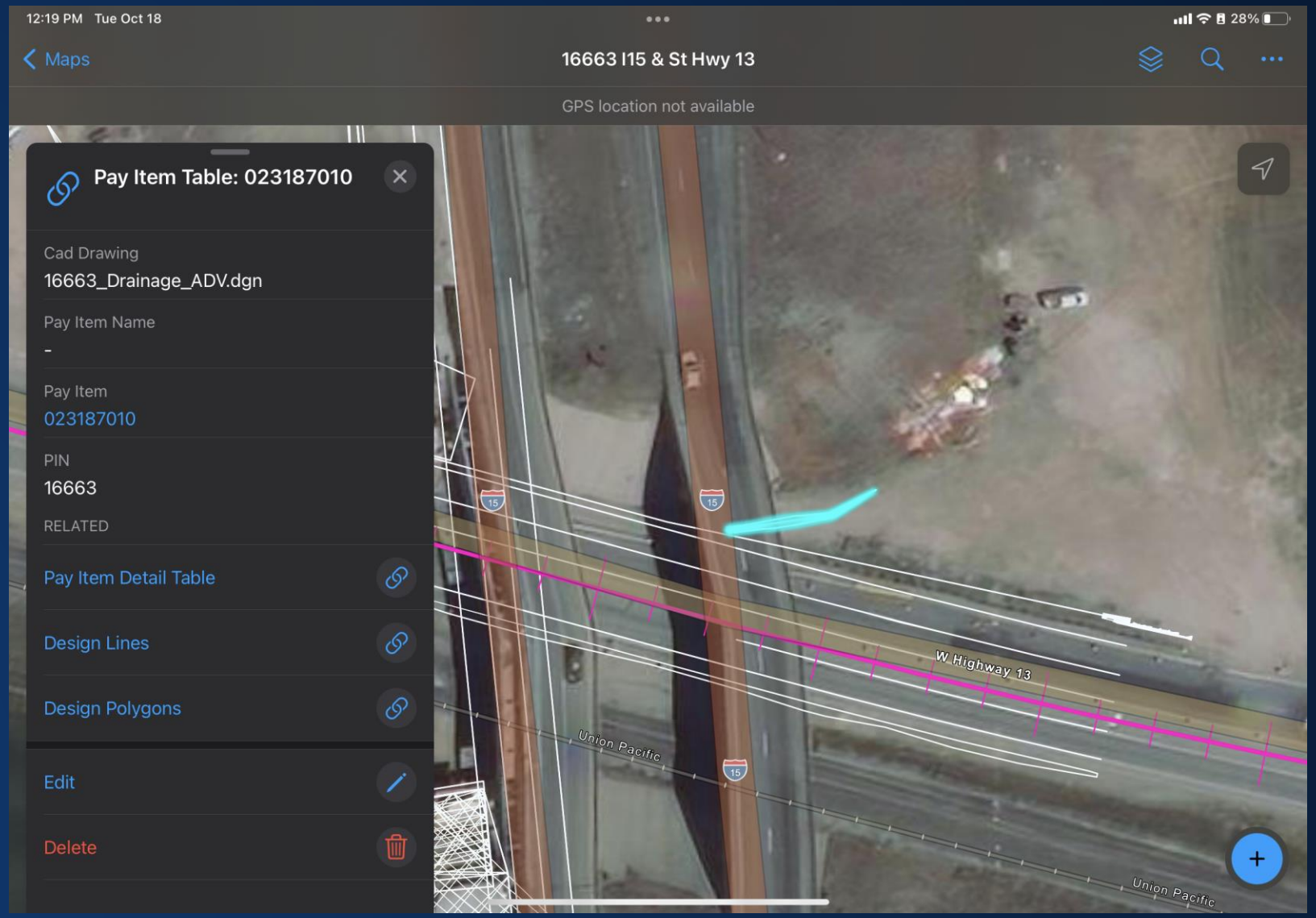
Apps

GIS = Construction Progress Inspections, Geotechnical, e-Ticketing, Dashboards, Collaboration

Construction Progress Inspection

Select design elements to copy attributes to construction inspection location data

