U.S. Department of Transportation
Federal Highway Administration

AEGIST Webinar Series

Spatial Data Governance to Support Enterprise Business Needs

Webinar 1

February 11, 2021

1 – 4 PM EST

U.S. Department of Transportation
Federal Highway Administration

Introduction

Joseph Hausman
Federal Highway Administration
Office of Planning

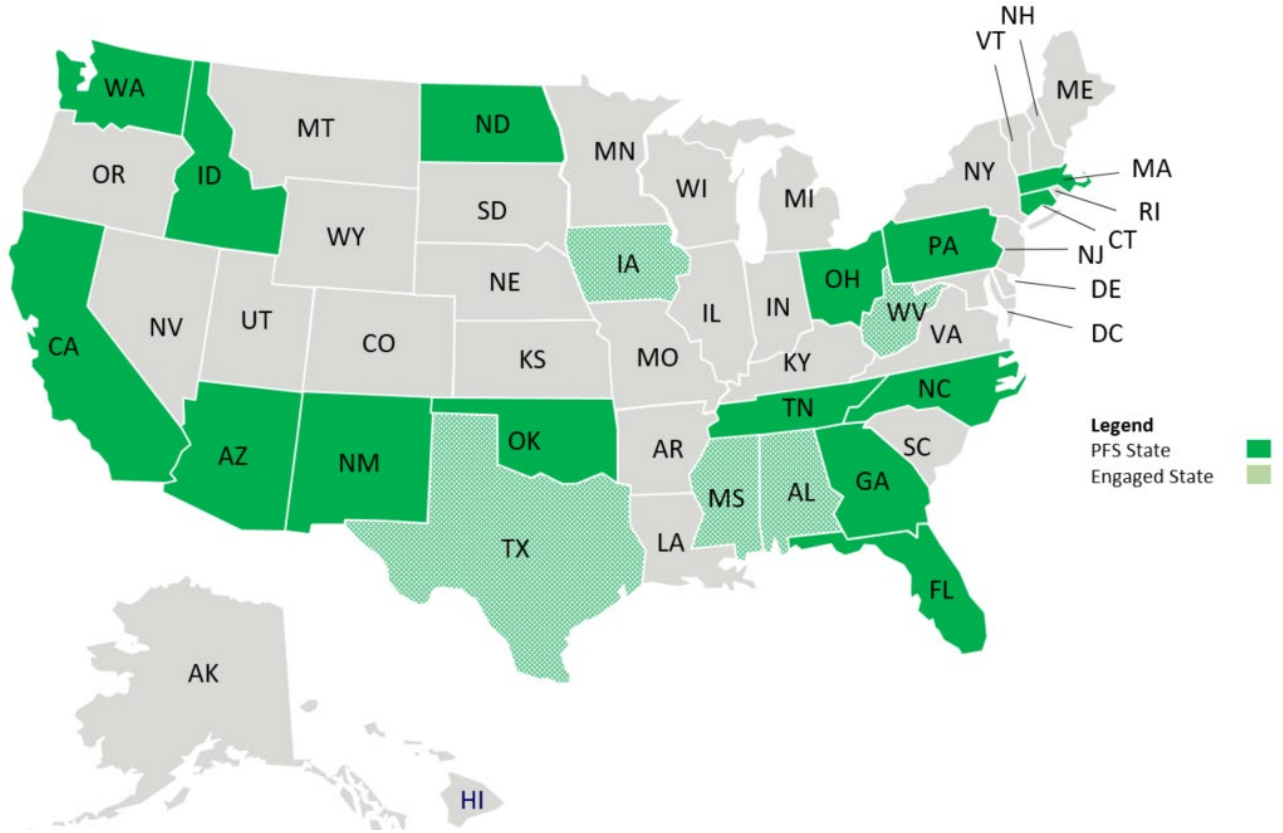
Abhishek Bhargava
Data Scientist
WSP USA

Lisa Saldin
Public Involvement Coordinator
WSP USA

About AEGIST

Pooled Fund Study (PFS): FHWA and 15+ States Enhancing Enterprise Data Management and Governance Practices

- **Spatial Data Modeling**
  - » Linear Referencing System & Data Models, Data Structures
  - » Spatial Referencing Data Models and Structures
  - » Data Quality, Availability, Readiness (FAIR), Authoritative Sources
- **Spatial Data Integration and Engineering**
  - » Integrating and Engineering Business Data using LRS.GIS
  - » Data Conflation, Integration using LRS.GIS
  - » Data Hubs and Data Engineering Platforms for Preparing Data
- **Spatial Data Analytics**
  - » Spatial Statistics, Econometrics, AI/ML, System of Engagement
  - » Federal, State Reporting: HPMS 9.0 with MIRE: Standard APIs
  - » Open Data Portals, Data Sharing and Use for Business Intelligence



Roads and Assets Data Modeling Use Cases
Classified by Business Functions

Project Planning & Programming

- **P2P** Cross-Asset Programming & STIP Development
- **CPM** Capital Projects Management
- **HERS** HERS Economic Analysis

Asset Management

(Operations and Maintenance)

- **PMS:** Pavement Life Cycle Plan
- **BMS:** Bridge Life Cycle Plan
- **MMS:** Maintenance Work Orders
- **ER:** Emergency Response
- **AMS:** Asset Inventory & Routine Inspection Operations

GIS
LRS

Design and Construction

- **CM** Construction Management & Work Zones
- **UAS** Unmanned Aerial System Surveys (Lidar, Photos, Mosaics, Video)
- **ASBH** Construction As-Builts Handoff to Asset Management

Traffic and Safety

- **TDM:** Travel Demand Modeling
- **HSM:** Highway Safety Analysis
- **FAF:** Freight / Truck Routing
- **CMS:** Congestion Management
- **TSMO:** Traffic Systems Operations and Management

Webinar Objective

- FHWA AEGIST Vision: Spatial Data Governance
  - » State DOT Data Governance Councils, Data Offices at DOTs Integrating and Managing Enterprise Data
  - » Spatial Data Engineering and Delivery Platforms: Management and Governance
  - » State GIS Offices, Local Agencies, Other Federal State and Local GIS Stakeholders
  - » Open and Proprietary Spatial Data Platforms, Services, Portals
- State Presentations: Spatial Data Governance to Support Enterprise Business Needs
  - » Ohio DOT
  - » New York State DOT
  - » Florida DOT
- Next Steps
  - » AEGIST 2021 Calendar

Goal: Integrating Data Models using LRS-GIS

Figure 4. Graphic. Geometric and non-geometric BIM for infrastructure data models used during the planning and programming phase.

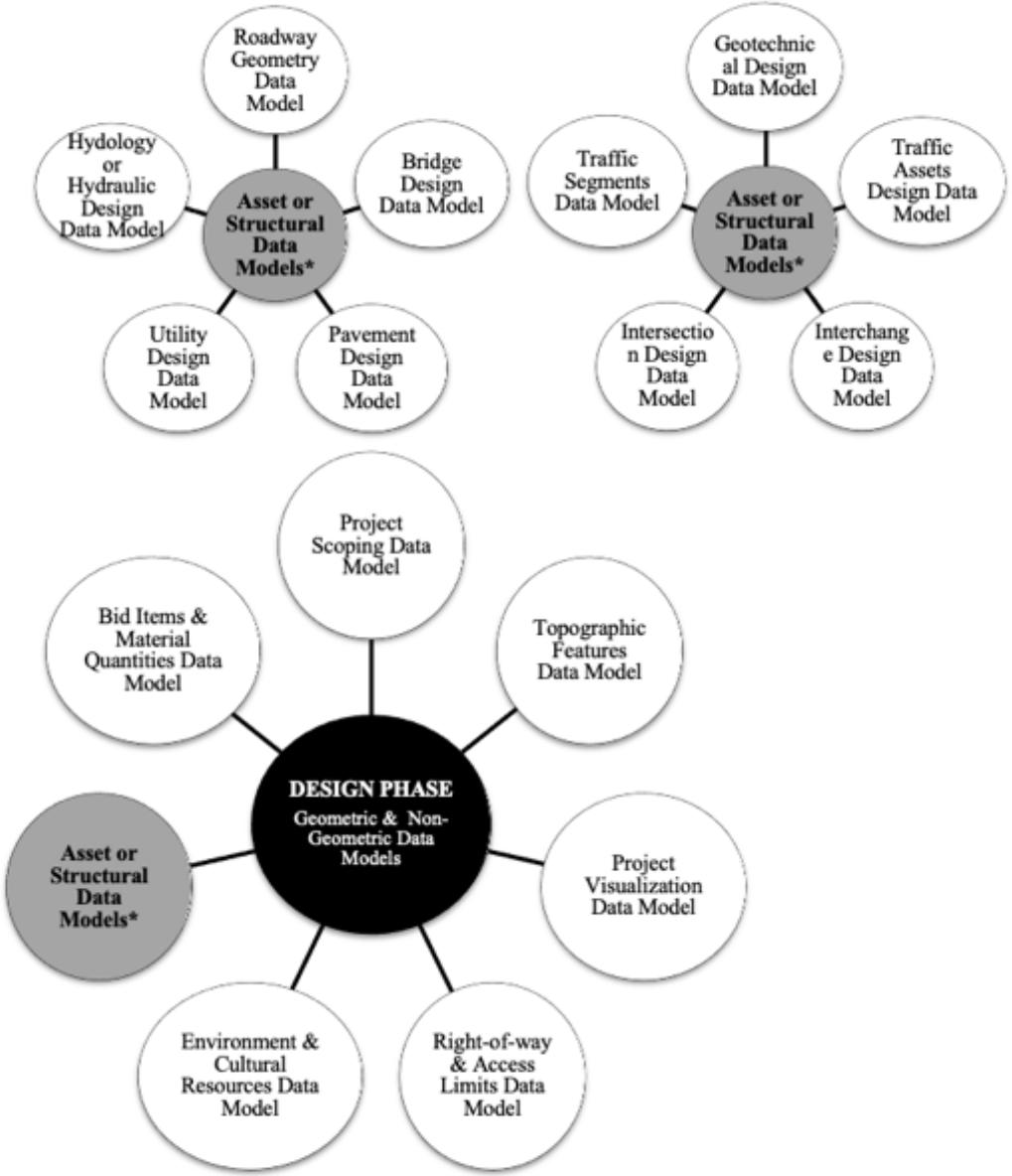


Figure 5. Graphic. Geometric and non-geometric data models created, updated, used, and managed during the design phase.

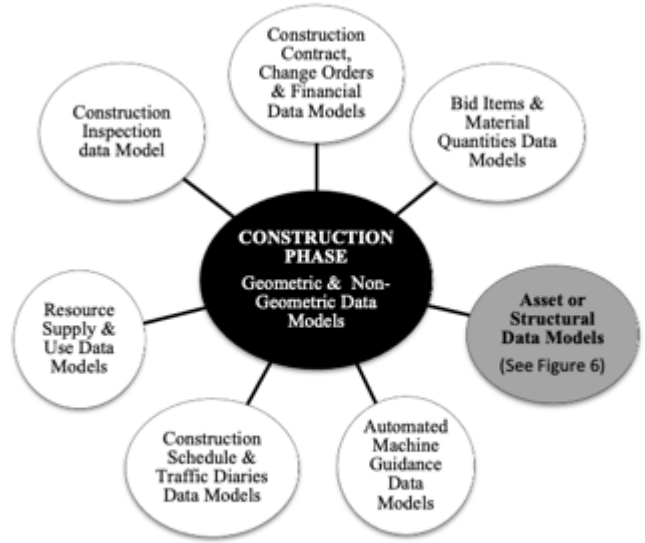
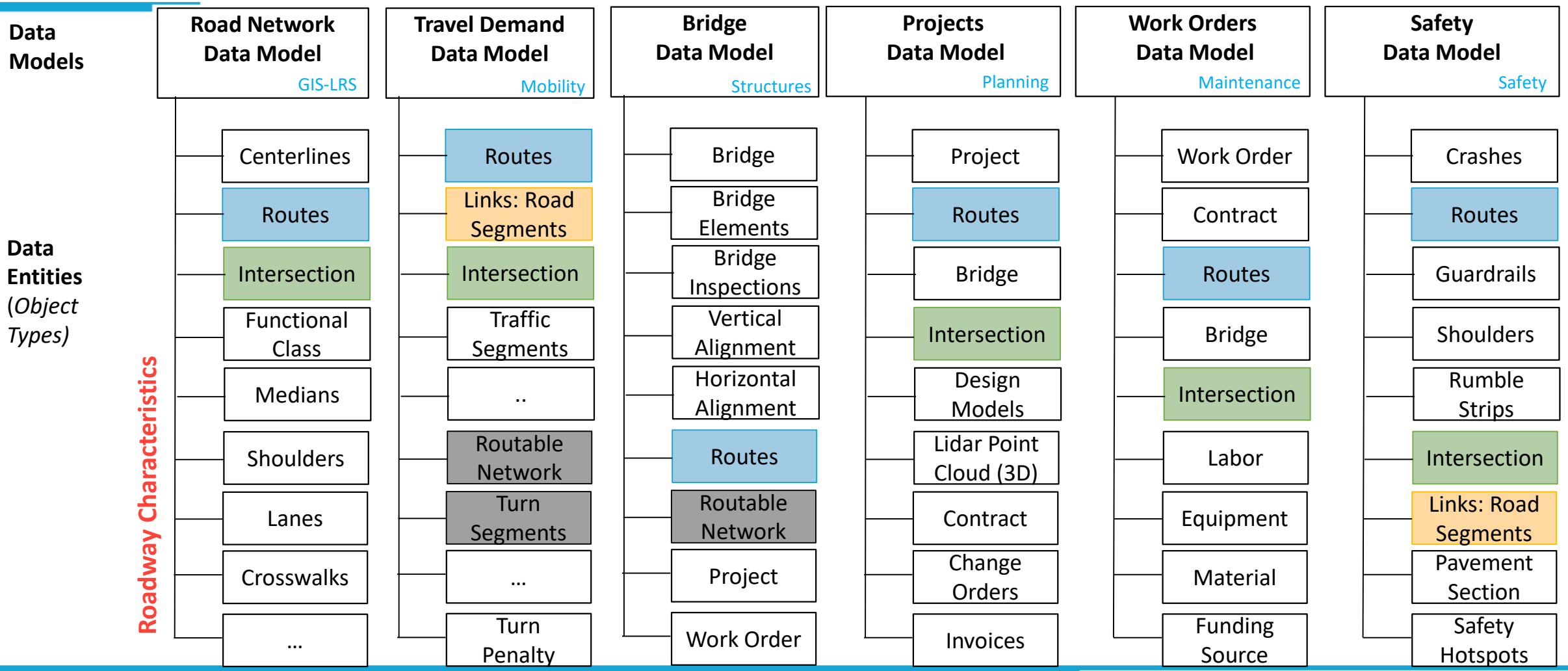


Figure 6. Graphic. Geometric and non-geometric data models created, updated, used, and managed during construction phase.

Figure 7. Graphic. Geometric and non-geometric BIM for infrastructure data models used during the O&M phase.

© Source: Bhargava et.al. (2021). Identifying Data Frameworks and Governance for Civil Integrated Management. FHWA Research. WSP

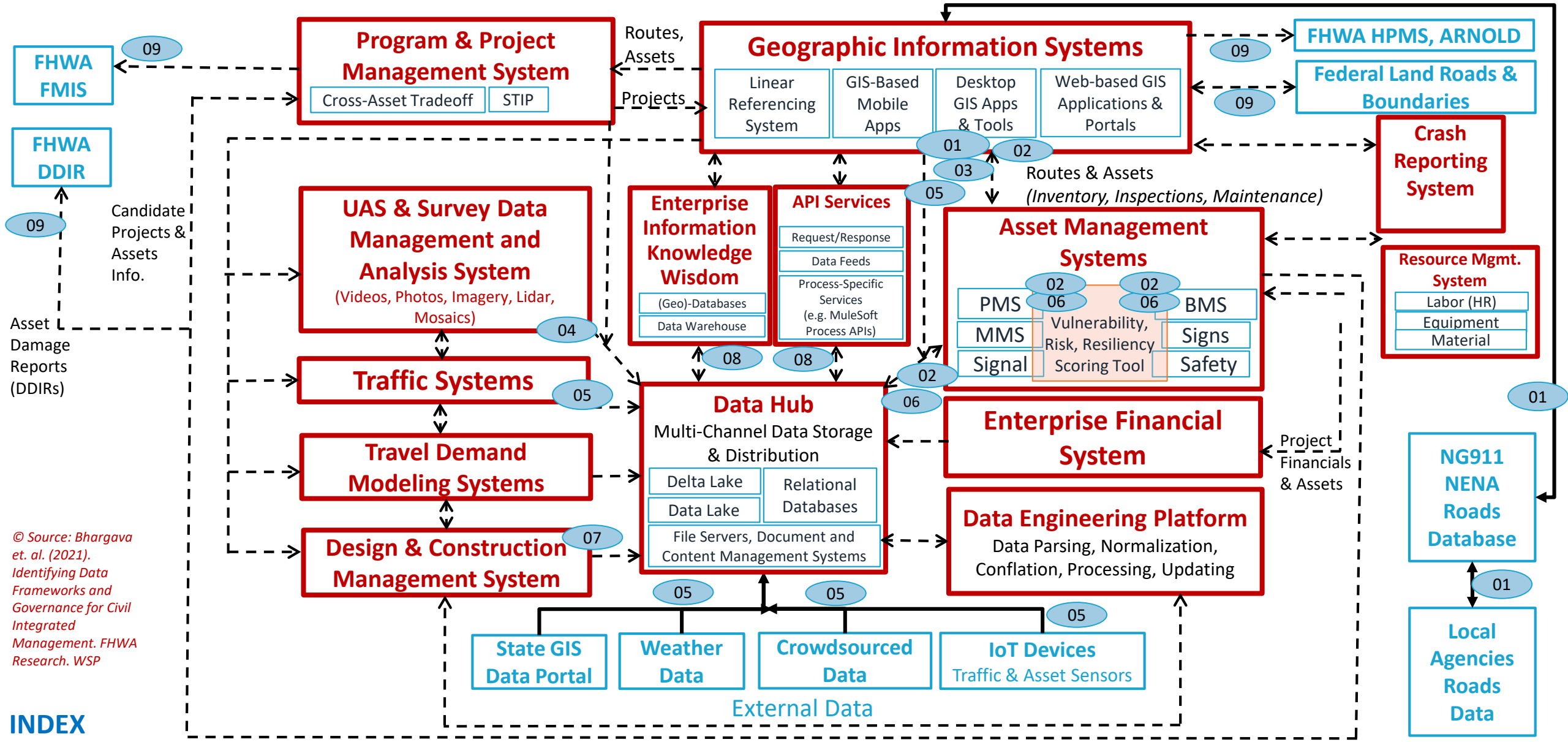
Spatial Data Models Governance in Enterprise BTRS, TIMS, TAMS-DST Publication Databases (for consistent use of data models across agency)



© Source: Bhargava et.al. (2021). Identifying Data Frameworks and Governance for Civil Integrated Management. FHWA Research. WSP

U.S. Department of Transportation
Federal Highway Administration

Template: Spatial Data Modeling, Management, Delivery/Exchange using for Supporting Business Users

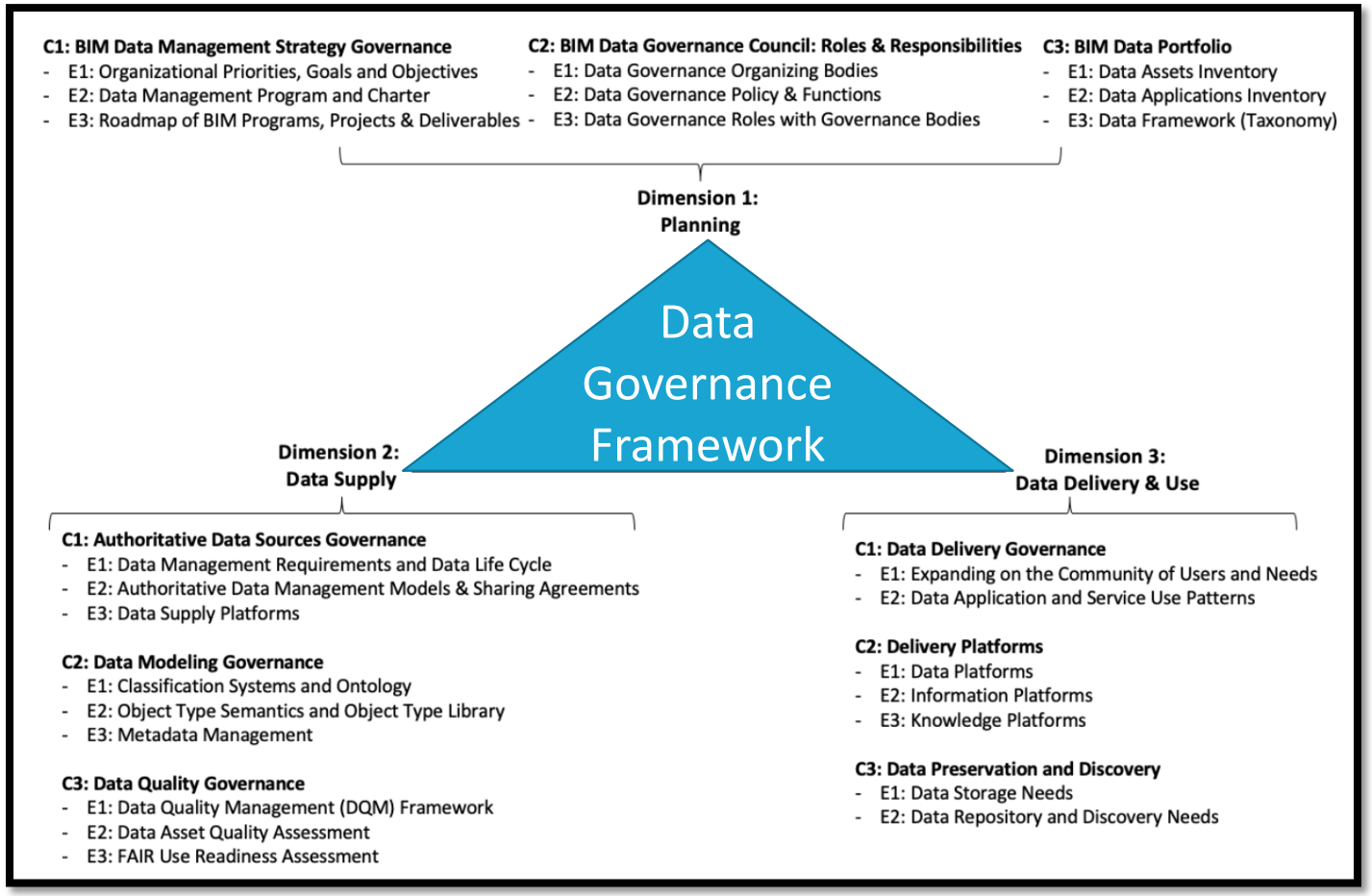


INDEX

01: [Routes and Assets Data] from Road Inventory Systems → LRS, Road Inventory, Asset & Project Systems, Data Hub
02: [Asset Inventory, Condition and Work History, Plans Data] from AMS → Data Hub & Vulnerability Analysis Systems
03: [Asset Damages Data] from Asset Inspection & Damage Assessment Apps → Asset Management System, GIS
04: [Survey, Inspection Data] from UAS → AMS, GIS, Design, Construction, Data Hub Systems
05: [Incident, Traffic & Asset Data] from Weather, Traffic and Asset Systems to Data Hub, Warehouse, GIS, BI
06: [Repair Projects and Work Plan/Requests Data] from Vulnerability Analysis & DDIR Apps → PPMS & AMS
07: [As-Built Asset Data] Design, Construction → LRS and Asset Management Systems
08: [Processed and Integrated Data for Analytics] from Data Hub → Data Warehouse & BI Systems
09: [Roads and Assets, Projects, Damages] from DOT Systems → FHWA HPMS, FMIS, DDIR Systems

BUILDING INFORMATION MODELING (BIM) FOR INFRASTRUCTURE
Data Management & Governance

- Data Portfolio (Architecture)
  - Data Assets Inventory
  - Data Applications and Use Patterns
  - Data Modeling
- Data Supply
  - Authoritative (Master) & Reference Data Management Systems and Models (including Content & Document Data Management)
  - Data Quality
- Data Delivery and Use for Analytics & Decision Support
  - Data Integration & Interoperability
  - Data Sharing and Delivery Platforms
  - Data Security
  - Data Storage & Archival (Preservation)
  - Data Warehousing & Business Intelligence
  - Reporting and Analytics



© Source: Bhargava et.al. (2021). Identifying Data Frameworks and Governance for Civil Integrated Management. FHWA Research. WSP

U.S. Department of Transportation
Federal Highway Administration

Ohio Department of Transportation

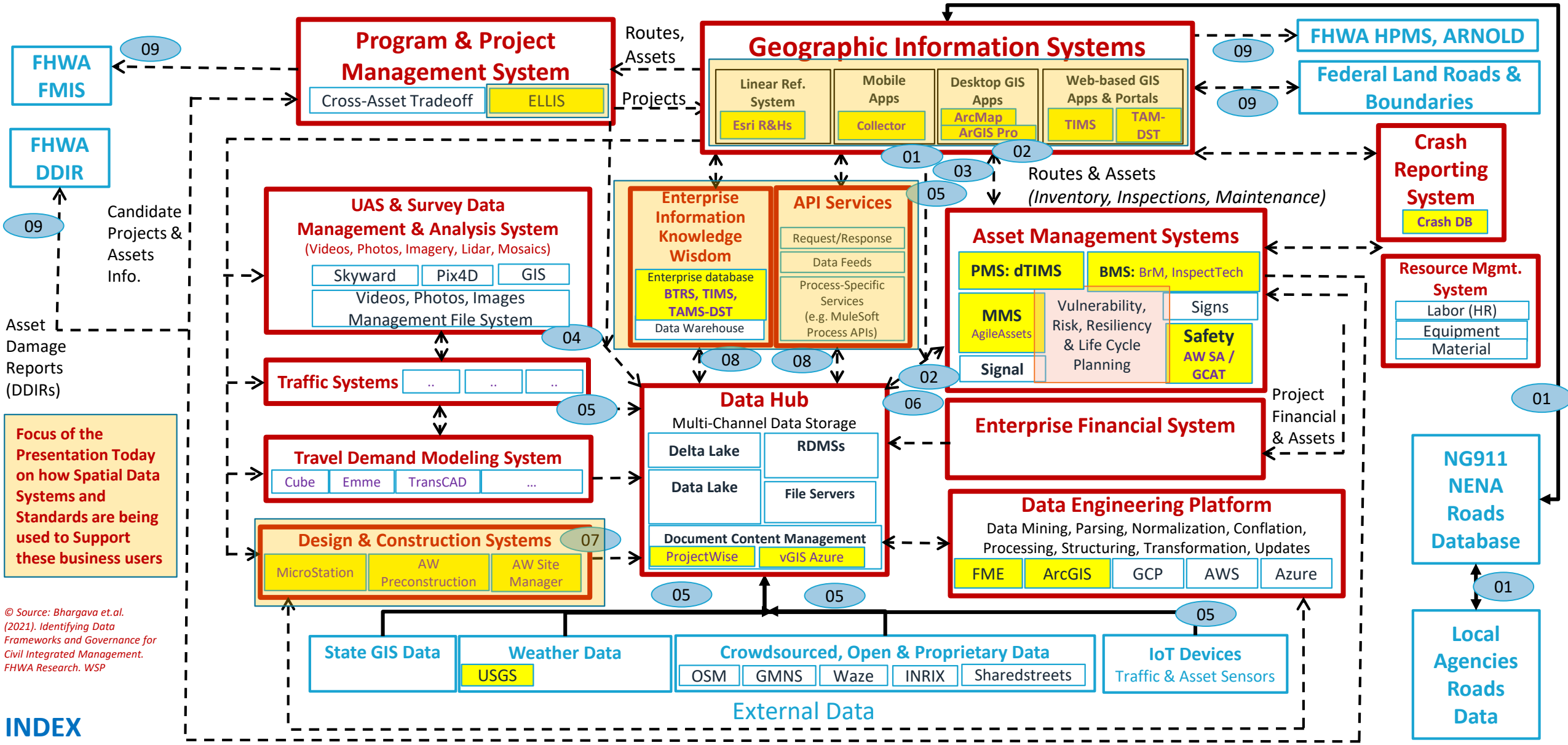
Ian Kidner
GIS Program Manager

John Puente
Administrator, Chief Data Officer

U.S. Department of Transportation
Federal Highway Administration

Enterprise Data Systems and Dataflows

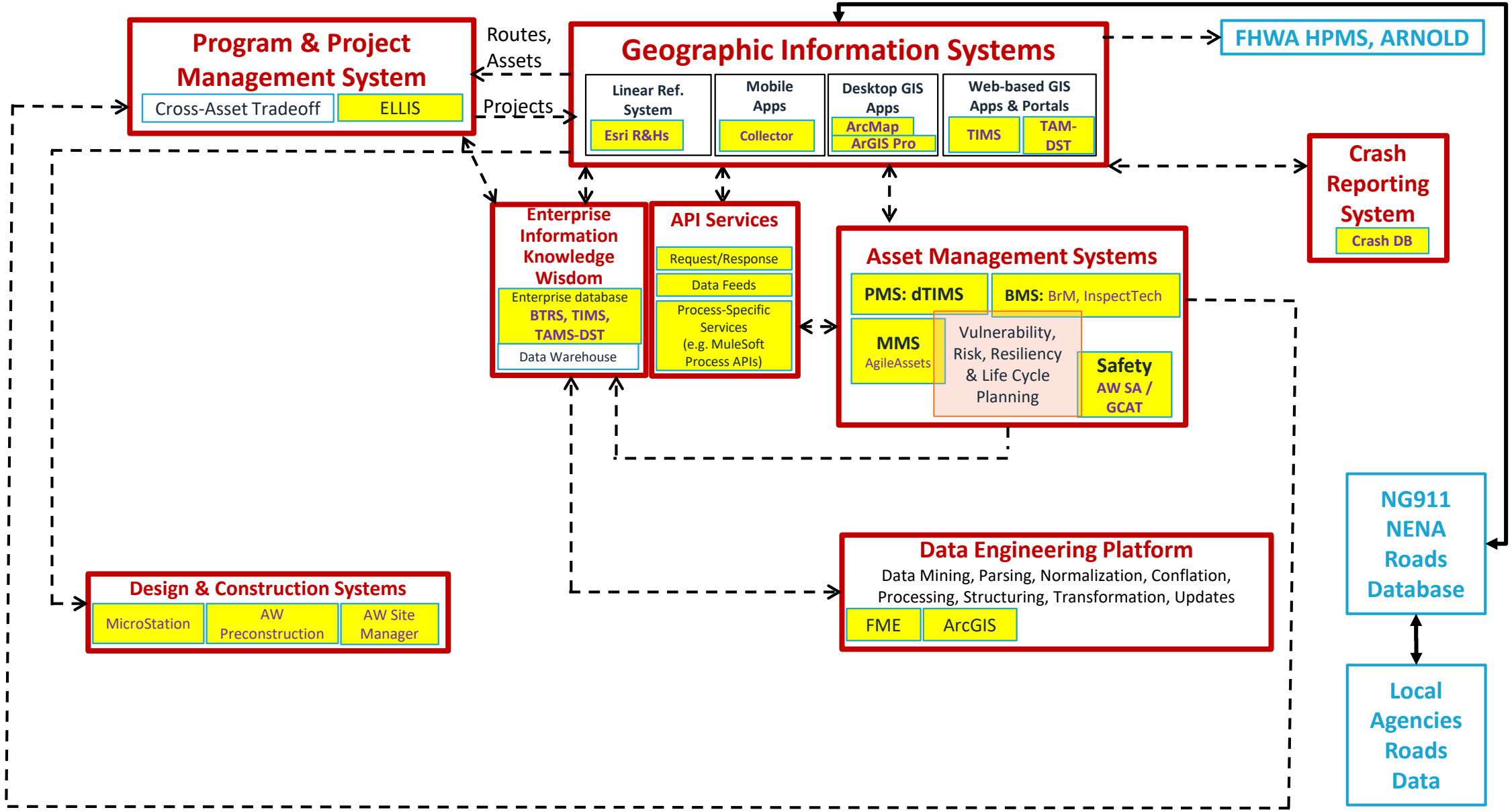
OHIO DOT VISION (DRAFT): Spatial Data Modeling, Management, Delivery/Exchange using for Supporting Business Users



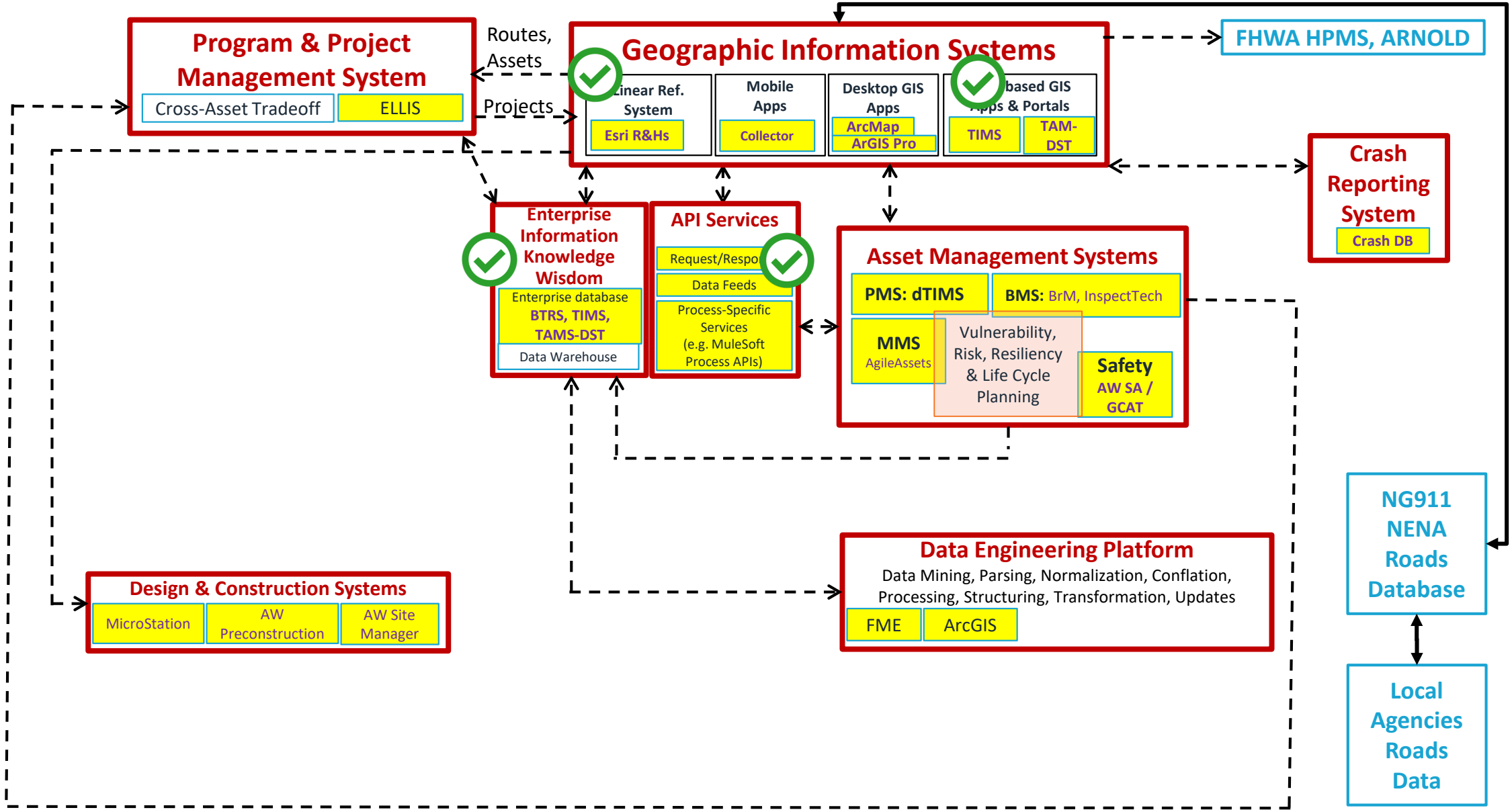
INDEX

01: [Routes and Assets Data] from Road Inventory Systems → LRS, Road Inventory, Asset & Project Systems, Data Hub
02: [Asset Inventory, Condition and Work History, Plans Data] from AMS → Data Hub & Vulnerability Analysis Systems
03: [Asset Damages Data] from Asset Inspection & Damage Assessment Apps → Asset Management System, GIS
04: [Survey, Inspection Data] from UAS → AMS, GIS, Design, Construction, Data Hub Systems
05: [Incident, Traffic & Asset Data] from Weather, Traffic and Asset Systems to Data Hub, Warehouse, GIS, BI
06: [Repair Projects and Work Plan/Requests Data] from Vulnerability Analysis & DDIR Apps → PPMS & AMS
07: [As-Built Asset Data] Design, Construction → LRS and Asset Management Systems
08: [Processed and Integrated Data for Analytics] from Data Hub → Data Warehouse & BI Systems
09: [Roads and Assets, Projects, Damages] from DOT Systems → FHWA HPMS, FMIS, DDIR Systems

OHIO DOT: Spatial Data Modeling, Management, Delivery/Exchange using for Supporting Business Users



OHIO DOT: Spatial Data Modeling, Management, Delivery/Exchange using for Supporting Business Users



LRS/RI Development & Distribution

Creating and Sharing Enterprise Data Models with Business Users

- What are the routes and measures values in the linear referencing system?
- At a certain location, if two routes overlap, which is primary and which is secondary?
- How did a route change from one year to the next?
- How did an intersection change from one year to next?
- What are the measure values of an intersection on a certain route?
- What are the roadway characteristics at a certain location in the network?
  - » Lane width, shoulder width, number of lanes, etc. (HPMS and MIRE attributes)

LRS/RI Development & Distribution: Pre-2014

- LRS/RI Management
  - » GeoMedia (LRS) & DBASE (attributes)
  - » Separate DBASE tables for State System (IR, US, SR), County/Township, Municipal
- LRS/RI Distribution
  - » Base Transportation Reference System (BTRS)
    - Series of mainframe validations & enterprise table creation
    - Home grown system (early 2000s)
    - Utilized “BTRS_LINK” field for tracking changes
    - Worked well, but very labor intensive (approx. 3 months processing time)

LRS/RI Development & Distribution: 2014 ->

- LRS/RI Management
  - » Move to ESRI Roads & Highways
  - » Consolidated separated DBASE tables for State System (IR, US, SR), County/Township, Municipal
- LRS/RI Distribution
  - » Base Transportation Reference System (BTRS)
    - – R&H project began modernization project to move away from BTRS
    - – Shift validations to front end processes (daily FME tools for QAQC)
    - – Develop custom API for data distribution

LRS/RI Development & Distribution: 2014 ->

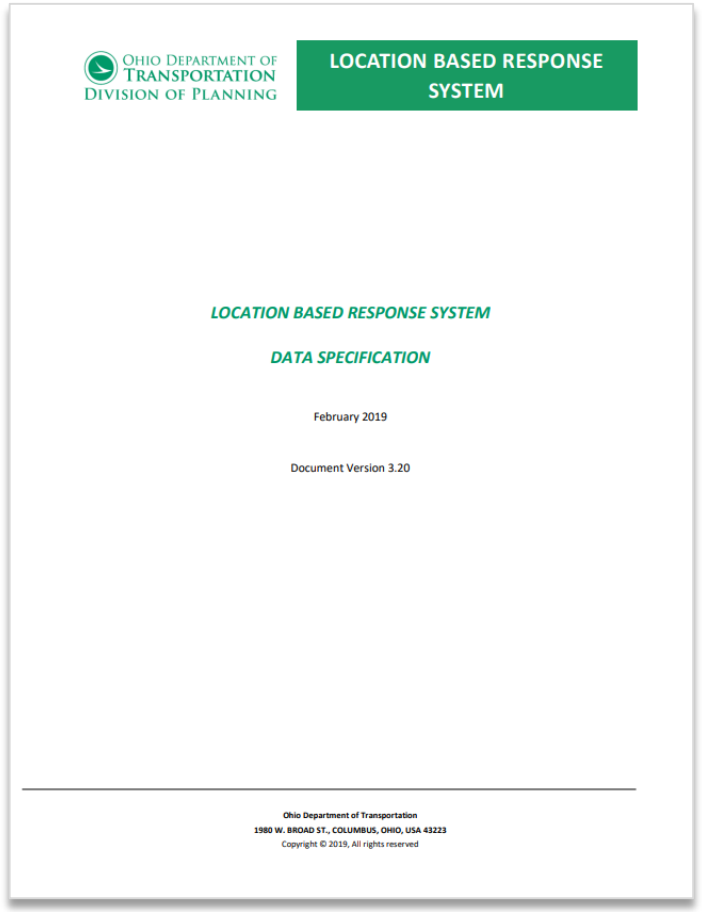
Why Custom API vs. ESRI R&H event layer integration?

- Tech. Capability vs. Business Need vs. Timing
  - » Initial R&H Implementation project challenges
    - Challenging scope
    - R&H maturity
    - Requirements alignment with capabilities
  - » LBRS Project re-started

LRS/RI Development & Distribution: 2014 ->

Location Based Response System (LBRS)

- State / County partnership to develop
  - » Street Centerline, address ranges
- Originally started around 2005
  - » Varying levels of participation
  - » Re-started to complete specification state-wide
- Current Project
  - » Data QAQC & Conflation 40+ counties into ODOT R&H (RIMS)



http://www.dot.state.oh.us/lbrs/Documents/LBRS_Specifications_3.2.1_2019_01.pdf

LRS/RI Development & Distribution: 2014 ->

Custom API for LRS/RI Distribution

- Tech Stack
  - » Java/Groovy
  - » Spring Boot
  - » Hibernate-Spatial
  - » Java Topology Suite
  - » GeoTools
- Benefits
  - » Code Reuse
  - » Enables cross-platform accessibility
  - » New Features
    - – Supports 3-decimal log points
    - – Provides entire network to enterprise (Muni previously excluded)
  - » Provides Capabilities Developers Struggle with
    - – Attribute / segmentation collapsing
    - – Conflation
    - – Spatial capabilities
    - – Temporal (access to geometry back to 2008)
  - » Enables more frequent publishing

LRS/RI Development & Distribution: 2014 ->

Custom API for LRS/RI: Endpoints

- Routes
  - » Route Search - supports autocomplete interfaces as well
  - » Domain Data Lookup - Provides various domain values for applications such as list of counties, districts, etc. Often used in a web application for dropdown lists.
  - » Route Boundary Data for use with validating routes
  - » RI Event Data
  - » Supports ability to select specific attributes
  - » Will collapse segmentation so that segmentation is minimized

LRS/RI Development & Distribution: 2014 ->

Custom API for LRS/RI: Endpoints

- Streets
  - » Relates LRS to street names
  - » Users can provide a street name and get back the relationship between route ID
- Spatial
  - » Closest Point
    - – Returns GEOJSON and can be used for locating route/log point based on a using providing a Coordinate
  - » CRS (County-Route-Section) Conversion
    - – Convert from one CRS to Another

LRS/RI Development & Distribution: 2014 ->

Custom API for LRS/RI: Endpoints

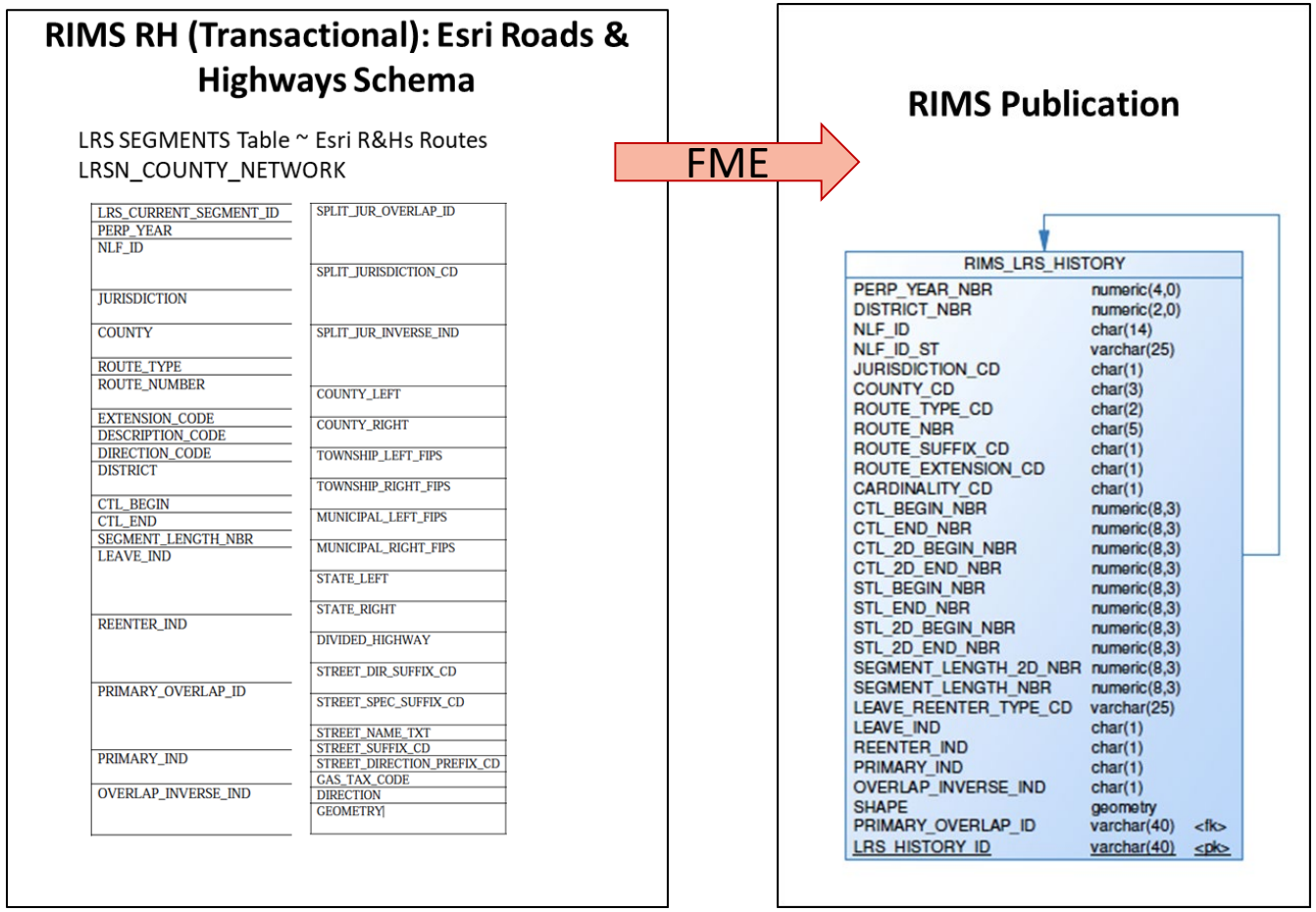
- Conflation
  - » Given a year, route, point or linear event measures and target year, Returns that section in the target year.
  - » Can go forward or backward, multiple years
  - » To make easy, has been wrapped into an FME Custom Transformer.