Capture inspection data with high accuracy survey equipment



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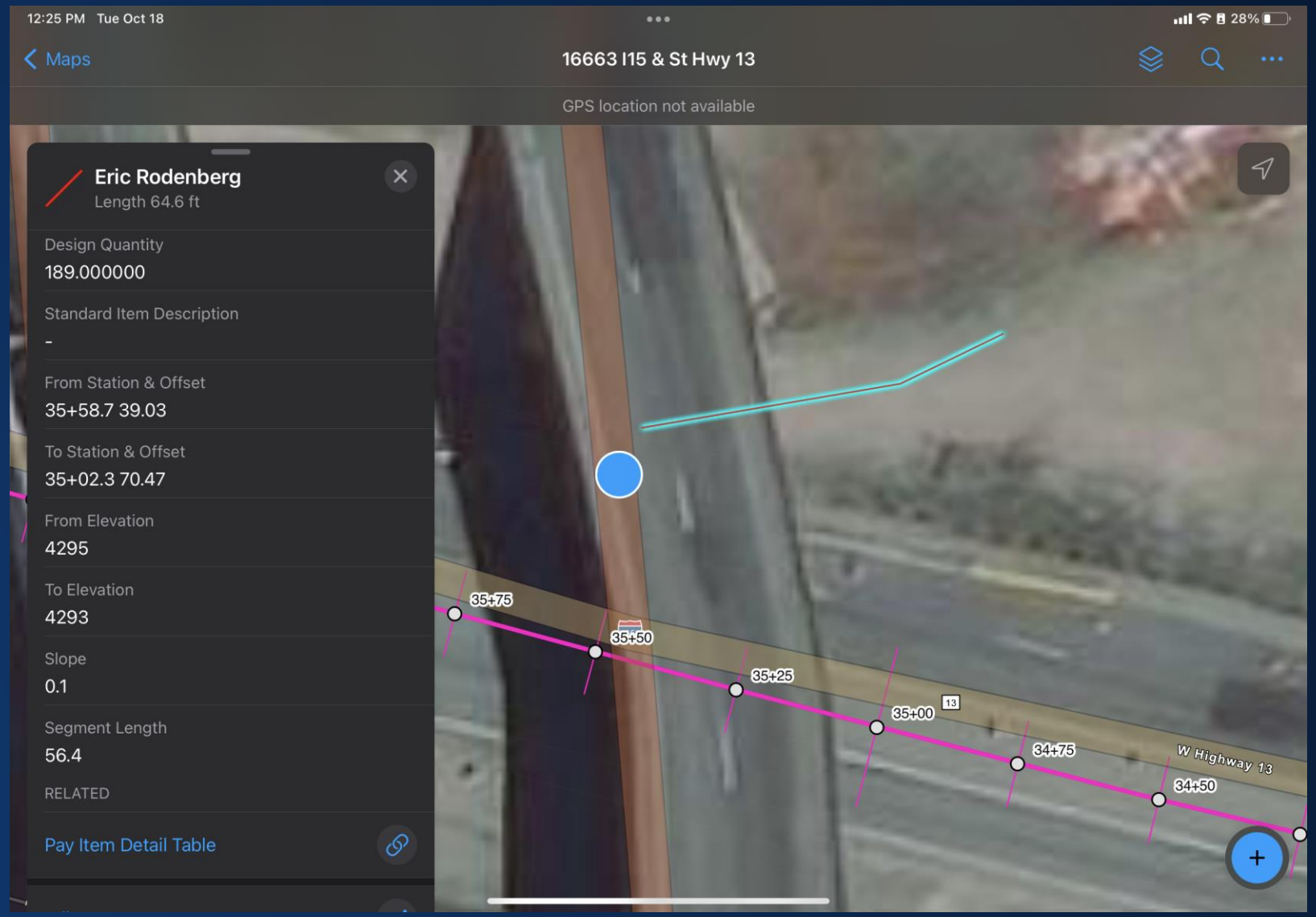
Construction Progress Inspection

Station value & offset calculations

Slope calculations

Quantity calculations



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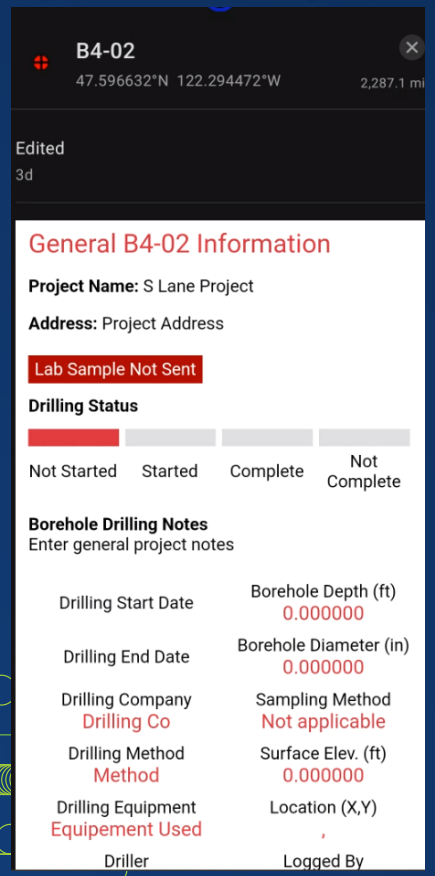
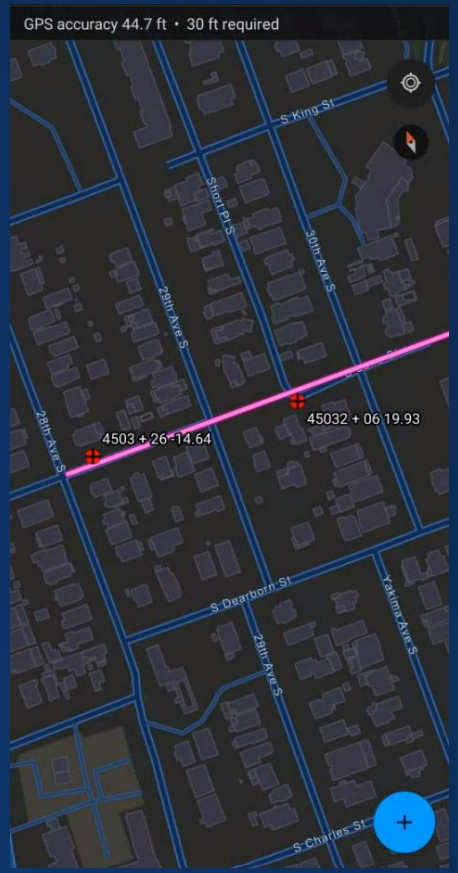
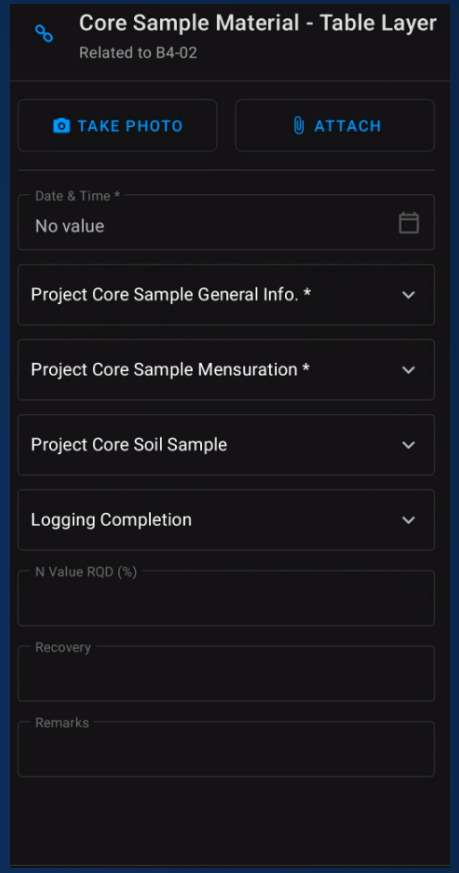
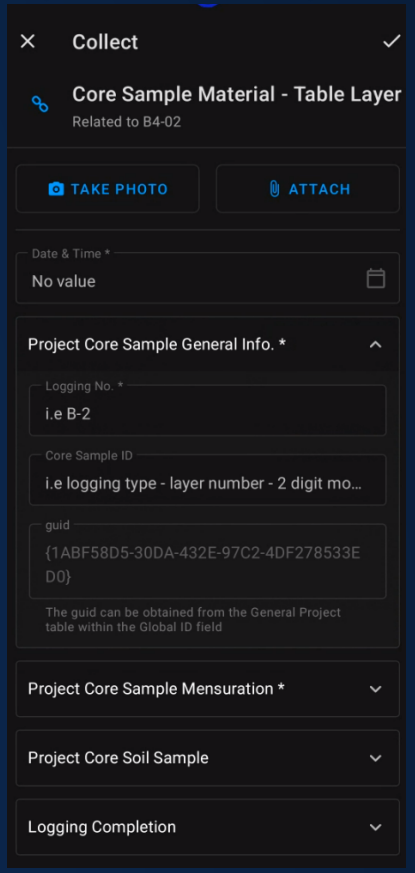
Planning		Collection	Analytics		Visualization		Integration
Baseline Establishment	Boring Location Layout	Boring Location Validation	Boring Data Field Collection	Lab Input & Analysis	Data Reporting & Import/Export	Geotechnical Analytics	Design Integration