	CHANGE_TYPE_TXT	FROM_PERP_YR	FROM_NLF_ID	FROM_CTL_3D_BEGIN_NBR	FROM_CTL_3D_END_NBR	TO_NLF_ID	TO_CTL_3D_BEGIN_NBR	TO_CTL_3D_END_NBR
1	TRANSFER_ROUTE_SEGMENT	2018	CPRECR00357**C	0	1.011	CPRECR00028**C	0	1.012
2	TRANSFER_ROUTE_SEGMENT	2018	CPRECR00357**C	1.011	2.043	CPRECR00028**C	1.012	2.043
3	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00008**C	0	0.069	MPREMR00010**C	0	0.067
4	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00008**C	0.069	0.1	MPREMR00010**C	0.067	0.112
5	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00009**C	0	0.041	MPREMR00008**C	0	0.039
6	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00009**C	0.041	0.08	MPREMR00008**C	0.039	0.1
7	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00010**C	0.06	0.09	MPREMR00009**C	0	0.031
8	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00011**C	0	0.09	MPREMR00013**C	0	0.087
9	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00012**C	0	0.12	MPREMR00014**C	0	0.111
10	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00013**C	0	0.04	MPREMR00016**C	0	0.038
11	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00014**C	0	0.039	MPREMR00023**C	0.058	0.099
12	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00014**C	0.042	0.104	MPREMR00023**C	0.099	0.165
13	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00014**C	0.104	0.17	MPREMR00023**C	0.165	0.235
14	TRANSFER_ROUTE_SEGMENT	2018	MPREMR00015**C	0	0.152	MPREMR00017**C	0	0.152

RIMS_PERPETUATION_AUDIT		
PERPETUATION_AUDIT_ID	varchar(40)	<pk>
VERSION_ID	numeric(6,0)	
FROM_PERP_YR	numeric(4,0)	
TO_PERP_YR	numeric(4,0)	
FROM_NLF_ID	char(14)	
TO_NLF_ID	char(14)	
FROM_SLM_BEGIN_NBR	numeric(7,3)	
FROM_BACKSTATION_BEGIN_CD	char(1)	
FROM_SLM_END_NBR	numeric(7,3)	
FROM_BACKSTATION_END_CD	char(1)	
FROM_CTL_BEGIN_NBR	numeric(7,3)	
FROM_CTL_END_NBR	numeric(7,3)	
FROM_LEAVE_IND	char(1)	
FROM_REENTER_IND	char(1)	
FROM_GAP_LEAVE_IND	char(1)	
FROM_GAP_REENTER_IND	char(1)	
TO_SLM_BEGIN_NBR	numeric(7,3)	
TO_BACKSTATION_BEGIN_CD	char(1)	
TO_SLM_END_NBR	numeric(7,3)	
TO_BACKSTATION_END_CD	char(1)	
TO_CTL_BEGIN_NBR	numeric(7,3)	
TO_CTL_END_NBR	numeric(7,3)	
TO_LEAVE_IND	char(1)	
TO_REENTER_IND	char(1)	
TO_GAP_LEAVE_IND	char(1)	
TO_GAP_REENTER_IND	char(1)	
CHANGE_TYPE_TXT	varchar(64)	
CHANGE_NOTES_TXT	varchar(255)	
FROM_CTL_3D_BEGIN_NBR	numeric(7,3)	
FROM_CTL_3D_END_NBR	numeric(7,3)	
TO_CTL_3D_BEGIN_NBR	numeric(7,3)	
TO_CTL_3D_END_NBR	numeric(7,3)	

LRS/RI Development: Future / In-Progress

Network Routing (nodes / links)

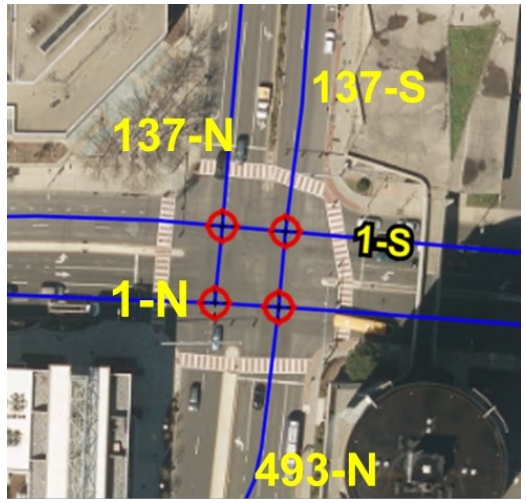


- Initial testing / prototyping
- Able to create basic node / link network using FME
- Basic routing capability (i.e. shortest path) works
- Need to define requirements, cost values, etc.

LRS/RI Development: Future / In-Progress

Governed
- ✓ Structure
- ✓ Quality Rules
- ✓ Temporality

Intersections



Intersection/Navigation Points: GDF Junctions

INTER PT_ID	Valency (GDF)	Routes & Measures	Geom. (XYZ)
002421	2	Relate Table	X_1,Y_1,Z_1
000257	2	Relate Table	X_2,Y_2,Z_2
000258	2	Relate Table	X_3,Y_3,Z_3
000018	3	Relate Table	X_4,Y_4,Z_4

Intersection Points Relate Table: Route Measures

INTER PT_ID	Route	Measure
002421	137-S	0.00
002421	1-N	6.93
000257	137-S	0.01
000257	1-S	6.93
000258	1-S	0.0
000258	137-N	0.01
000018	137-N	0.01
000018	1-N	6.94
000018	493-N	0.34

RIMS_INTERSECTIONS

INTERSECTION_EVENT_ID	varchar(36)	<pk>
OBJECTID	int	
INTERSECTION_ID	varchar(36)	
PERP_YEAR_NBR	numeric(4)	
PERP_DATE	datetime	
RETIRE_DT	datetime	
VALID_IND	char(1)	
LOCAL_ONLY_IND	char(1)	
GEOMETRY	geometry	
RETIRED_IND	char(1)	
MODIFIED_IND	char(1)	
ADDED_IND	char(1)	

RIMS_CROSS_ROUTE_PTS

CROSS_ROUTE_ID	varchar(36)	<pk>
INTERSECTION_EVENT_ID	varchar(36)	<fk>
OBJECTID	int	
NLF_ID	char(14)	
CTL_NBR	numeric(7,3)	
PRIMARY_IND	char(1)	
GEOMETRY	geometry	

RIMS_CROSS_ROUTE_LEGS

CROSS_ROUTE_LEG_ID	varchar(36)	<pk>
CROSS_ROUTE_ID	varchar(36)	<fk>
OBJECTID	int	
NLF_ID	char(14)	
APPROACH_ANGLE	numeric(6,3)	
APPROACH_ANGLE_ENG	numeric(6,3)	
LEG_DIRECTION	varchar(10)	
CTL_NBR	numeric(7,3)	
CTL_BEGIN_NBR	numeric(7,3)	
CTL_END_NBR	numeric(7,3)	
GEOMETRY	geometry	
SEGMENT_LENGTH	numeric(7,3)	
GEOM_LENGTH_METERS	numeric(7,3)	
PRIMARY_IND	char(1)	

PERP_YEAR_NBR	NLF_ID	CTL_NBR	PRIMARY_IND	INTERSECTION_EVENT_ID	INTERSECTION_ID	GEOM
2017	SPRESR00503**C	5.24	Y	0124fe76-6364-40cd-9067-faea4e05cce4	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425182.53000000119 183835.23000000045
2017	TPRETR00315**C	4.41	Y	0124fe76-6364-40cd-9067-faea4e05cce4	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425182.53000000119 183835.23000000045
2018	SPRESR00503**C	5.24	Y	255acd42-2b38-4b80-a8ad-f6b89752c543	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425182.5300000757 183835.23000329174
2018	TPRETR00315**C	4.41	Y	255acd42-2b38-4b80-a8ad-f6b89752c543	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425182.5300000757 183835.23000329174
2019	SPRESR00503**C	5.244	Y	2600b5b8-7a19-4e54-9f74-2cb1dea97a18	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425192.11000007368 183844.34000328922
2019	TPRETR00315**C	4.369	Y	2600b5b8-7a19-4e54-9f74-2cb1dea97a18	0124fe76-6364-40cd-9067-faea4e05cce4	POINT (425192.11000007368 183844.34000328922

Temporal Intersections Data Model for storing the Routes and Measure Values

LRS/RI Development: Future / In-Progress

Interchange IDs

- Currently managed in legacy Access DB format
  - » Manually updated
- Need to define requirements
  - » Full business use / needs not well understood currently
    - – Assets interaction, Safety areas of influence, reporting, etc.
- Anticipate:
  - » Fully automated creation via FME
  - » Association with the intersection file(s)

Tools

- TIMS
- TAM-DST
- SLD

Ohio Transportation Information Mapping System (TIMS)

https://gis.dot.state.oh.us/tims

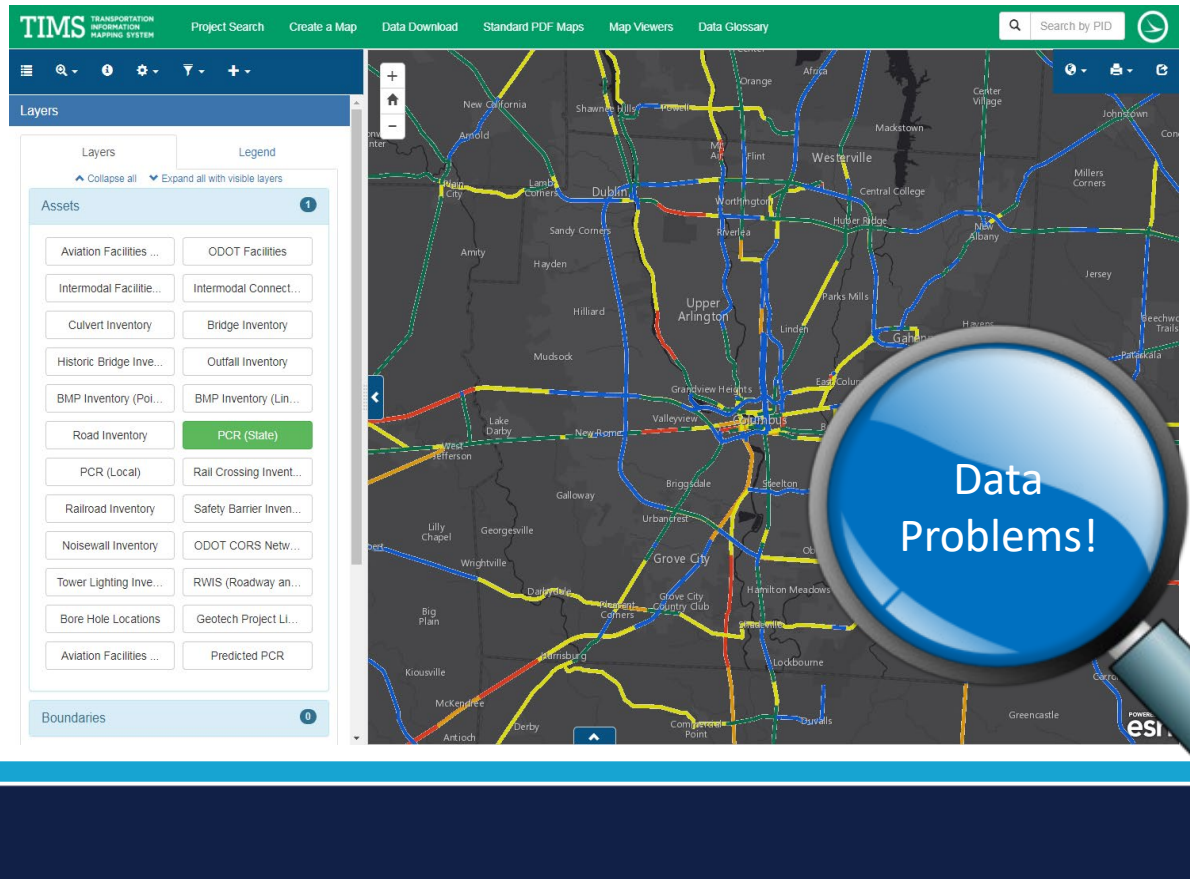
What's In It For Me?

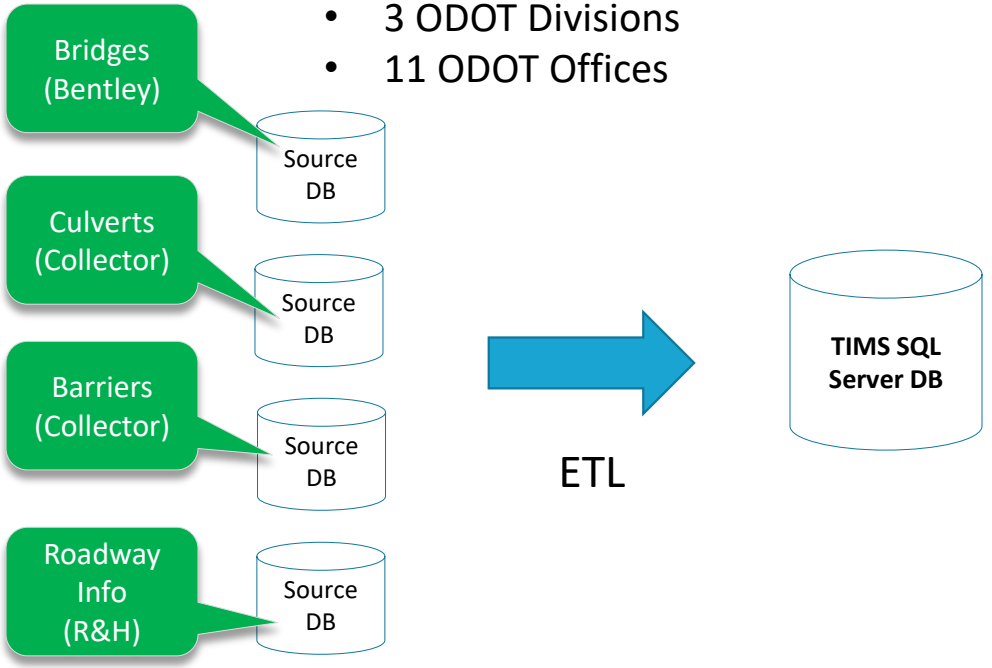
Access/Excel/Flat -> SQL

Minor DB standards

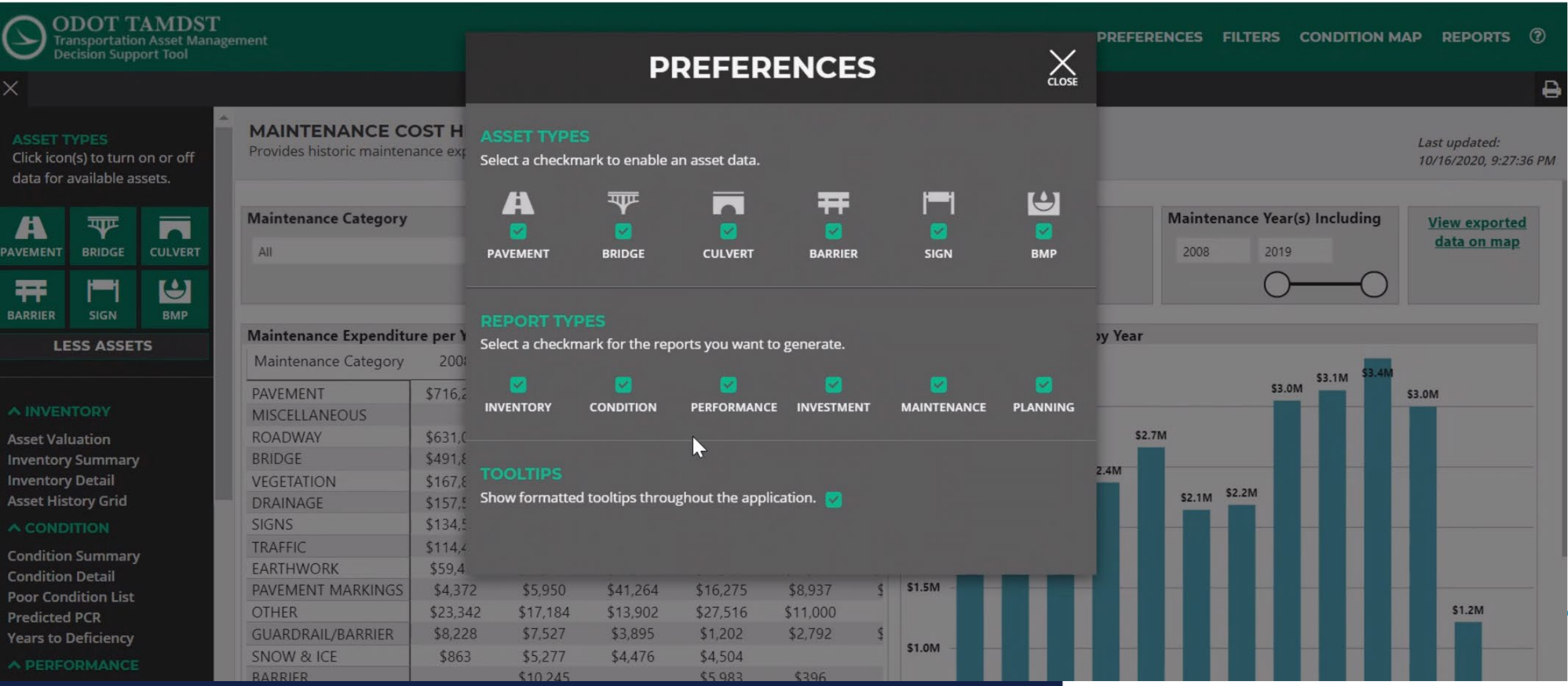
- Transparency
- Enable sharing
- Increase data usage
- Increase data value
- Exposes issues

- Information Portal
- User friendly
- Business Areas want their data available here
- 80+ Datasets
- 5 Agencies (State/Fed)
- 3 ODOT Divisions
- 11 ODOT Offices

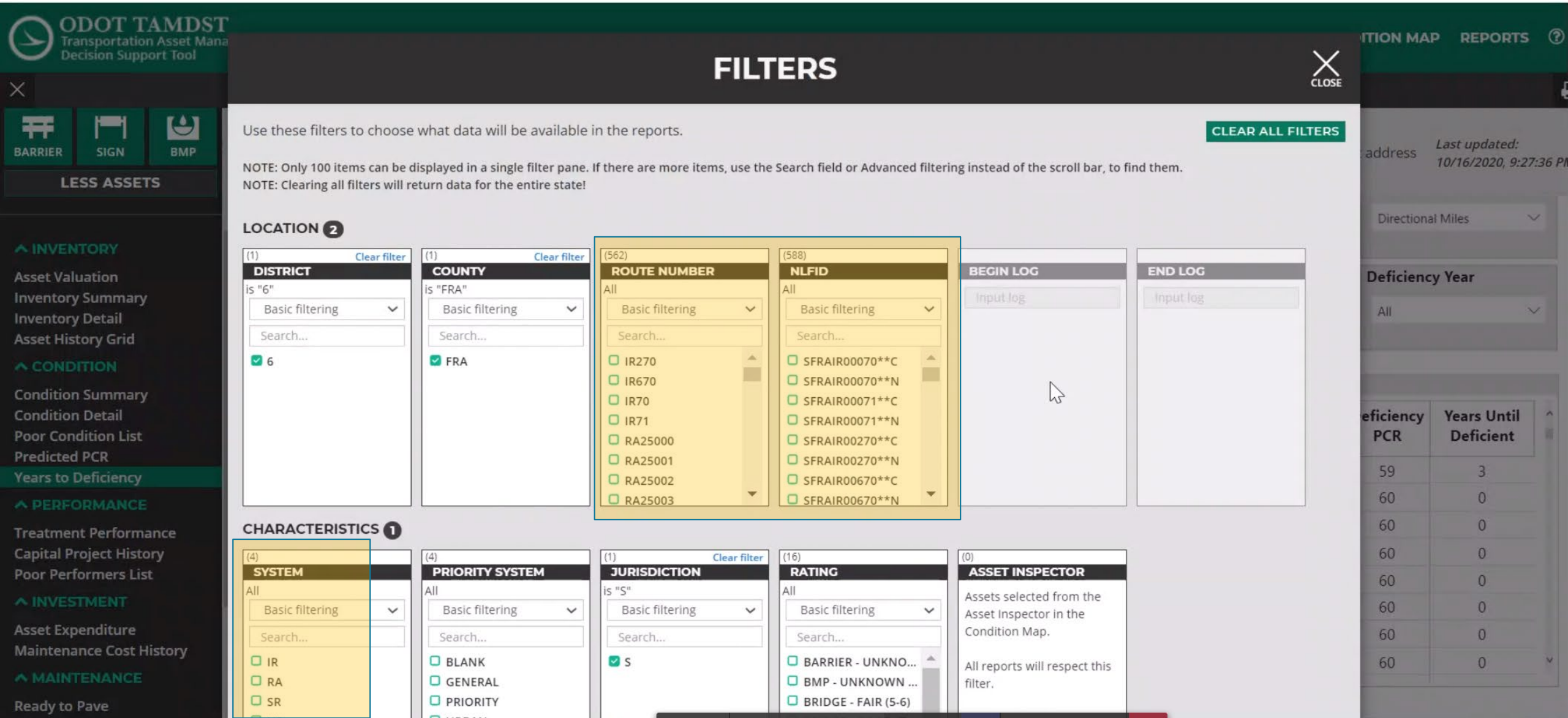




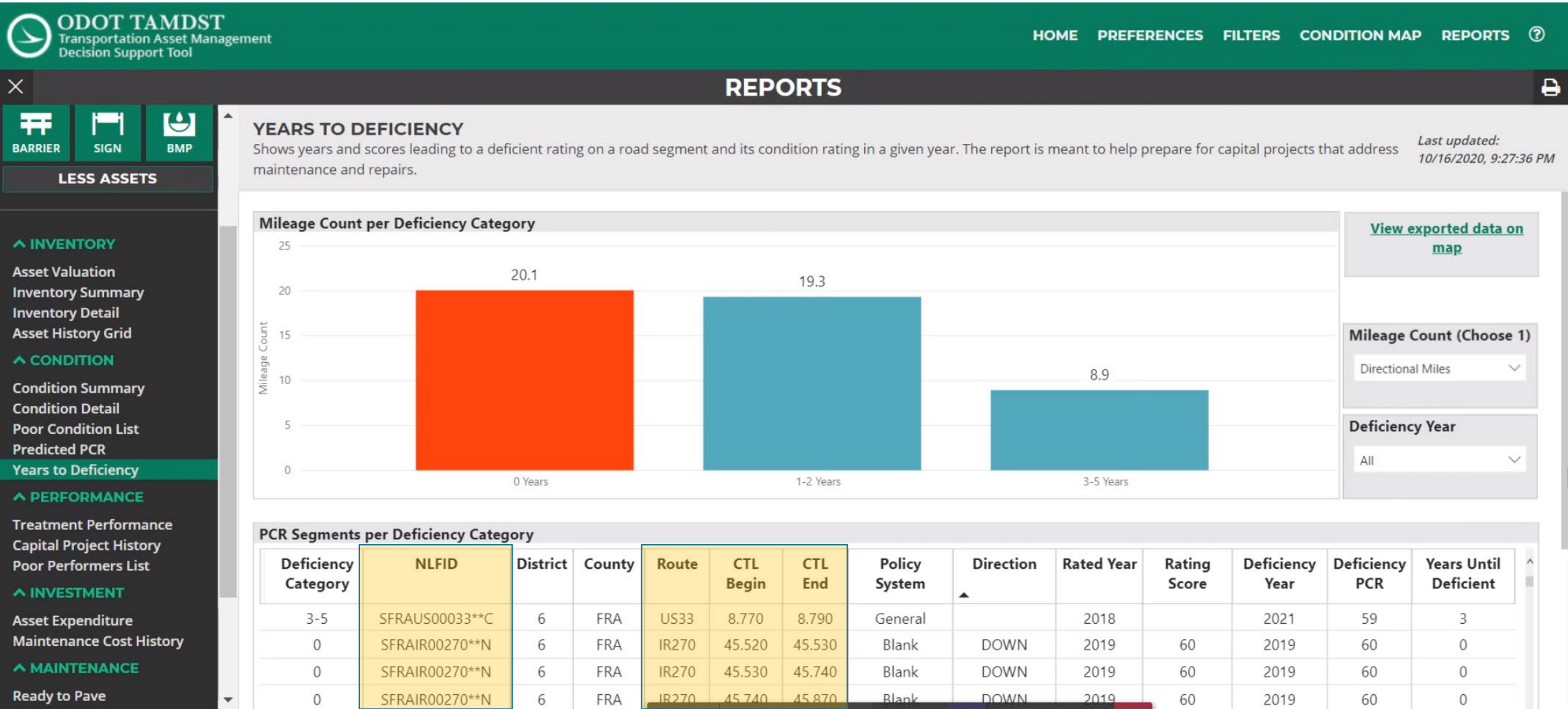
Transportation Asset Management Decision Support Tool



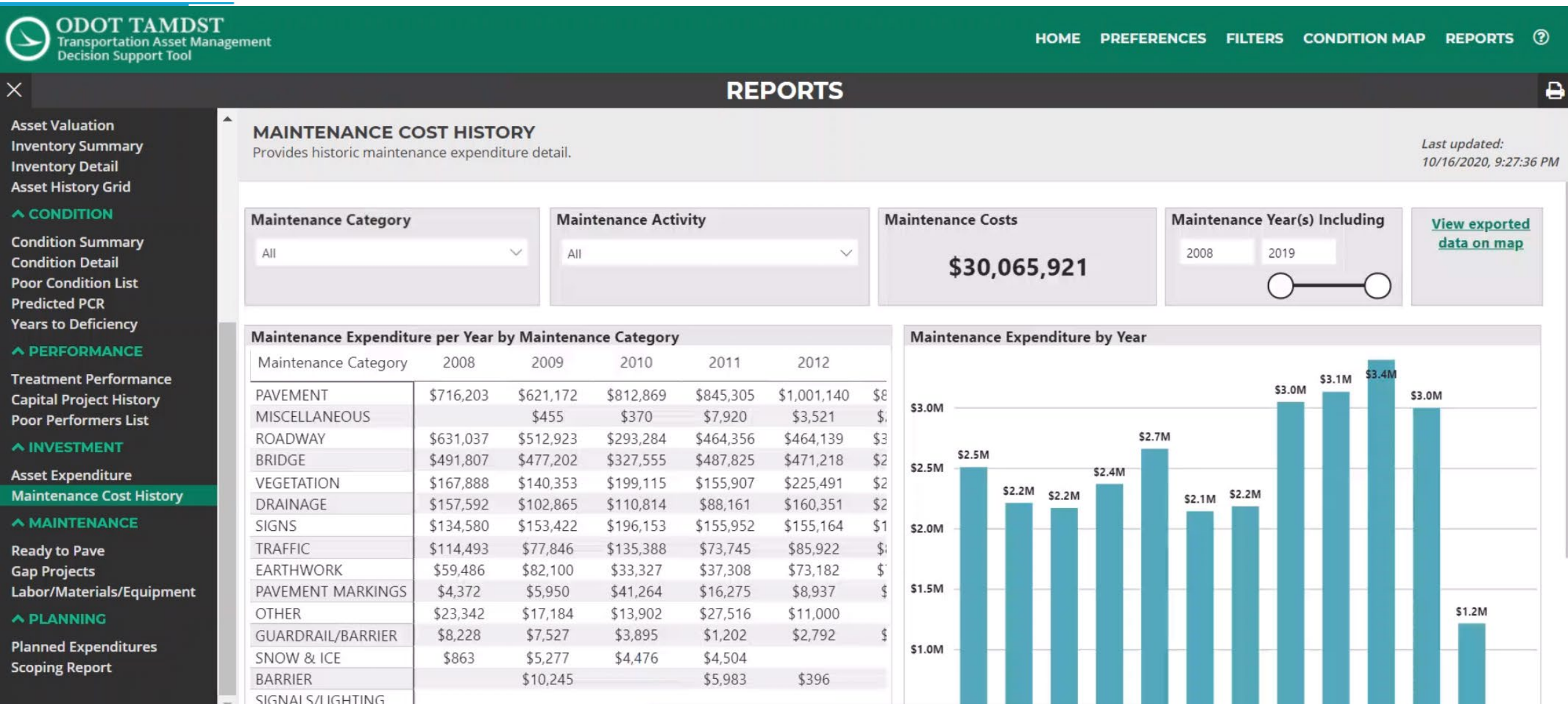
Reference Data Management at Enterprise Level



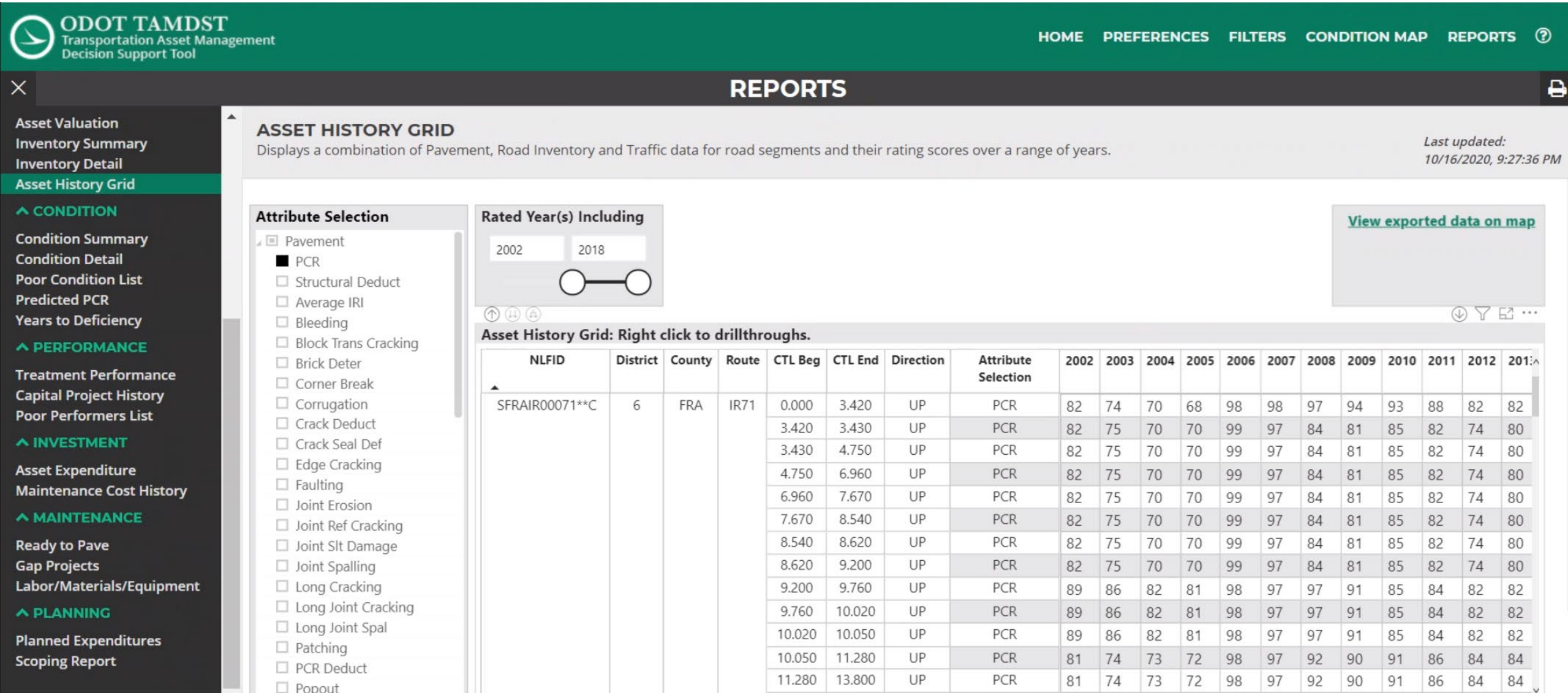
Transportation Asset Management Decision Support Tool



Transportation Asset Management Decision Support Tool



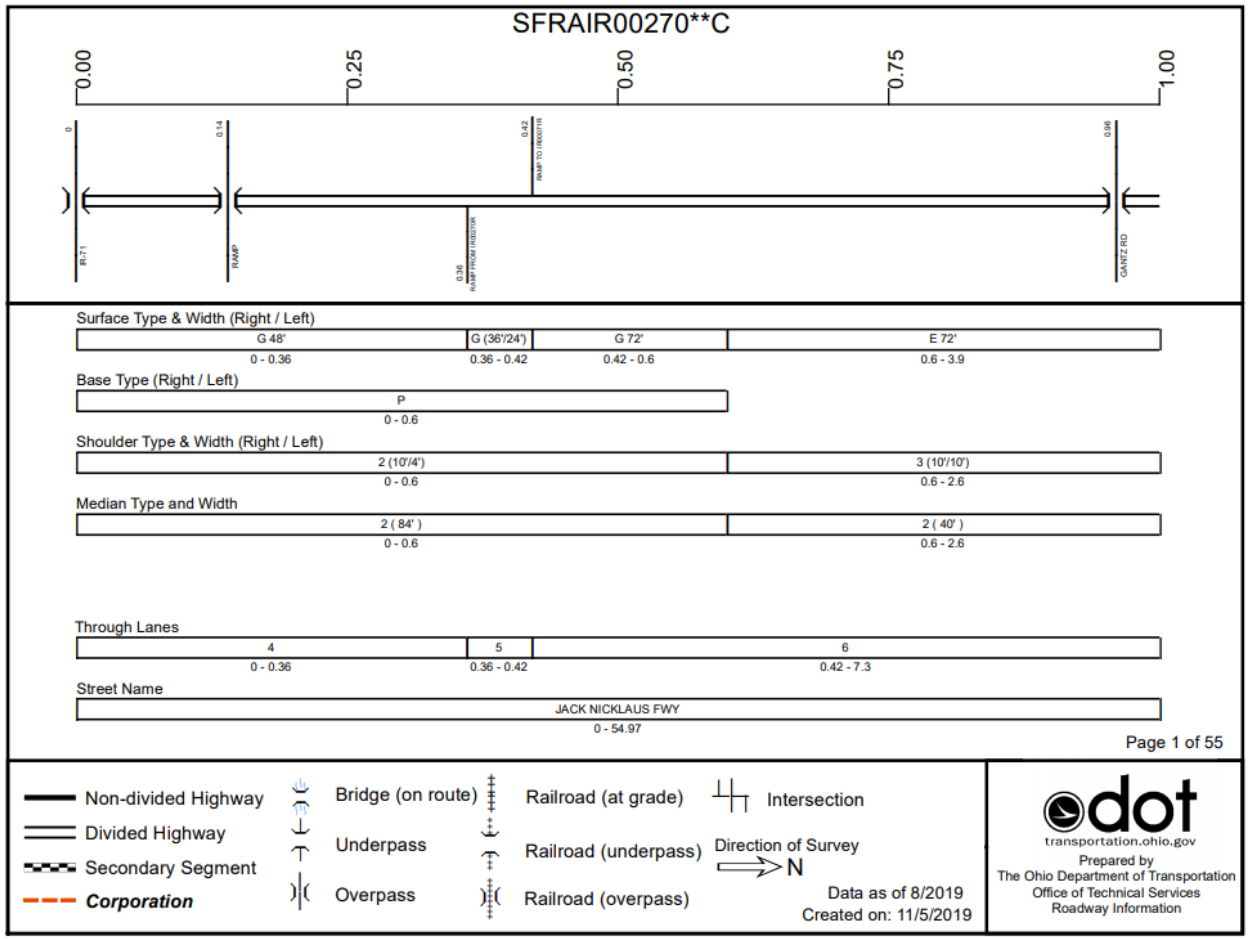
Data from Pavement Management System



NLFID	District	County	Route	CTL Beg	CTL End	Direction	Attribute Selection	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	201
SFRAIR00071**C	6	FRA	IR71	0.000	3.420	UP	PCR	82	74	70	68	98	98	97	94	93	88	82	82
				3.420	3.430	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				3.430	4.750	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				4.750	6.960	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				6.960	7.670	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				7.670	8.540	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				8.540	8.620	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				8.620	9.200	UP	PCR	82	75	70	70	99	97	84	81	85	82	74	80
				9.200	9.760	UP	PCR	89	86	82	81	98	97	97	91	85	84	82	82
				9.760	10.020	UP	PCR	89	86	82	81	98	97	97	91	85	84	82	82
				10.020	10.050	UP	PCR	89	86	82	81	98	97	97	91	85	84	82	82
				10.050	11.280	UP	PCR	81	74	73	72	98	97	92	90	91	86	84	84
				11.280	13.800	UP	PCR	81	74	73	72	98	97	92	90	91	86	84	84

Straight Line Diagrams (SLD)

- Automated SLD PDF creation using Python
- https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/technical-services/resources/sld
- Now included in annual LRS/RI publication



AEGIST Objectives Summary

Pooled Fund Study (PFS): FHWA and 16+ States Enhancing Enterprise Data Management and Governance Practices

- **Spatial Data Modeling**
  - Linear Referencing System & Data Models, Data Structures
  - Spatial Referencing Data Models and Structures
  - Data Quality, Availability, Readiness (FAIR), Authoritative Sources

R&H, Intersections, Interchanges, Network Routing, LBRS

- **Spatial Data Integration and Engineering**
  - Integrating and Engineering Business Data using LRS.GIS
  - Data Conflation, Integration using LRS.GIS
  - Data Hubs and Data Engineering Platforms for Preparing Data

LRS / RI API, LBRS

- **Spatial Data Analytics**
  - Spatial Statistics, Econometrics, AI/ML, System of Engagement
  - Federal, State Reporting: HPMS 9.0 (with MIRE and Intersections)
  - Open Data Portals, Data Sharing and Use:

TIMS, TAMDST, SLD

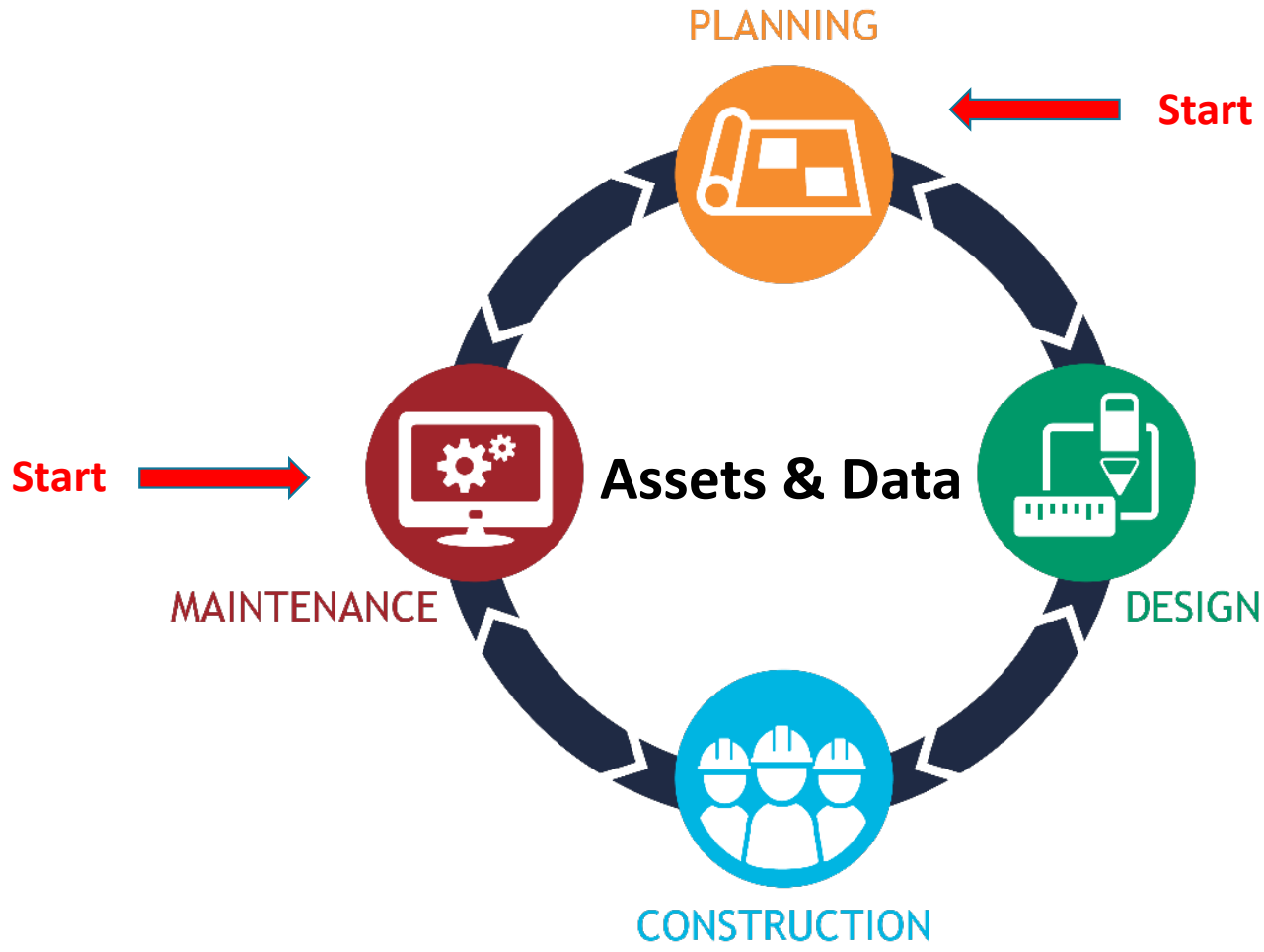
Asset Management and Data Governance

Transportation Asset Management

- Manage the ***Asset Lifecycle***

Data Governance

- Manage the ***Data Lifecycle***



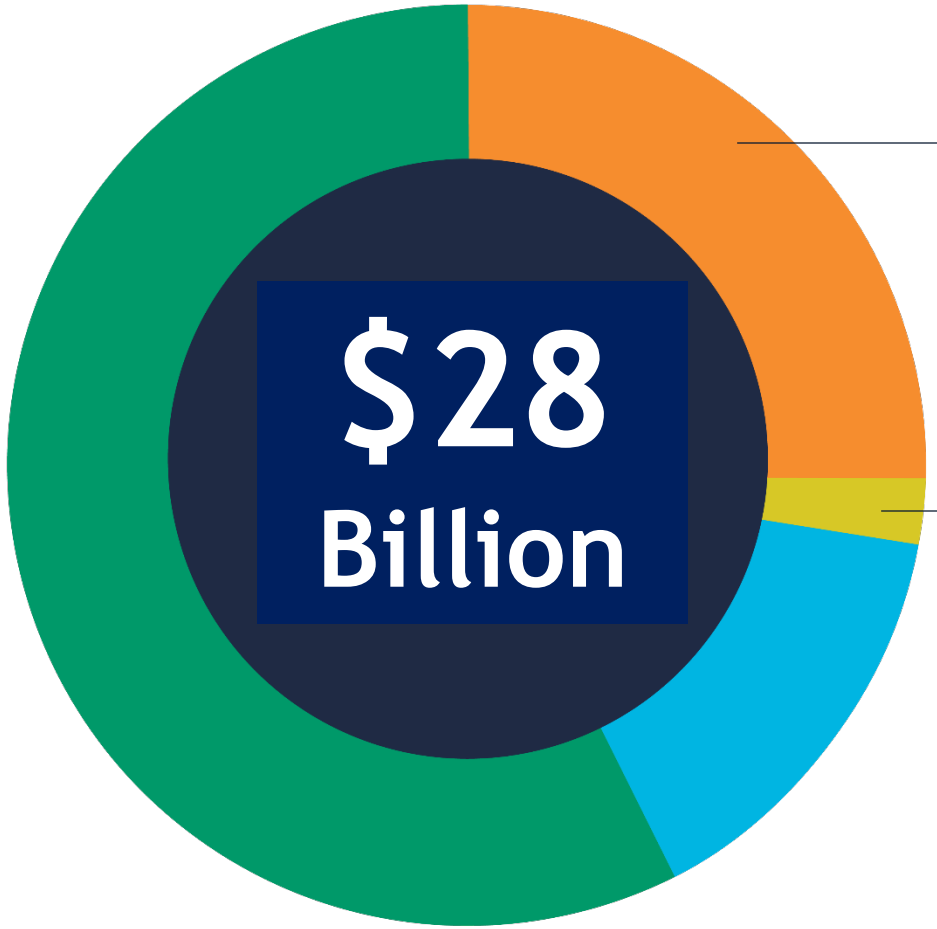
TAM Audit Group

ESRI Image

ODOT Transportation Assets – Ancillary

14 Asset Categories
- 53 Asset Types

- BMPs
- Geo Hazards
- ITS and Signals
- BMPs
- Mire Intersections
- Underdrains
- Noise Walls
- Overhead Signs
- Barrier
- Retaining Walls
- Highway Lighting
- ADA Rights of Way ……



$25 Billion
in “Other”

$3 Billion
in Conduits

872,000 Active Assets

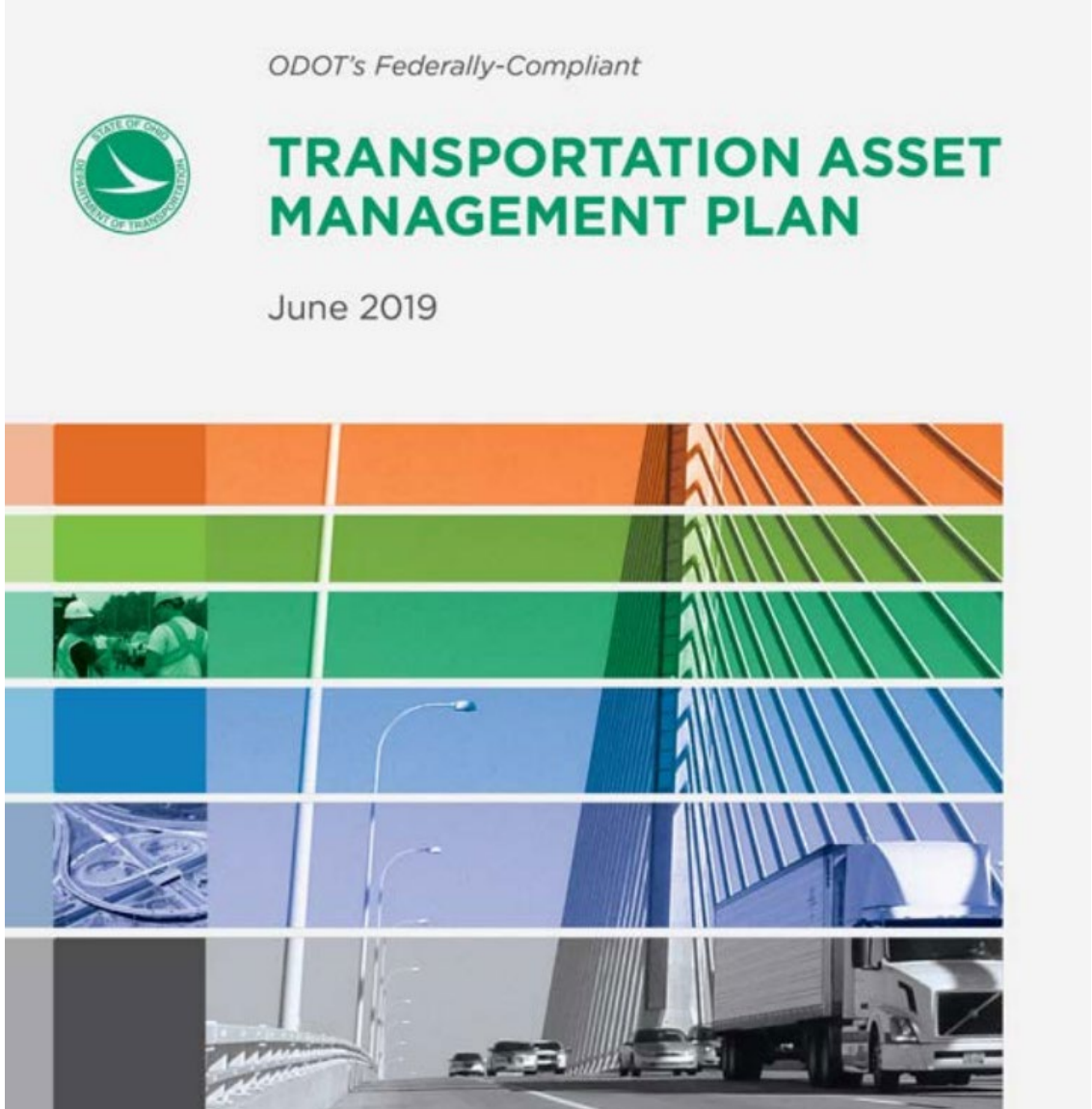
Pre-Transportation Asset Management Plan (TAMP)

ODOT Technology Council

Needs

- **Needed a Formal Process Analyze Asset Requests**
- **Provide Asset Summary Reports**
- **Assist Businesses in Developing Solution Options**
- **Mechanism to Prioritize Application Requests**

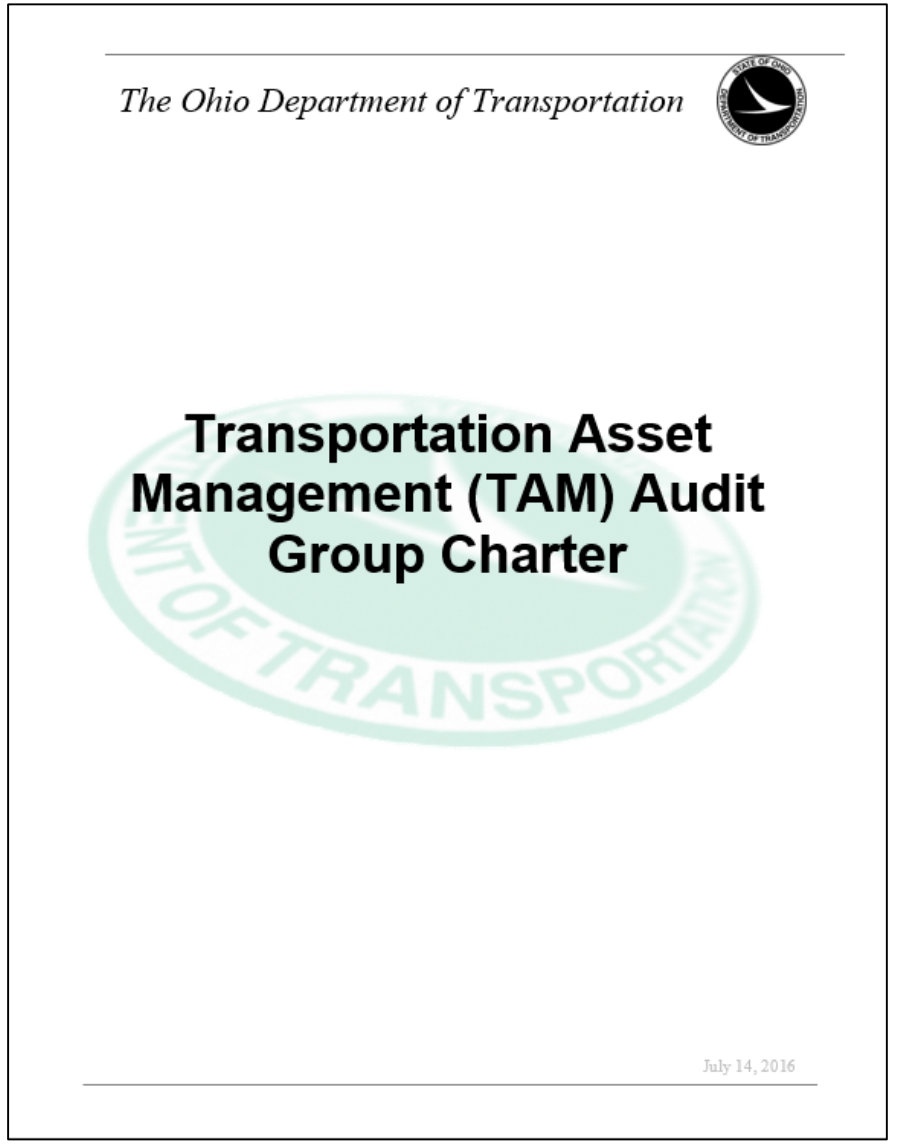
- **<u>Transportation Asset Management Audit Group (TAMAG)</u>**



Transportation Asset Management Audit Group (TAMAG)

TAM Audit Group Responsibilities – 15 Member Committee

- **Asset Oversight**
- **Create Enterprise Standards – Data Integrity**
- **Liaison between Business, Tech Council and Districts**
- **Provide Asset Collection Equipment**
- **Business & Stakeholder Requirements**
- **In-House products using ESRI Collector and Web Apps**
- **COTS Product Research**
- **RFI and RFP Subject Matter Experts (SME)**
- **Inclusion in Vendor Selection Committees**

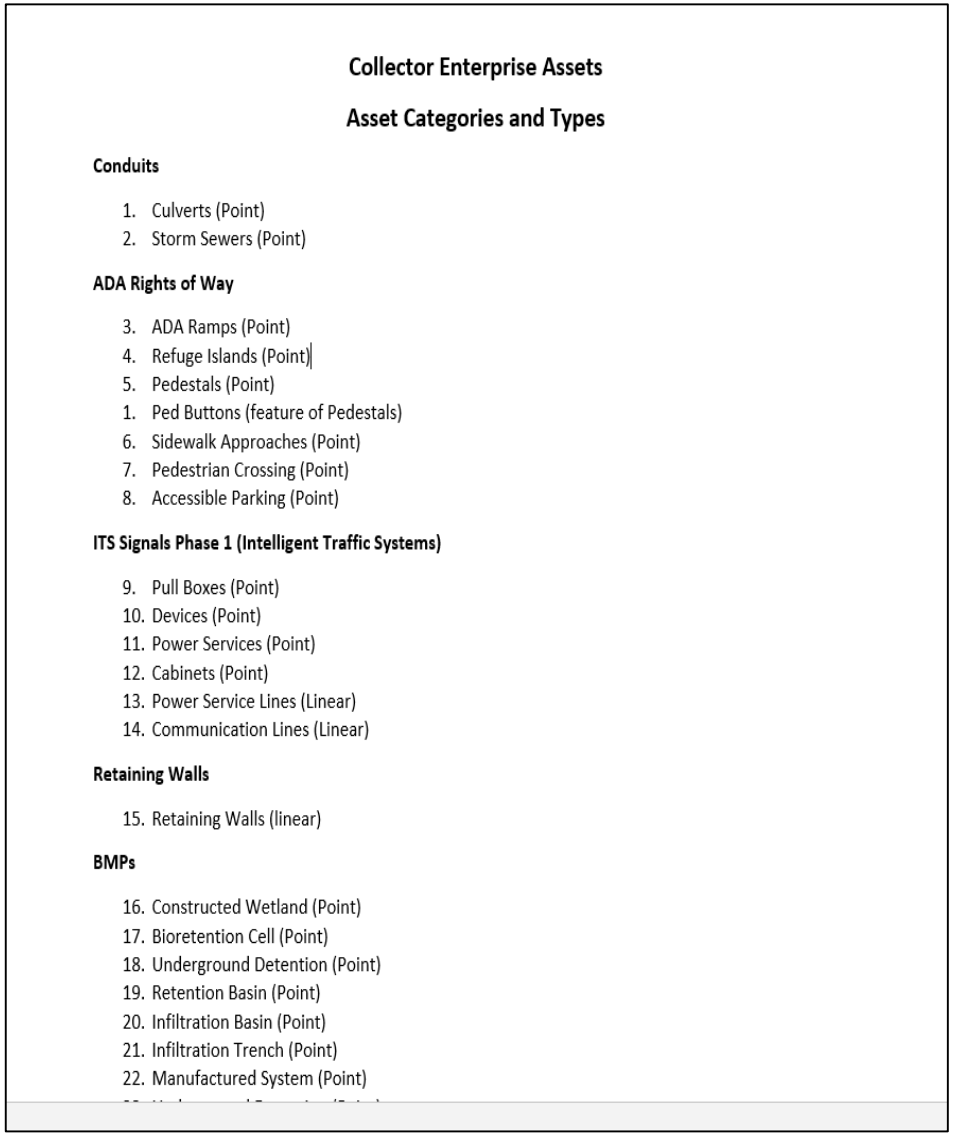


Transportation Asset Management Audit Group (TAMAG)

Tools

- ODOT Collector Handheld Application (field workers)
- Web editing tools (Mid-Level Management)
- Reports (Everyone)
  - QC
  - Data Entry Errors
  - PowerBI and Excel
- Executive Dashboard
- TIMS – Public Facing Website
- GQL Models

*** Tools are Identical for all Assets**



Collector Enterprise Assets

Asset Categories and Types

Conduits

1. Culverts (Point)
2. Storm Sewers (Point)

ADA Rights of Way

3. ADA Ramps (Point)
4. Refuge Islands (Point)
5. Pedestals (Point)
1. Ped Buttons (feature of Pedestals)
6. Sidewalk Approaches (Point)
7. Pedestrian Crossing (Point)
8. Accessible Parking (Point)

ITS Signals Phase 1 (Intelligent Traffic Systems)

9. Pull Boxes (Point)
10. Devices (Point)
11. Power Services (Point)
12. Cabinets (Point)
13. Power Service Lines (Linear)
14. Communication Lines (Linear)

Retaining Walls

15. Retaining Walls (linear)

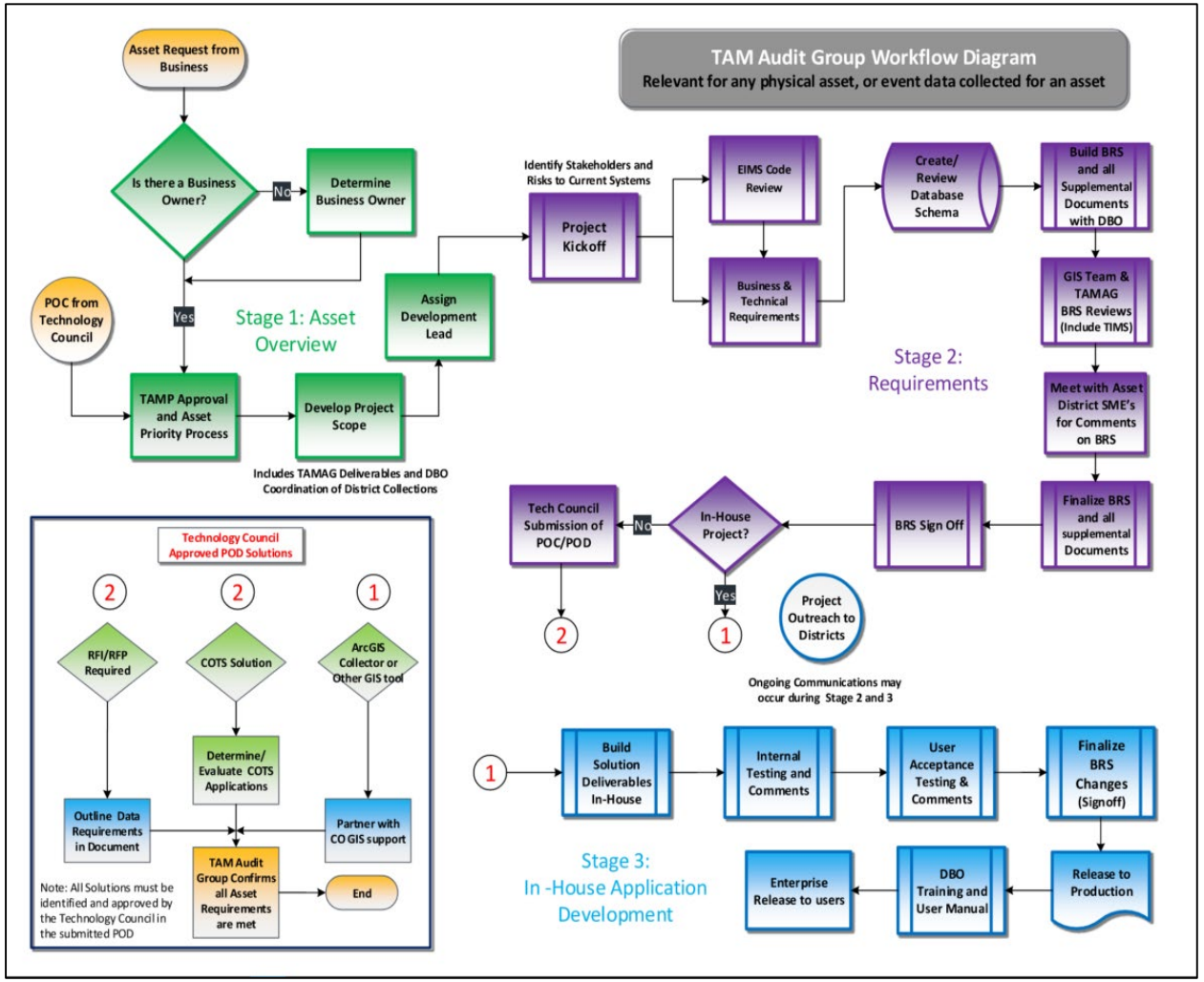
BMPs

16. Constructed Wetland (Point)
17. Bioretention Cell (Point)
18. Underground Detention (Point)
19. Retention Basin (Point)
20. Infiltration Basin (Point)
21. Infiltration Trench (Point)
22. Manufactured System (Point)

Transportation Asset Management Audit Group (TAMAG)

- Process
  - *All* Asset Collections Required to Participate
  - *All* Assets have a DBO Identified
  - Repeatable
  - All New or Enhanced Data Collections
  - TAMAG Standards – Data Integrity
  - Update LRS Data to Assets Annually

- Deliverables:
  - Business Requirements Specifications (BRS)
  - Technical Requirements Document (TRD)
  - Asset Lifecycle Document
  - User Roles – Security
  - Report Templates
  - Data Model – Data Integrity
  - User Manual (DBO) – Business Glossary & Data Catalog
  - Collector Workflow
  - Application Development



Transportation Asset Management Audit Group (TAMAG)

TAM Audit Group Standard Attributes

- LRS Based – Locational Information
  - Includes Domain Values
- Across all Assets – Physical and Events
  - Integrations
  - Consistency
  - Data Integrity

Data Governance Standards

- Enterprise Data Elements (EDE)
- Critical Data Elements (CDE)
- Functional Data Elements (FDE)

ODOT
Standard Attribute Requirements

Organizational LRS Standards

OBJECTID	System	*(System generated value in ESRI ArcSDE databases)*
NLF_ID	*Char (14)*	*(Network Linear Feature Identifier – Follow guidelines)*
ODOT_DISTRICT	*Char (2)*	*(District Number: 01, 02…leading zero)*
CRS	Char (14)	(County Route Section w/no leading zeros in route)
COUNTY	*Char (10)*	*(County Full Name)*
COUNTY_CD	*Char (3)*	*(County three letter Code)*
ROUTE_TYPE	Char (2)	(Formally Route Designation: US, IR, SR)
ROUTE_NBR	Char (5)	(Route ID; 5 characters to account for local systems)
ROUTE_SUFFIX	Char (1)	(For routes such as 309D or 115A)
CTL_BEGIN_NBR	Number (7.3)	(County Begin Point – Both point and linear)
CTL_END_NBR	Number (7.3)	(County End point - linear)
STL_BEGIN_NBR	Number (7.3)	(State Begin Point – Both point and linear)
STL_END_NBR	Number (7.3)	(State End Point - Linear)
LATITUDE_DD_BEGIN	Decimal Degrees (6 positions) (8, 6)	
LONGITUDE_DD BEGIN	Decimal Degrees (6 positions) (8, 6)	
LATITUDE_DD_END	Decimal Degrees (6 positions) (8, 6)	
LONGITUDE_DD END	Decimal Degrees (6 positions) (8, 6)	
PERP_YEAR	Number (4,0)	(Year of published LRS = CY year - 1)

Functional Standards

QC_COMPLETE	Char (1)	(QC Complete Y/N. Default Value 'N')
STATUS	Char (1)	(**P**roposed, **R**etired, **C**ancelled, **I**nactive or **A**ctive)
INSTALLATION_DATE	Date	(Date the asset was installed/constructed)
PROJECTION	WGS84 Mercator Auxiliary Sphere (m)	(Required for mapping, not an attribute in DB)
PID_NBR	Int (10,0)	(Capital Projects Unique Project Identifier)
AWARD_DATE	Date	(ELLIS date assigned for project award to contractor)
ASSET_OWNER	Char(1)	(Entity that owns the asset)
MAINTAIN_RESPONIBLE	Char(1)	(Entity that has Maintenance Responsibility on asset)
MUNI_FIPS_CODE	Vchar (75)	(Municipality Federal Information Processing Code)
TWP_FIPS_CODE	Vchar (75)	(Township Federal Information Processing Code)
MAINTAIN_REQUIRED	Char (1)	(Y/N, Default Value 'N')
MAINTAIN_COMPLETE	Char (1)	(Y/N, Default Value 'Null')
LET_PLANS_URL	Vchar (150)	(URL to PID Project Construction Plan Set)
INTERSECTION_ID	TBD	(To be used with any asset in an intersection)
LEG_ID	TBD	(Identifies intersection leg the asset is associated with)
INTERCHANGE_ID	TBD	(To be used with any asset related to an interchange)

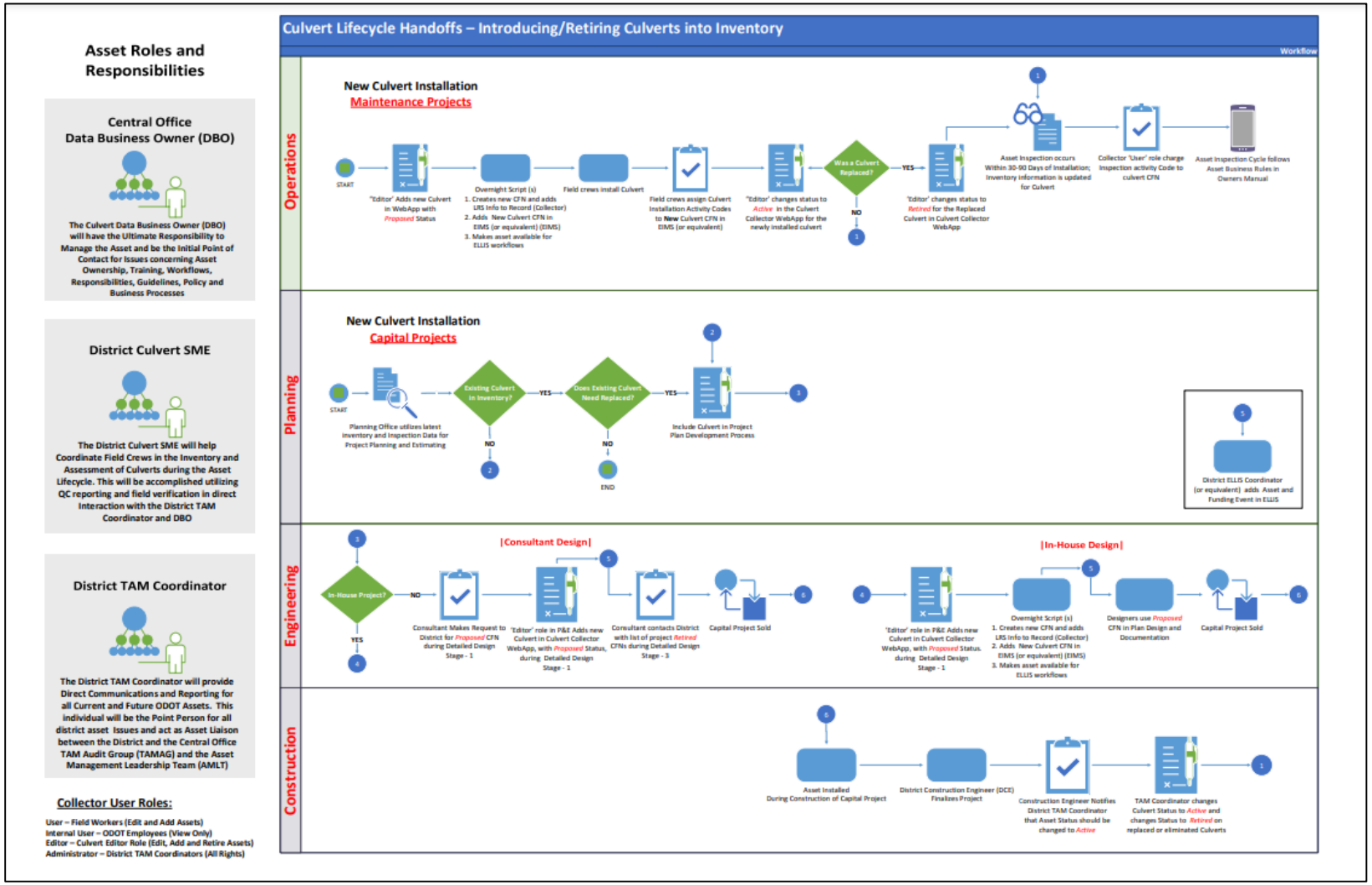
Asset Lifecycle Diagram – TAMAG

Tracks Responsibilities (Handoffs)

- Phases of the PDP and Maintenance
  - Operations
  - Capital Projects

Defines Roles

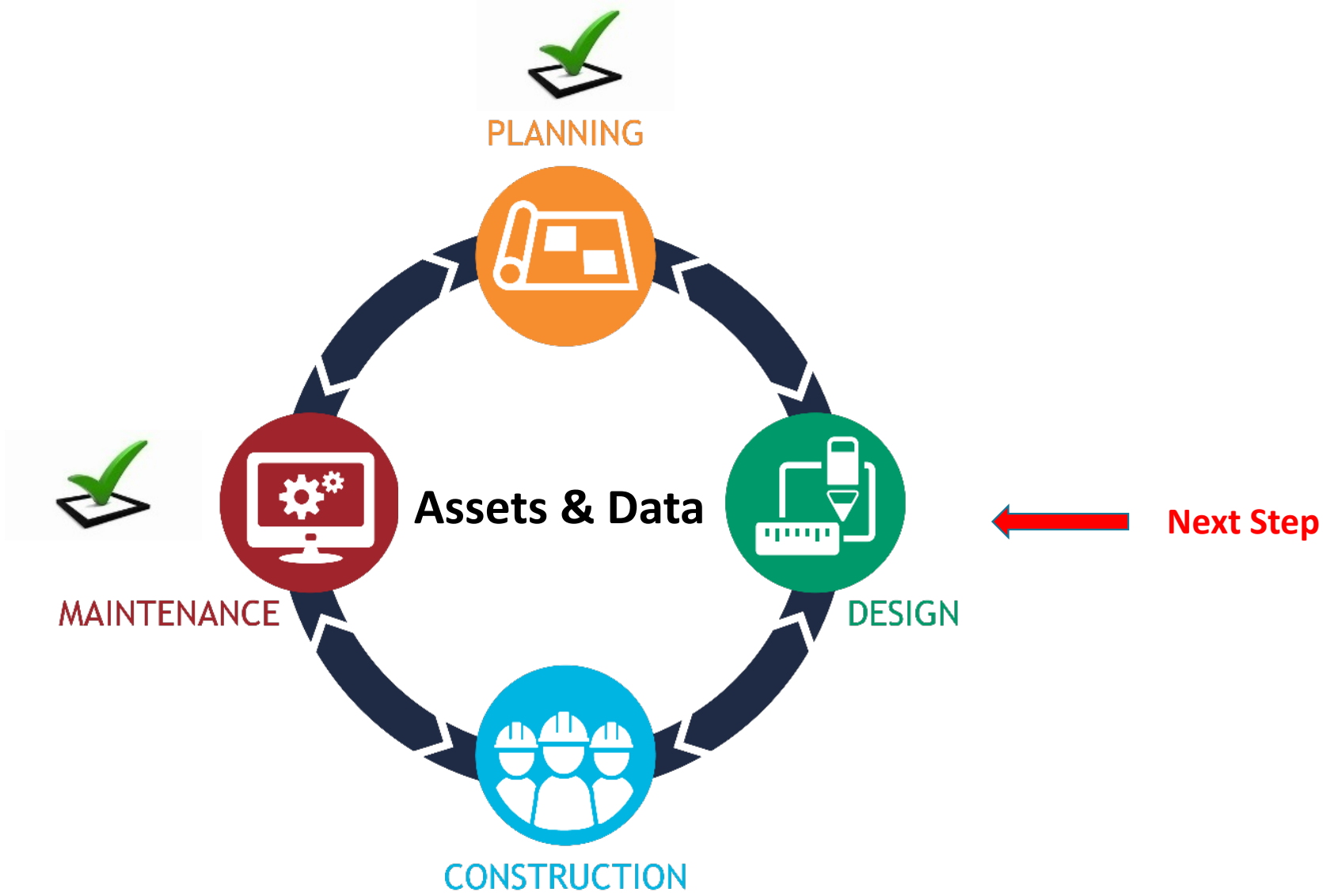
- Data Business Owner
- Asset Subject Matter Experts
- District TAM Coordinator (TAMC)



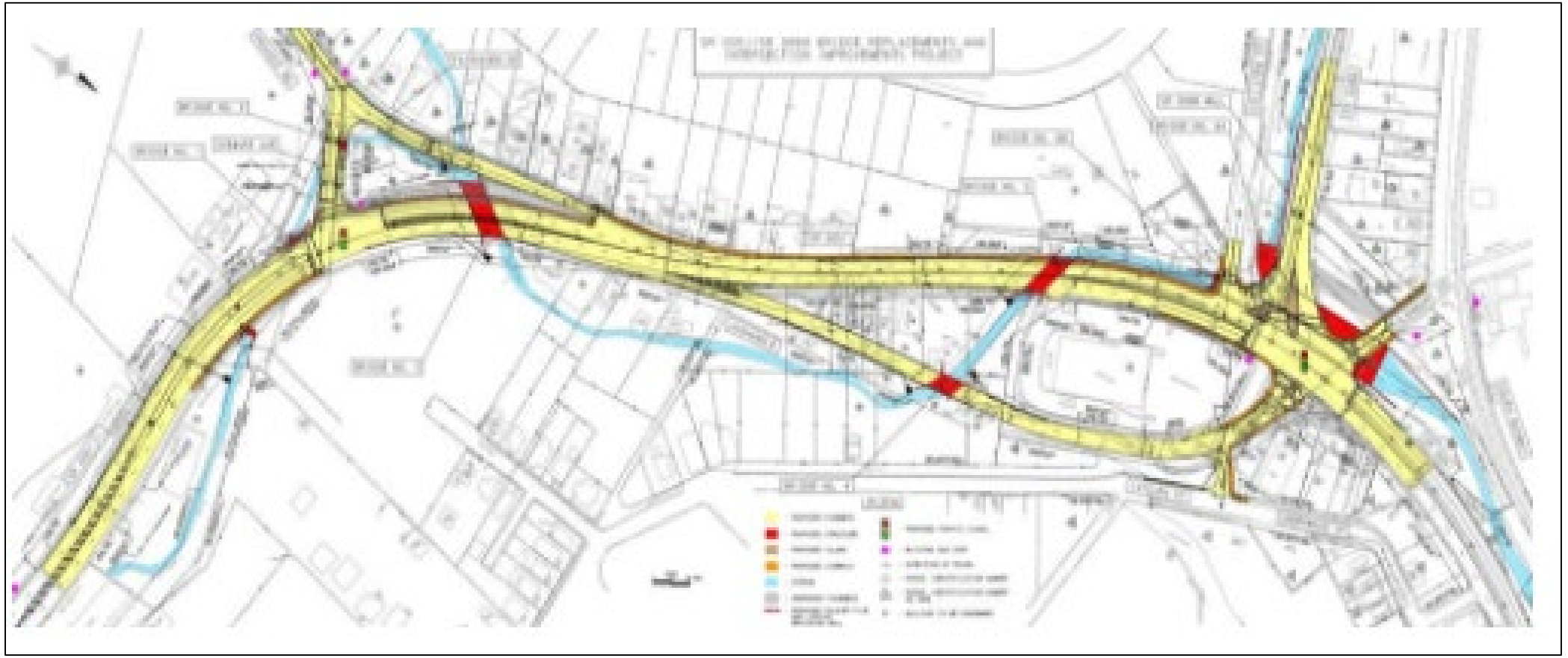
Transportation Asset Management Audit Group (TAMAG)

Annually
Prioritized Projects

Calendar Year Anticipated Rollout QTR	Data Business Owner (DBO)	DBO Contact	Stage	In Production Date	Current Status	Next Steps Required	Goal for Next Month	Collection/Update Cycle
7(2020)	Geotech	Steve Taliaferro	Stage 3		Application Development	Application Development	Application Development	As Required by Tier Level
10(2020)	Maintenance	Jeff Syar	Stage 3		Application Development	Application Development	Application Development	
2(2021)	Hydraulics	Jeff Syar	Stage 3		Enhancement (#3) Requirements Gathering Completed	In Development Que for Spring of 2020 Release	N/A	Based off General Appraisal (GA), and updtate cylcle outlined in Asset Owners Manual
3(2020)	Traffic Engineering	Charlie Fisher	Stage 2		N/A	N/A	N/A	TBD
	Diversity	Sarah Wade			Initial Project was completed by contracting the inspections of ODOT state-wide facilites			TBD
	Environmental	Matt Perlik	Stage 1		Established Monthly meeting with OES to map high level project needs / hire consultant to perform assessment	Evaluate assessment, determine long-range strategy	Monitor assessment progress	TBD
	Environmental	Matt Perlik	Stage 1		Established Monthly meeting with OES to map high level project needs / hire consultant to perform assessment	Evaluate assessment, determine long-range strategy	Monitor assessment progress	TBD
	Pavement				Email to business on 8-26-16 to	Pending: Follow-up with vendor		


PLANNING
DESIGN
CONSTRUCTION
MAINTENANCE
Assets & Data
Next Step

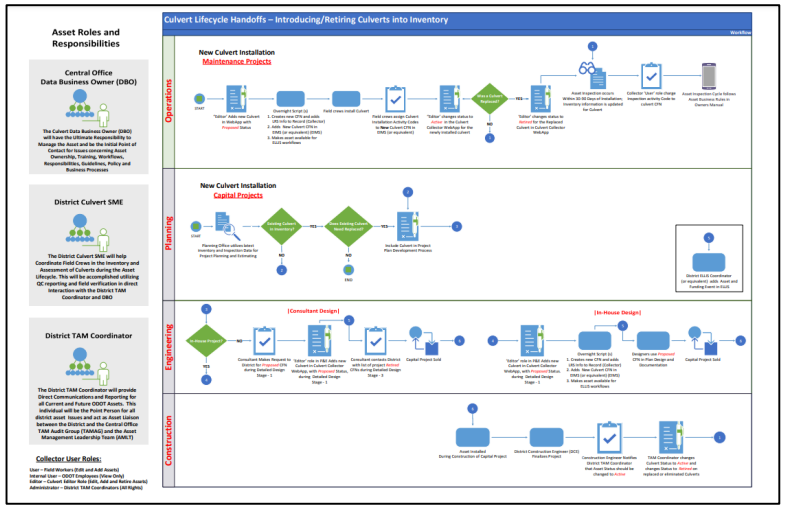
DGN to GIS



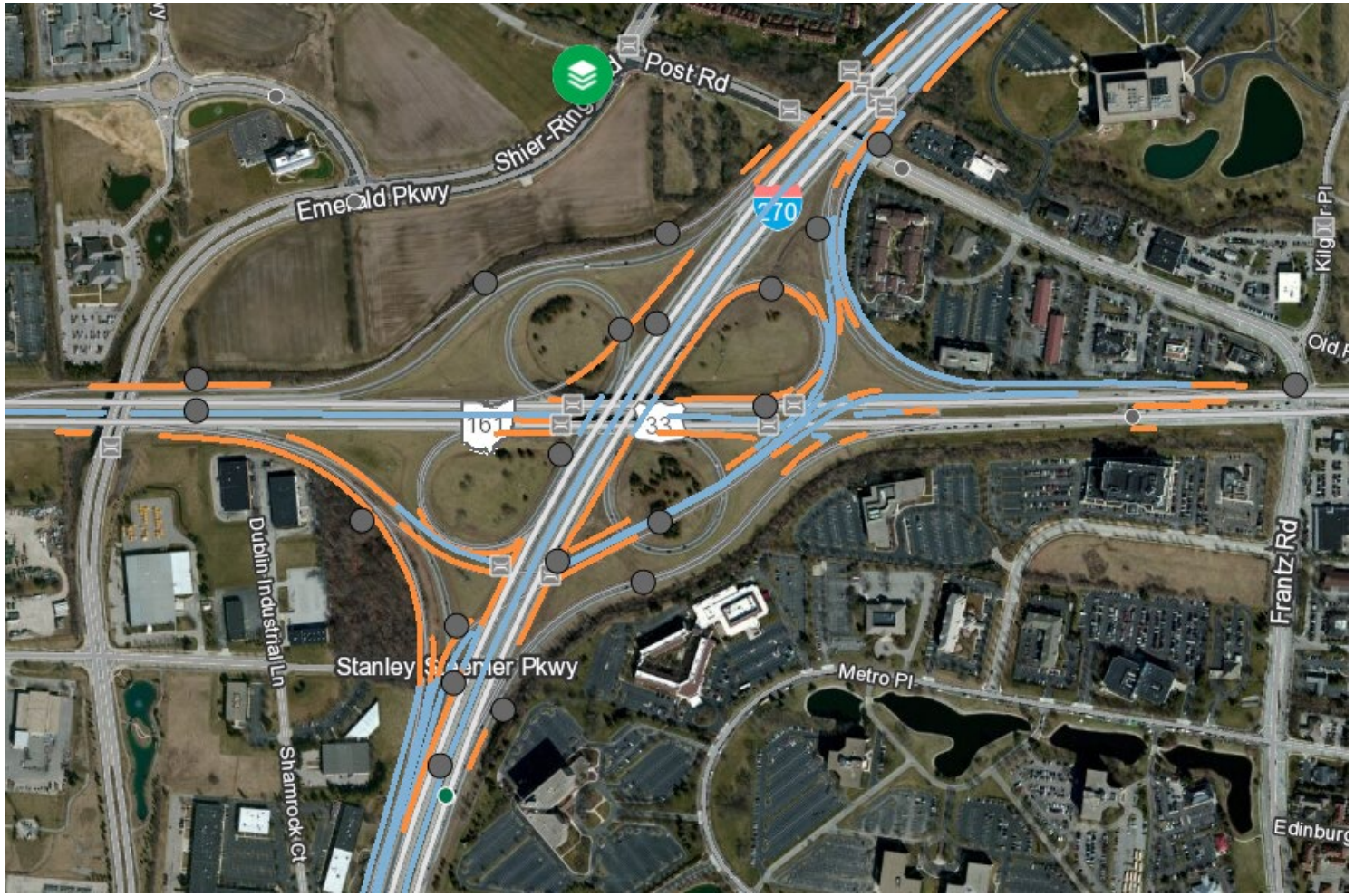
Asset Lifecycle Diagram – DGN to GIS

Reasons to Automate – DGN to GIS

- Manual Process
- Very Time Consuming
- Individual Collector Web Applications



100's of Potential Asset in a Capital Project



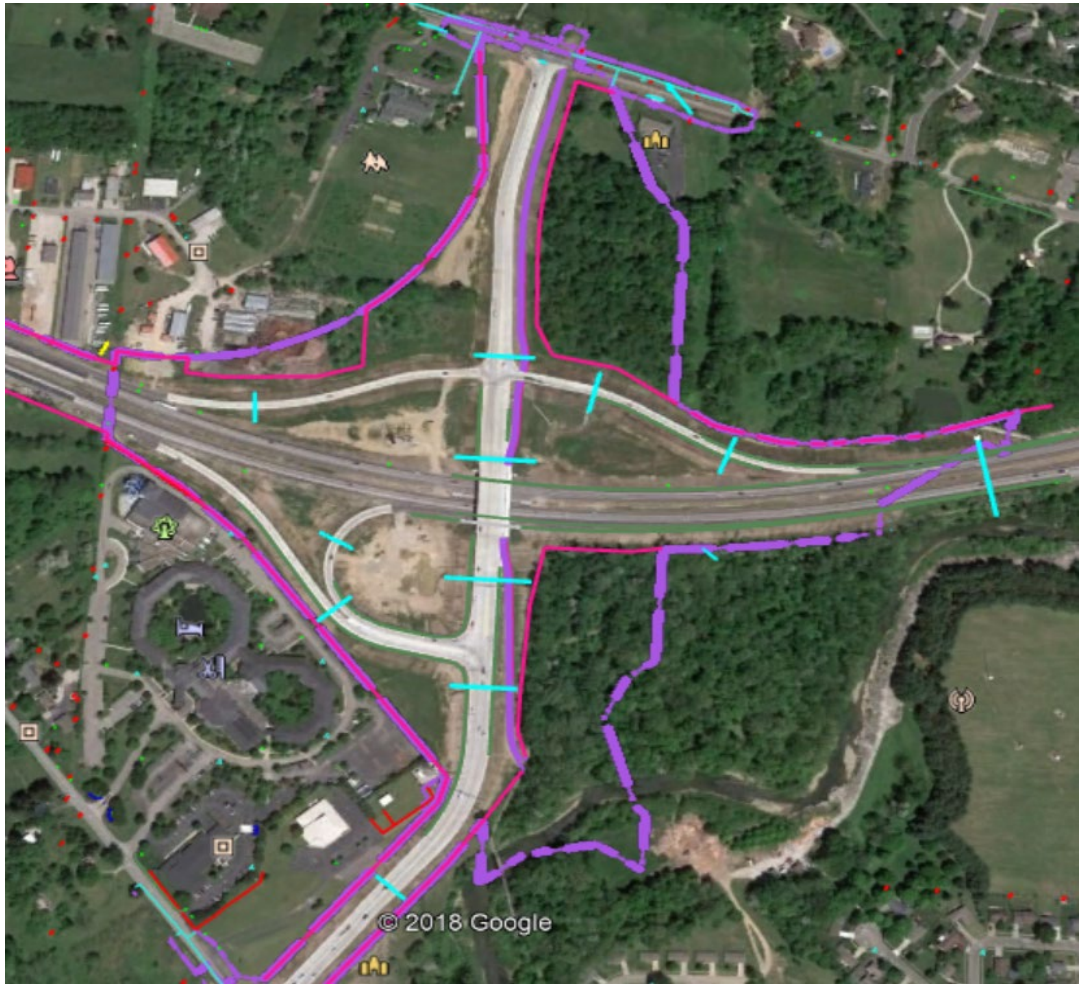
Project History – DGN to GIS

Item 623, As Per Plan Note

- Standardize ??
- New Item in Spec Book ??
- Would provide ‘As Built’ info – Sort of

DGN to GIS request from Executive Staff

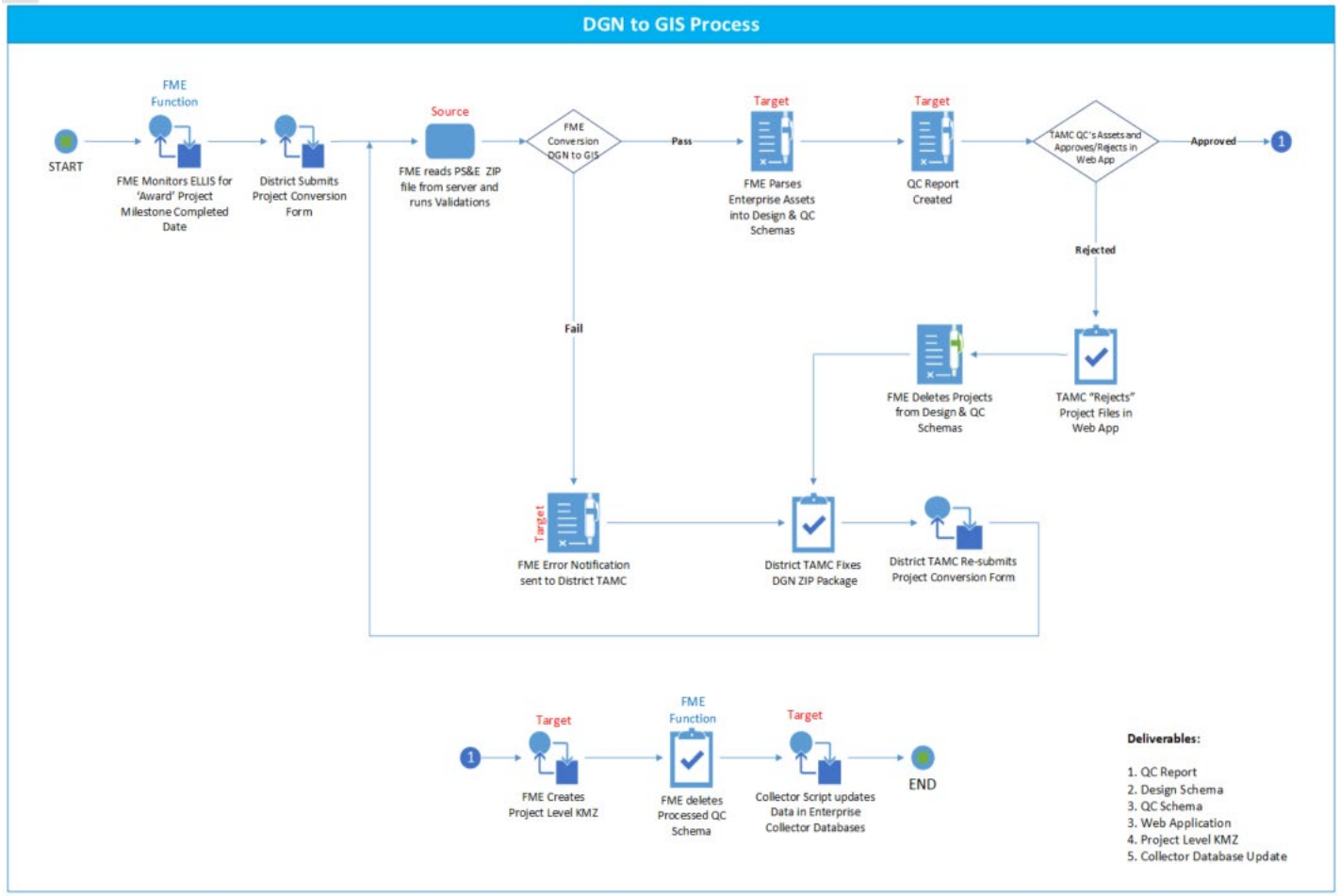
- Central Office Deputy Directors
  - Planning
  - Engineering
  - Construction



Process – DGN to GIS

- Feature Manipulation Engine (FME)
- Database Schemas (3)
  - Staging -> Design - > QC
- Automatic Notifications to TAMCs
- PowerBI Detailed Reporting
- QC Web Application for TAMCs
- Project Level KMZs
- ‘As Designed’ Project GIS Data
  - Can be referenced back into MicroStation Designs
- Push Enterprise Assets to ODOT Collector!