Geotechnical Workflow Support









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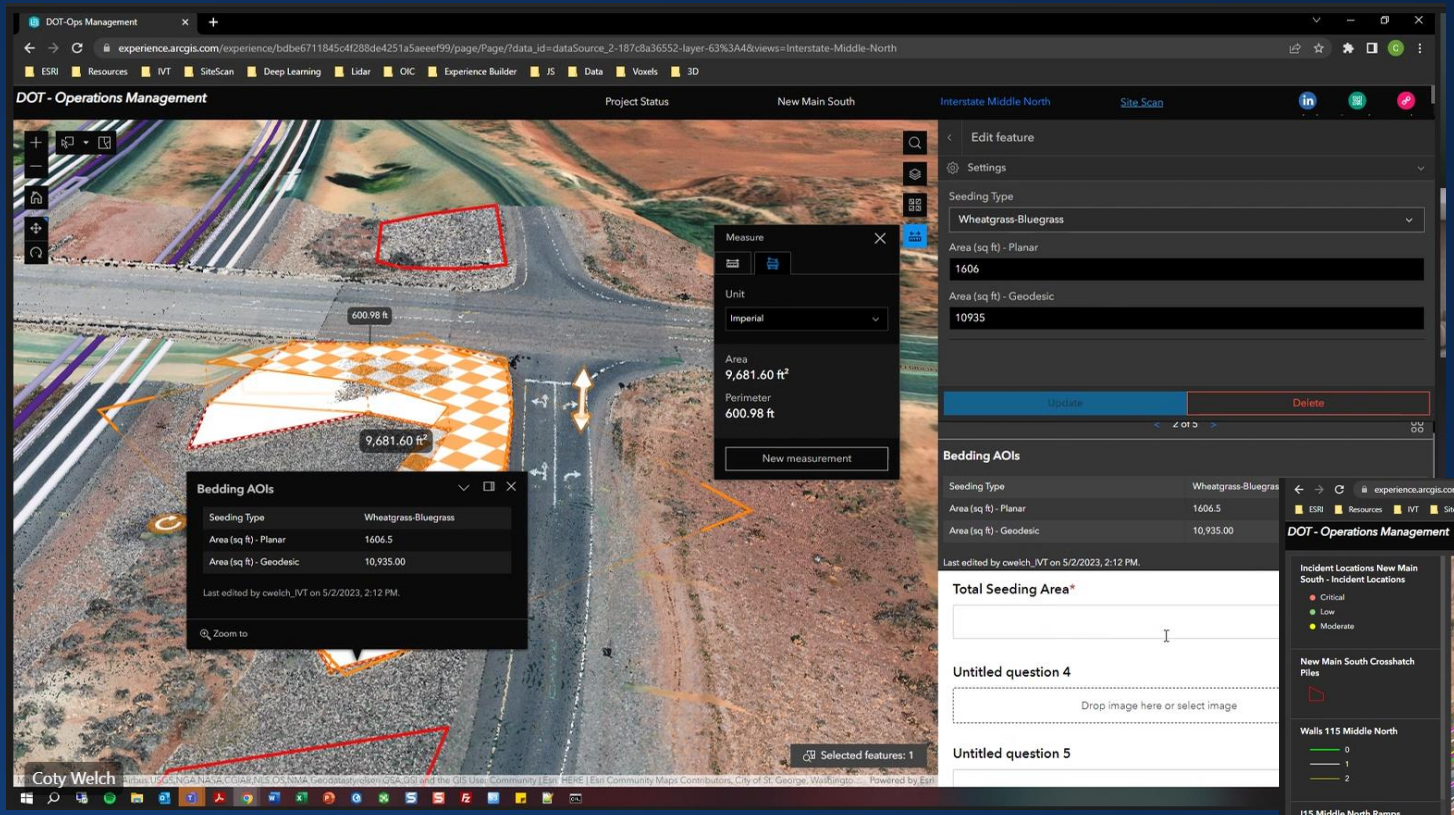
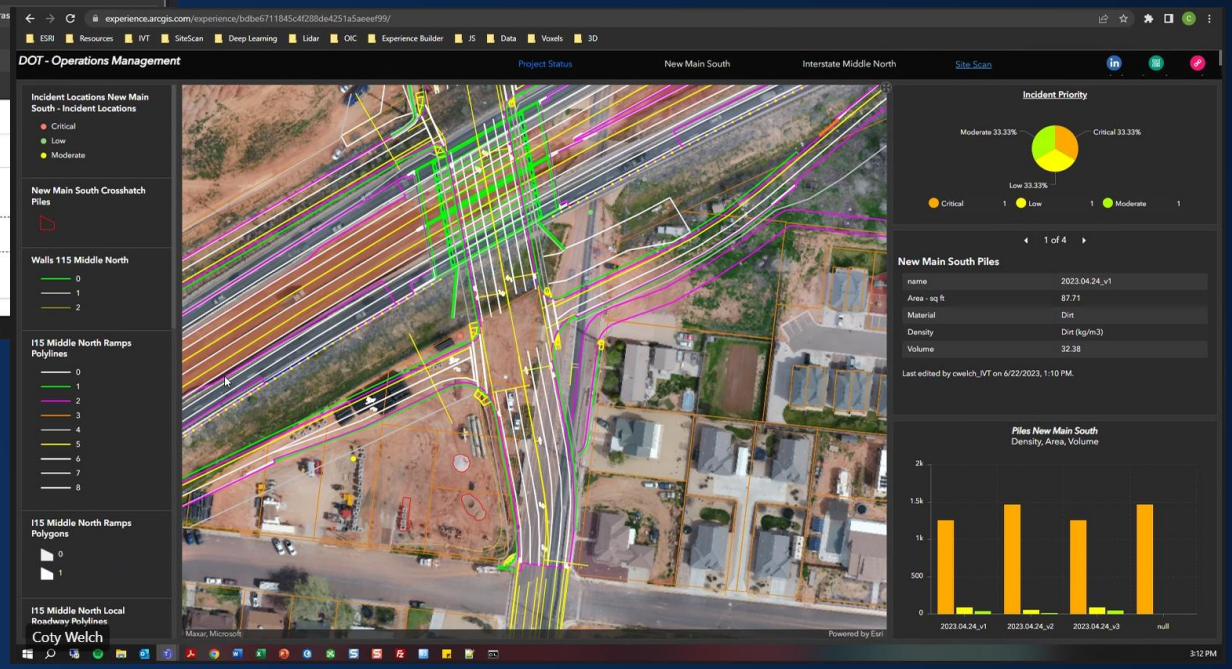


Drone Support

- Volume, Area & Length Calculations
- Change detection
- Design Visualization
- Underground Utility Data Management