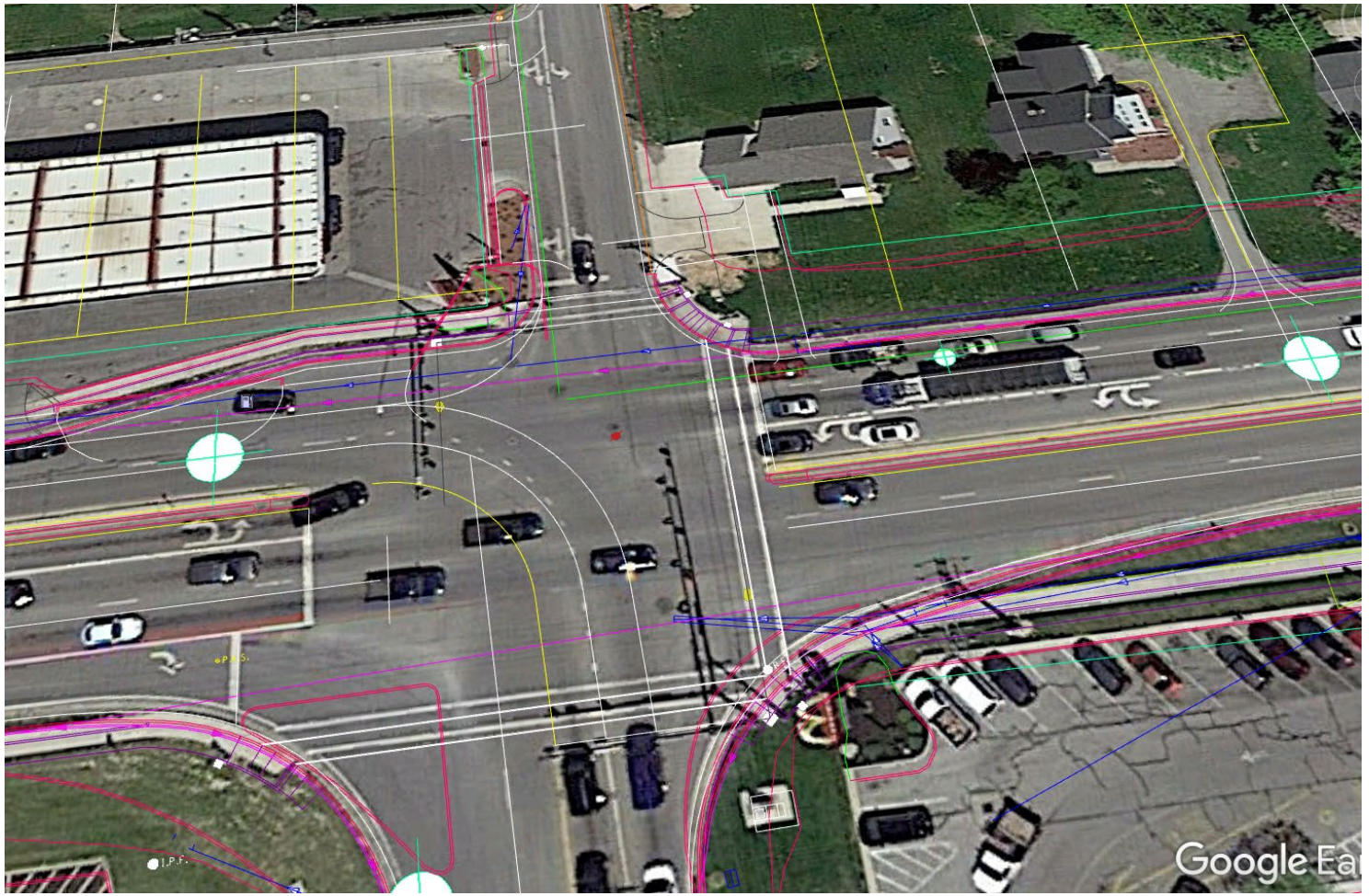
Workflow Map and Target Deliverables

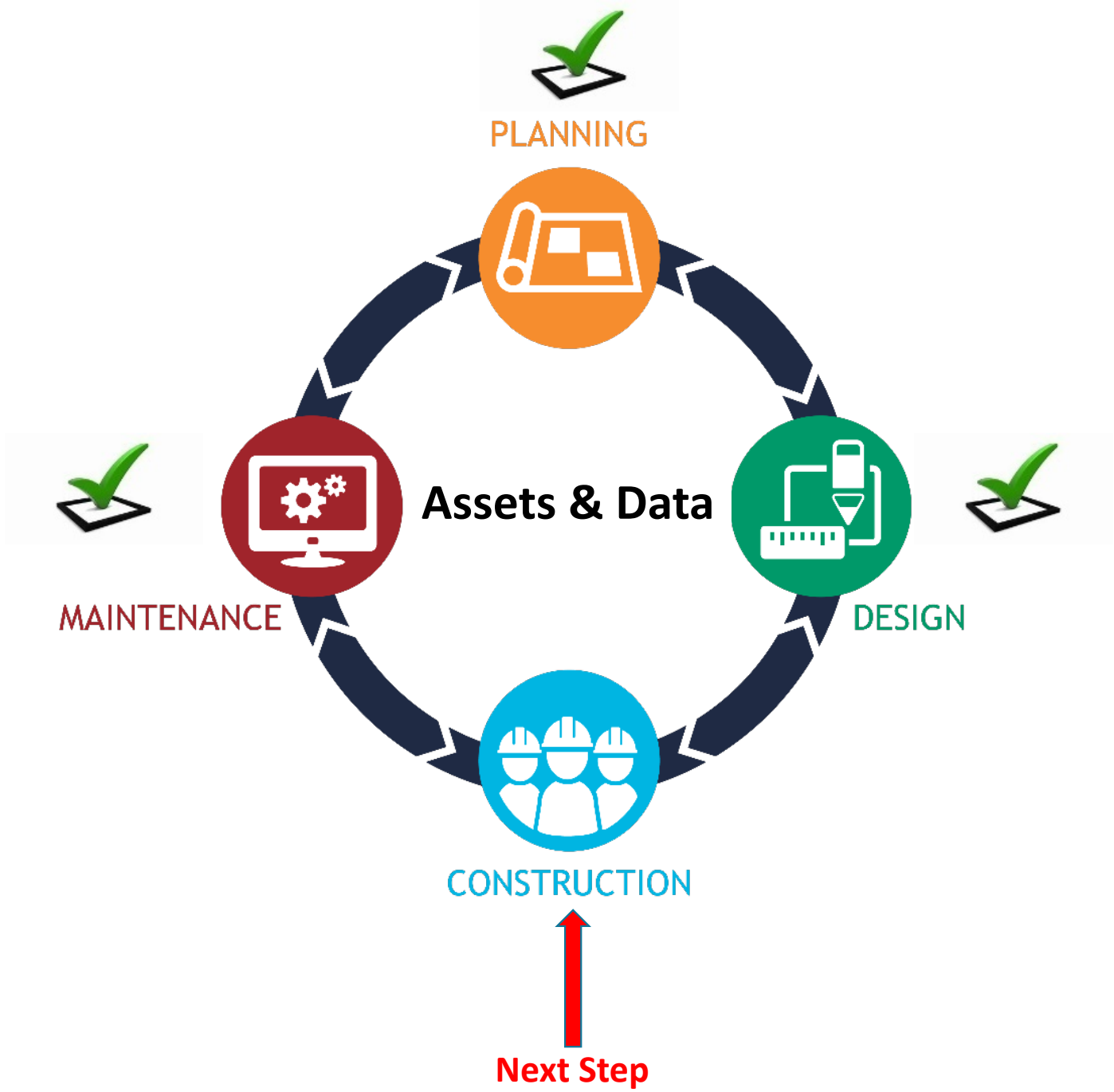


Advantages – DGN to GIS

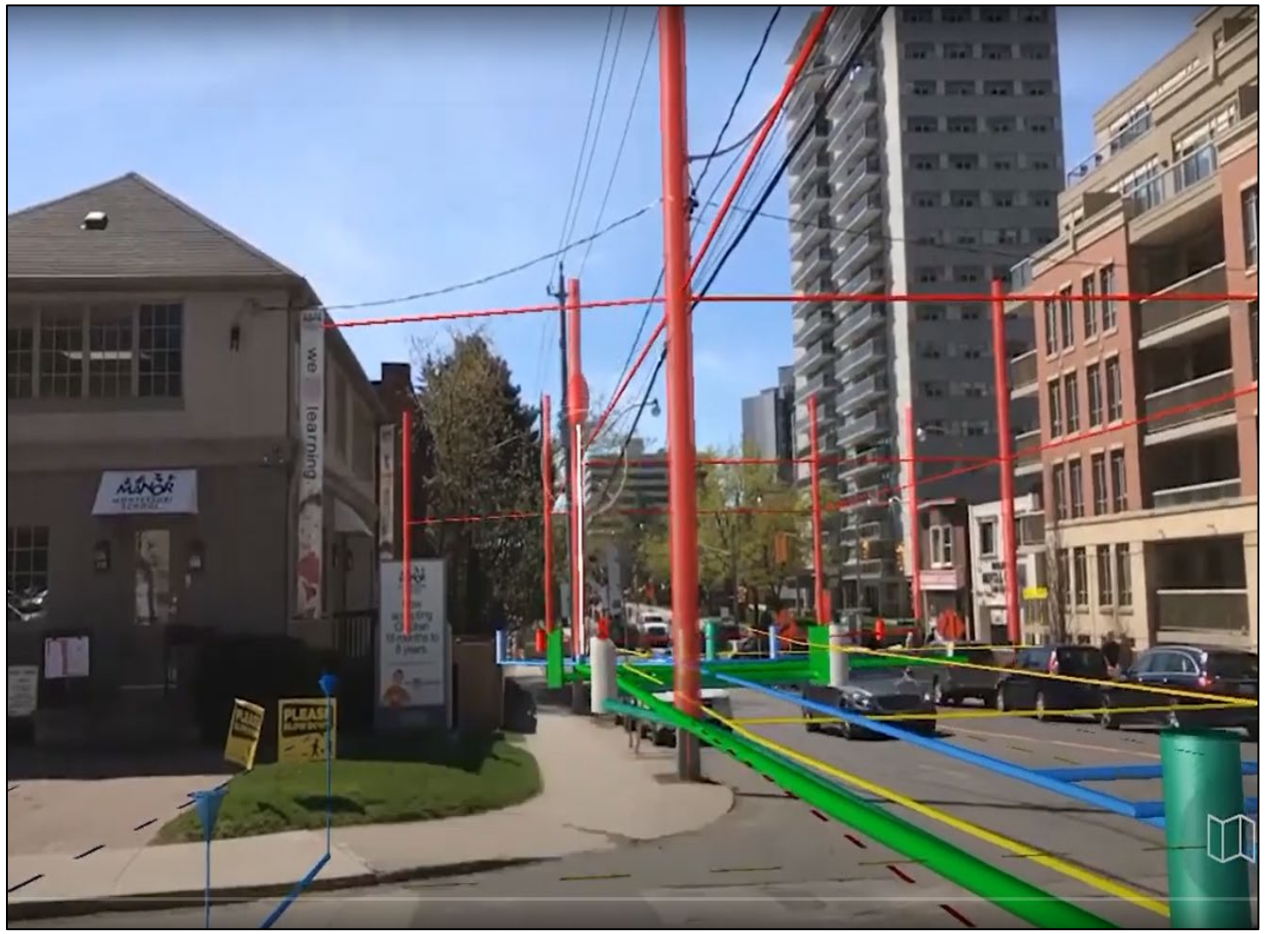
- **Non-Enterprise Assets**
  - R/W
  - Driveways
  - Underground Utilities
  - Striping (GIS)
  - Sidewalk
  - Curb and Gutter
- **Sources**
  - Design Files
  - ELLIS (Project Management App)
  - Site Manager (Construction App)

Project Designs Translated to GIS




PLANNING
MAINTENANCE
Assets & Data
DESIGN
CONSTRUCTION
Next Step

Augmented Reality



Augmented Reality – vGIS Pilot

SaaS Middleware

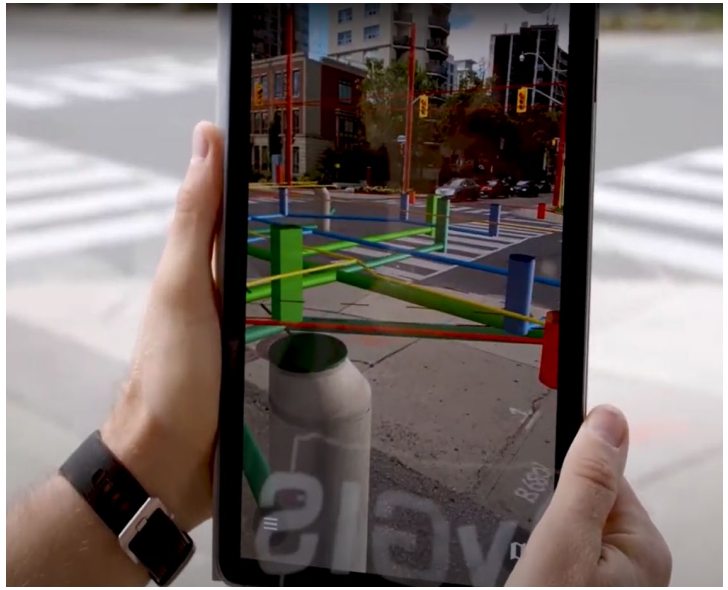
- Microsoft Azure Cloud
  - State and Local Government Cloud Available (FedRamp)
- Licensed per Device

Planning Tool: GPS Accuracy

- Out of the ox 6” (Horizontal)
  - Uses device GPS
- External Antennas - Bluetooth
  - Trimble R2
  - RTK (Survey Grade)

Device Options

- iOS
  - 556 iPads in TAM
- Android
- Microsoft Hololens

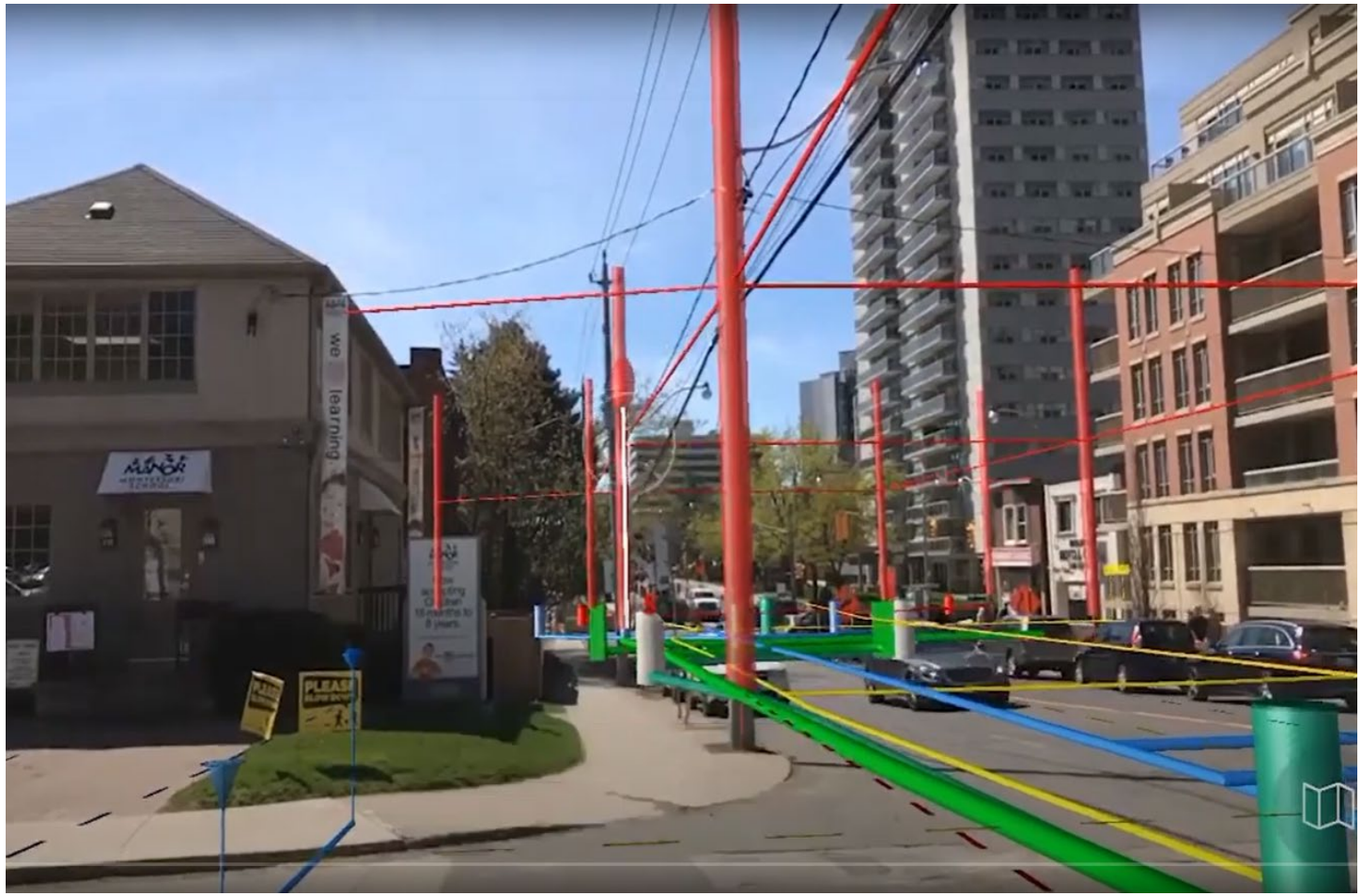


Augmented Reality – vGIS Pilot

- **ESRI ArcGIS**
  - Feature/Map Services
  - Scene Services
- **Bentley Twin or BIM**
  - .dgn, dwg, .ifc or .skp
- **Digital Twin**
- **Shapefiles**
- **File Geodatabase**
- **KML**
- **WFS, WMS/WMTS**

Augmented Reality – vGIS Pilot

- User Configurations
  - Lines, Points & Shapes
    - Weights
    - Styles
    - Colors
- Configure Z values for 2D Designs
- 300’ Buffer for Assets



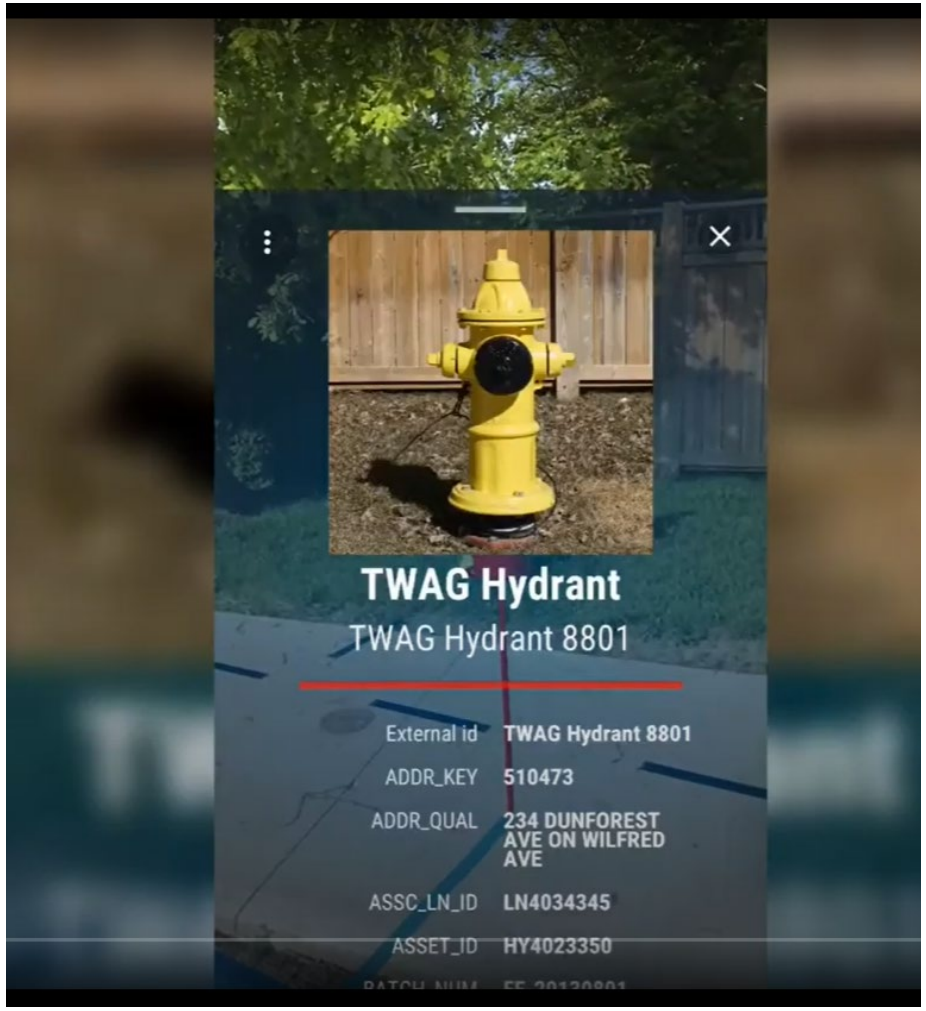
DGN to GIS Design Translations

Augmented Reality – vGIS Pilot

ODOT Collector Infrastructure

- View Asset Records
- Edit Asset Records
- Adjust GPS Locations

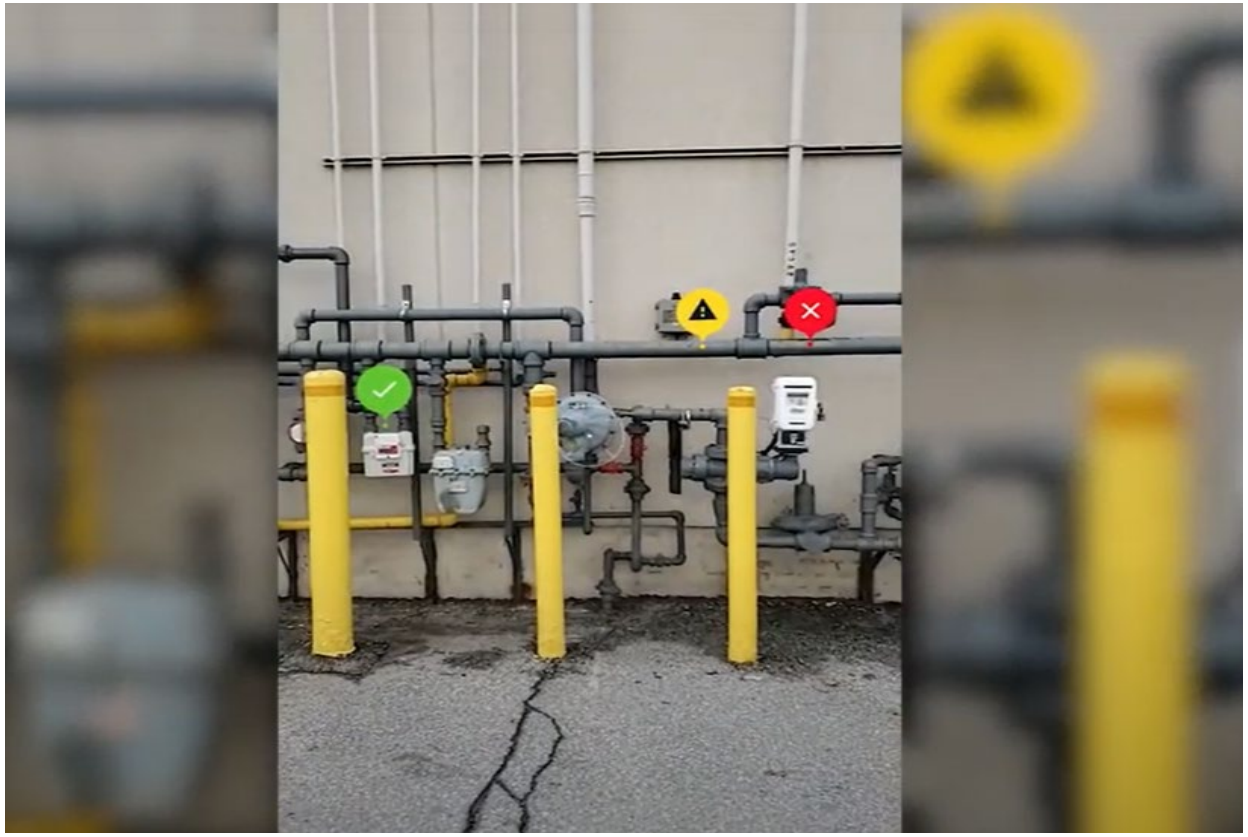
- Utilizes Web Service URLs



Direct Connection to ODOT Collector Infrastructure

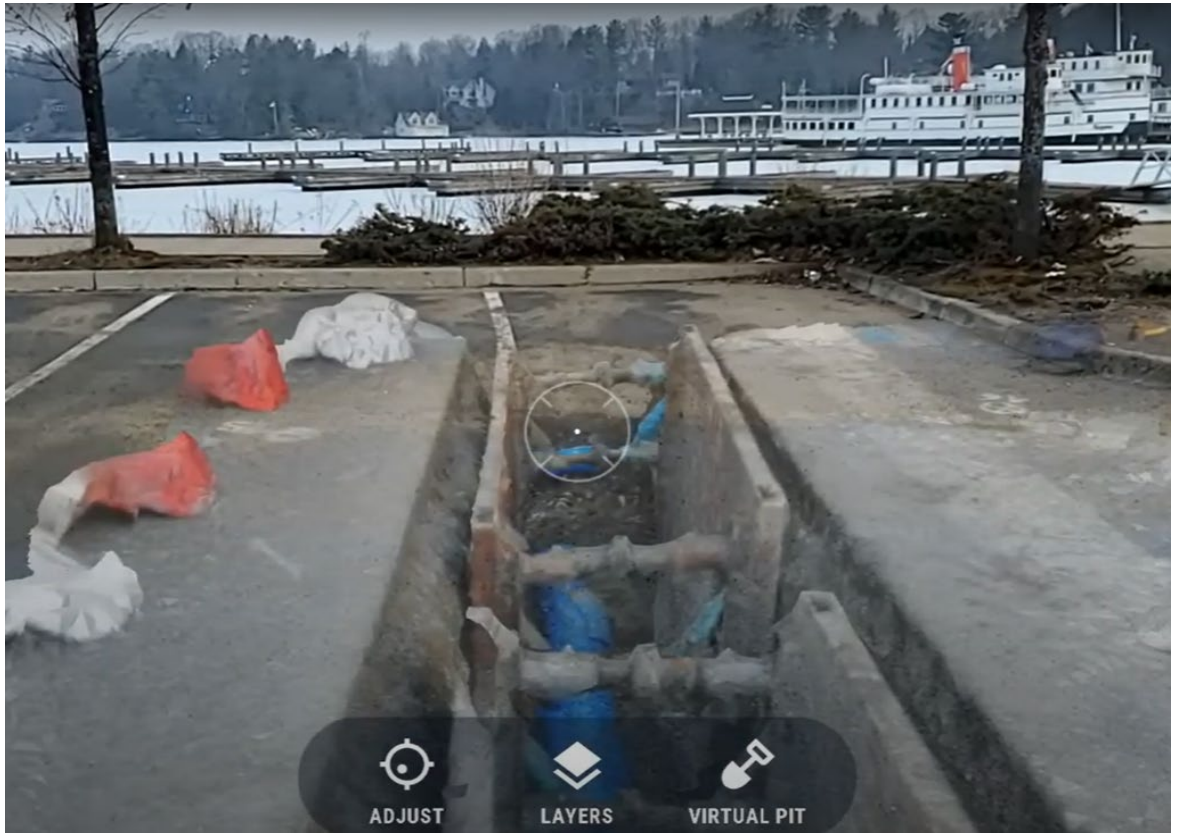
Reality Mesh – Construction

Asset Tags



Maintenance Asset Tagging for Repair

GPS Photos GPS Videos



Construction ‘As Built’ and Utilities in R/W

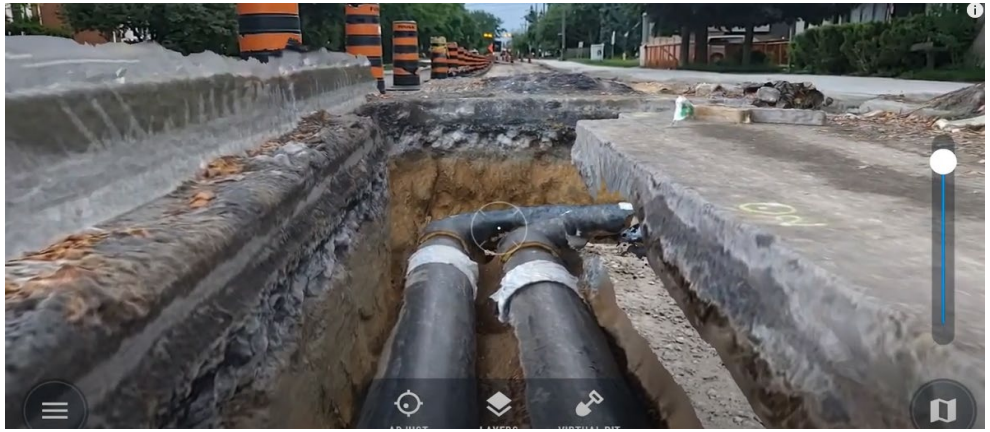
Augmented Reality – vGIS Pilot

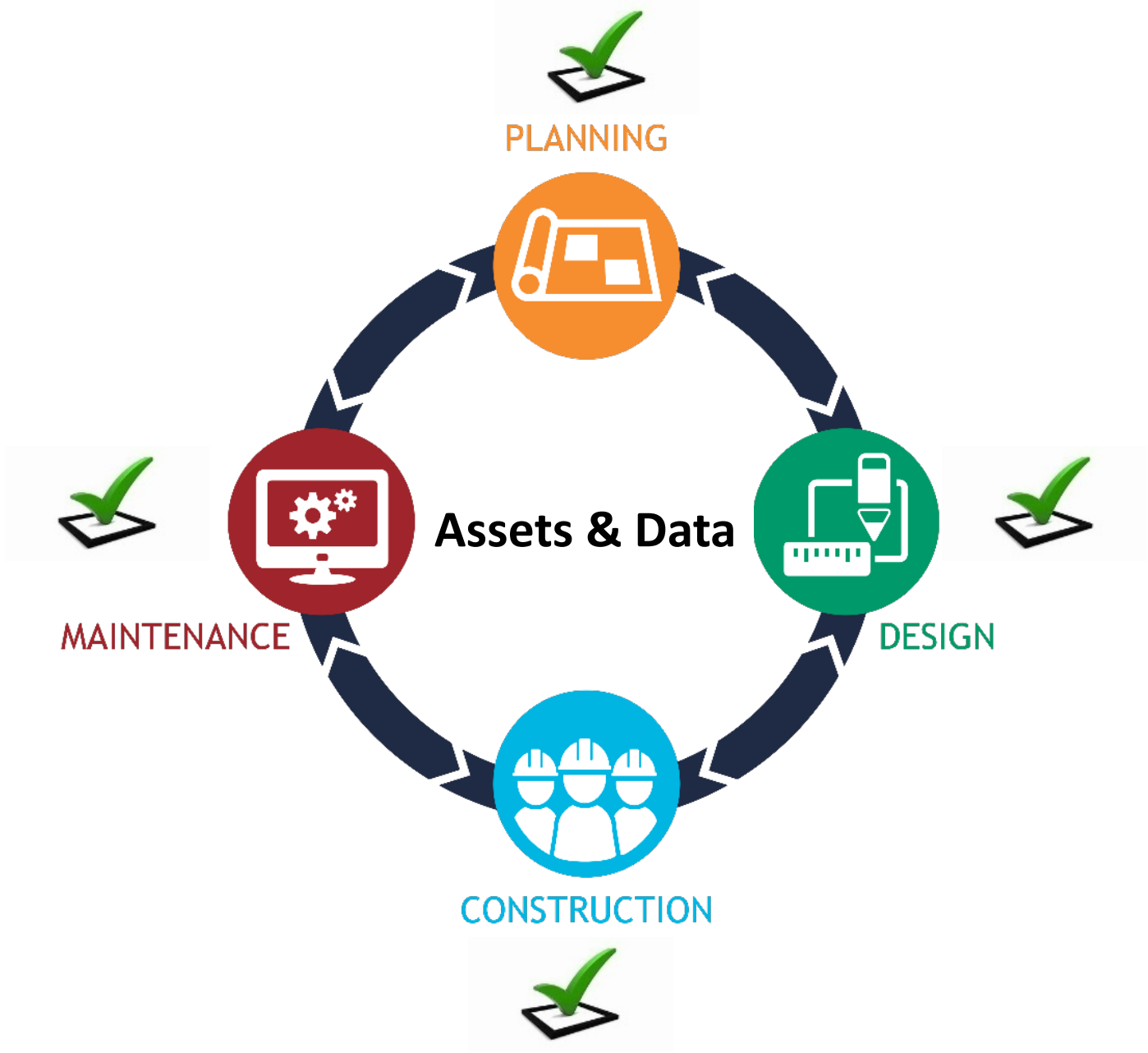
Use Cases

- Construction Projects – As Built Designs
- Facilities – Underground Utility and Communication Lines
- Collector – View & Edit Assets
- Planning - Project Scoping Field Reviews & Estimates
- Utility Companies in ODOT Rights of Way – As Built Designs

Pilot

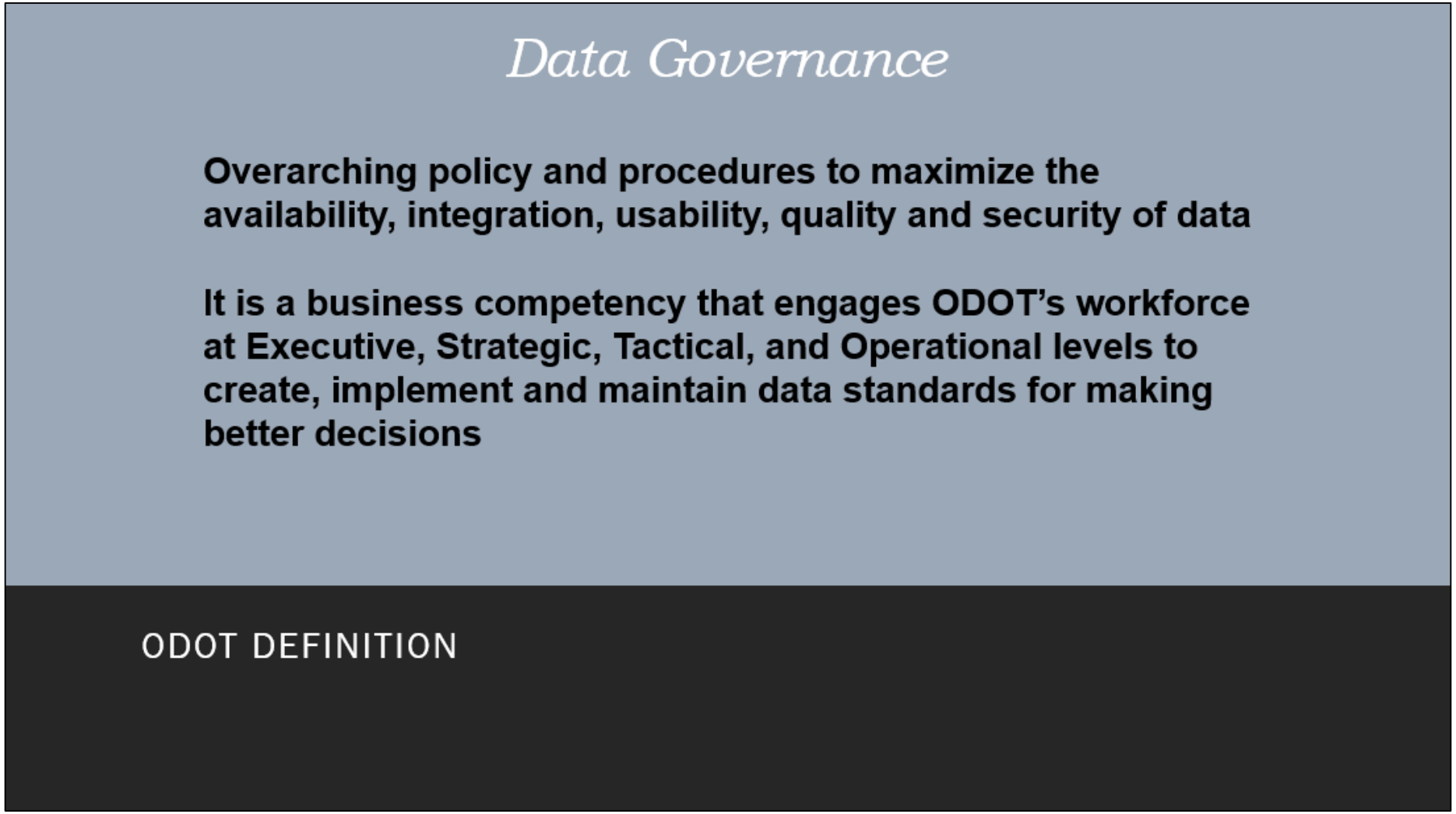
- Implementation and Procurement Jan. - April
- Pilot April - April
- Unlimited Devices




PLANNING
MAINTENANCE
Assets & Data
DESIGN
CONSTRUCTION

Data Governance

** Built Program off success of the TAM Program and TAMAG Efforts **

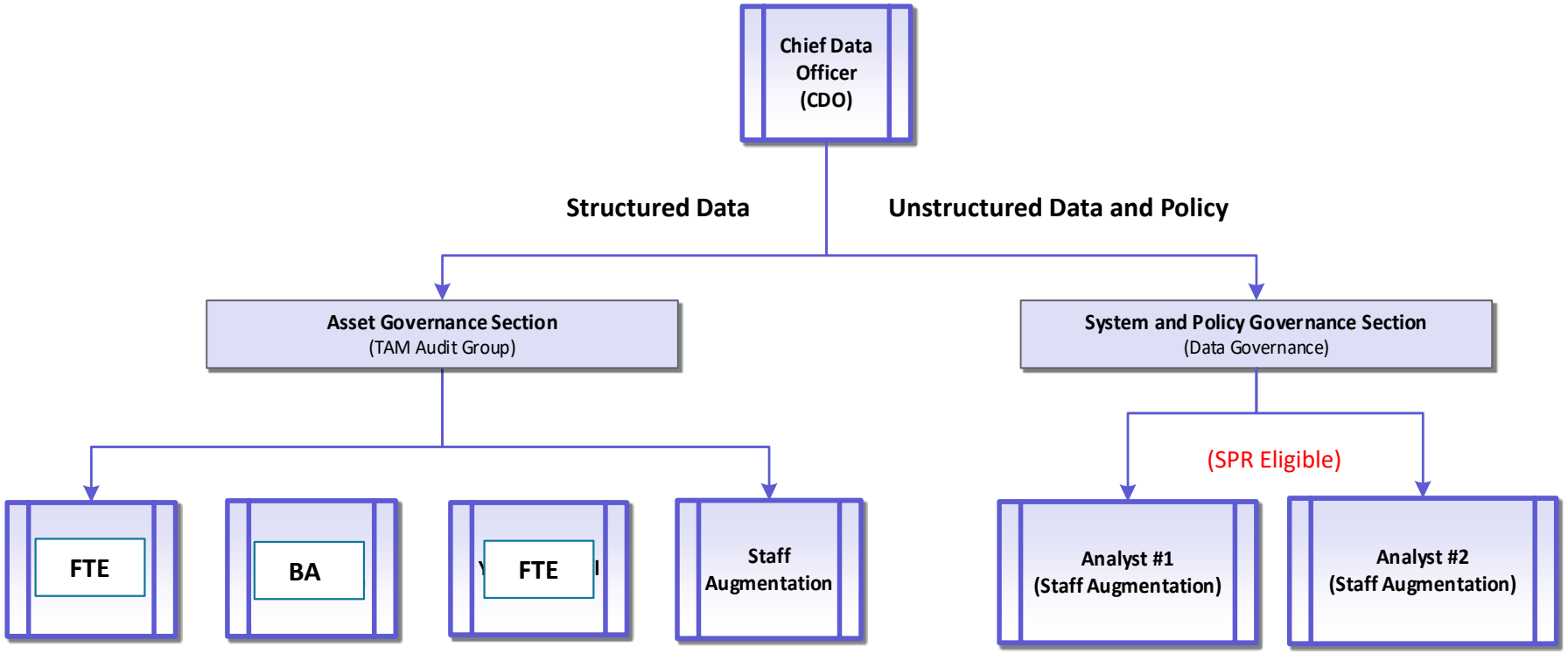


Data Governance – Office

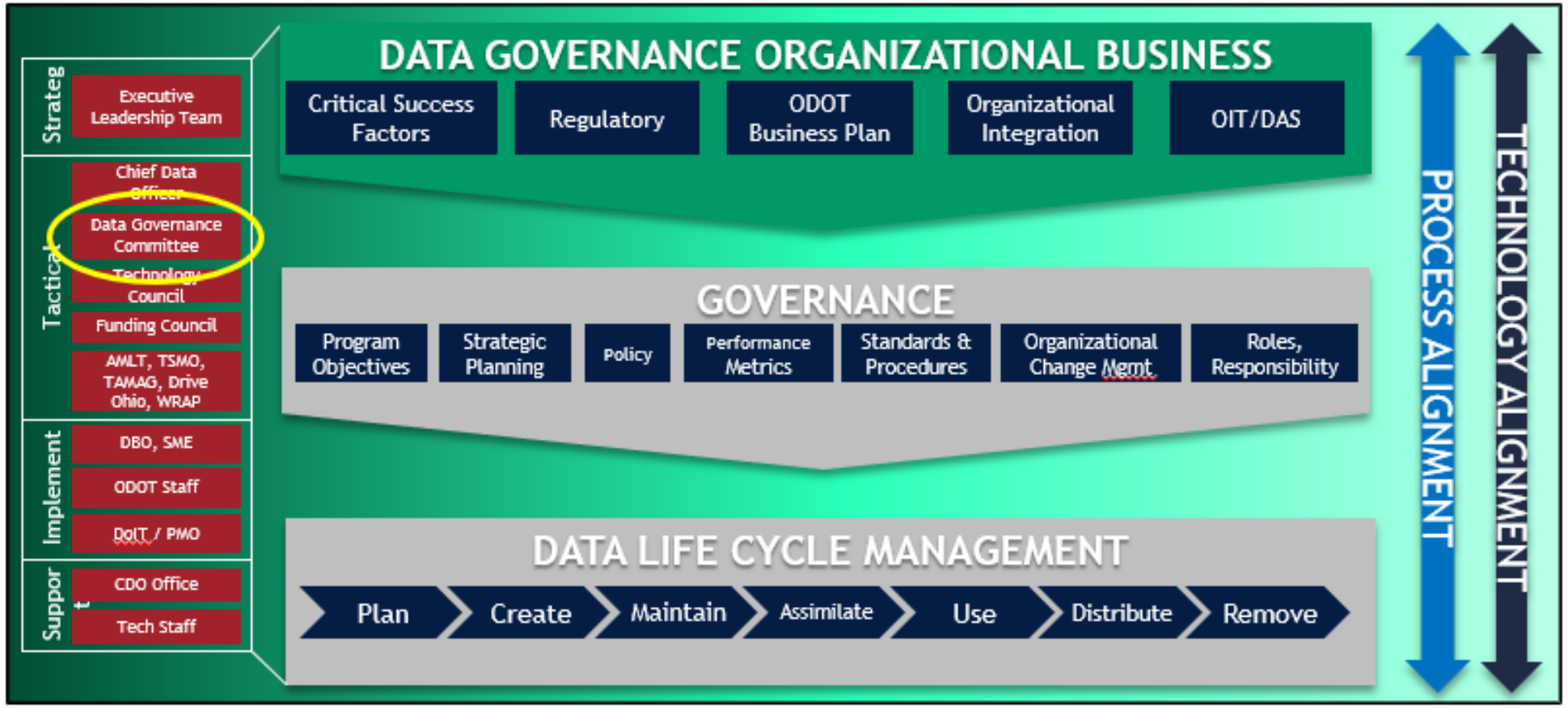
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF DATA GOVERNANCE

'Managing Information t save Lives and Money'

Data Governance



Data Governance – Framework



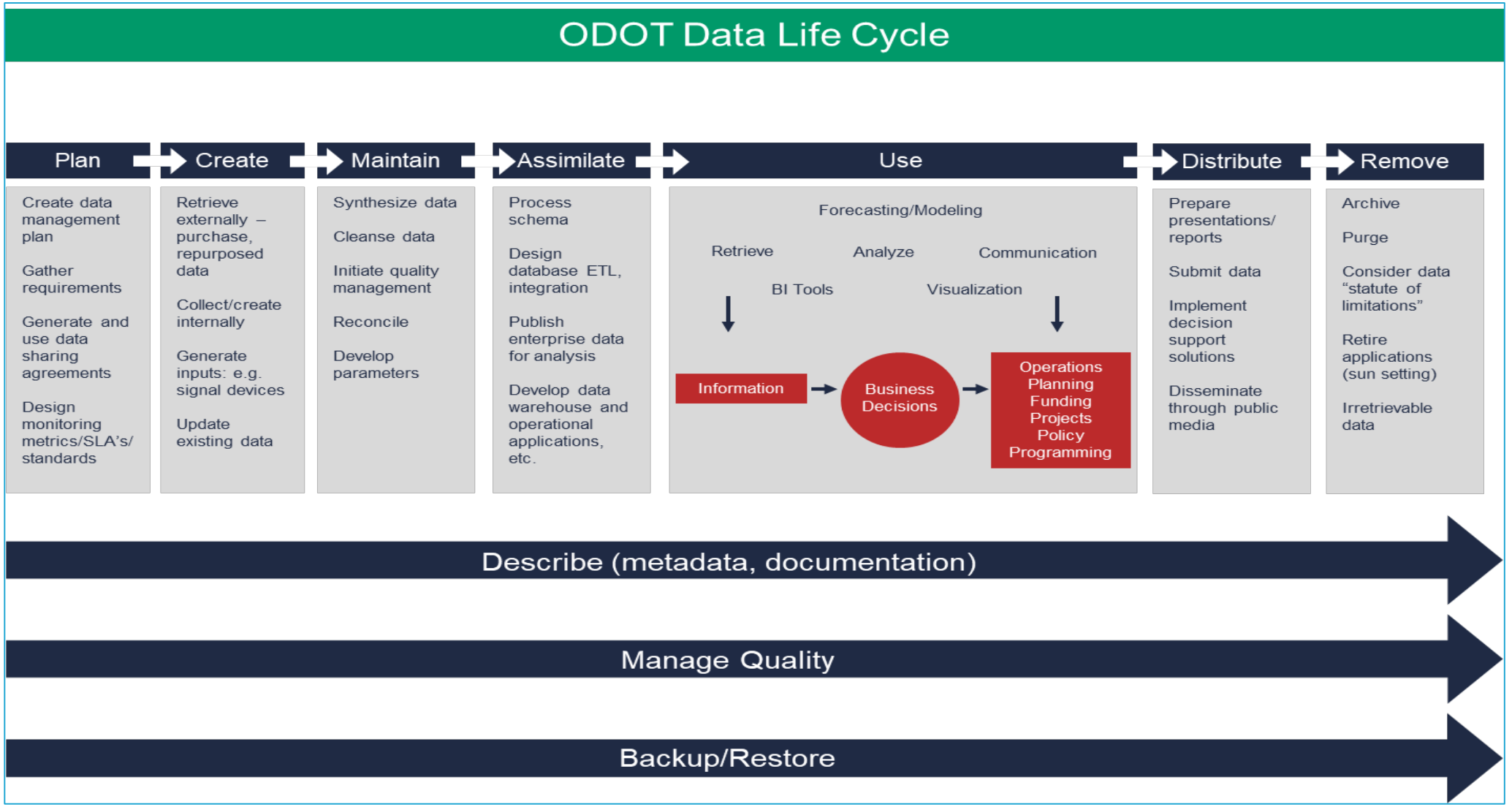
Framework Definition: Establishes guidelines and rules of engagement for business and management activities of enterprise data. Formalizes data life cycle interactions between people, process, and technologies to support positive outcomes

Data Governance – Roles and Responsibilities

High Level Responsibility by Governance Area

Level	Role	GOVERNANCE AREA						
		Program Objectives	Strategic Planning	Policy	Performance Metrics	Standards & Procedures	OCM	Roles & Responsibilities
Strategic	Executive Leadership	Mission Vision	CSF Leadership	Approve Endorse	Endorse Embrace Input	Support Empower	Sponsor Support	Empower Leadership
Tactical	Chief Data Officer	Plan Develop Implement Monitor	Plan Develop Implement Monitor	Plan Develop Implement Monitor	Plan Develop Implement Monitor	Plan Develop Implement Monitor	Align across ODOT Continuous Improvement	Define Support Monitor
	DG Committee							
	Technology Council							
	Funding Council							
	Initiatives							
Implement	DBO, SME	Business Functions Manage Programs Subject Matter Expert	Execute Plan Provide Feedback Adhere to Strategy	Enforce Adhere Communicate	Collect Monitor Report	Enforce	Communicate Direction Orientation Onboarding Training	Data Business Ownership Adhere to Policy Education
	ODOT Staff							
	DoIT / PMO							
Support	CDO Office	Accountability Meta Data	Execute Plan Provide Feedback	Research/Input Implement Enforce	Collect Monitor Report	Formalize Enforce	Plan Develop Deliver	Program Management Paternships Consult/Support Provide IT Resources
	Tech Staff							

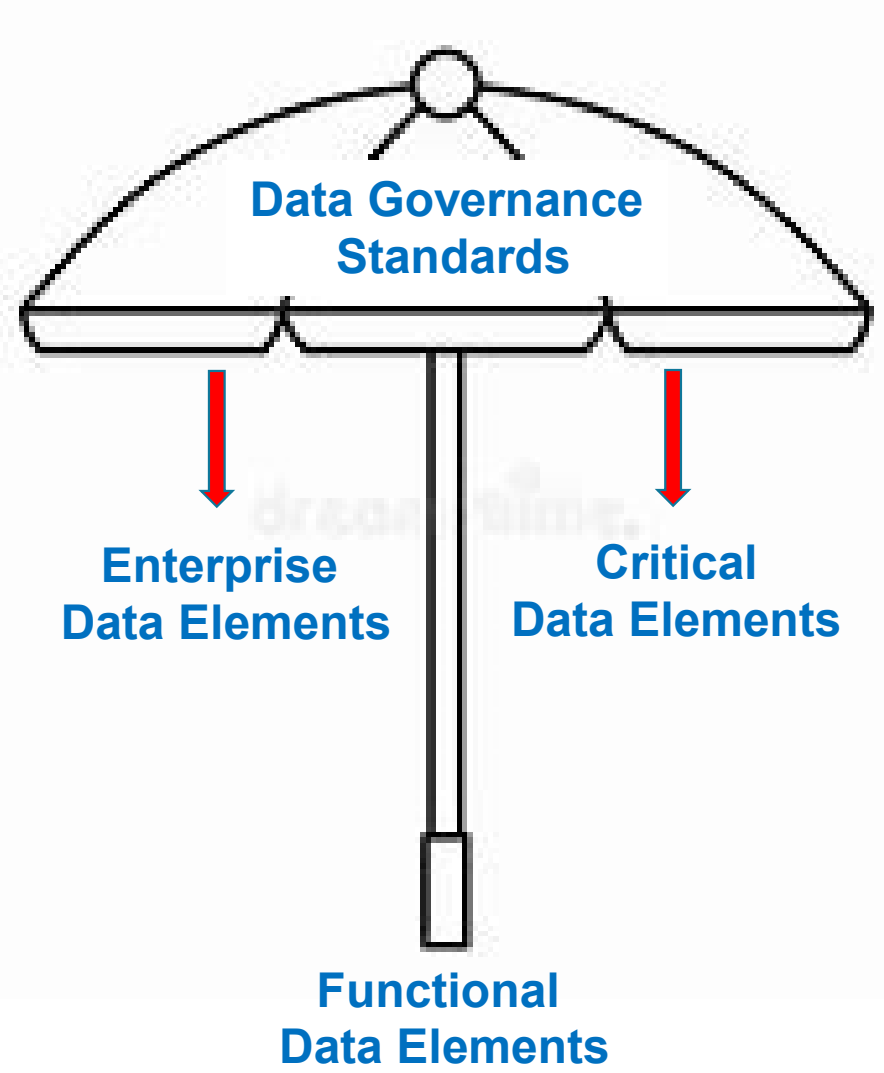
Data Governance



Data Governance - Standards

Enterprise Standards

- Used TAMAG Standards as Template
- Source System/Table
  - Naming Conventions
  - Types
  - Domain Values
  - Descriptions
- Dashboards – Business Intelligence (BI)



CDE's are considered data elements that are sourced or created in primary business systems or collections, but used throughout the organization to make important decisions or references vital to ODOT business functions.

Data Governance - IT Relationship

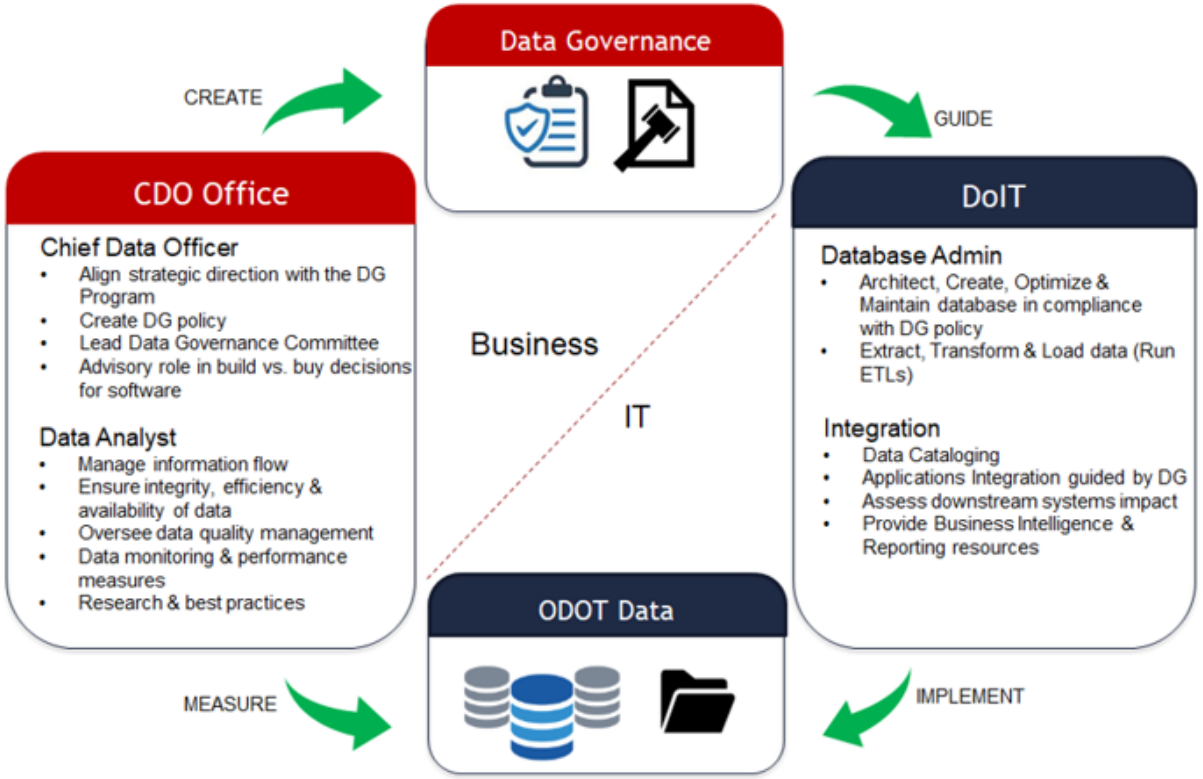
Coordination

- Database Group - Warehouse
- Project Management Office - Projects
- Event Streaming Platform – Governance
- Dashboards – Business Intelligence (BI)

People, Process, and Technology

Chief Data Officer (CDO)

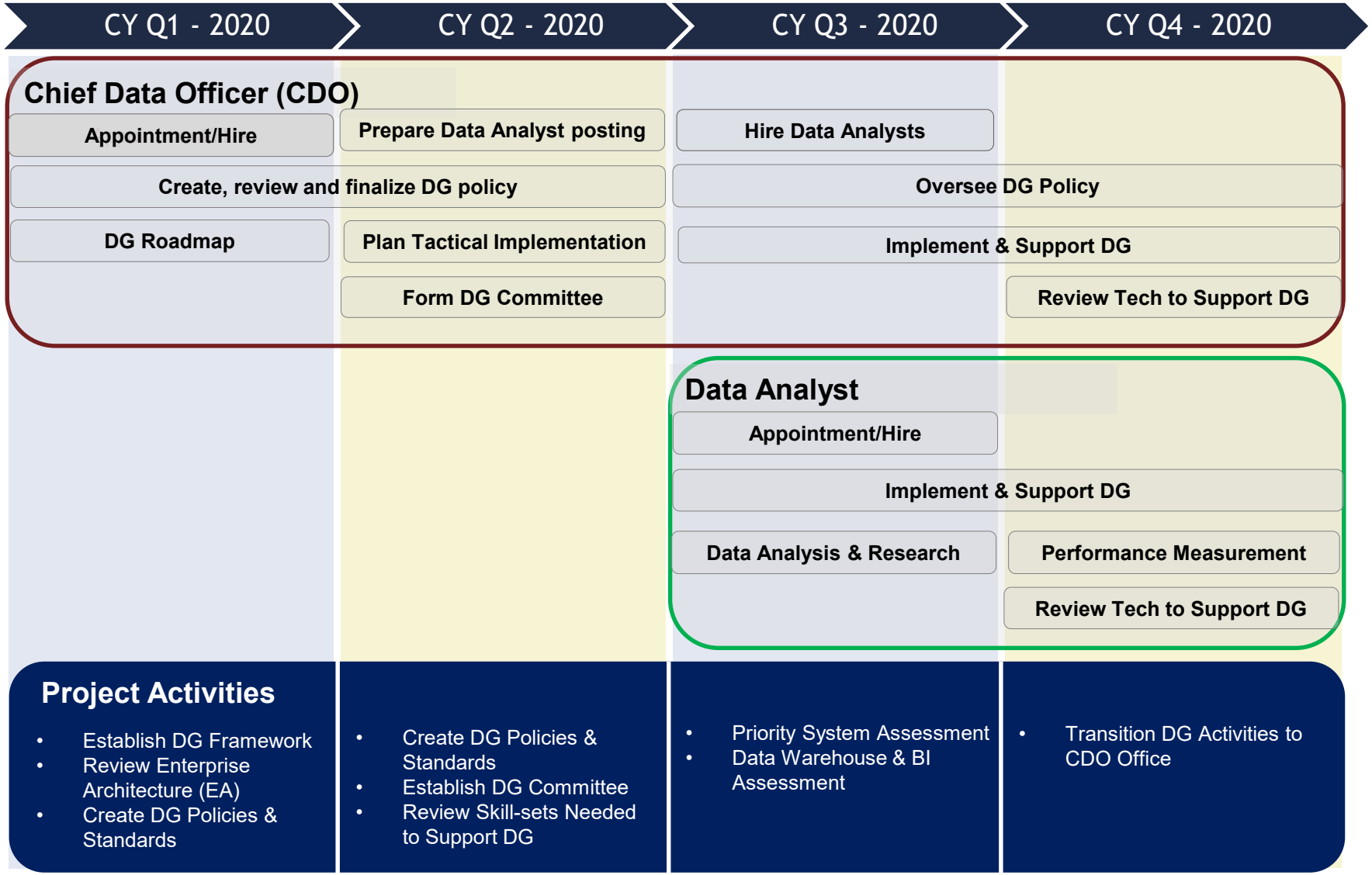
What We Do (Policy)



Chief Information Officer (CIO)

How we do it (Technology)

Data Governance – 2020 Roadmap



U.S. Department of Transportation
Federal Highway Administration

Question & Answer

Ian Kidner
GIS Program Manager

John Puente
Administrator, Chief Data Officer

U.S. Department of Transportation
Federal Highway Administration

New York State Department of Transportation & Office of Information Technology Services

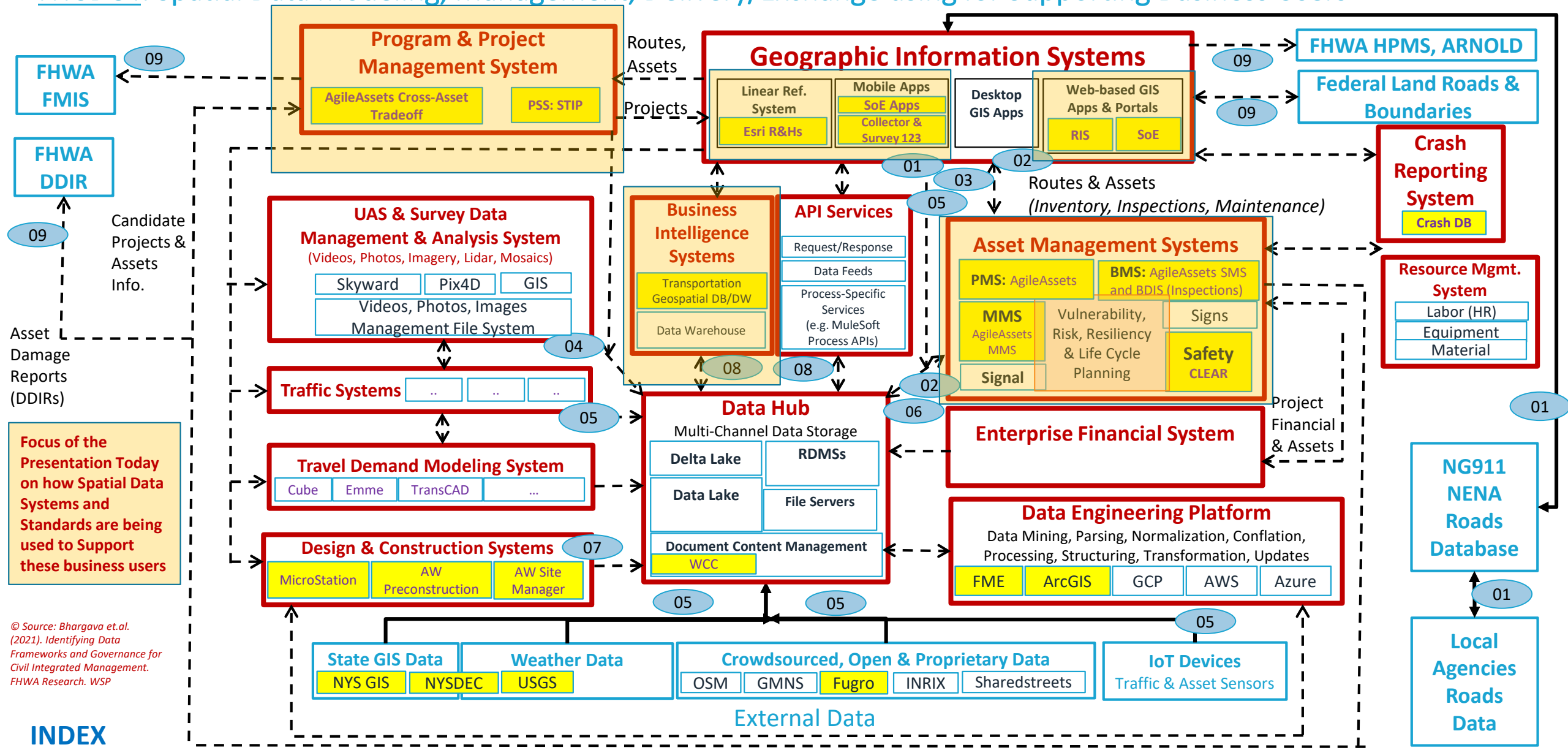
Pat Kemble
Highway Data Section Supervisor

Kevin Hunt
Geographic Information Systems Manager, Transportation

New York Presentation Outline

- NYSDOT's Enterprise Linear Referencing System (ELRS) – the foundational system of record
  - Roadway Inventory System v2 (RIS 2.0) – Smart Entry Engine
  - Event Editors
  - Roadway Data Mart
  - Project Planner for NYSDOT Program Management
- Geospatial Data Warehouse (GDW) and SoE Applications for Business Users (Kevin)
  - Data Standards, ETL Standards. Geospatial data made available to business users, apps and reporting tools
  - NYSDOT's System of Engagement: "NYSDOT Maps and Apps"
- ELRS System Integrations supporting Enterprise Asset Management and Highway Safety
  - EAMP - PMS, SMS, MMS
  - CLEAR

NYSDOT: Spatial Data Modeling, Management, Delivery/Exchange using for Supporting Business Users



INDEX

01: [Routes and Assets Data] from Road Inventory Systems → LRS, Road Inventory, Asset & Project Systems, Data Hub
02: [Asset Inventory, Condition and Work History, Plans Data] from AMS → Data Hub & Vulnerability Analysis Systems
03: [Asset Damages Data] from Asset Inspection & Damage Assessment Apps → Asset Management System, GIS
04: [Survey, Inspection Data] from UAS → AMS, GIS, Design, Construction, Data Hub Systems
05: [Incident, Traffic & Asset Data] from Weather, Traffic and Asset Systems to Data Hub, Warehouse, GIS, BI
06: [Repair Projects and Work Plan/Requests Data] from Vulnerability Analysis & DDIR Apps → PPMS & AMS
07: [As-Built Asset Data] Design, Construction → LRS and Asset Management Systems
08: [Processed and Integrated Data for Analytics] from Data Hub → Data Warehouse & BI Systems
09: [Roads and Assets, Projects, Damages] from DOT Systems → FHWA HPMS, FMIS, DDIR Systems

U.S. Department of Transportation
Federal Highway Administration

Enterprise Linear Referencing System (ELRS)

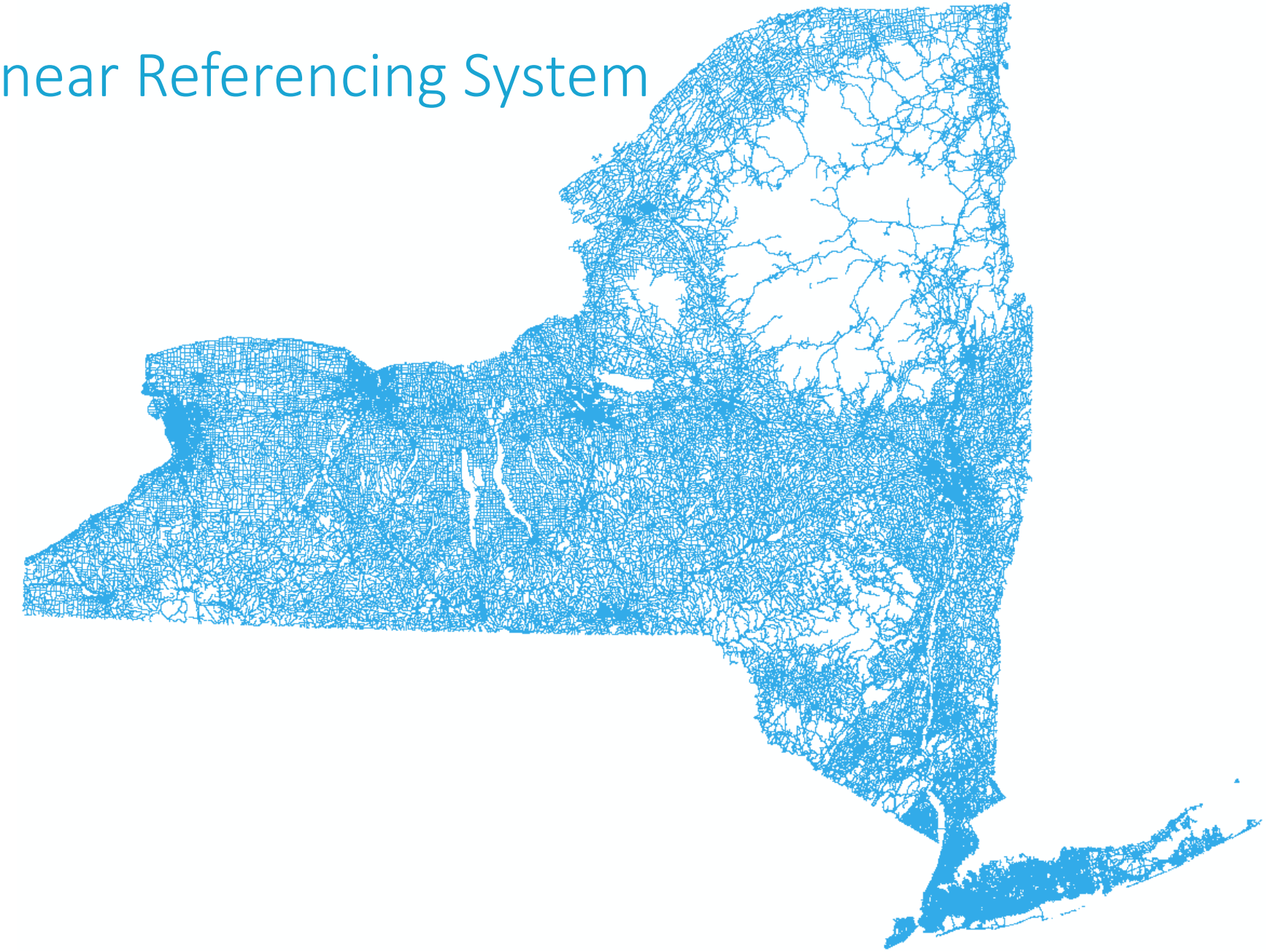
Roadway Inventory System v2 (RIS)

Event Editor

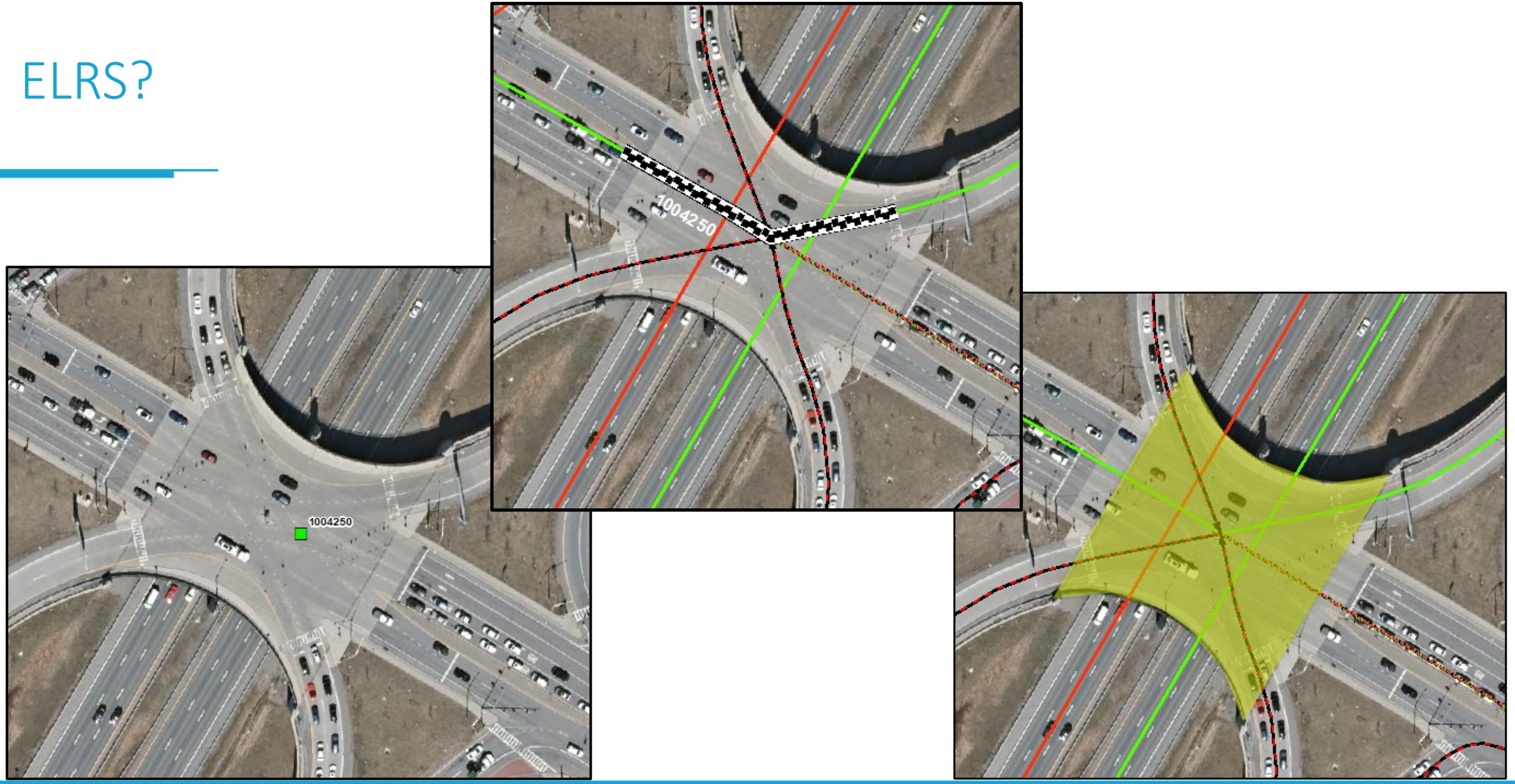
NYSDOT Project Planner

NYSDOT Enterprise Linear Referencing System (ELRS)

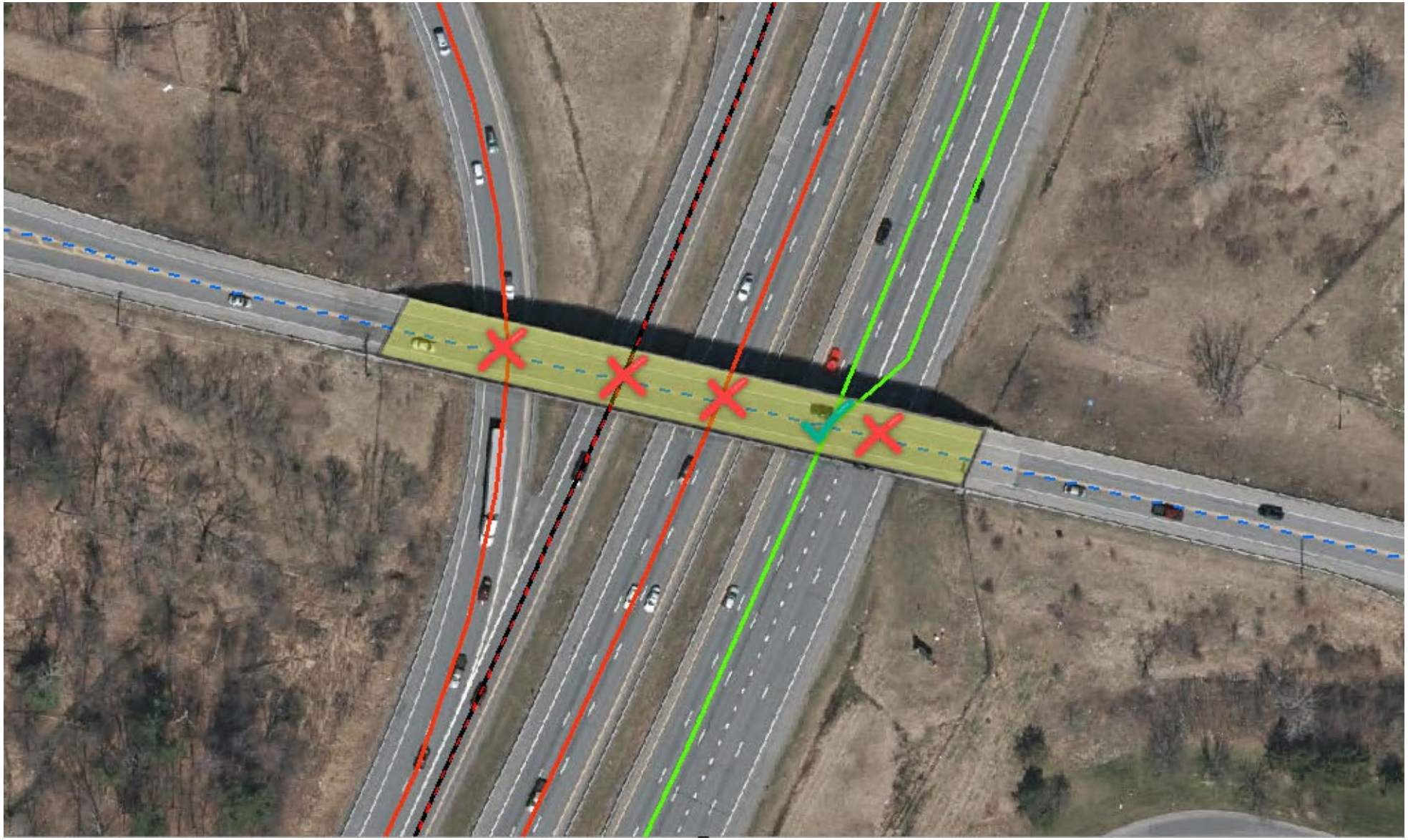
- R&H's on 10.7.1
- 197,700+ Route ID's
- 127,767 miles
- Average ≈ 0.65 miles
- County Based*



ELRS?



ELRS!



NYSDOT Enterprise Linear Referencing System

- Changes for the “Enterprise”
  - » Asset Management
    - Guiderail
    - Pavement
    - Culverts
    - Signs
  - » Plow Beats
  - » Crash Locations

NYSDOT Enterprise Linear Referencing System

- Changes for ARNOLD/CLEAR

ELRS - Updating

- Older Update Process
  - » Regional Input
  - » Local Highway Inventory
  - » Chance
  - » Orthoimagery
- Newer Update Process
  - » Project Planner Events
  - » Data Collection Vehicle Analysis
  - » DGN to GIS

RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)

AgileAssets Smart Entry Engine (SEE) Inventory Maintenance 2/8/2021 Version: ELRS.Pat Reconcile and Post | Patrick

Home / Inventory Maintenance

Input search values, or use map selection tools to get roadway data.

Show Segments

DOT ID / Route ID (GIS ID): 100495

Roadway Type: Route

Route Signing: I

Route Number: 87

Route Suffix: None

Route Qualifier: No qualifier

Road Number:

Jurisdiction:

Region:

County:

Municipality:

Geo Code:

Road Name:

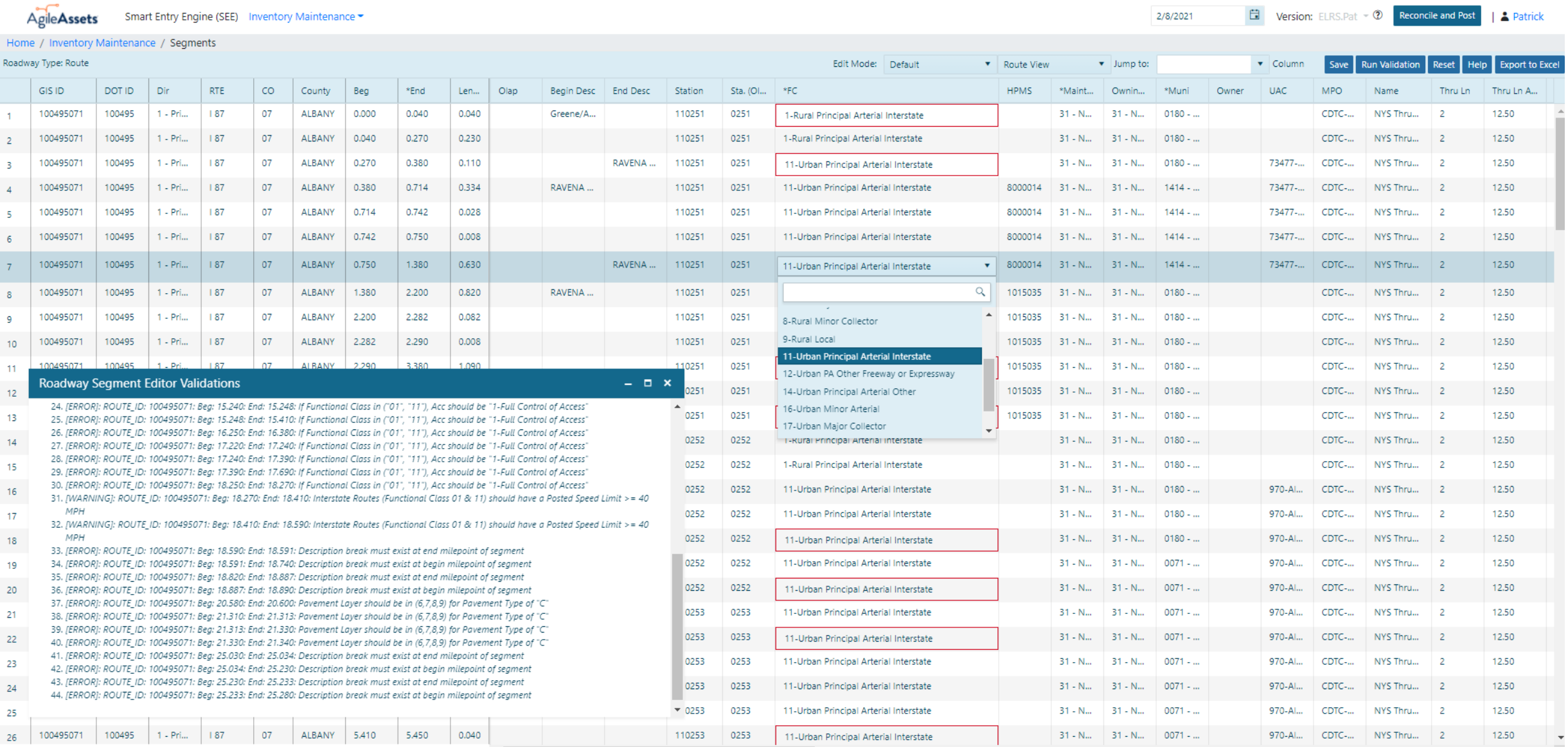
Start Mile Point: End Mile Point:

Clear Search

	Route ID (GIS ID)...	DOT ID	County Order	Direction	County	Route Signing	Route Number	Route Suffix	Route Qualifier	Roadway Type	Parkway	Roadway Feature
9	100495051	100495	05	1 - Primary Direct...	111 - ULSTER	I	87	None	No qualifier	Route	No	
10	100495052	100495	05	2 - Reverse Direct...	111 - ULSTER	I	87	None	No qualifier	Route	No	
11	100495061	100495	06	1 - Primary Direct...	39 - GREENE	I	87	None	No qualifier	Route	No	
12	100495062	100495	06	2 - Reverse Direct...	39 - GREENE	I	87	None	No qualifier	Route	No	
13	100495071	100495	07	1 - Primary Direct...	1 - ALBANY	I	87	None	No qualifier	Route	No	
14	100495072	100495	07	2 - Reverse Direct...	1 - ALBANY	I	87	None	No qualifier	Route	No	
15	100495081	100495	08	1 - Primary Direct...	91 - SARATOGA	I	87	None	No qualifier	Route	No	
16	100495082	100495	08	2 - Reverse Direct...	91 - SARATOGA	I	87	None	No qualifier	Route	No	
17	100495091	100495	09	1 - Primary Direct...	113 - WARREN	I	87	None	No qualifier	Route	No	
18	100495092	100495	09	2 - Reverse Direct...	113 - WARREN	I	87	None	No qualifier	Route	No	
19	100495101	100495	10	1 - Primary Direct...	31 - ESSEX	I	87	None	No qualifier	Route	No	
20	100495102	100495	10	2 - Reverse Direct...	31 - ESSEX	I	87	None	No qualifier	Route	No	
21	100495111	100495	11	1 - Primary Direct...	19 - CLINTON	I	87	None	No qualifier	Route	No	
22	100495112	100495	11	2 - Reverse Direct...	19 - CLINTON	I	87	None	No qualifier	Route	No	

U.S. Department of Transportation
Federal Highway Administration

RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)



RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)

AgileAssets Smart Entry Engine (SEE) HPMS ▾ 2/8/2021 Version: ELRS.Pat Reconcile and Post | Patrick

Home / HPMS

HPMS Samples | Traffic Growth Rate | Estimate Catalog | Summary Vehicle Catalog | Metadata Catalog

Input search values, or use map selection tools to get HPMS data.