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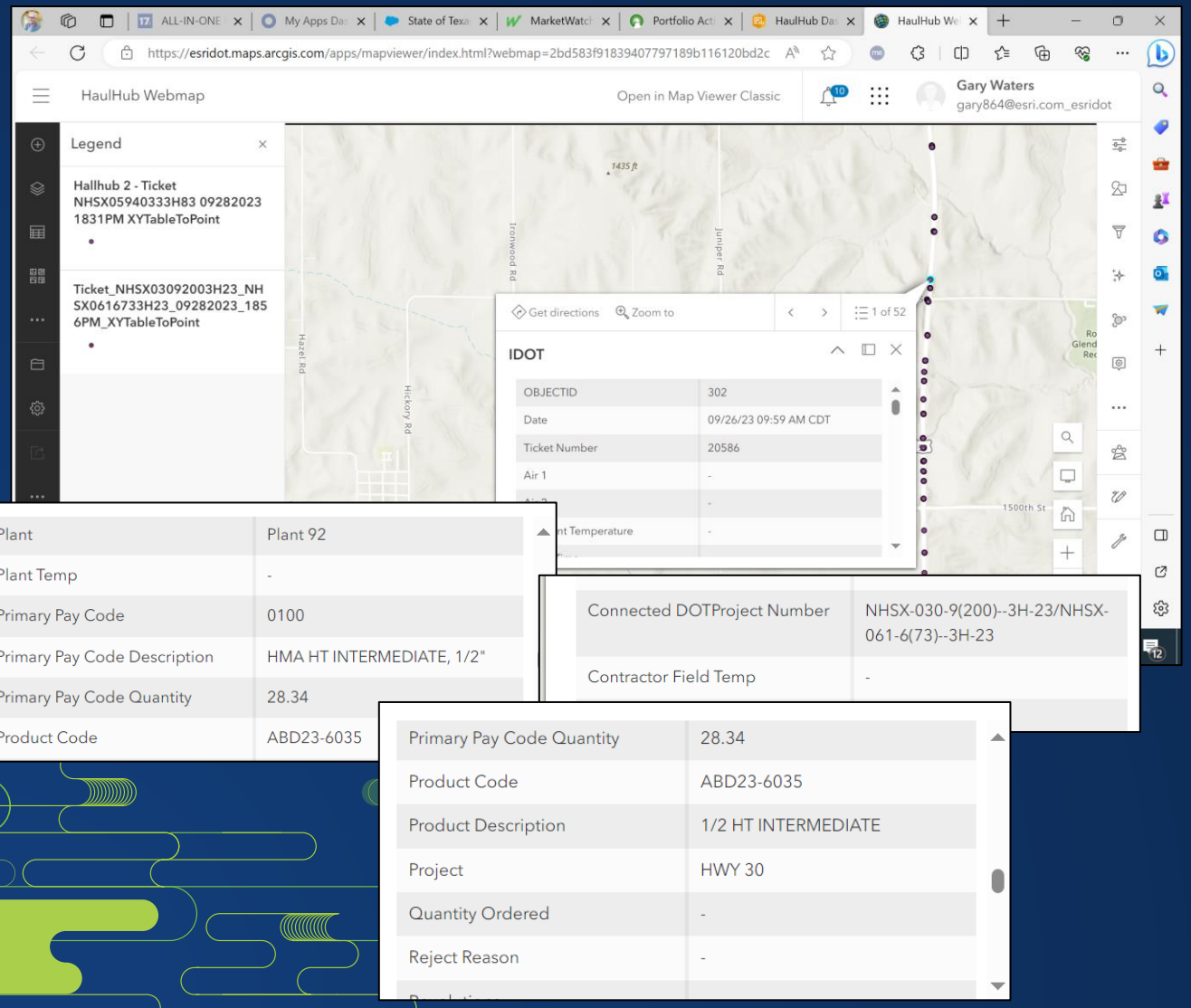
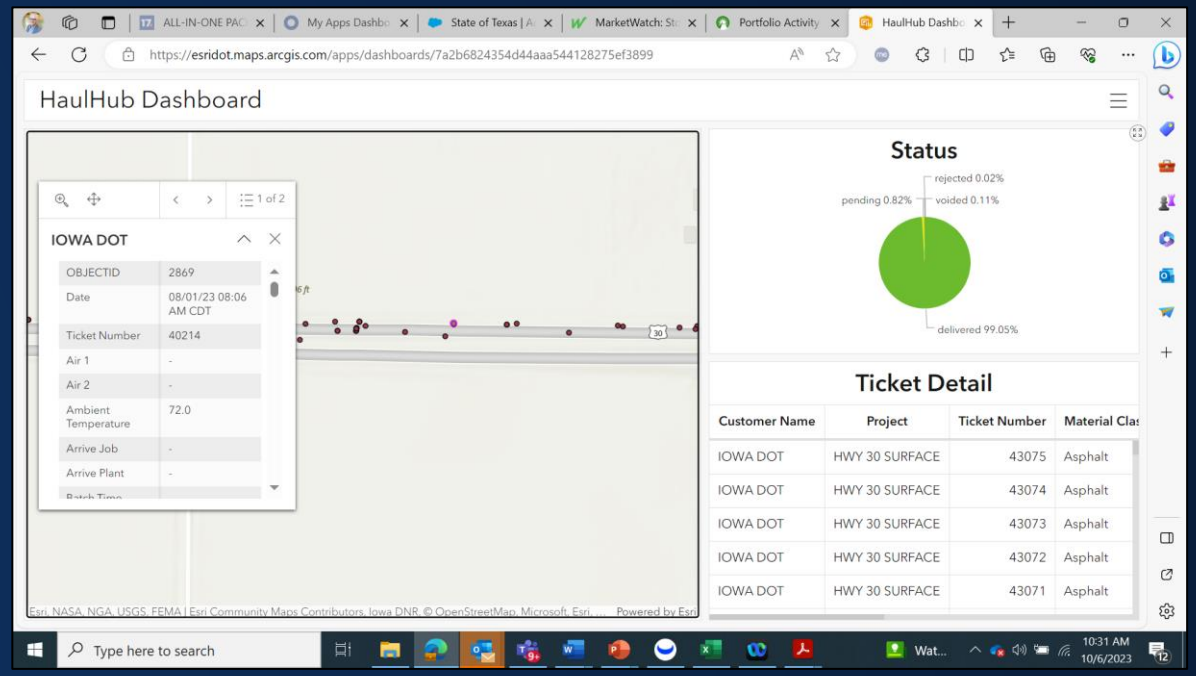