HPMS Sample ID

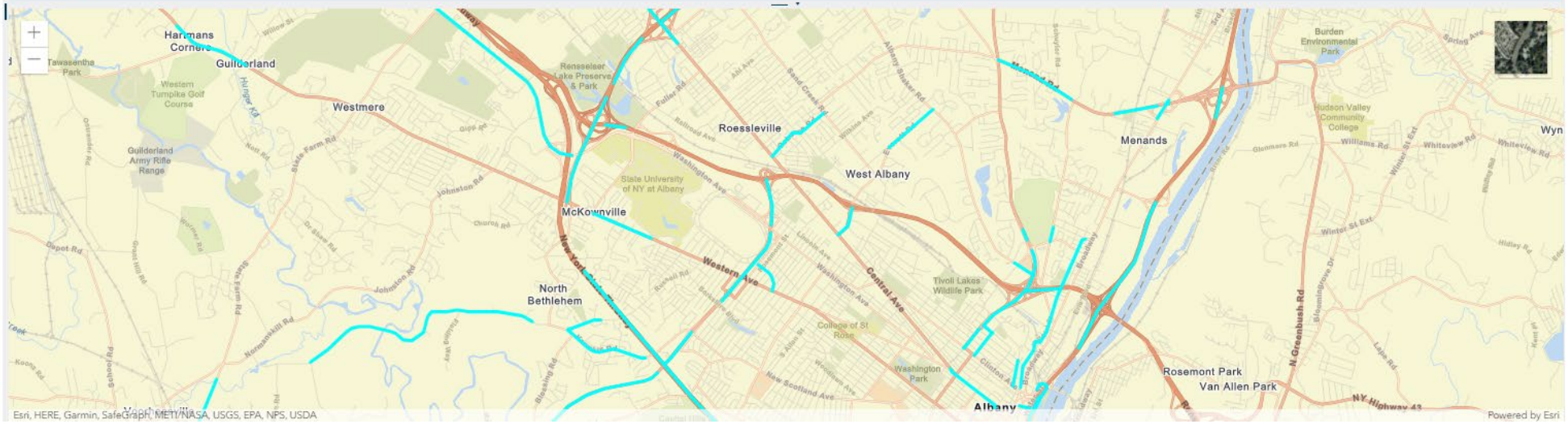
Region: 1 - Albany ×

County: ALBANY ×

⊗ Clear | Search

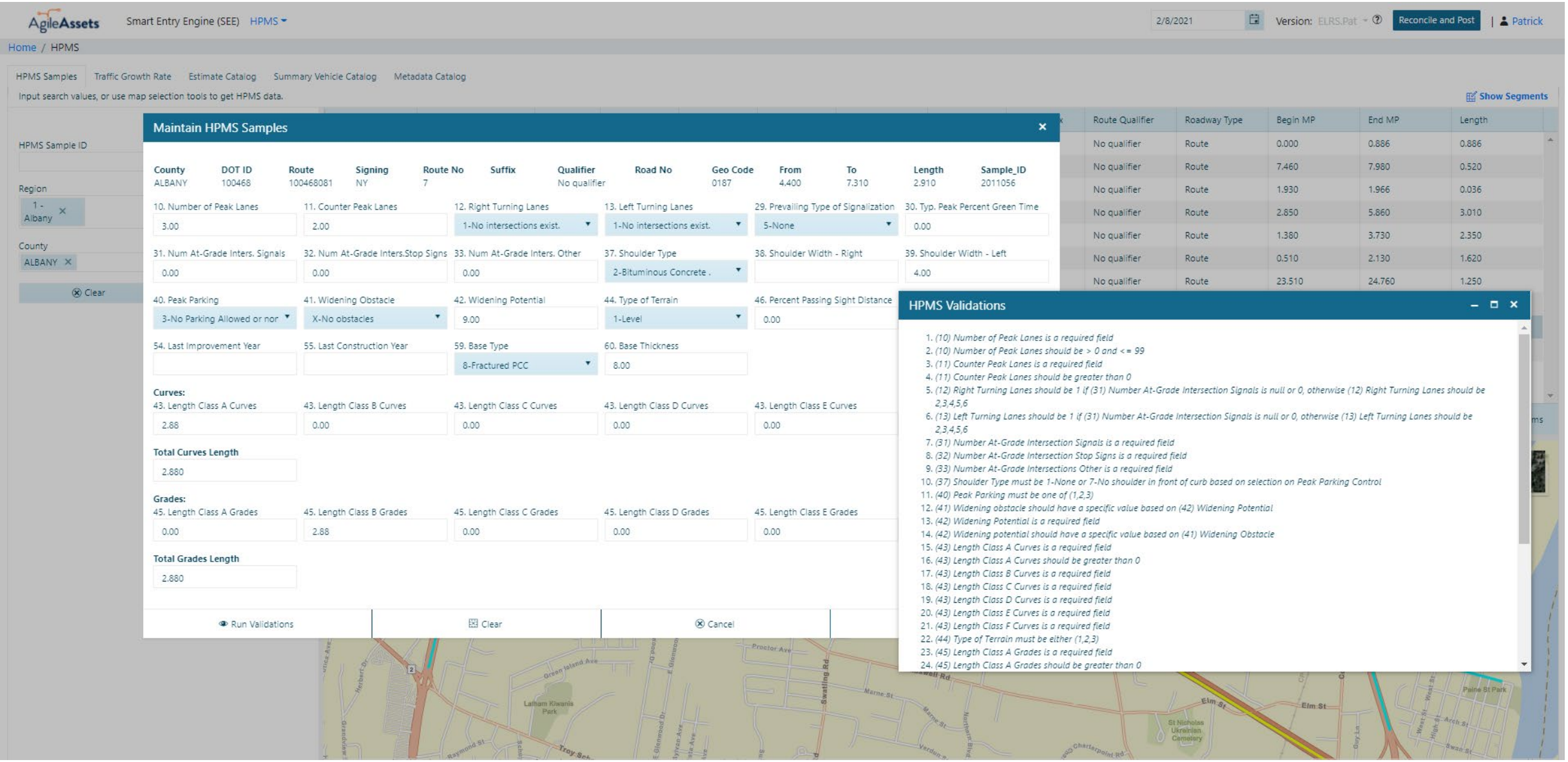
HPMS Sample ID...	Route_ID (GIS_ID)	DOT ID	County Order	Direction	County	Route Signing	Route Number	Route Suffix	Route Qualifier	Roadway Type	Begin MP	End MP	Length
333333	100348011	100348	01	0 - Primary D...	ALBANY	NY	378	None	No qualifier	Route	0.000	0.886	0.886
444444	100081021	100081	02	0 - Primary D...	ALBANY	NY	146	None	No qualifier	Route	7.460	7.980	0.520
999888	100348011	100348	01	0 - Primary D...	ALBANY	NY	378	None	No qualifier	Route	1.930	1.966	0.036
1007252	100147201	100147	20	0 - Primary D...	ALBANY	US	20	None	No qualifier	Route	2.650	5.860	3.010
1015035	100495071	100495	07	1 - Primary D...	ALBANY	I	87	None	No qualifier	Route	1.380	3.730	2.350
1016910	100079021	100079	02	0 - Primary D...	ALBANY	NY	145	None	No qualifier	Route	0.510	2.130	1.620
2011005	100495071	100495	07	1 - Primary D...	ALBANY	I	87	None	No qualifier	Route	23.510	24.760	1.250
2011055	100468081	100468	08	0 - Primary D...	ALBANY	NY	7		No qualifier	Route	7.590	7.846	0.256
2011056	100468081	100468	08	0 - Primary D...	ALBANY	NY	7		No qualifier	Route	4.400	7.310	2.910
2011105	100514081	100514	08	0 - Primary D...	ALBANY	US	9	None	No qualifier	Route	2.620	2.950	0.330

1 2 3 4 5 6 7 8 9 10 ... 1 - 10 of 110 items



U.S. Department of Transportation
Federal Highway Administration

RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)



RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)

AgileAssets Smart Entry Engine (SEE) Traffic Stations 2/8/2021 Version: ELRS.Pat Reconcile and Post | Patrick

Home / Traffic Stations

Traffic Station ID

Region: 1 - Albany

County: ESSEX

Clear Search

Reset Save Delete Add

Station Mapping

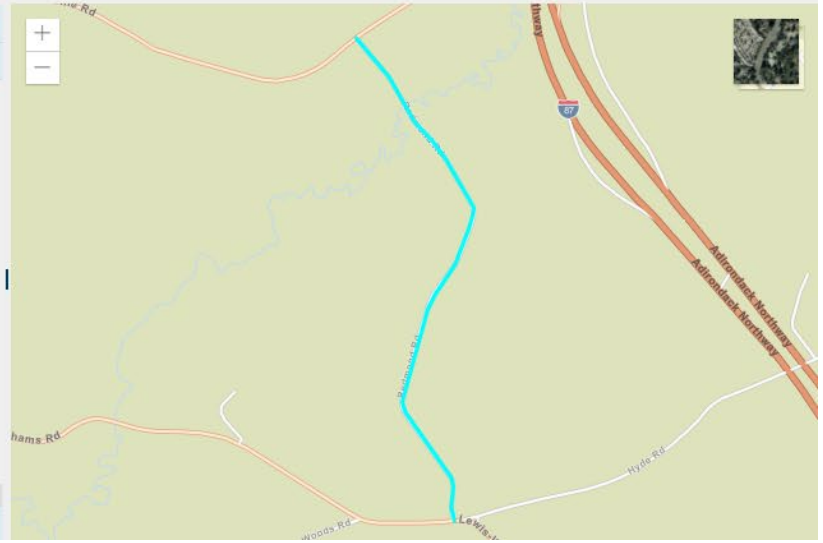
Station #	Region	County	Region Co...	Station Type	Route Name	Road Name	Station Lin...	PDIRDIR	FG	P Lanes	NP Lanes	Latitude	Longitude	CC Station	Off Network	Roadway T...	Retired
126083	1 - Albany	ESSEX	12	0-No Virtu...		HURRICAN...		P-Pos	30	1	1	44.217821	-73.639579		☐	Road	
126084	1 - Albany	ESSEX	12	0-No Virtu...		N WOODS...		P-Pos	30	1	1	43.810638	-74.011752		☐	Road	
126091	1 - Albany	ESSEX	12	0-No Virtu...		DORSEY TE...		E-East	40			0	0		☑		
126092	1 - Albany	ESSEX	12	0-No Virtu...		SCHAFFER ...		N-North	30	1	1	44.23347	-73.77372		☐	Road	
126093	1 - Albany	ESSEX	12	0-No Virtu...		BRAINARD...		N-North	30	1	1	44.24945	-73.52046		☐	Road	
126094	1 - Albany	ESSEX	12	0-No Virtu...		REDMOND...		P-Pos	30	1	1	0	0		☐	Road	
126095	1 - Albany	ESSEX	12	0-No Virtu...		DONNELLY...		E-East	30	1	1	43.77375	-73.92787		☐	Road	
126096	1 - Albany	ESSEX	12	0-No Virtu...		TITUS RD		E-East	30	1	1	44.06145	-73.50833		☐	Road	
126097	1 - Albany	ESSEX	12	0-No Virtu...		WHITE CH...		N-North	30	1	1	43.97383	-73.48809		☐	Road	
126098	1 - Albany	ESSEX	12	0-No Virtu...		SOPER RD		E-East	30	1	1	44.51153	-73.4605		☐	Road	

1 2 3 4 5 6 7 8 9 10 ... 1 - 10 of 291 items

Segment Summary Show Segments

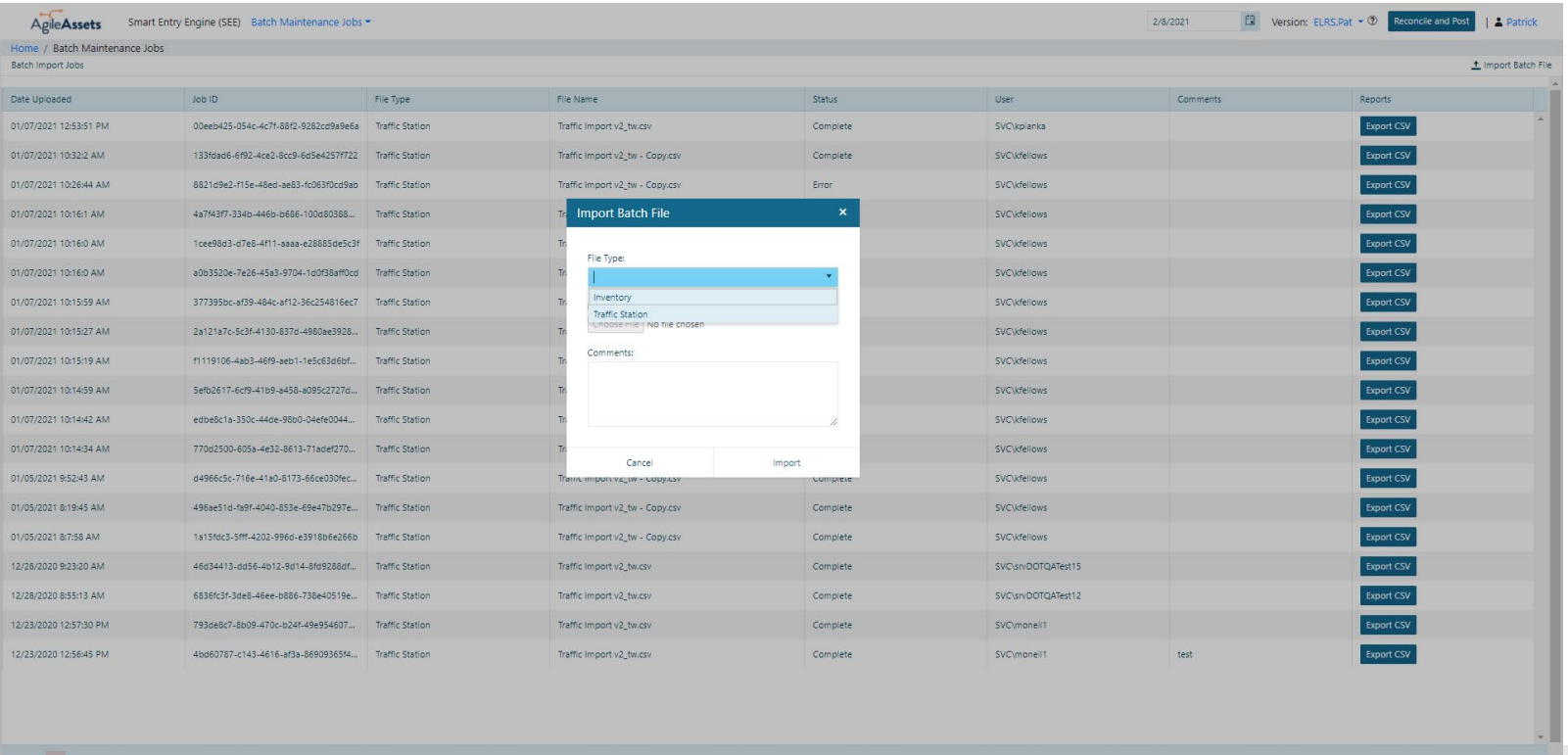
Route ID (...	DOT ID	County ...	Direction	Route S...	Route ...	Road N...	Route S...	Route ...	Roadw...	Begin ...	End MP	Length
105485011	105485	ESSEX	0 - Pri...					No qua...	Road	0	1.1456...	1.1456...

1 1 - 1 of 1 items



U.S. Department of Transportation
Federal Highway Administration

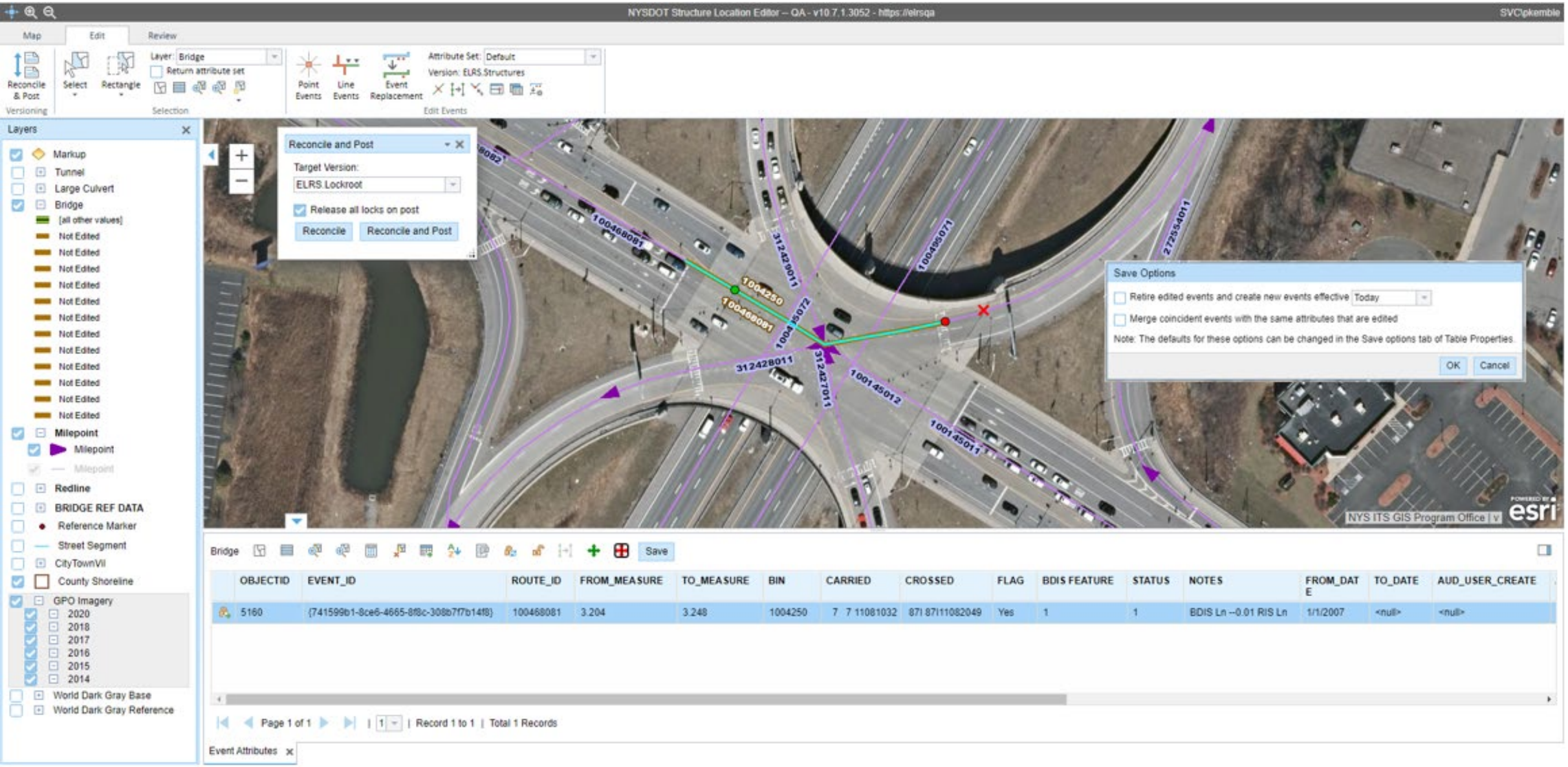
RIS 2.0 R&Hs Event Editing – Smart Entry Engine (SEE)



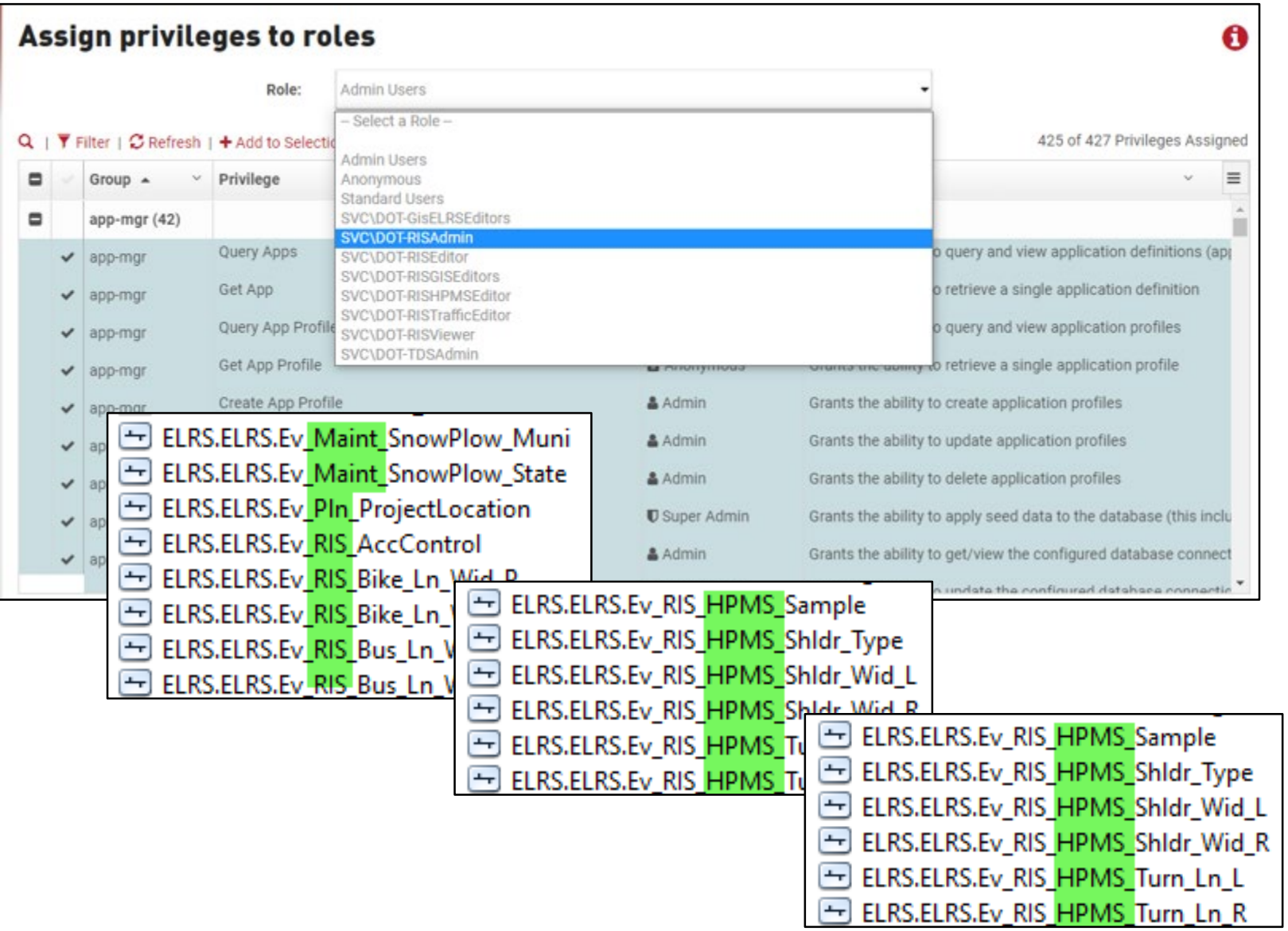
- Misc. discussion –
  - » Batch Loading with validations
  - » Permissions

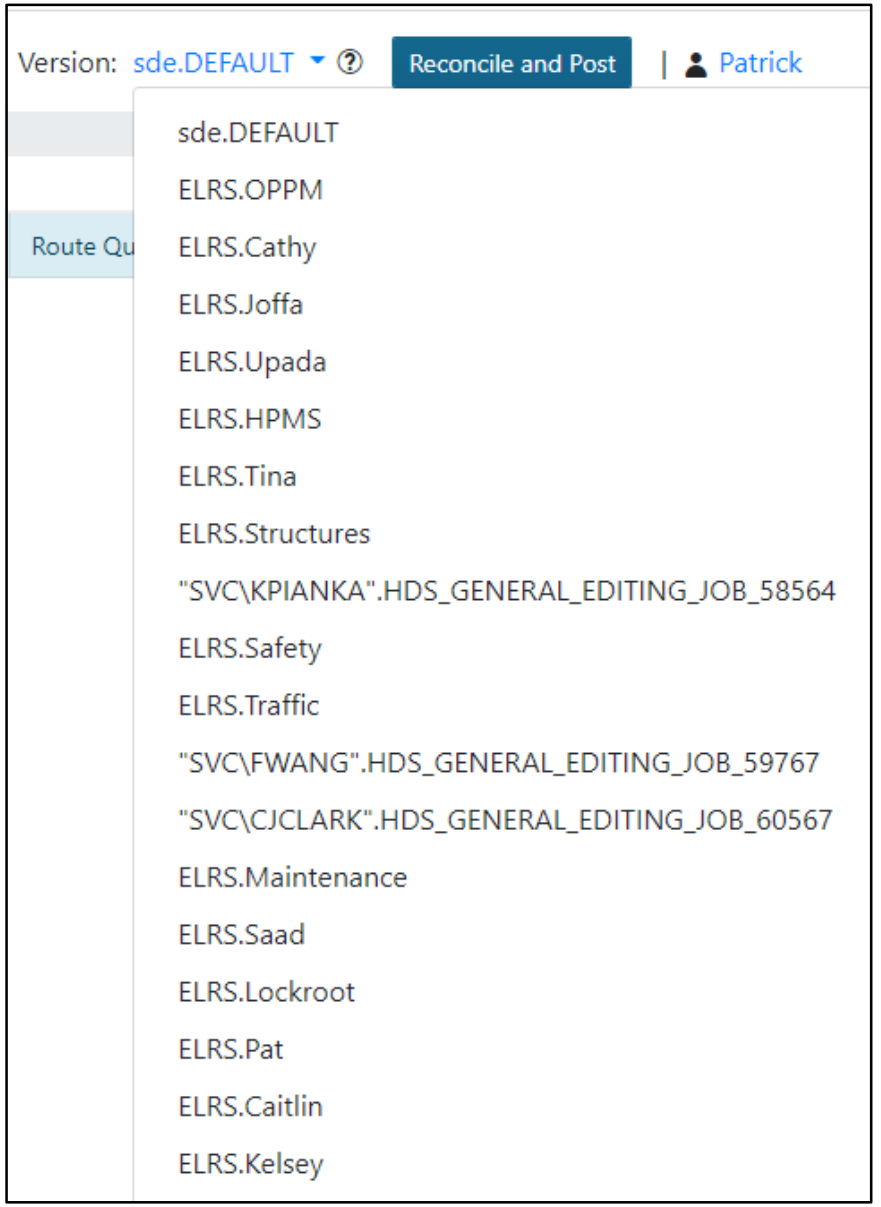
	A	B	C	D	E	F	G	H	I	O	P	Q	R	S	T	U	
1	GIS ID	DOT ID	Dir	RTE	CO	County	Beg	*End	Length	*FC	HPMS	*Maint Jur	Owning Jur	*Muni	Owner	UAC	MPO
82	100495071	100495	1	I 87	07	ALBANY	18.74	18.75	0.01	11-Urban Principal Arterial Interstate		31 - NYS Thruway	31 - NYS Thruway	2001 - Albany - C - ALBANY		970-Albany	
83	100495071	100495	1	I 87	07	ALBANY	18.75	18.82	0.07	11-Urban Principal Arterial Interstate		31 - NYS Thruway	31 - NYS Thruway	2001 - Albany - C - ALBANY		970-Albany	
84	100495071	100495	1	I 87	07	ALBANY	18.82	18.8867934	0.0667934	11-Urban Principal Arterial Interstate		31 - NYS Thruway	31 - NYS Thruway	2001 - Albany - C - ALBANY		970-Albany	
85	100495071	100495	1	I 87	07	ALBANY	18.8867934	18.89	0.0032066	11-Urban Principal Arterial Interstate		31 - NYS Thruway	31 - NYS Thruway	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
86	100495071	100495	1	I 87	07	ALBANY	18.89	19.03	0.14	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
87	100495071	100495	1	I 87	07	ALBANY	19.03	19.07	0.04	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
88	100495071	100495	1	I 87	07	ALBANY	19.07	19.1	0.03	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
89	100495071	100495	1	I 87	07	ALBANY	19.1	19.27	0.17	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
90	100495071	100495	1	I 87	07	ALBANY	19.27	19.273	0.003	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap
91	100495071	100495	1	I 87	07	ALBANY	19.273	19.3	0.027	11-Urban Principal Arterial Interstate		01 - NYSDOT	01 - NYSDOT	2001 - Albany - C - ALBANY		970-Albany	CDTC-Cap

RIS 2.0 R&Hs Event Editing – Structures RCE

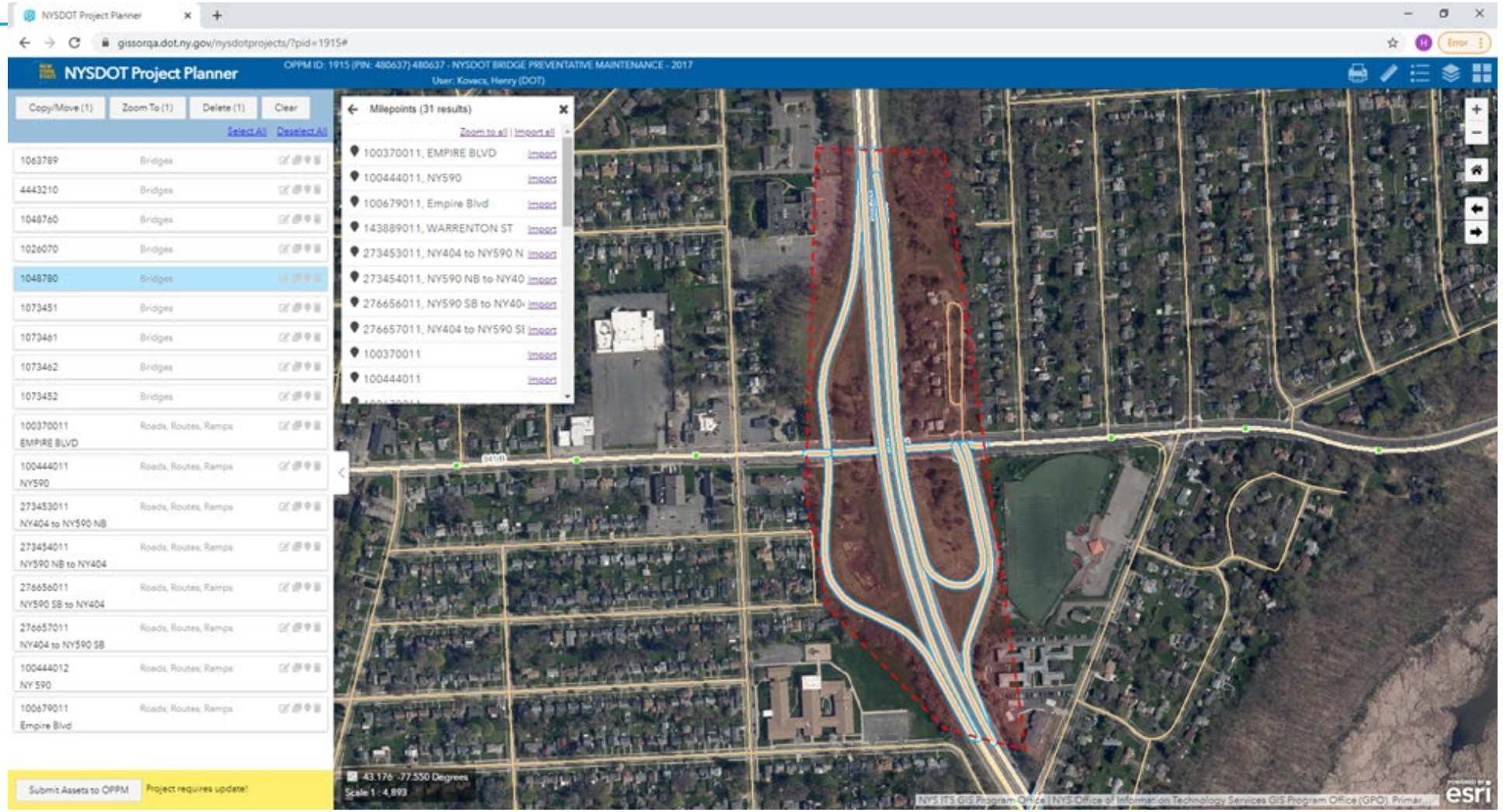


ELRS Governance





NYSDOT Project Planner – Leveraging LRS to support the Capital Program

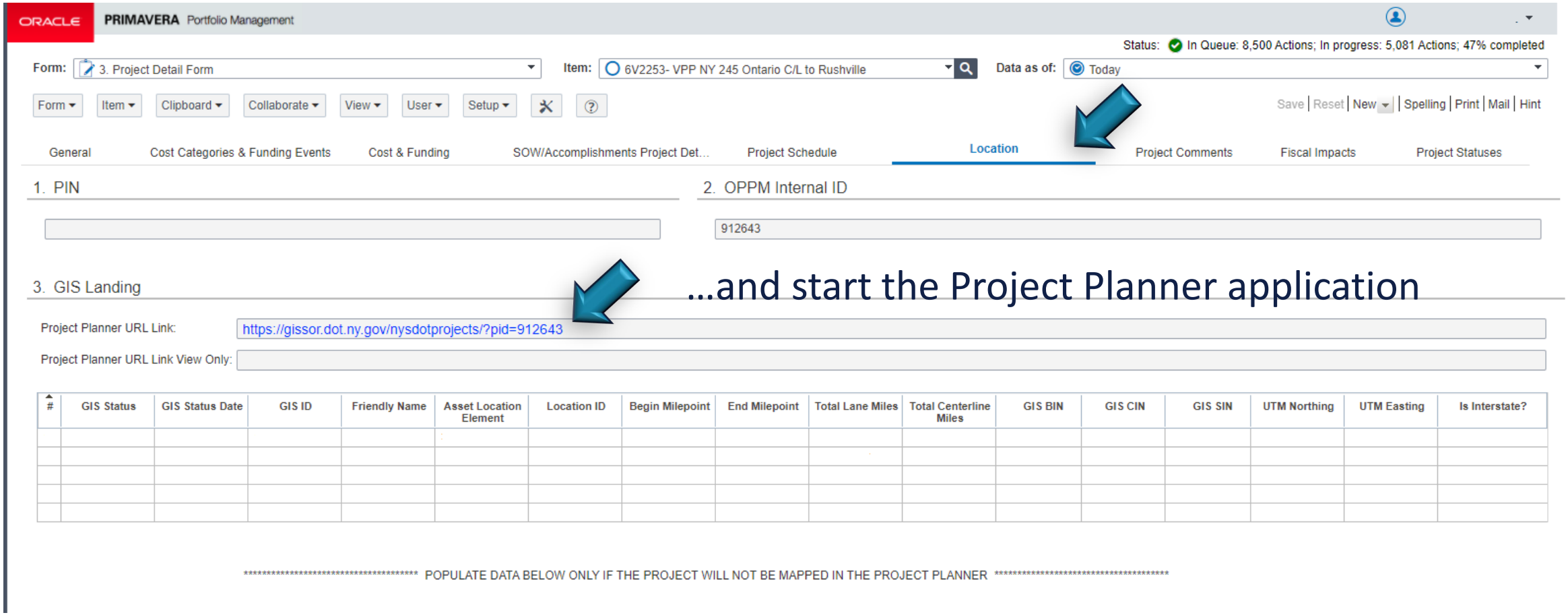


NYSDOT Project Planner – an “internal” ELRS interface

- 2017-2018 – Designed and developed to allow NYSDOT Program Management to locate projects for the new Oracle Primavera Portfolio Management (OPPM) System using the Enterprise Linear Referencing System.
- The NYSDOT Project Planner is a custom developed Esri application that runs on ELRS (Roads and Highways) infrastructure and maintains project locations as “internal events” in the Roads and Highways geodatabase.
- Leverages structure locations already maintained in the ELRS.

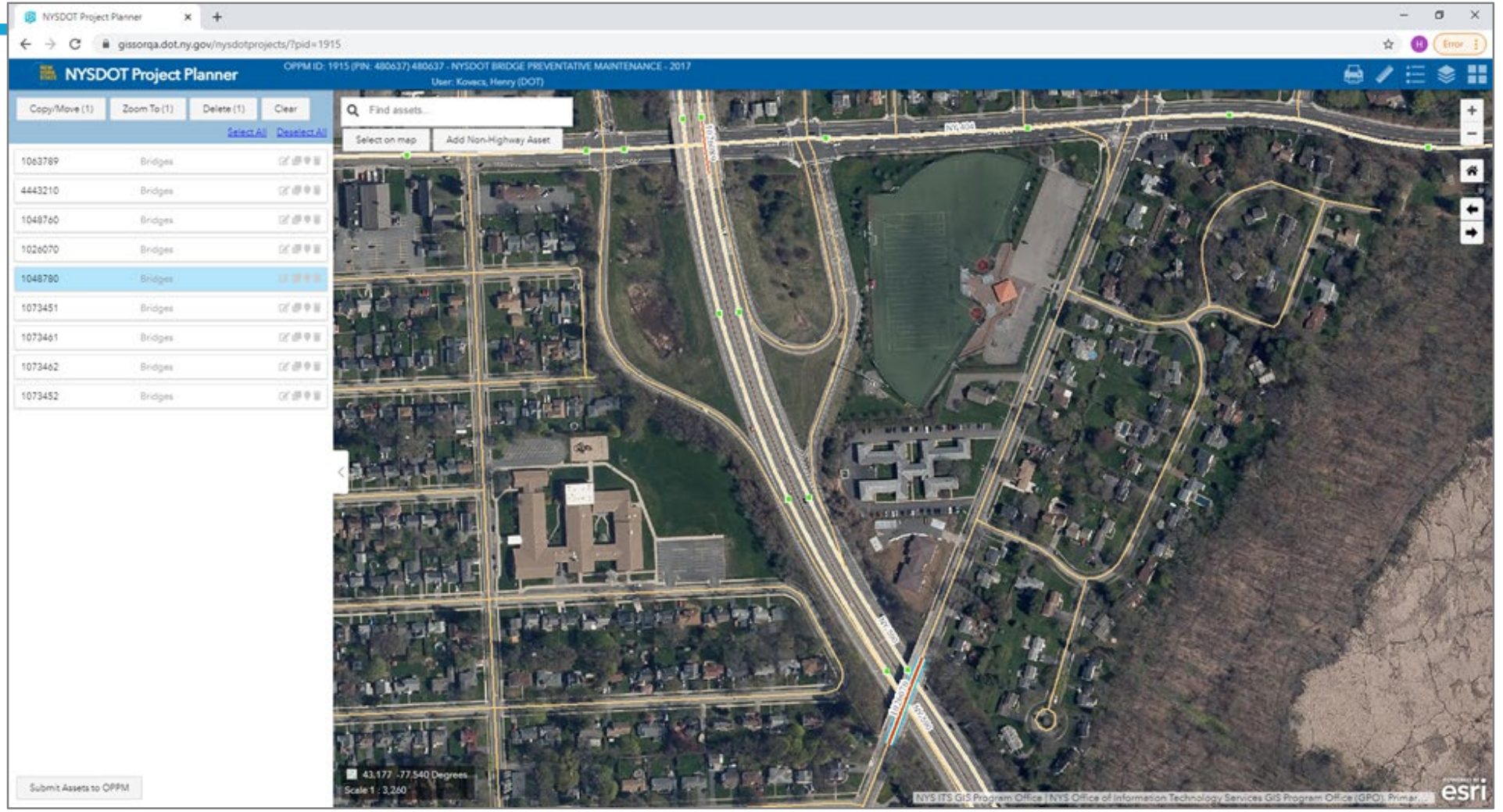
NYSDOT Project Planner feeds locations into OPPM

Program Managers initiate a new project in the OPPM interface…



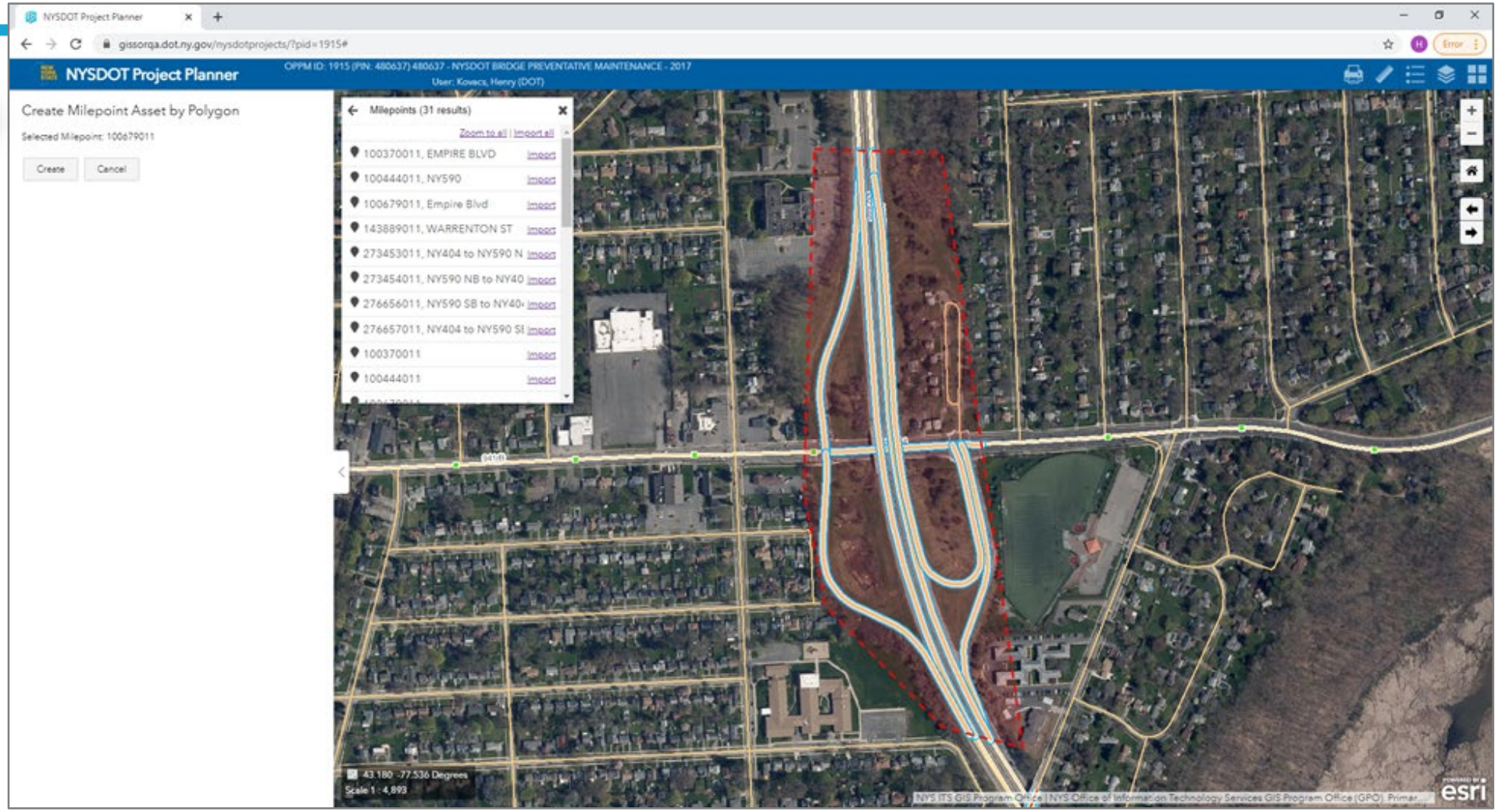
…and start the Project Planner application

NYSDOT Project Planner – adding LRS locations to a project



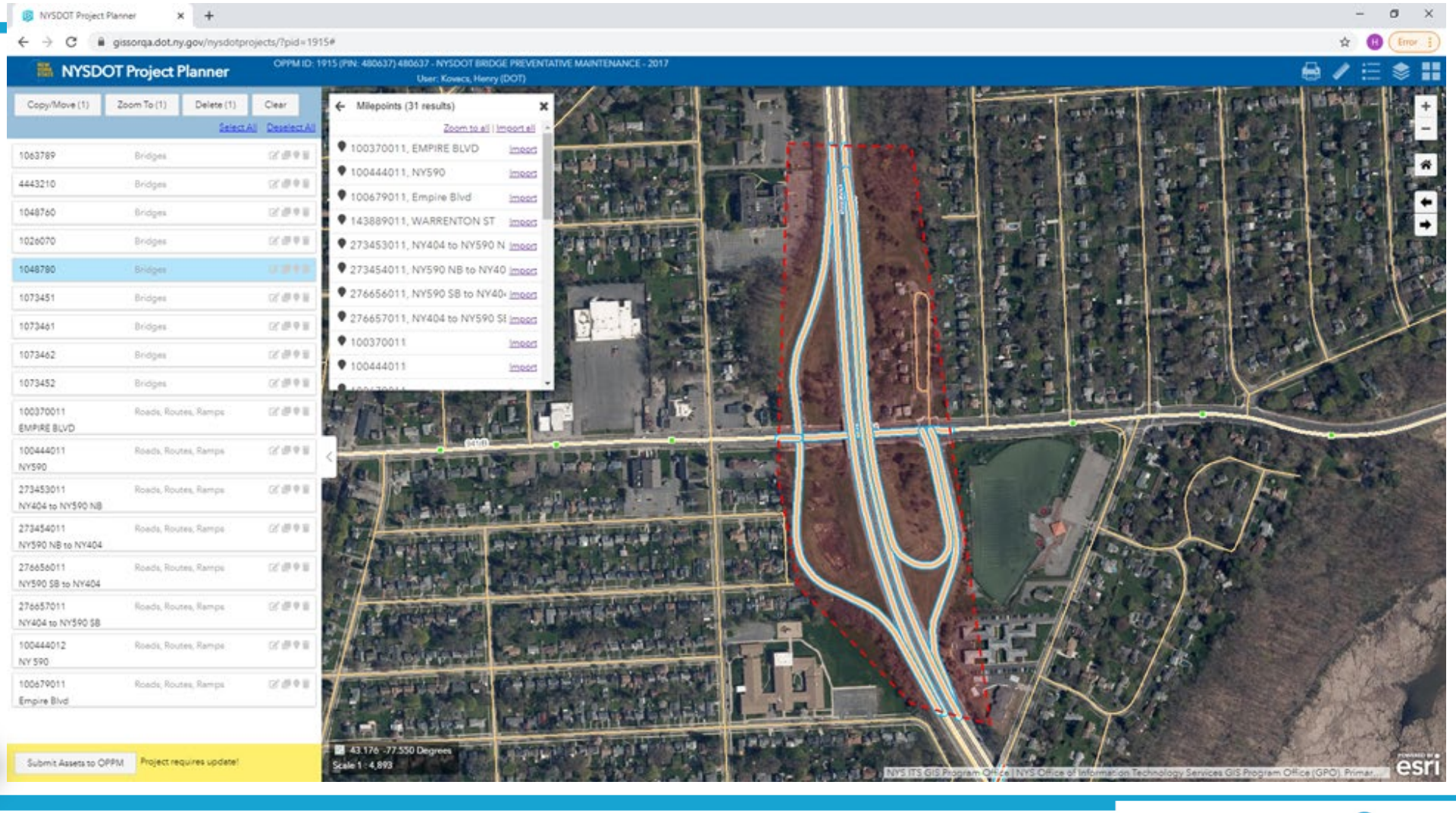
Bridges, Large Culverts and Overhead Sign Structures may be added to the project

NYSDOT Project Planner – adding LRS locations to a project



One or more roadway segments may be added to the project by defining the project area

NYSDOT Project Planner – adding LRS locations to a project

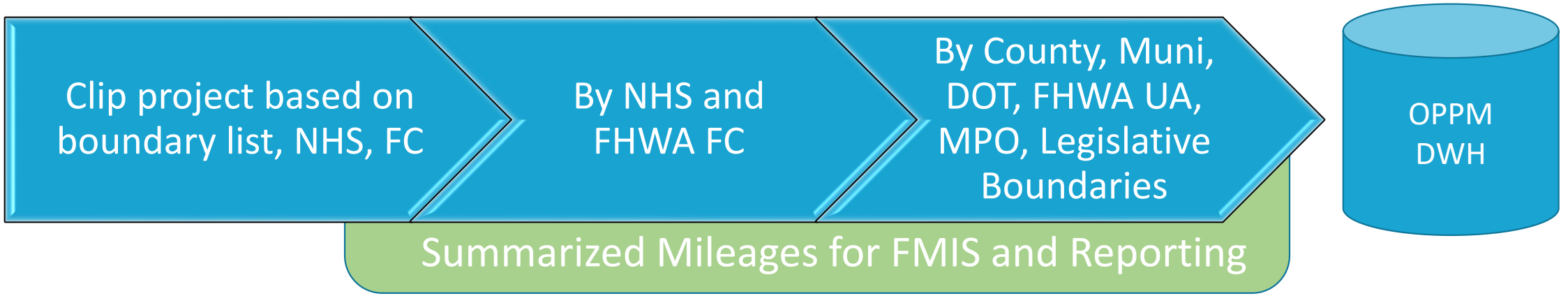


One or more roadway segments may be added to the project by defining the project area

NYSDOT Project Planner – Geo-Enrichment for Project Data

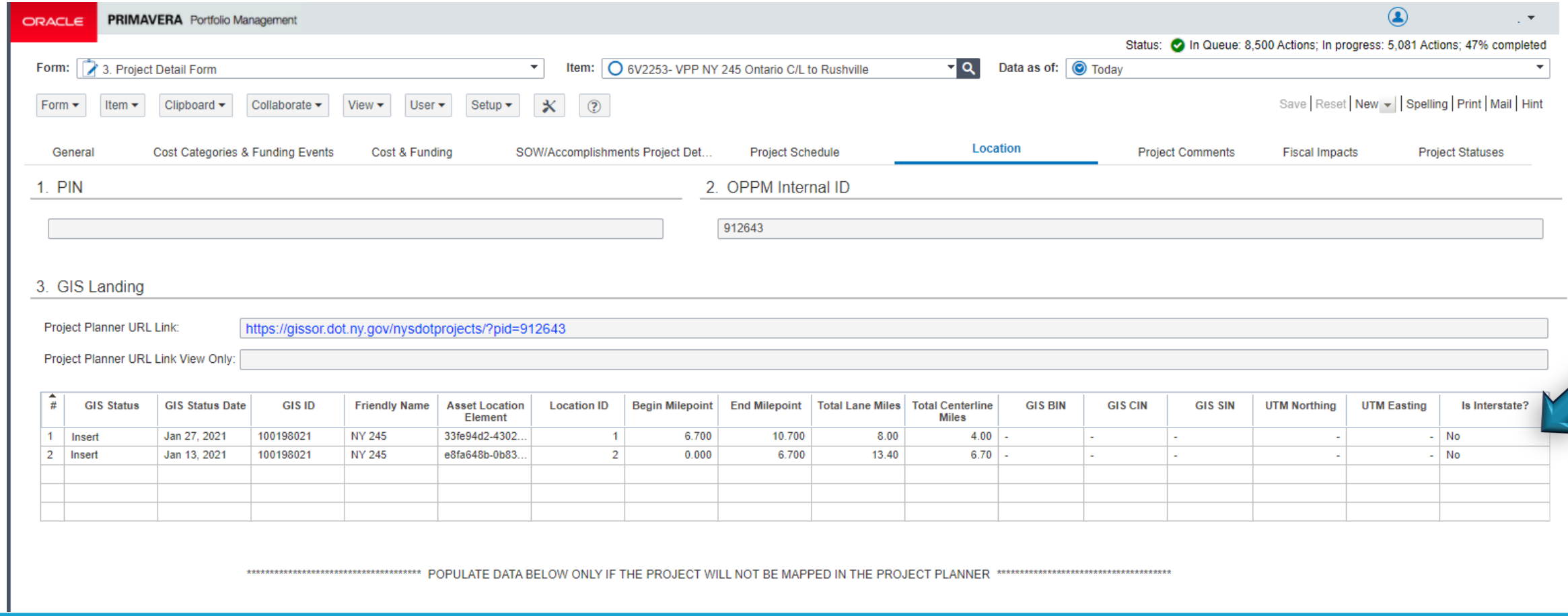
The “Submit to OPPM” button uses the identified location to generate:

Nightly Data Warehouse update:



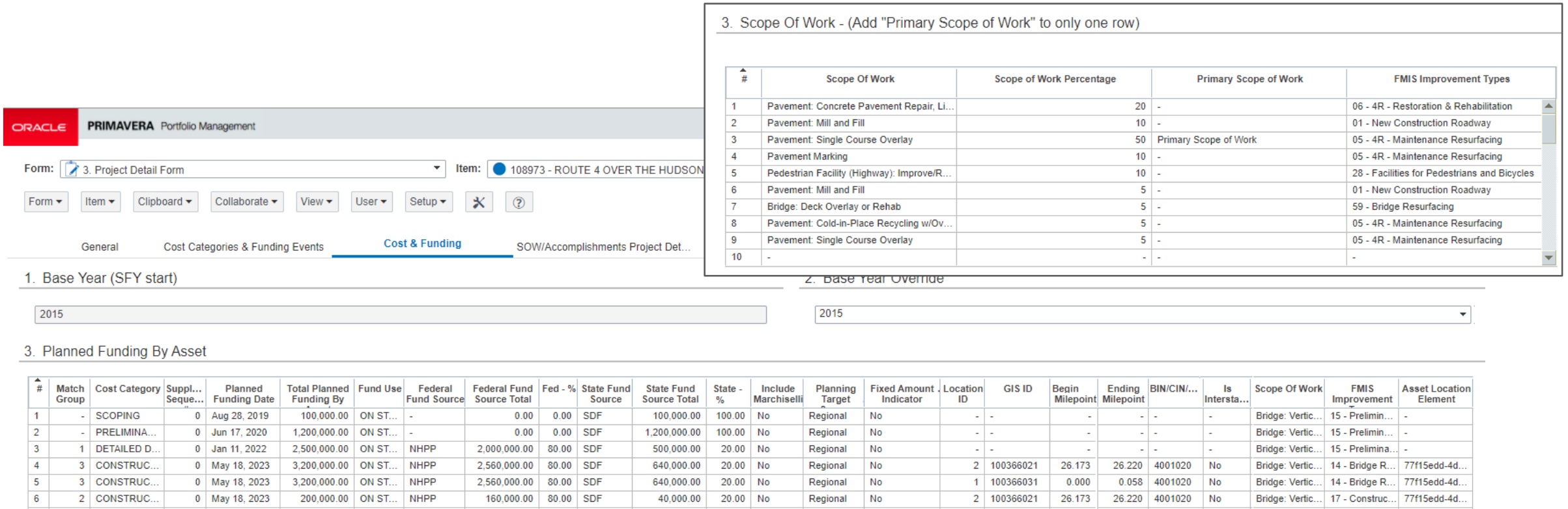
NYSDOT Project Planner feeds locations into OPPM

Program Managers initiate a new project in the OPPM interface…



NYSDOT Project Planner – Geo-Enrichment for Project Data

The “Submit to OPPM” button uses the identified location to generate:



ORACLE PRIMAVERA Portfolio Management

Form: 3. Project Detail Form Item: 108973 - ROUTE 4 OVER THE HUDSON

Form | Item | Clipboard | Collaborate | View | User | Setup

General | Cost Categories & Funding Events | Cost & Funding | SOW/Accomplishments Project Det...

3. Scope Of Work - (Add "Primary Scope of Work" to only one row)

#	Scope Of Work	Scope of Work Percentage	Primary Scope of Work	FMIS Improvement Types
1	Pavement: Concrete Pavement Repair, Li...	20	-	06 - 4R - Restoration & Rehabilitation
2	Pavement: Mill and Fill	10	-	01 - New Construction Roadway
3	Pavement: Single Course Overlay	50	Primary Scope of Work	05 - 4R - Maintenance Resurfacing
4	Pavement Marking	10	-	05 - 4R - Maintenance Resurfacing
5	Pedestrian Facility (Highway): Improve/R...	10	-	28 - Facilities for Pedestrians and Bicycles
6	Pavement: Mill and Fill	5	-	01 - New Construction Roadway
7	Bridge: Deck Overlay or Rehab	5	-	59 - Bridge Resurfacing
8	Pavement: Cold-in-Place Recycling w/Ov...	5	-	05 - 4R - Maintenance Resurfacing
9	Pavement: Single Course Overlay	5	-	05 - 4R - Maintenance Resurfacing
10	-	-	-	-

1. Base Year (SFY start)

2015

2. Base Year Override

2015

3. Planned Funding By Asset

#	Match Group	Cost Category	Suppl... Seque...	Planned Funding Date	Total Planned Funding By	Fund Use	Federal Fund Source	Federal Fund Source Total	Fed - %	State Fund Source	State Fund Source Total	State - %	Include Marchiselli	Planning Target	Fixed Amount Indicator	Location ID	GIS ID	Begin Milepoint	Ending Milepoint	BIN/CIN/...	Is Intersta...	Scope Of Work	FMIS Improvement	Asset Location Element
1	-	SCOPING	0	Aug 28, 2019	100,000.00	ON ST...	-	0.00	0.00	SDF	100,000.00	100.00	No	Regional	No	-	-	-	-	-	-	Bridge: Vertic...	15 - Prelimin...	-
2	-	PRELIMINA...	0	Jun 17, 2020	1,200,000.00	ON ST...	-	0.00	0.00	SDF	1,200,000.00	100.00	No	Regional	No	-	-	-	-	-	-	Bridge: Vertic...	15 - Prelimin...	-
3	1	DETAILED D...	0	Jan 11, 2022	2,500,000.00	ON ST...	NHPP	2,000,000.00	80.00	SDF	500,000.00	20.00	No	Regional	No	-	-	-	-	-	-	Bridge: Vertic...	15 - Prelimina...	-
4	3	CONSTRUC...	0	May 18, 2023	3,200,000.00	ON ST...	NHPP	2,560,000.00	80.00	SDF	640,000.00	20.00	No	Regional	No	2	100366021	26.173	26.220	4001020	No	Bridge: Vertic...	14 - Bridge R...	77f15edd-4d...
5	3	CONSTRUC...	0	May 18, 2023	3,200,000.00	ON ST...	NHPP	2,560,000.00	80.00	SDF	640,000.00	20.00	No	Regional	No	1	100366031	0.000	0.058	4001020	No	Bridge: Vertic...	14 - Bridge R...	77f15edd-4d...
6	2	CONSTRUC...	0	May 18, 2023	200,000.00	ON ST...	NHPP	160,000.00	80.00	SDF	40,000.00	20.00	No	Regional	No	2	100366021	26.173	26.220	4001020	No	Bridge: Vertic...	17 - Construc...	77f15edd-4d...
7	2	CONSTRUC...	0	May 18, 2023	200,000.00	ON ST...	NHPP	160,000.00	80.00	SDF	40,000.00	20.00	No	Regional	No	1	100366031	0.000	0.058	4001020	No	Bridge: Vertic...	17 - Construc...	77f15edd-4d...

Challenges working with the Enterprise Linear Referencing System

- Complexities in the ELRS (Roads and Highways) extend into systems that leverage it:
  - » Route Concurrencies
  - » Unintended retirements
  - » Temporality (see below)
- FHWA maintains Project Locations on an annual HPMS snapshot of the LRS network.
  - » We are maintaining project locations on the current Milepoint LRS network
  - » Program Management sometimes needs to adjust Milepoint location to allow a project to be accepted by FMIS

U.S. Department of Transportation
Federal Highway Administration

Enterprise Data Management

Geospatial Data Warehouse (GDW)

System of Engagement (SoE)

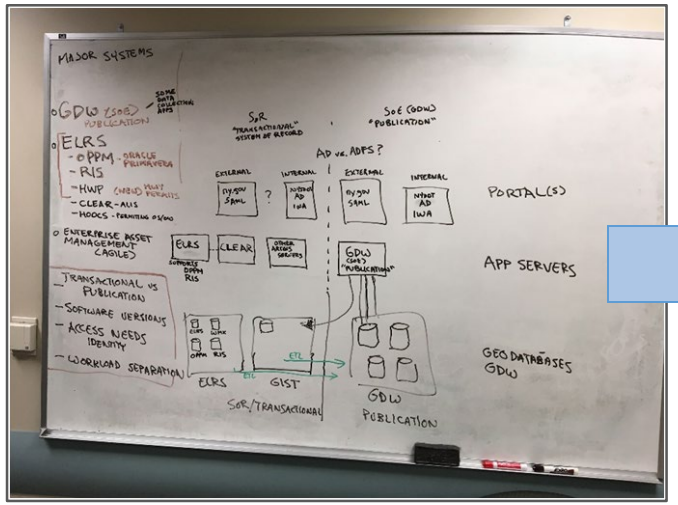
The NYSDOT System of Engagement Project

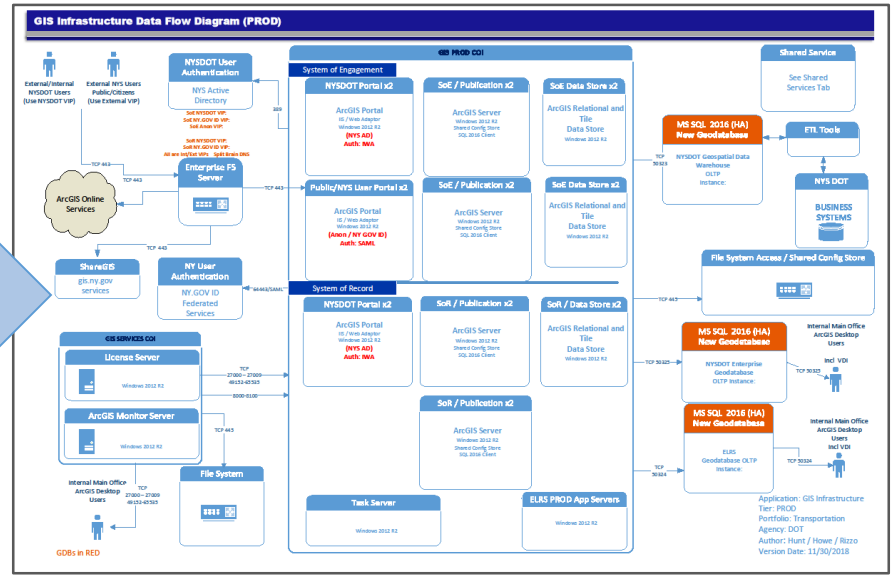
Goal: Make Commonly Requested Data Widely Available

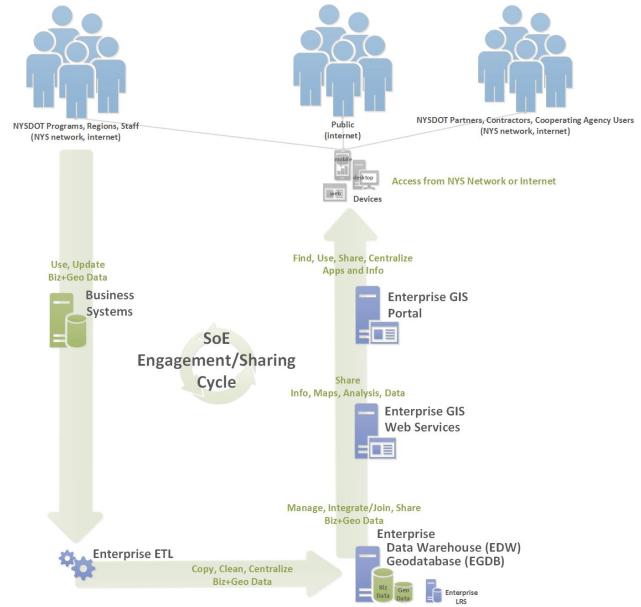
Make data from NYSDOT systems of record and other authoritative sources widely available through an ever-growing library of maps, apps, and other data service

The NYSDOT System of Engagement Project

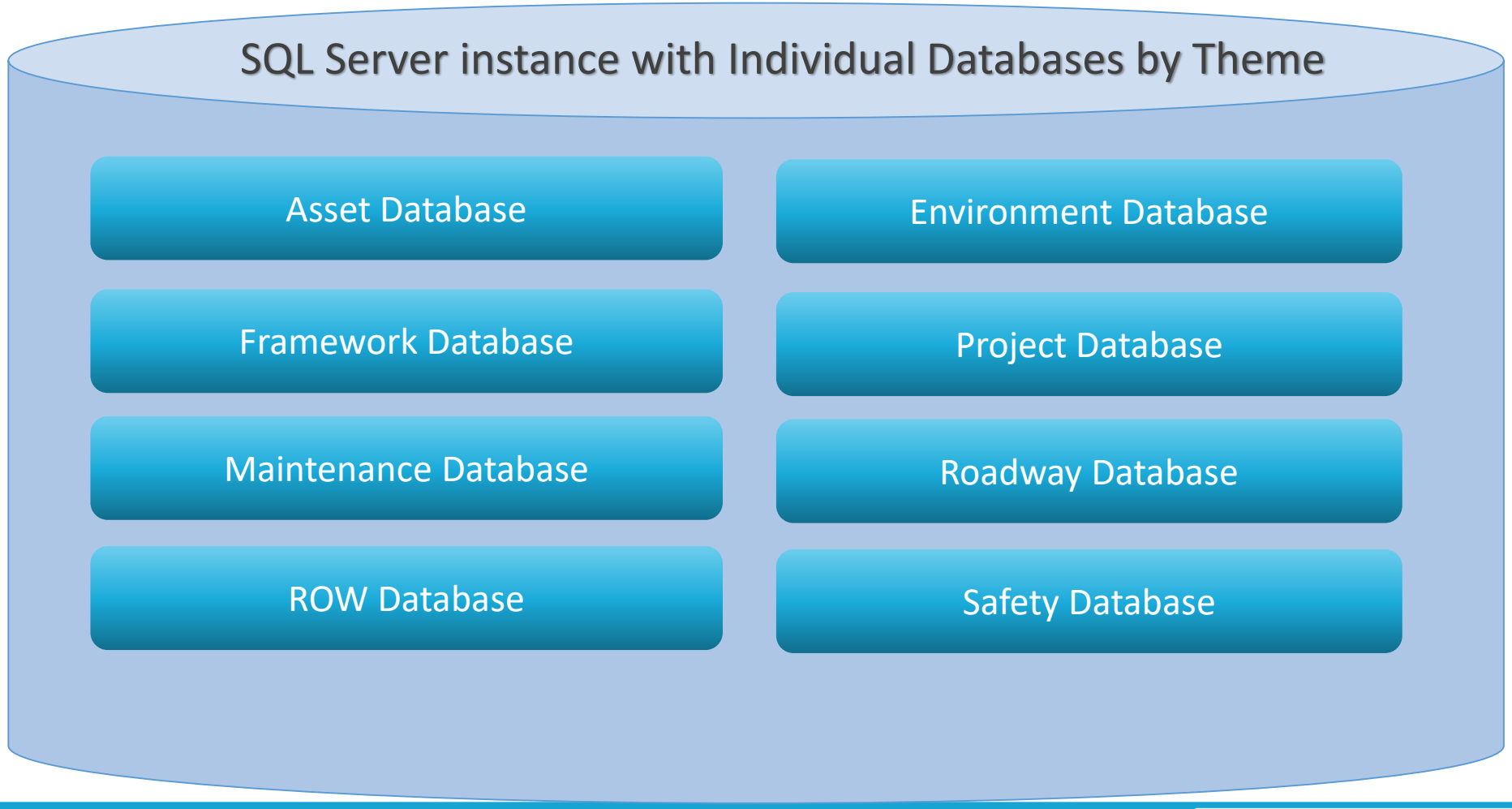
- 2018 – Redesign and build a robust NYSDOT Enterprise GIS System Environment
  - » Application Server Platform
  - » Geodatabase Servers (SQL Server 2016)
  - » **Rearchitect Data Management and ETL**



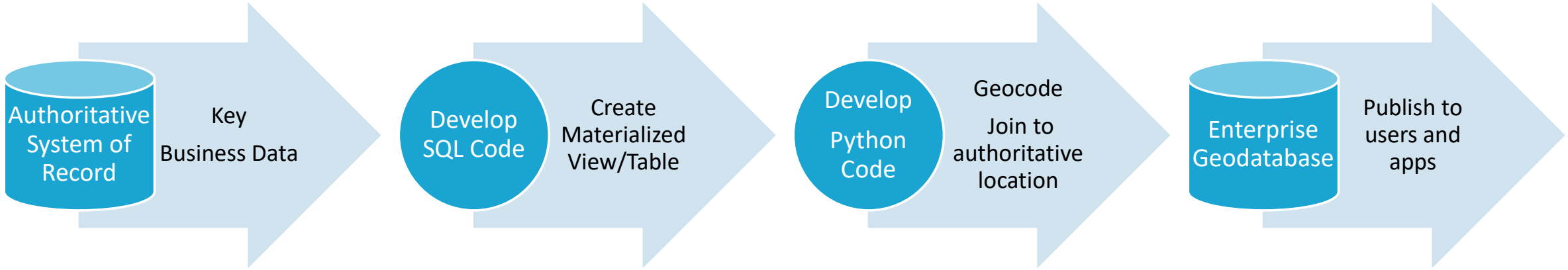




The NYSDOT Geospatial Data Warehouse (GDW)



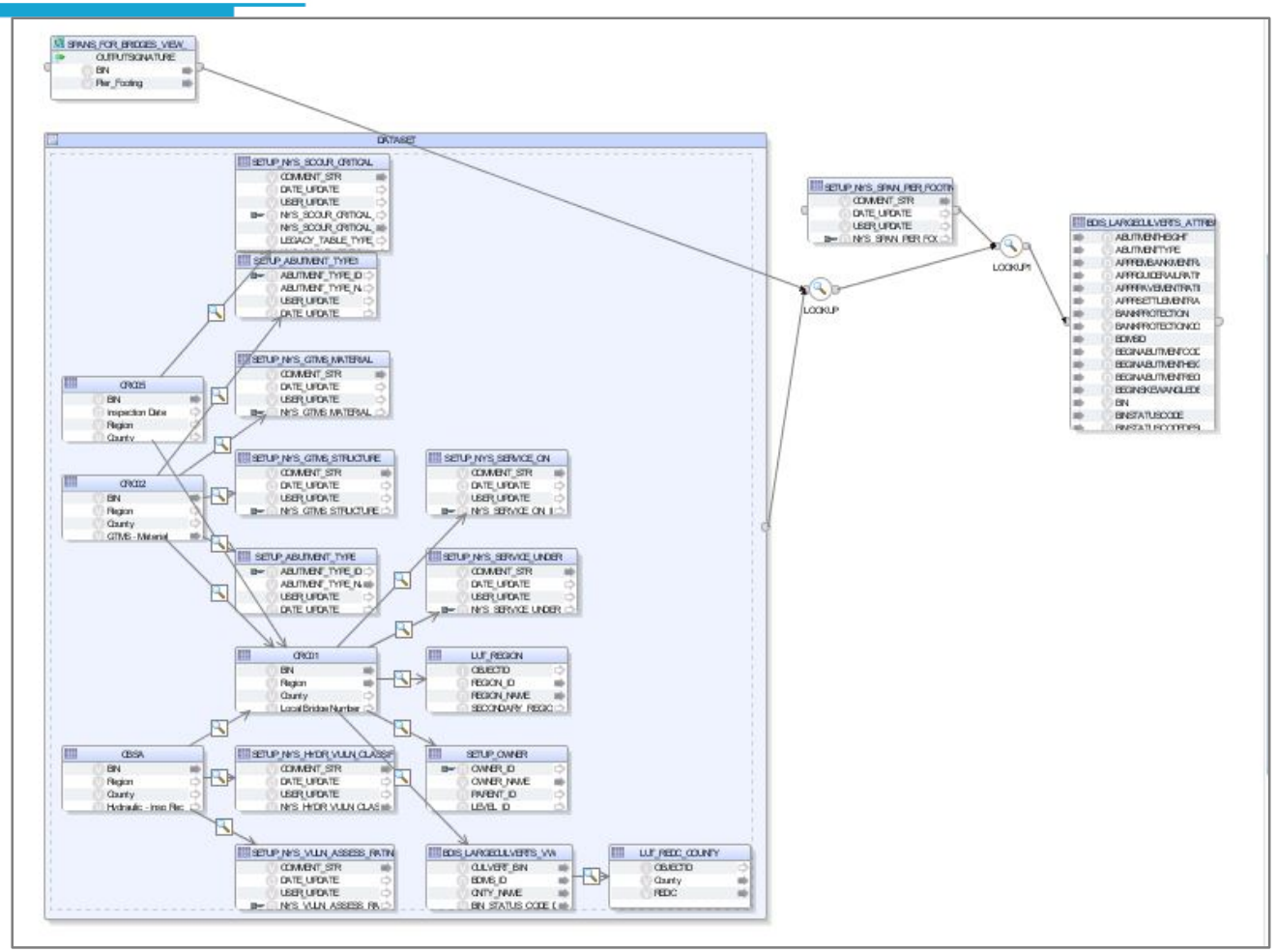
The old way to build enterprise geospatial datasets



Custom code to maintain for each NYSDOT system of record

Too inefficient and unsustainable for enterprise data management

Documented business data ETL – Oracle Data Integrator (ODI)



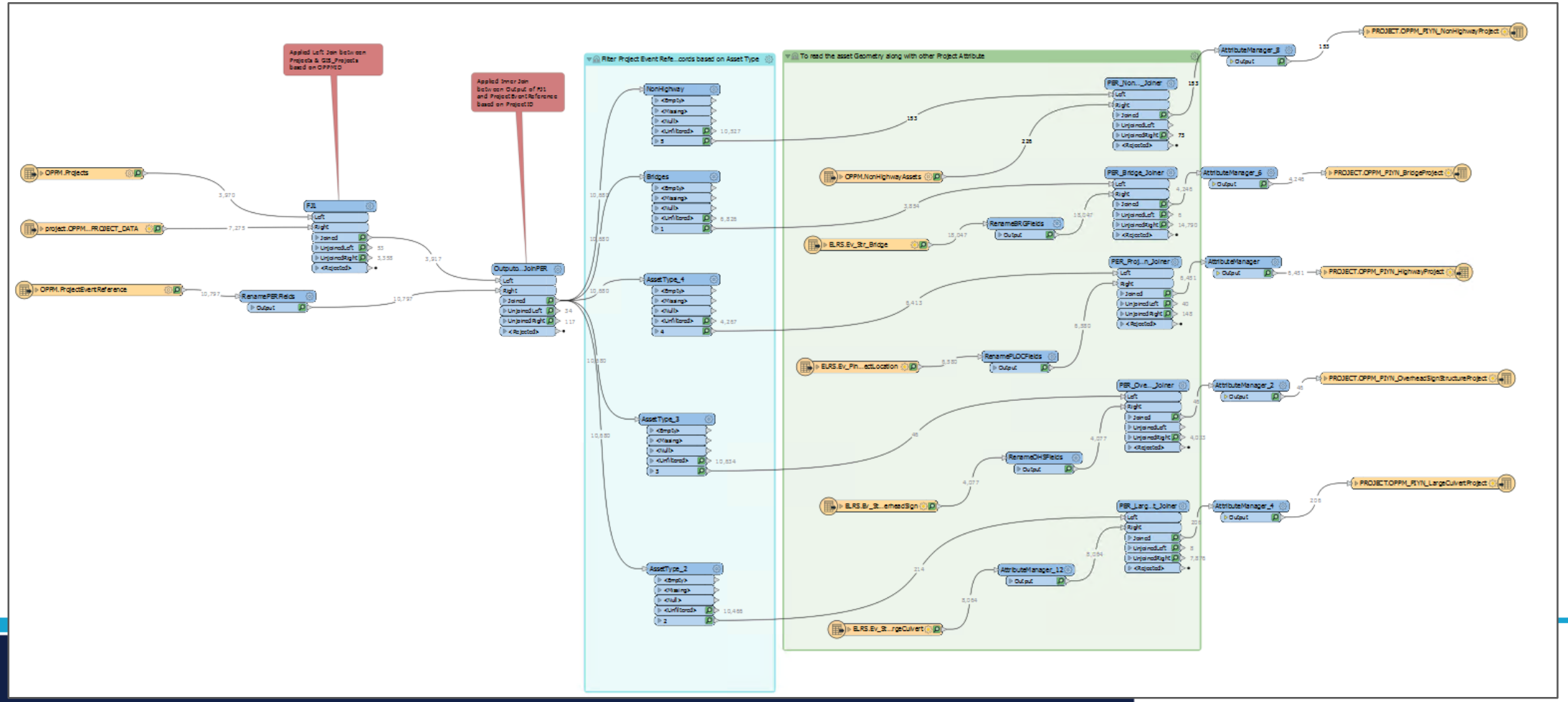
Advantages to an industry standard Extract, Transform, Load Tool:

- A visual, documented workflow
- Standardized ETL
- Efficient
- More Transferable

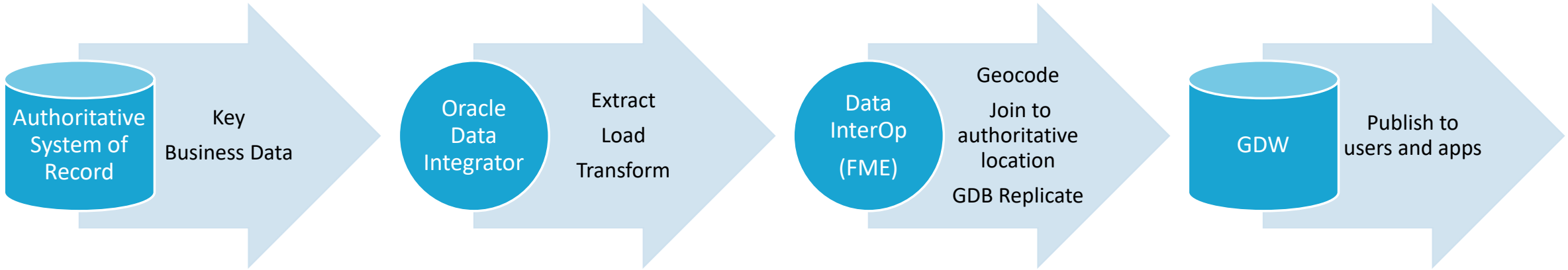
But ODI doesn't do Esri geodatabases

- Doesn't create the 'ObjectID' column (required in GDB)

Documented geospatial ETL - Esri Data Interoperability (FME)



A standard to access authoritative business data



- Visual, documented ETL processes
- Industry standard
- More easily maintained

GDW Data Standards established

- NYSDOT worked with Esri during the System of Engagement Project to establish general data standards for the Geospatial Data Warehouse

- Purpose: This document outlines the standards for NYSDOT System of Engagement Transportation Geodata Warehouse (GDW) and includes standard best practices for all databases. This document will provide a framework for creating new feature classes, tables and feature services that will feed the GDW/Open Data Portal.

  - **Field Format Standards**
  - **Standard Fields for Services**
  - **Geometry Requirements for Feature Classes**
  - **Metadata Requirements**

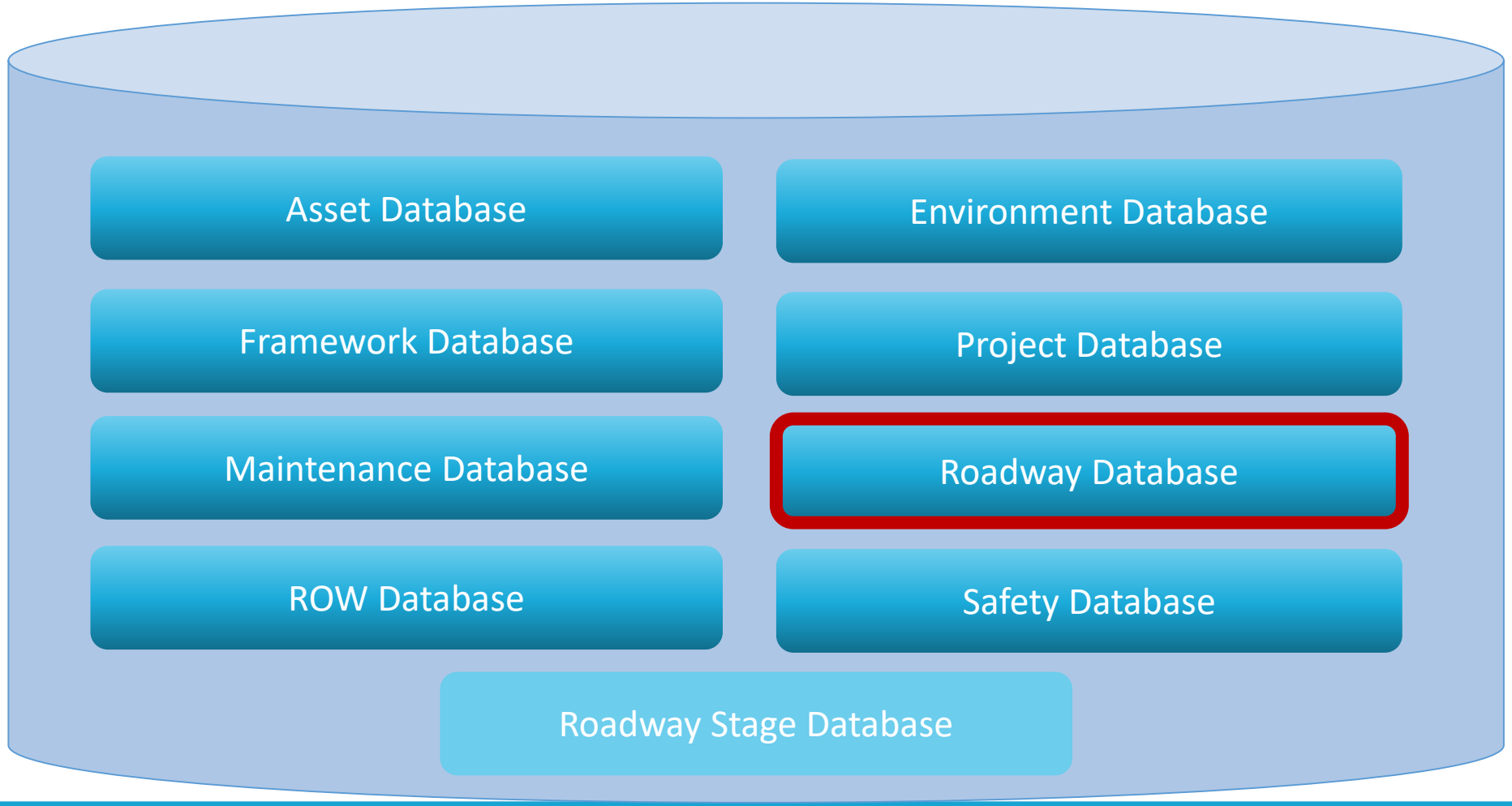
GDW Data Standards

- A guide for new datasets in the GDW and a measure for existing datasets
- Plenty of feature classes in the GDW do not yet meet the GDW Data Standards
- Sharing standards with NYS GIS and ITS peers for consideration in new layers and IT systems.

APPENDIX A: SCHEMA STANDARDS FOR GENERIC FIELDS

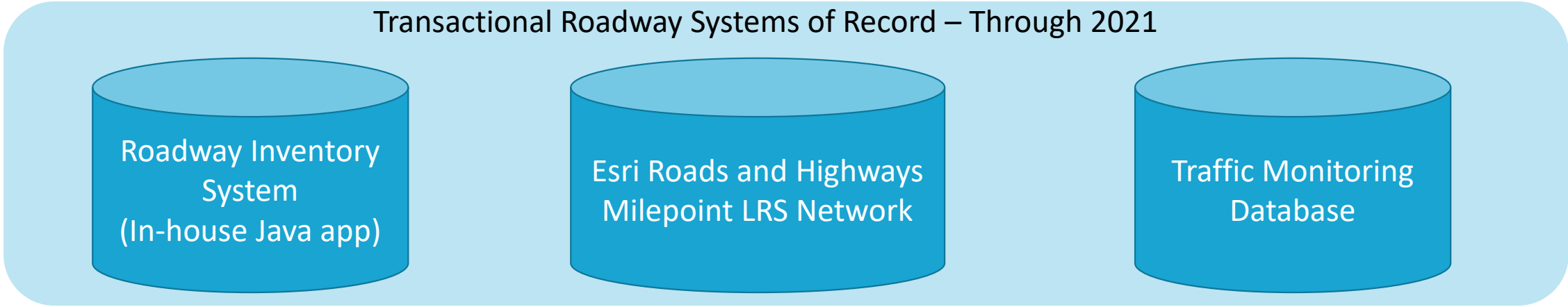
FIELD NAME	FIELD ALIAS	FIELD TYPE	LENGTH	EXAMPLE	NOTES
Address1	Address Line (1)	Text	100		If dataset doesn't need 2 address lines, then just call it 'Address'
Address2	Address Line (2)	Text	100		
AddressCity	Address City	Text	60		
AddressCountry	Address Country	Text	6	Canada or USA only	Only include if Canada-based fields exist in SoR data.
AddressState	Address State	Text	2		
AddressZipCode	Address Zip Code	Text	10	01234-5678	
AreaAcre	Area (Acres – UTM83-18N)	Double			For polygon geometry only.
AreaSquareMeter	Area (Square Meters – UTM83-18N)	Double			For polygon geometry only.
AreaSquareMile	Area (Square Miles-UTM83-18N)	Double			For polygon geometry only.
BeginLatitude	Latitude Start (DD – WGS84)	Double			Generally, for use in business data tables only. Decimal degrees. Where necessary, could be generated/updated nightly during ETL.
BeginLongitude	Longitude Start (DD-WGS84)	Double			Generally, for use in business data tables only. Decimal degrees. Where necessary, could be generated/updated nightly during ETL Decimal degrees.
BIN	BIN	Text	7		Bridge Identifier Number = NBI Field #8

The Roadway Data Mart (RDM)



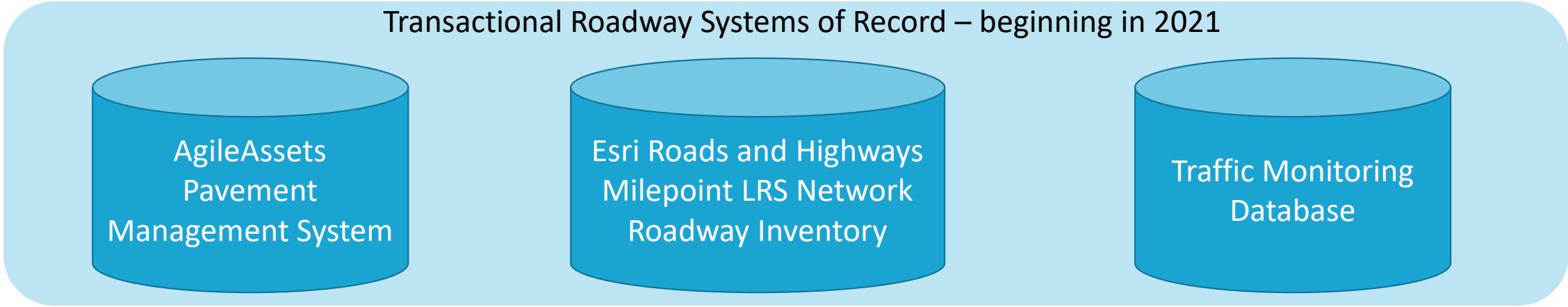
Roadway Data Mart – Current Roadway Systems

- Historically NYSDOT managed pavement and roadway inventory in the same in-house system – NYSDOT Roadway Inventory System (2010)
- Now transitioning to Pavement Management in Agile Assets and Roadway Inventory Maintenance in Esri Roads and Highways

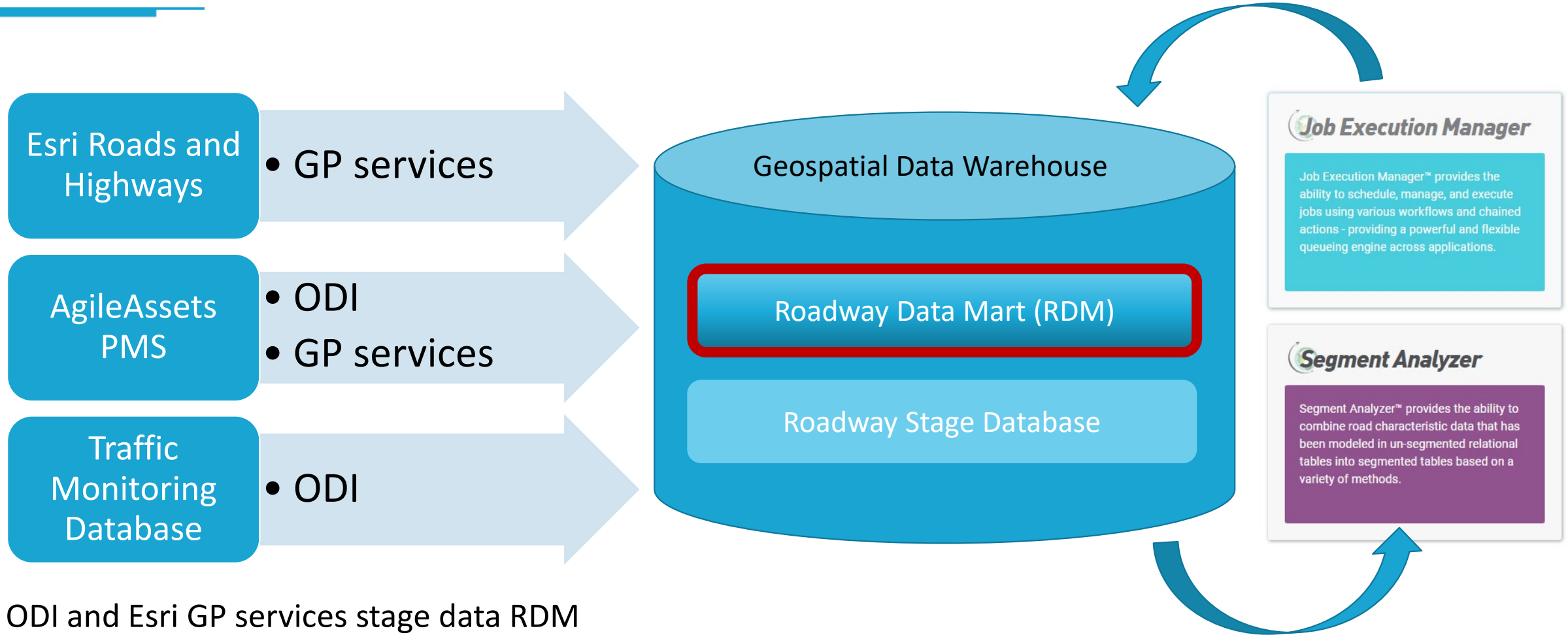


Roadway Data Mart – Geospatial data management with new capabilities

- NYSDOT would need to update the existing Roadway Inventory System warehouse to meet new data warehousing needs.
- Designed to publish roadway data from two separate LRS environments
- Simultaneously support traditional reporting, business intelligence and GIS services.