E-Ticket Support

- **Documenting deliveries**
- **Attaching materials to Design Elements/Pay Items**
- **Dashboarding of material deliveries**
- **System-wide query capabilities**



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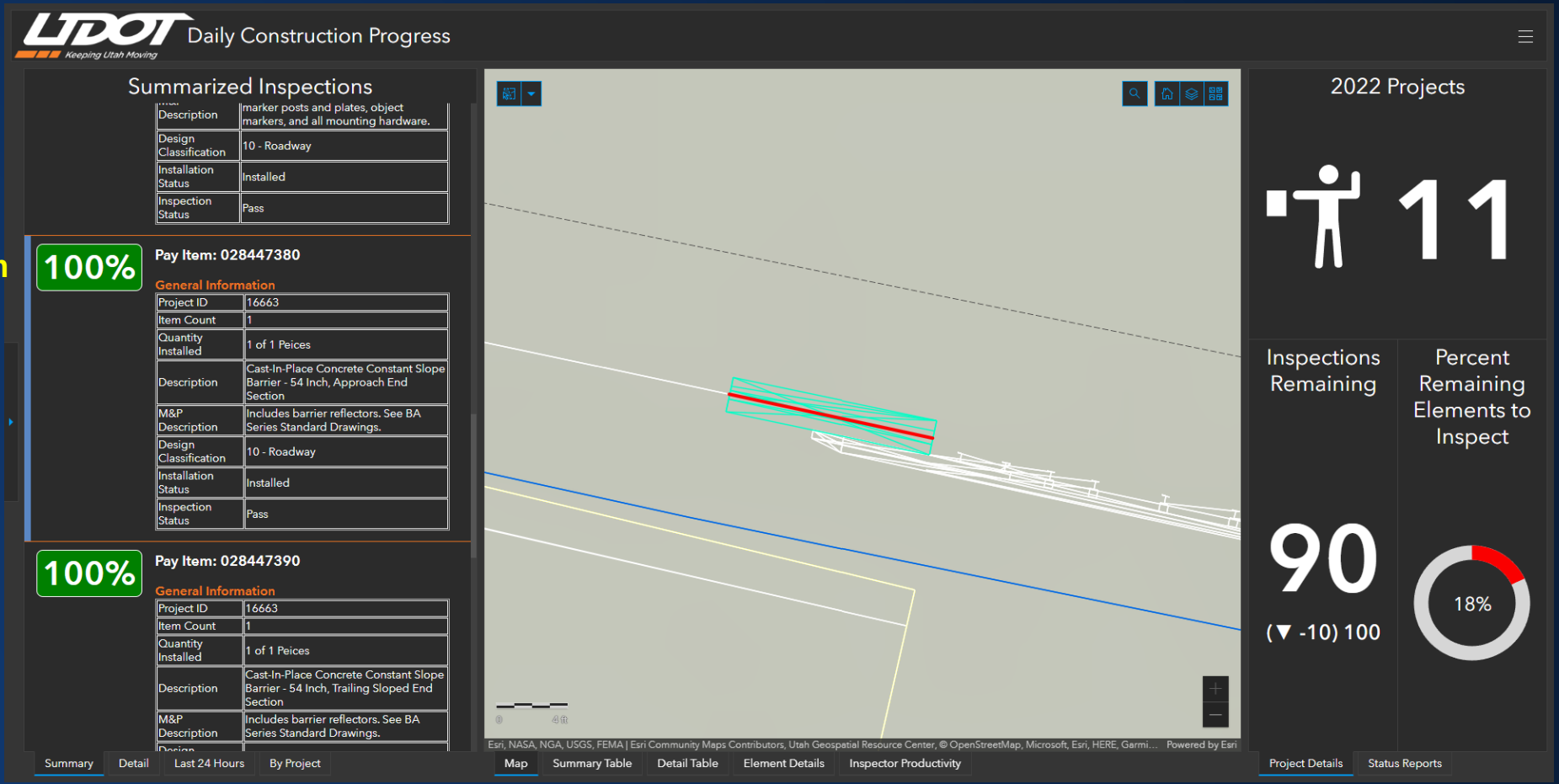
Integration with Contract Management Software

Move Field data to Aurigo Masterworks or other Contract Management System like AAHSTOWare Project



Digital Twin Database

GIS = 2D/3D, Reality Visualization, Analytics, Scenario Modeling, ArcGIS Feature Classes, Real-time

Digital representation of the system. Location and attribute information of the pipes, valves, hydrants, manholes, etc. Provides visualization, overlaying of digital information, and spatial relationships

Use of digital data in a connected environment to view, collect and update information in the office or field. Provides awareness of new or changing information through apps and dashboards

Connecting with other systems such as AMS, SCADA, AVI, and IoT. Provides near- or real-time operational management of people and the system to support proactive and reactive activities

Integrating real-time models and AI/ML, to simulate events. Provide decision support to optimize lifecycle costs, predict breaks, determine system attributes, and test response to change

Visual → **Awareness** → **Operational** → **Predictive**

Data Creation/Migration

Migrated from CAD, digitized from paper or collected in field, ArcGIS is the authoritative system of record for assets

$$

Base Platform Deployment

ArcGIS is a comprehensive location platform. It is a real-time web-based system that connects office and field with web and mobile

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Real-time Capabilities

ArcGIS provides advanced capabilities for real-time and analytics including configurable connections to other enterprise systems

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Adv. Decision Support

Typically requires specialized software or custom integration to fit specific workflows and data requirements

$$-$$$

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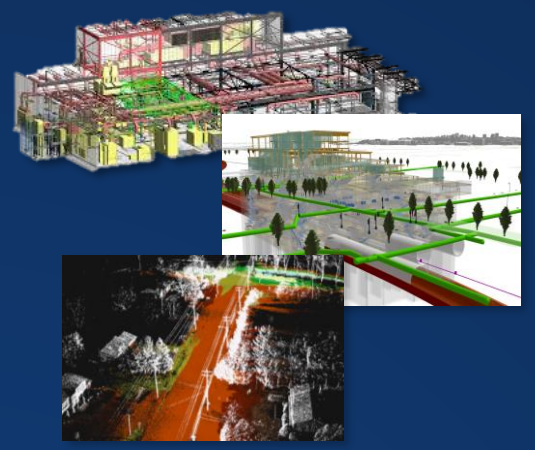
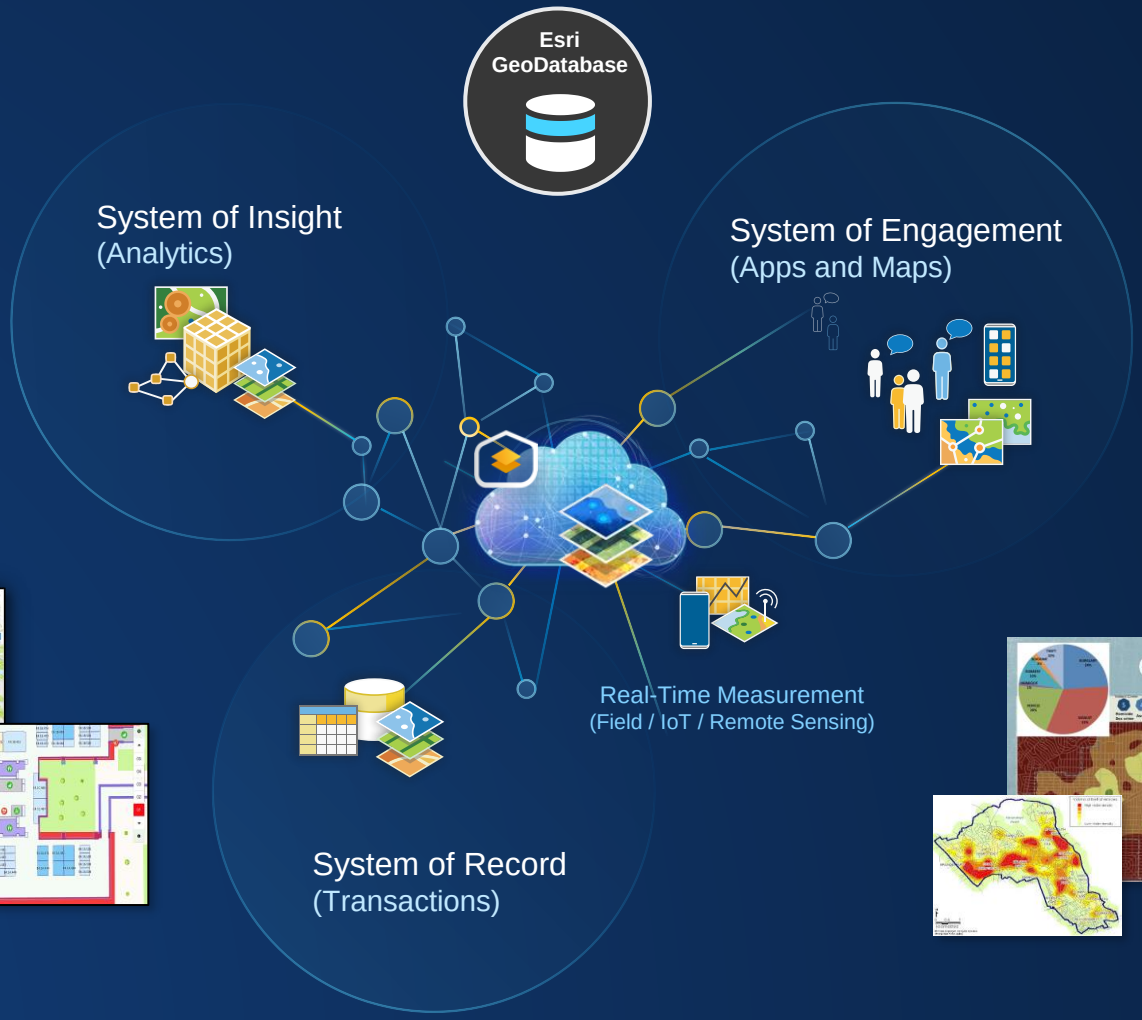
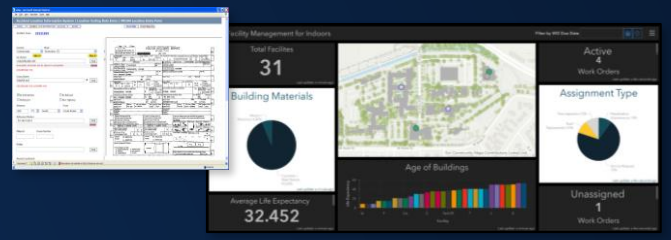
Digital Twin Data





Digital Twin Functionality



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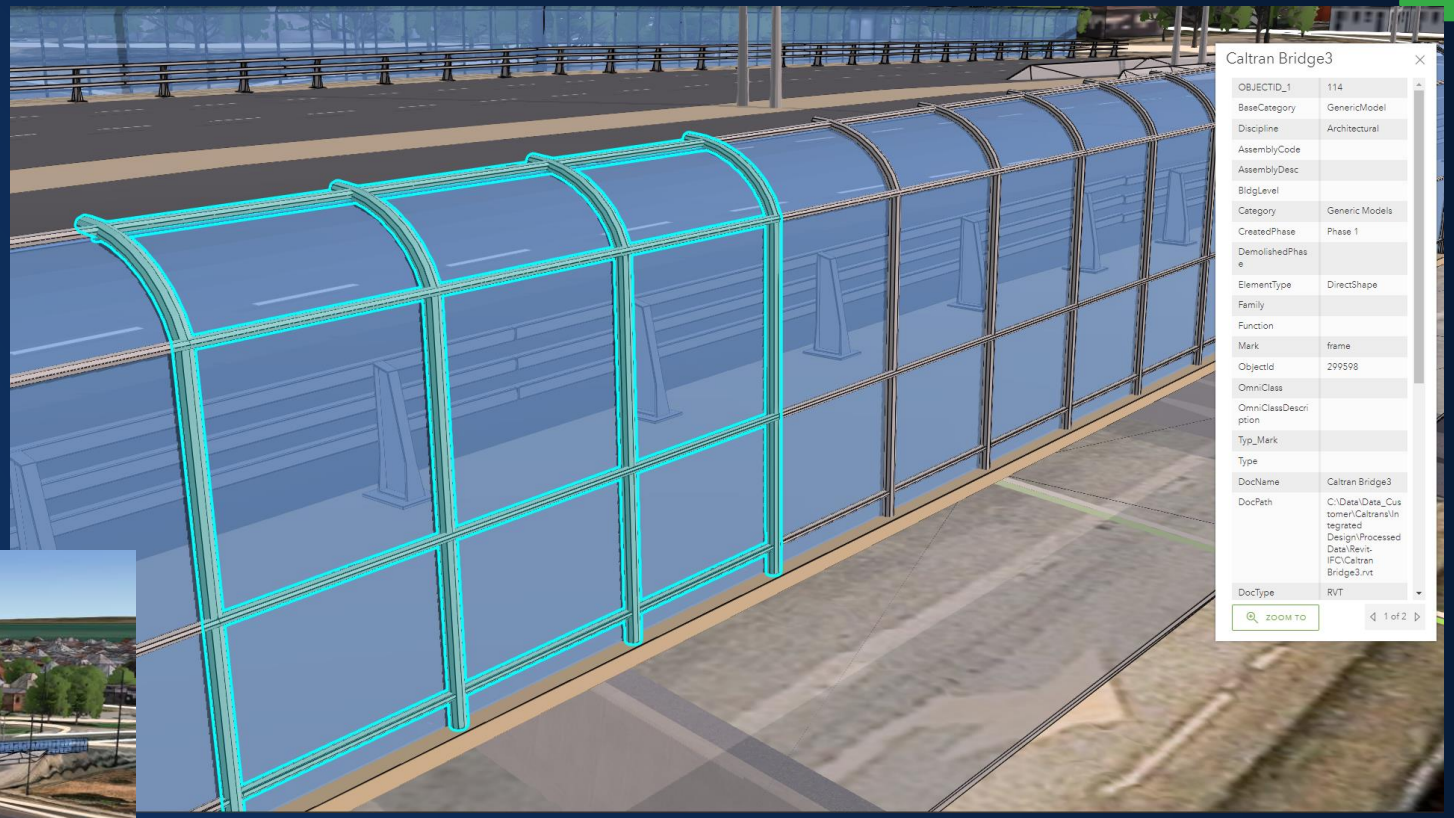

Digital Delivery Best Practices

Moving Asset Location and Descriptive Data Seamlessly with Zero Loss Throughout Its Lifecycle

Digital Delivery Best Practices
Moving Asset Location and Descriptive Data Seamlessly with Zero Loss Throu

Best Practice Inclusion of design, contract management, construction, survey, asset management and planning groups in the Digital Delivery effort

Why? Changing workflows across the groups of people in a DOT is complex, requires integration, recognition of data environments, changing software capabilities and requires process inter-relationships that can only be maximized by coordinated understanding and agreement between all parties. There are numerous instances where one groups process improvement and digitalization requires change from another to realize the goal.

Best Practice Recognition that Digital Delivery is fundamentally based on geographic data.

Why? Design and survey data files are geographic in nature. Assets all have locations. There isn't anything more geographic than a digital terrain model.

Best Practice Digital delivery is not solved by one vendor or one technology

Why? Use the correct tools to do the job they were designed for, need survey, contract management, performance management, collaboration, design, construction, GIS, field/mobile, point cloud, asset extraction, visualization, data management and a host of other functions to automate Digital Delivery. There simply is no single vendor who does all of this stuff.

Best Practice Change management

Why? Digitalization of Digital Delivery workflows requires new thinking, understanding technical possibilities and not just automating existing workflows. The level of change in process, tools, data and expertise are going to be significant warranting an official change management track. Digital Delivery is an evolutionary process, not a single system implementation.