Roadway Data Mart – The refresh process



ODI and Esri GP services stage data RDM

Orchestrated dynamic segmentation creates tables and GIS layers

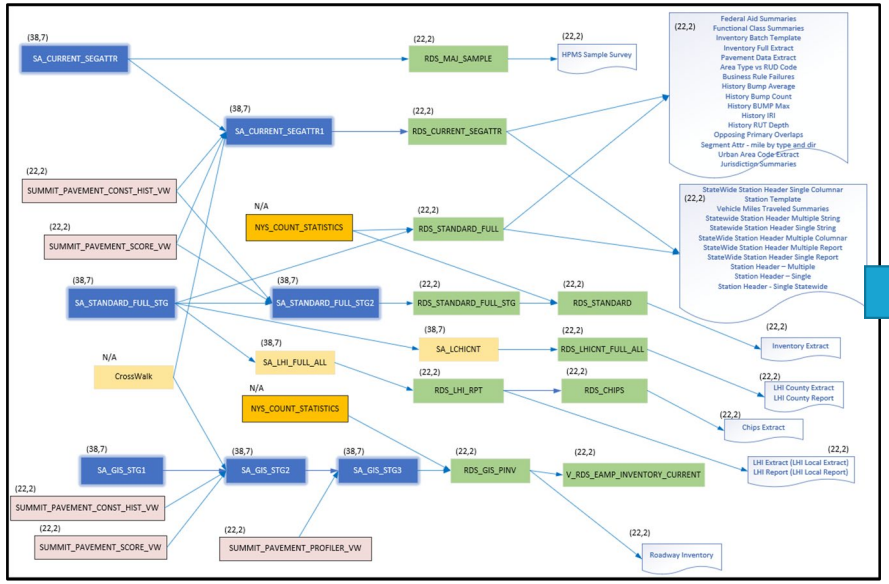
Roadway Data Mart –
One authoritative source for reporting and geospatial

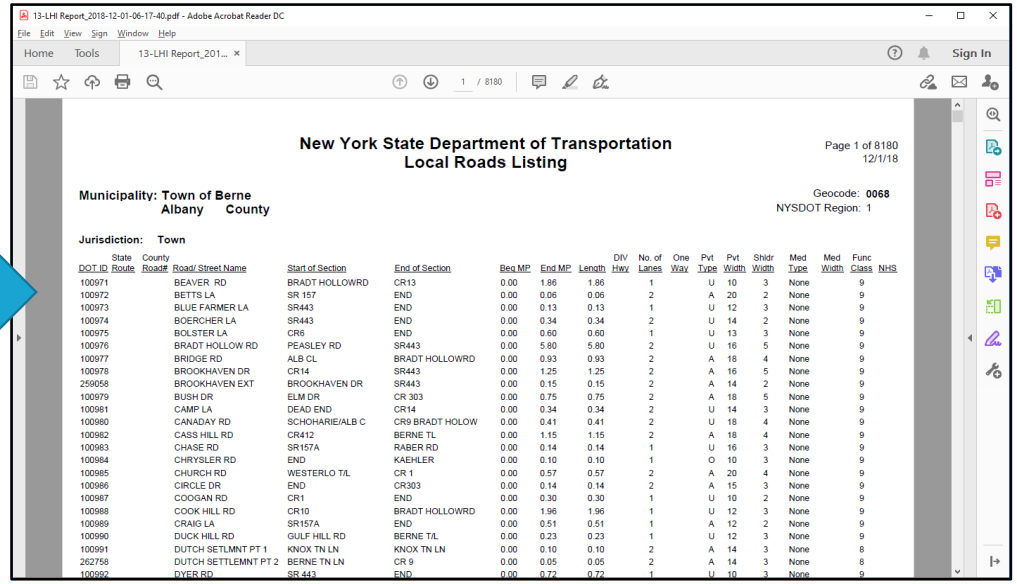
Reporting and BI

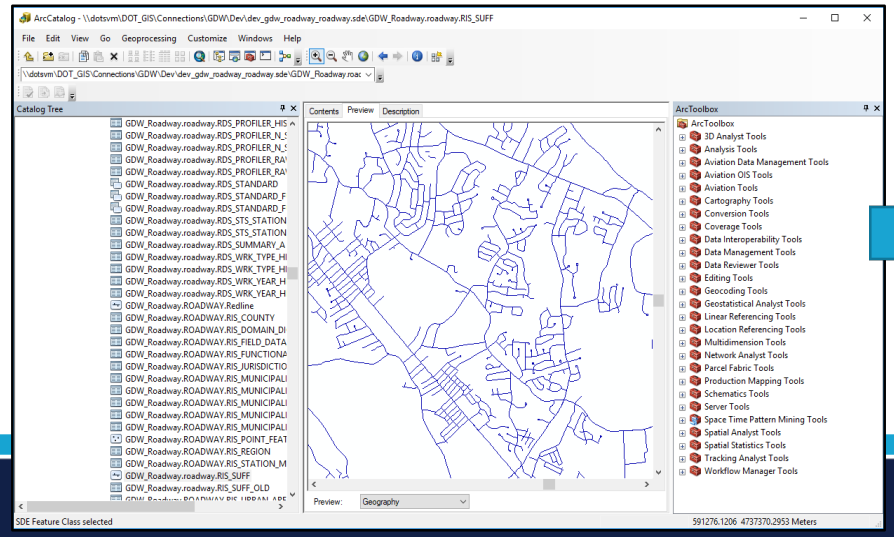
GDW

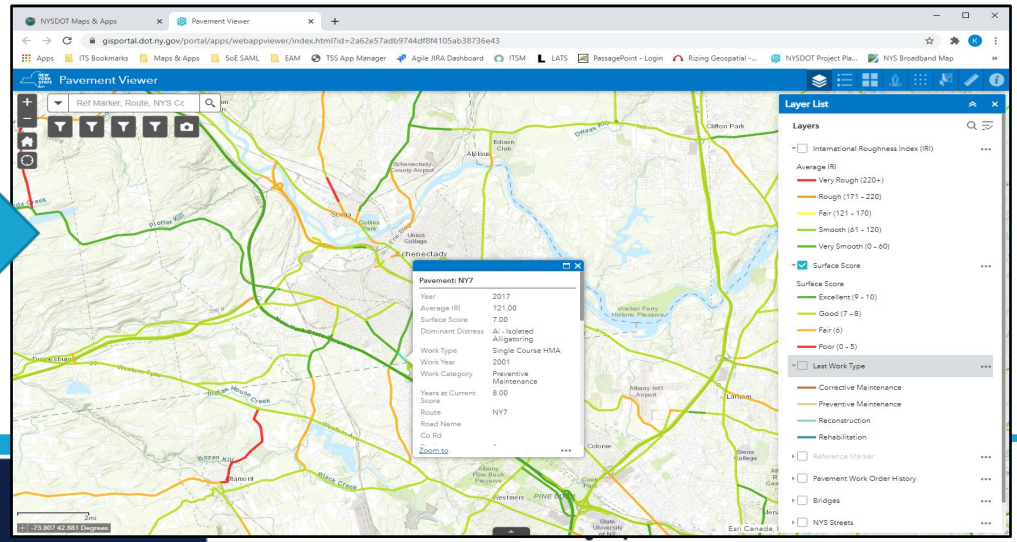
RDM

Desktop and Web GIS

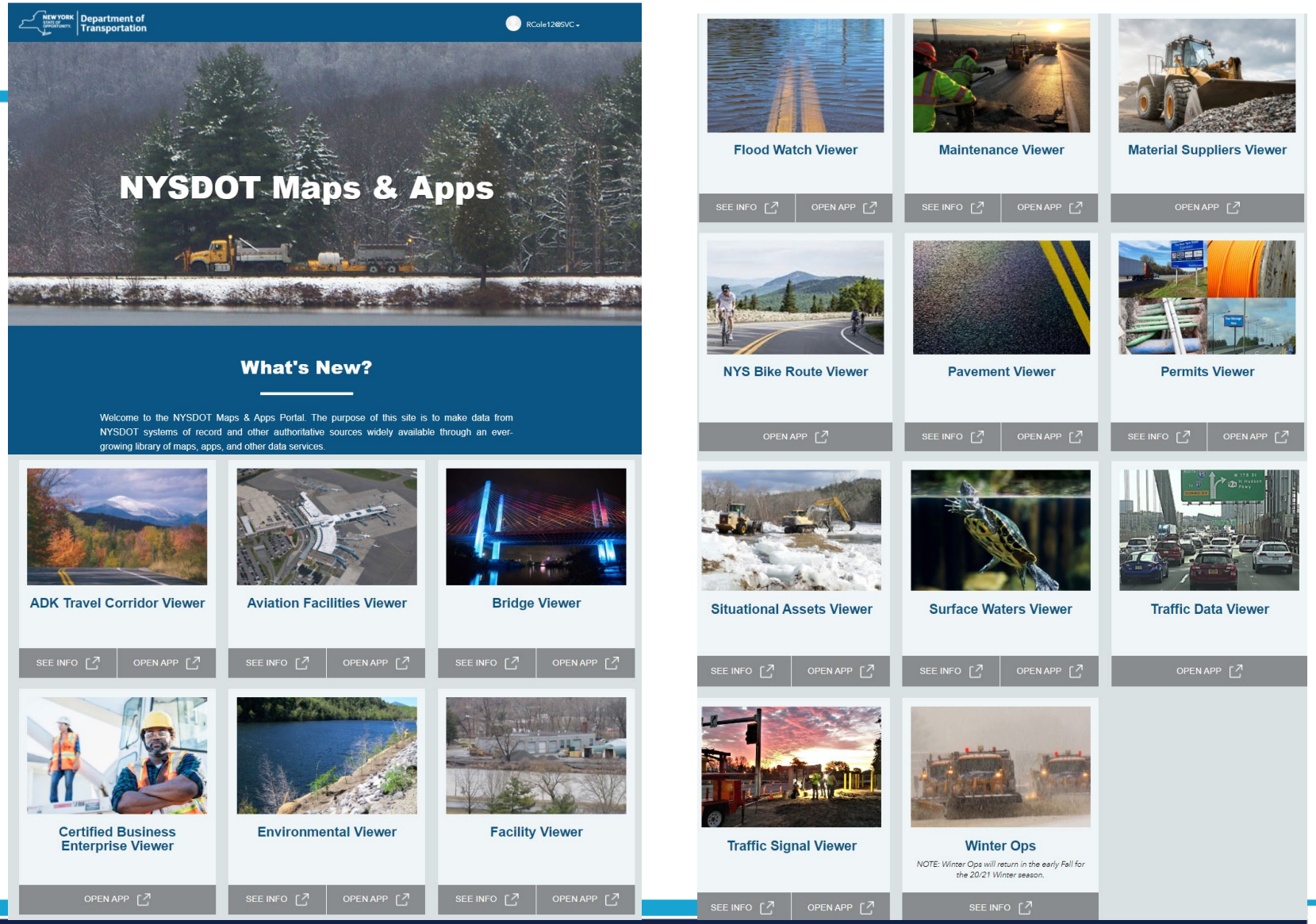






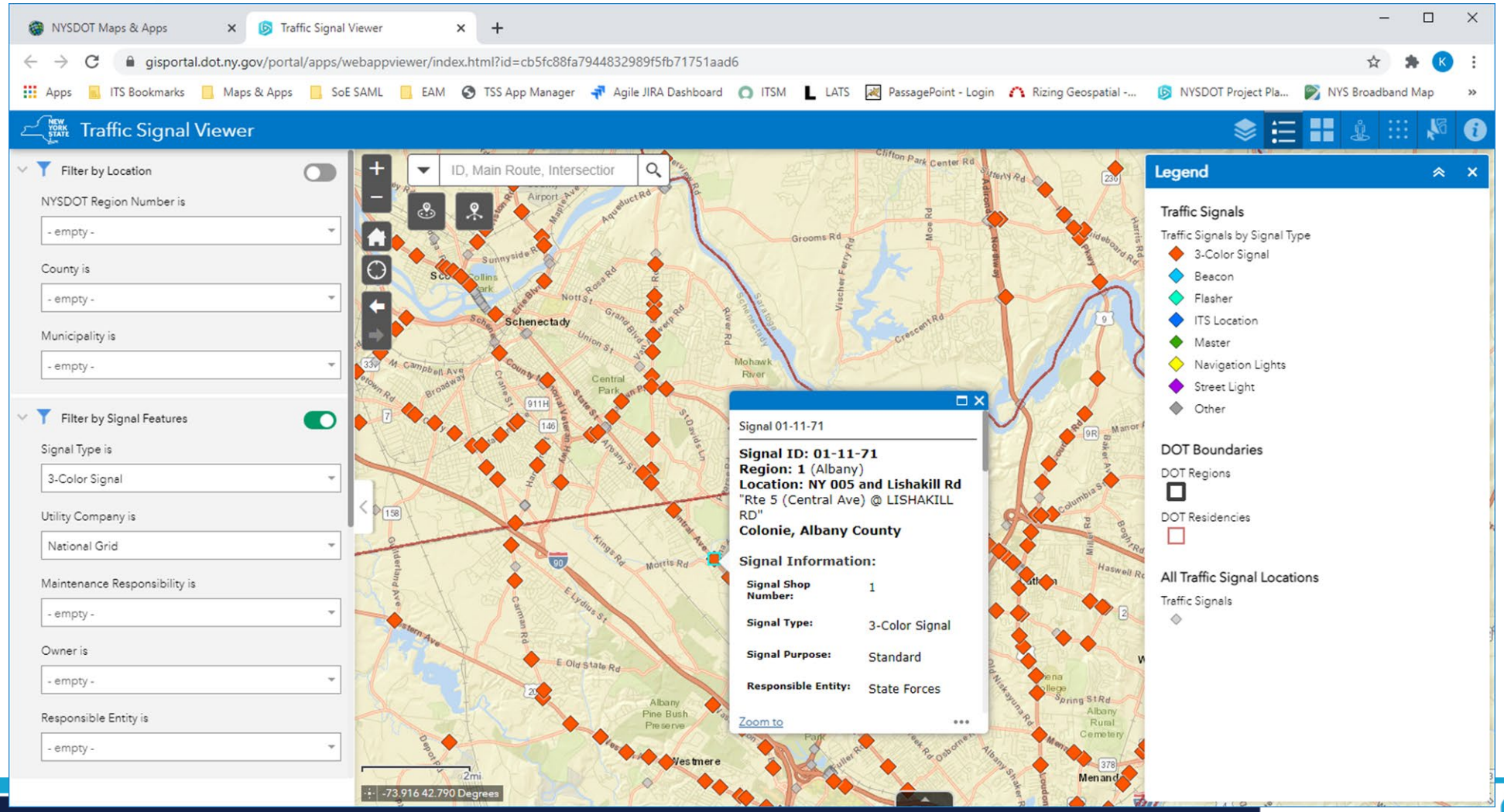


NYSDOT Maps and Apps

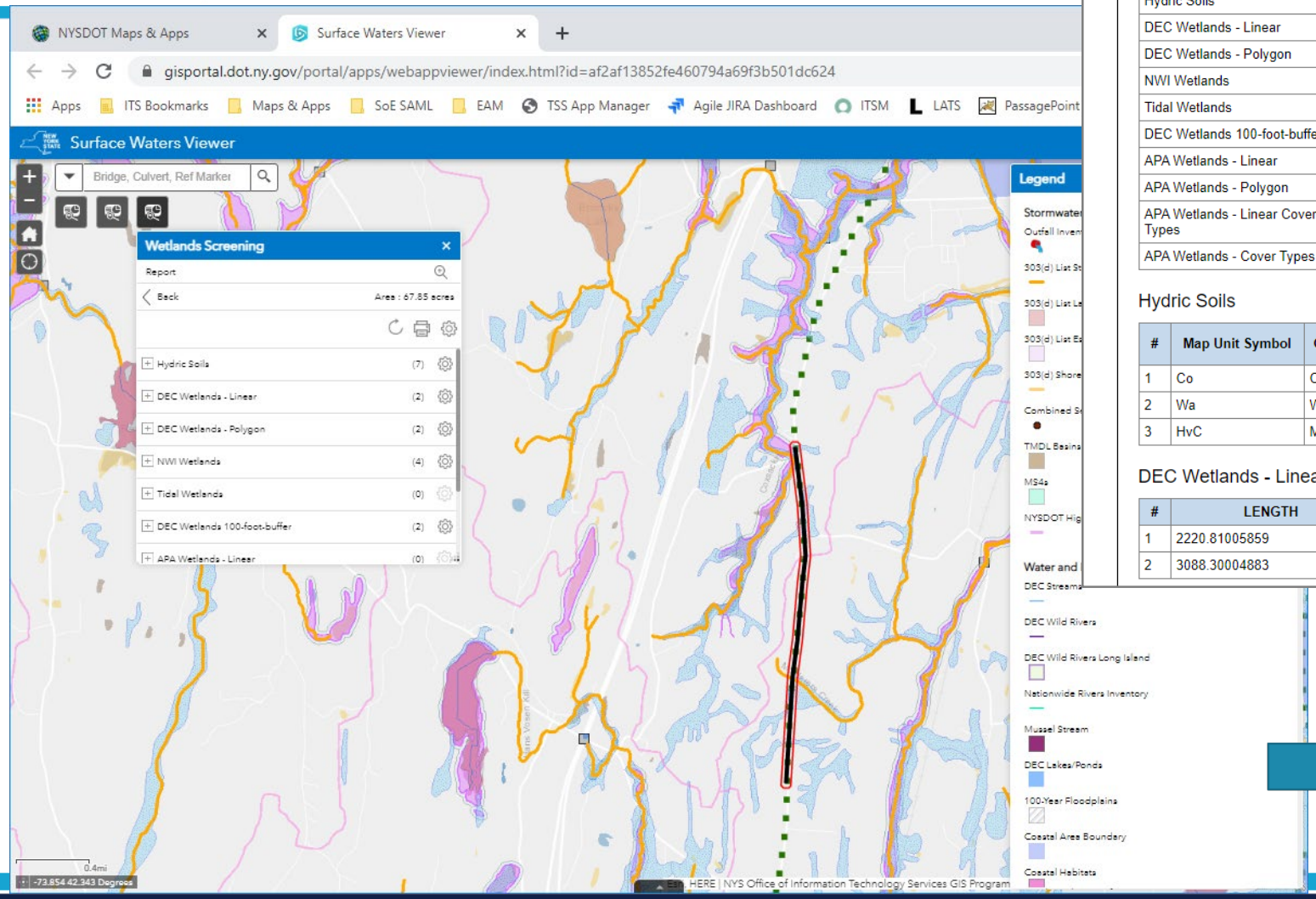


- A combination of agency and public facing applications that provide easily consumed authoritative information.

Traffic Signal Viewer – simple access to authoritative data



Surface Waters Viewer – with Preliminary Screening



Summary

Name	Count	Area(acres)	Length(mi)
Hydric Soils	7	11.93	N/A
DEC Wetlands - Linear	2	N/A	0.10
DEC Wetlands - Polygon	2	0.41	N/A
NWI Wetlands	4	1.13	N/A
Tidal Wetlands	0	0	N/A
DEC Wetlands 100-foot-buffer	2	2.00	N/A
APA Wetlands - Linear	0	N/A	0
APA Wetlands - Polygon	0	0	N/A
APA Wetlands - Linear Cover Types	0	N/A	0
APA Wetlands - Cover Types	0	0	N/A

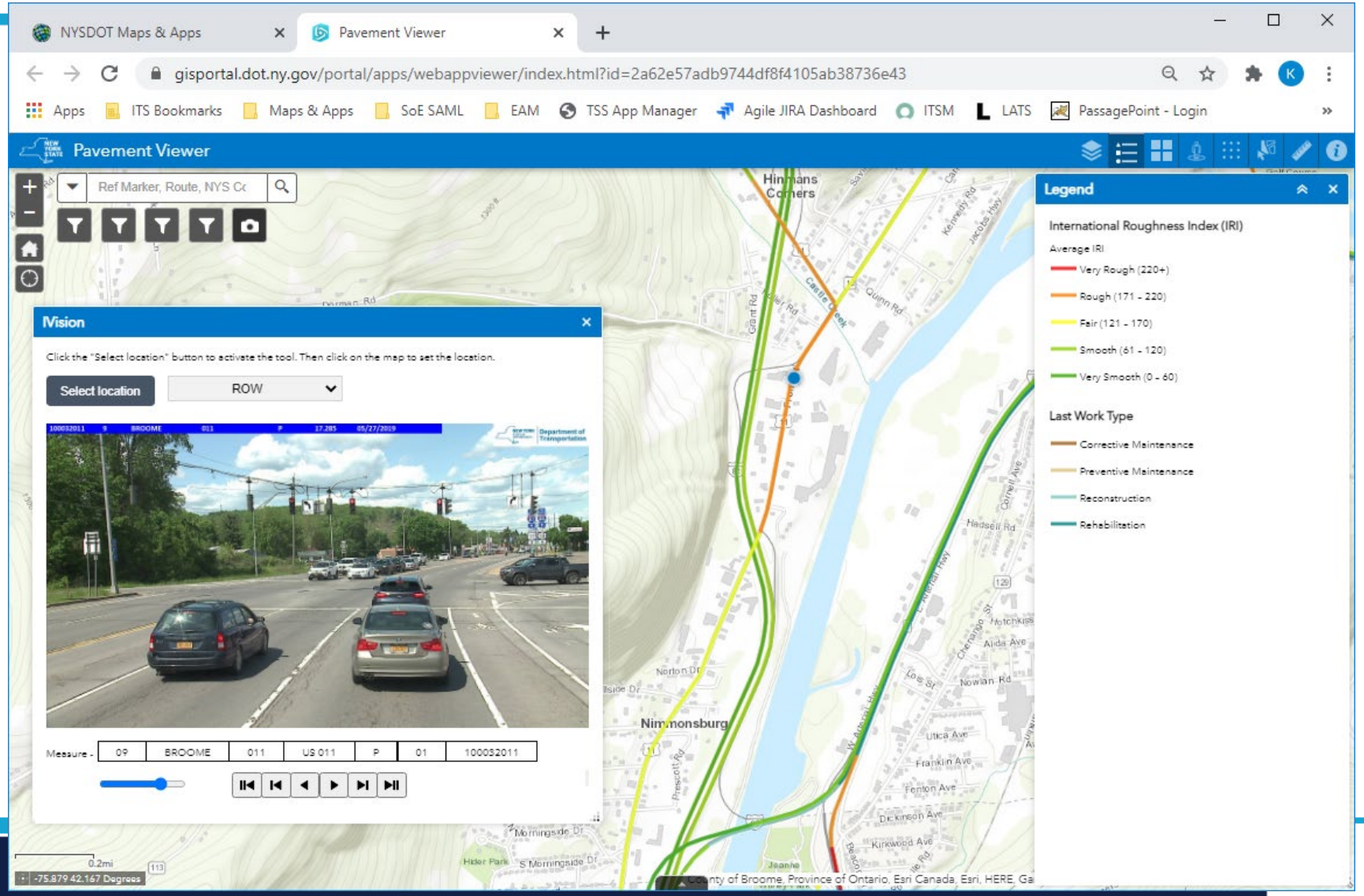
Hydric Soils

#	Map Unit Symbol	Component Name	Hydric Rating	Drainage Class	Hydrologic Soil Group	Area(acres)
1	Co	Covington	Yes	Poorly drained	D	10.48
2	Wa	Wayland	Yes	Poorly drained	B/D	0.79
3	HvC	Madalin	Yes	*No Data*	*No Data*	0.66

DEC Wetlands - Linear

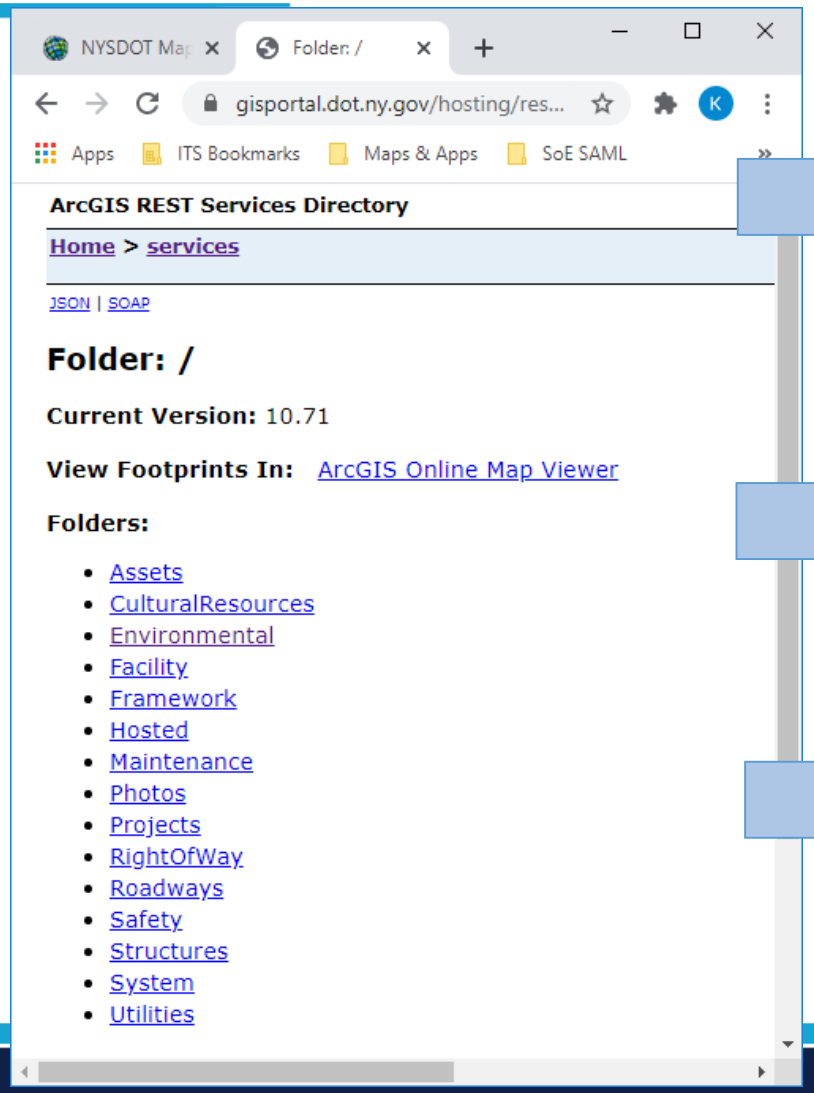
#	LENGTH	Wetland ID	Class	Length(mi)
1	2220.81005859	HN-105	1	0.05
2	3088.30004883	HN-105	1	0.05

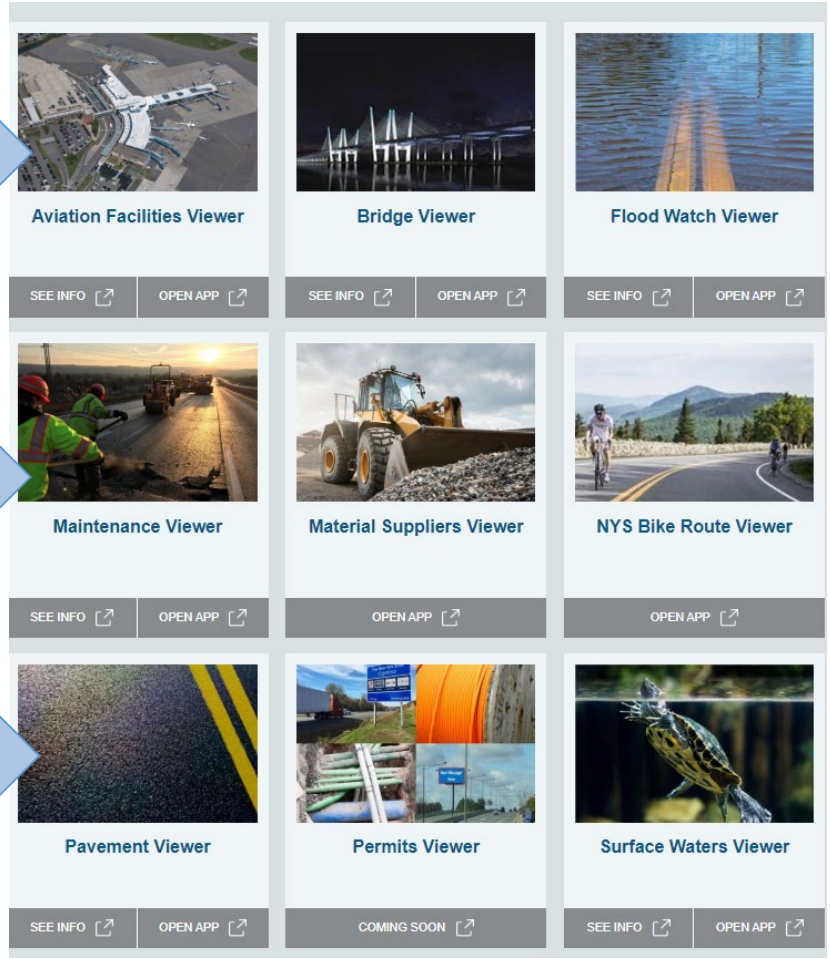
Pavement Viewer



- IRI
- Pavement Score
- Work Orders
- Projects
- NYSDOT Photolog

Reusable authoritative data services





Published from the GDW

…and reused across applications.

App Data Details document source and update frequency

Data Details - Winter Ops

Data Summary

The table below is a summary of the data in the Winter Ops application

Layer	Source	Update Frequency (Last Update)
Snow Plows	Verizon, LiGO, Web Tech & Samsara AVL	Real Time
Help Trucks - Networkfleet	Verizon Networkfleet AVL	Real Time
511NY - Accidents/Incidents	511 NY	Real Time
511NY - Cameras	511 NY	Real Time
511NY - Closures	511 NY	Real Time
Winter Travel Advisory	511 NY	Real Time
NOAA nowCoast Radar	NOAA	Real Time
NDFD Snow Fall Prediction	National Weather Service	Hourly
NWS Forecast	National Weather Service	Real Time
NYS_Mesonet	NYS Mesonet	Real Time
NYS Boundaries	NYS GIS Program Office	As Needed
DOT Boundaries	ITS Transportation GIS Group	As Needed
REDC	ITS Transportation GIS Group	As Needed
Snow Plow Beats	NYSDOT Transportation Maintenance	As Needed
Salt Stockpile - Capacity Available	NYSDOT Transportation Maintenance	Nightly
World Traffic Service	Esri, HERE	Real Time

Data Details – Flood Watch Viewer

Data Summary

The table below is a summary of the data in the Flood Watch Viewer

Layer	Source	Update Frequency (Last Update)
Bridges	• NYSDOT Bridge Data Information System • Structures Inventory Group Bridge Feature Class	Nightly
Flood Watch and Debris Prone Bridges	• NYSDOT Bridge Data Information System • Structures Inventory Group Bridge Feature Class	Nightly
Large Culverts	• NYSDOT Bridge Data Information System • Structures Inventory Large Culvert Feature Class	Nightly
Debris Prone Large Culverts	• NYSDOT Bridge Data Information System • Structures Inventory Large Culvert Feature Class	Nightly
DOT Regions	ITS Transportation GIS Group	As Needed
DOT Residencies	ITS Transportation GIS Group	As Needed
Metropolitan Planning Organizations	ITS Transportation GIS Group	As Needed
NOAA Radar Imagery	NOAA	Real Time
NWS River Gauges	National Weather Service	Real Time
NWS Watches and Warnings	National Weather Service	Real Time
NYS Civil Boundaries	NYS GIS Program Office	As Needed (2018)
NYS Streets	NYS GIS Program Office	Weekly
REDC	ITS Transportation GIS Group	As Needed
Reference Markers	Enterprise Linear Referencing System	Nightly
River Forecast Center – Hourly Quantitative Precipitation Estimates	National Weather Service River Forecast Center	Hourly
USGS – WaterWatch Hourly Stream Flow	USGS	Hourly
Waterways and Watersheds	Esri World Hydro Reference Overlay	As Available (2018)

Service and Source documentation maintenance

Service Name: Traffic Signals

Rest Endpoint: https://...dot.ny.gov/hosting/rest/services/Assets/Traffic_Signals/MapServer
Manager: https://....dot.ny.gov/hosting/manager/#f=Assets
Apps: Traffic Signal Viewer
Supporting Pro Project: \\...\ProProjects_Internal_SOE\Assets\TrafficSignals.aprx
Layers:
ETL Type: ODI + Data Interop
Source System: Cartegraph
Source Table Name(s): See ODI job
ODI Job name: CG_TRAFFICSIGNAL
ODI Job Scheduled Time: 4:00am
ODI Output Table Name(s): GDW_Asset.CG_TRAFFICSIGNAL
Brief overview/description of ODI Job: Combines multiple attributes from Cartegraph tables into a single CG_TRAFFICSIGNAL table.
FME/Python Job Name and File Location:
•D:\Jobs\GDW_Asset\TrafficSignals\TrafficSignal_Cartegraph_GDW.fmw
FME/Python Input(s):
•GDW_Asset.CG_TRAFFICSIGNAL
FME/Python Output(s):
•GDW_Asset.TrafficSignal
Scheduled Task Name: Traffic_Signals
Scheduled Task Time: 4:30am
Brief Overview/Description of FME/Python: This workbench pulls the output of Traffic Signal data from CarteGraph created by ODI. It performs some cleanup and standardization of attribute names and data. Builds point geometry based on valid UTM X/Y pairs and writes them out to a feature class. Additional notes are annotated within the workbench.

Map Service Layer	GDW Geodatabase Object (Feature Class/Table)
Traffic Signals (0)	GDW_Asset.TrafficSignal

Lessons

- A System of Engagement can be an effective vehicle toward better and more sustainable data management and governance processes.
  - » A few useful app examples allow stakeholders to recognize value of sound data management practices
- Go in with eyes wide open. Developing and maintaining a System of Engagement is a major commitment for decision makers, subject matter experts, users, GIS and IT resources.
- Be flexible and transparent. There will be times when the desired data management practice falls victim to reality…data quality problems, schedule conflicts, resource issues.
  - » There will be an opportunity to revisit it.

U.S. Department of Transportation
Federal Highway Administration

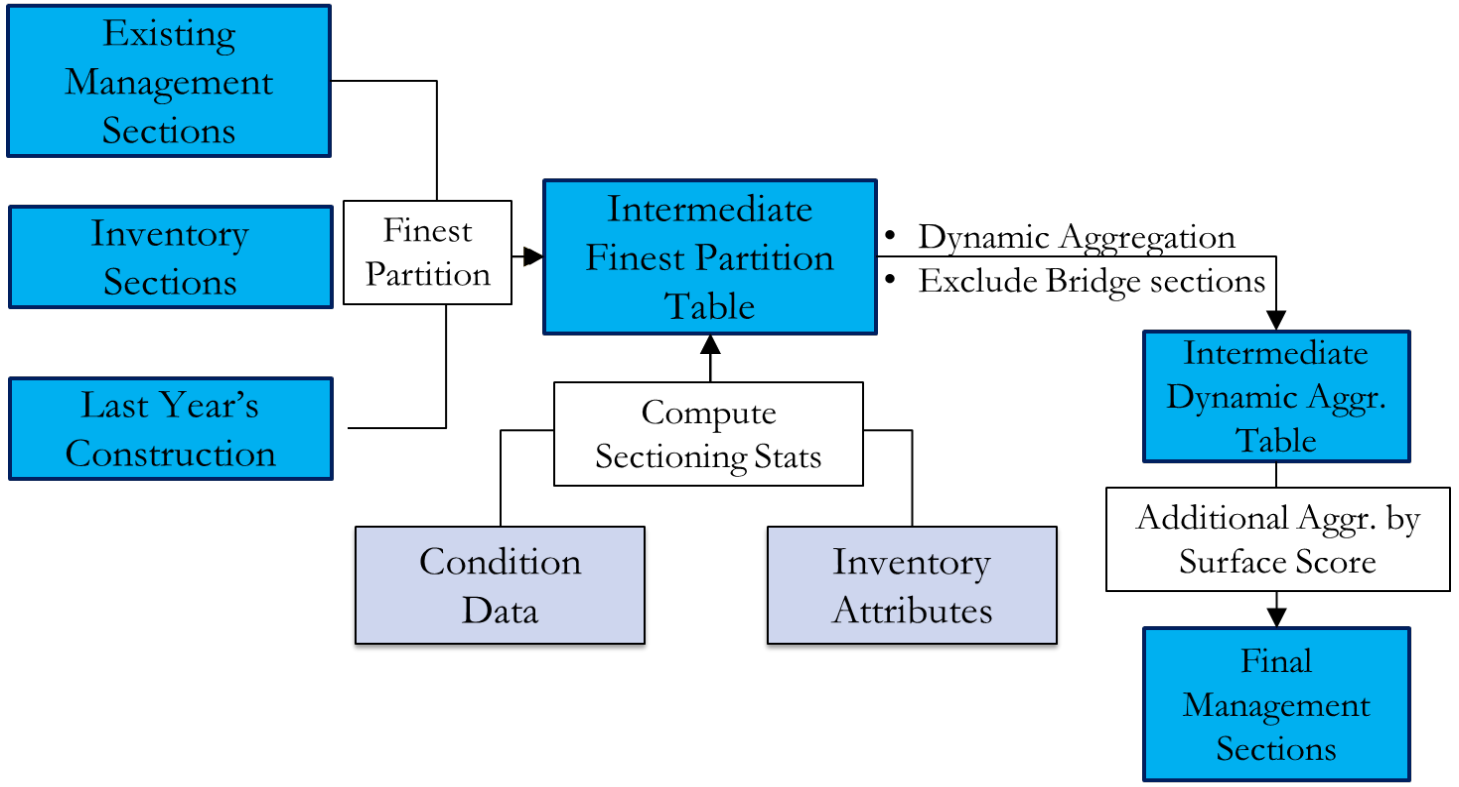
Enterprise Linear Referencing System External System Integrations

Enterprise Asset Management Program (EAMP) (PMS, SMS, MMS, Portfolio Mgmt)

Crash Location, Evalutation, Analysis and Reporting (CLEAR)

Pavement Management System

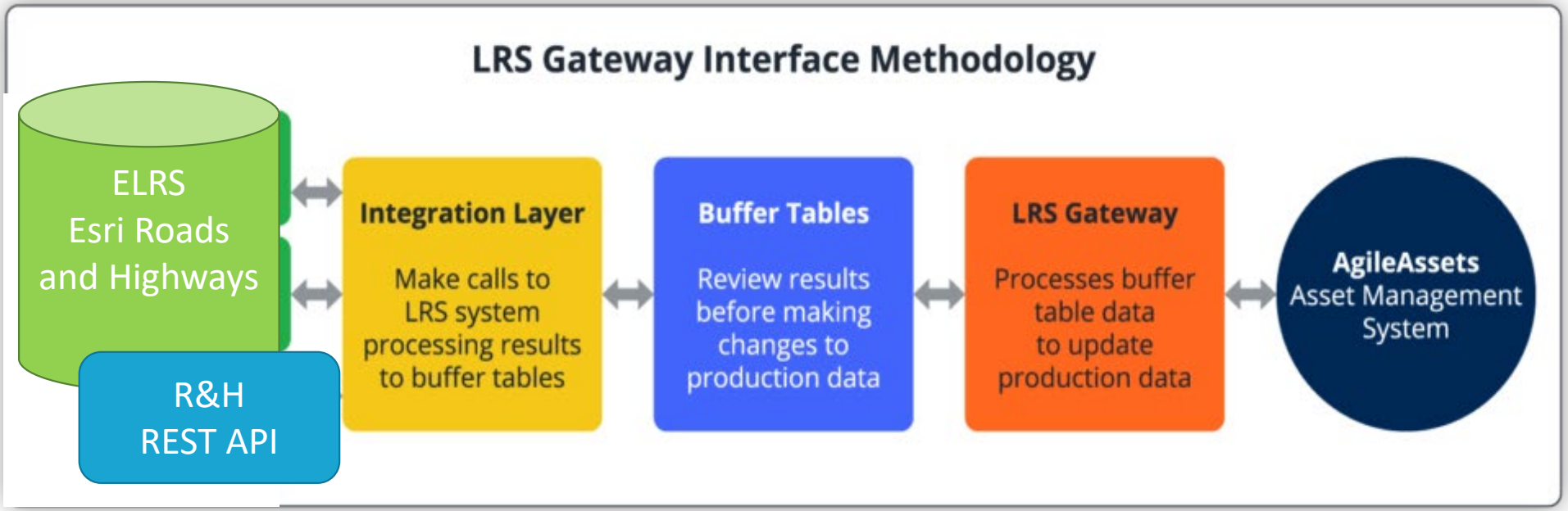
- Pavement Management Database and Analysis
  - » SoR for Pavement Condition Data
- Pavement Performance Analysis
- Work Program Management
- Pavement Score Generation
  - » Decision Tree
  - » PCI at a later date
- Network Optimization



Source: Agile Assets, International User Conference 2016

LRS Gateway – and external ELRS integration

- Updates the EAMP LRS network and external events maintained inside the system
- Provides the common location reference for asset data within the Enterprise Management System



- » Pavement
- » Structures
- » Roadside Assets

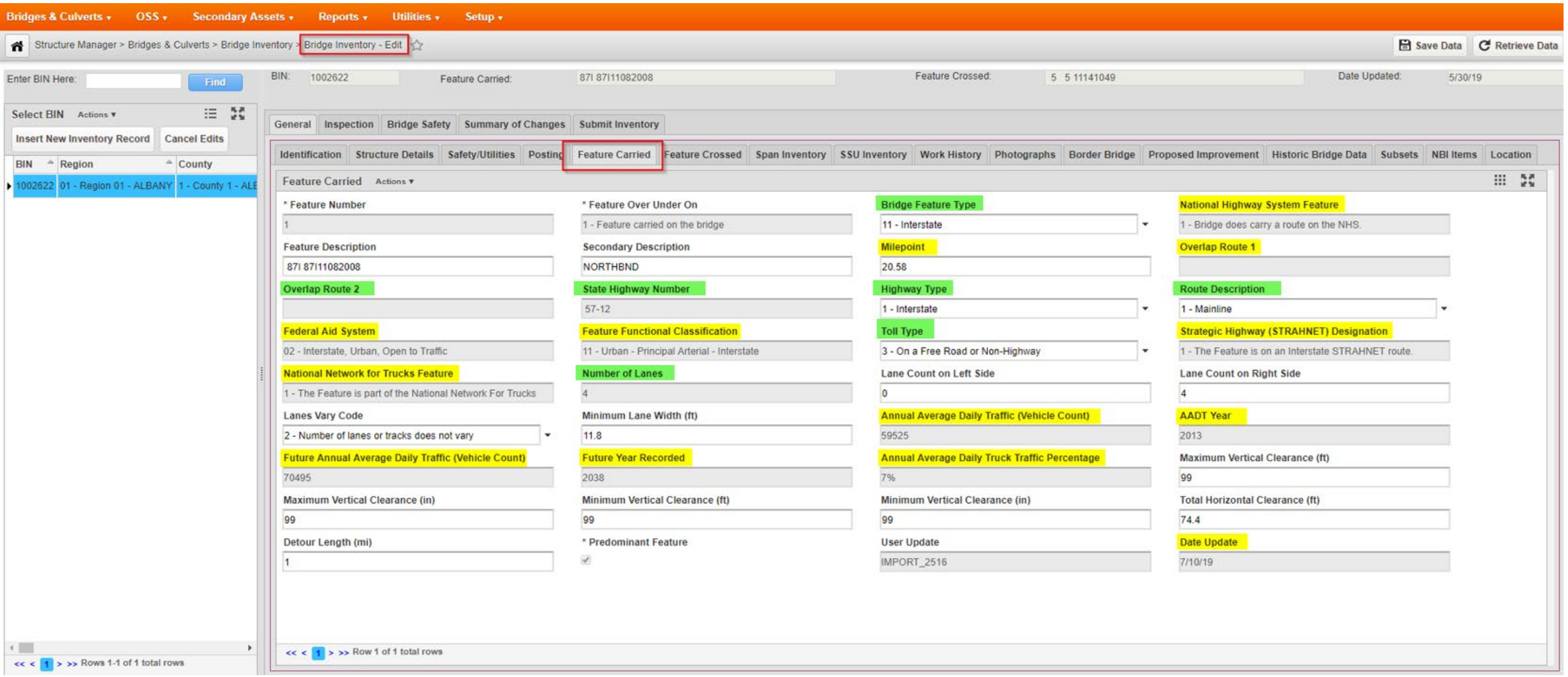
Source: Agile Assets, International User Conference 2016

Structures Management System

- Bridge Data Information System (BDIS)
  - » Bridge and Culvert Inventory and Inspection
  - » Inspection Scheduling
  - » Flag Tracking
  - » Load Rating
  - » Vulnerability Analysis
  - » Federal Reporting
  - » Daily Extract
- Secondary Structural Asset Inventory and Inspection
  - » Retaining Walls
  - » Noise Barriers
  - » Overhead Sign Structures
  - » Historic Bridges

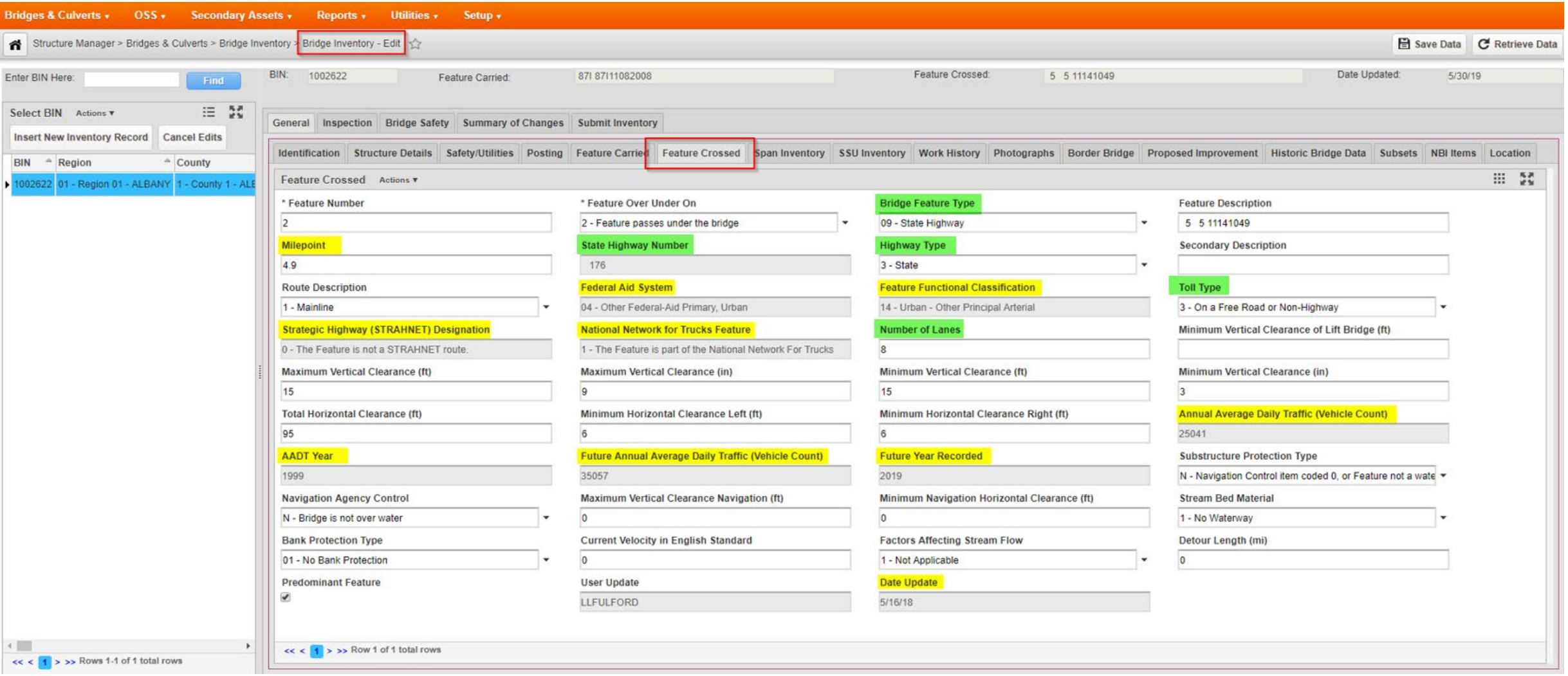
Source: Agile Assets, International User Conference 2016

Structures Management System



Source: Agile Assets, International User Conference 2016

Structures Management System



Source: Agile Assets, International User Conference 2016

Maintenance Management System

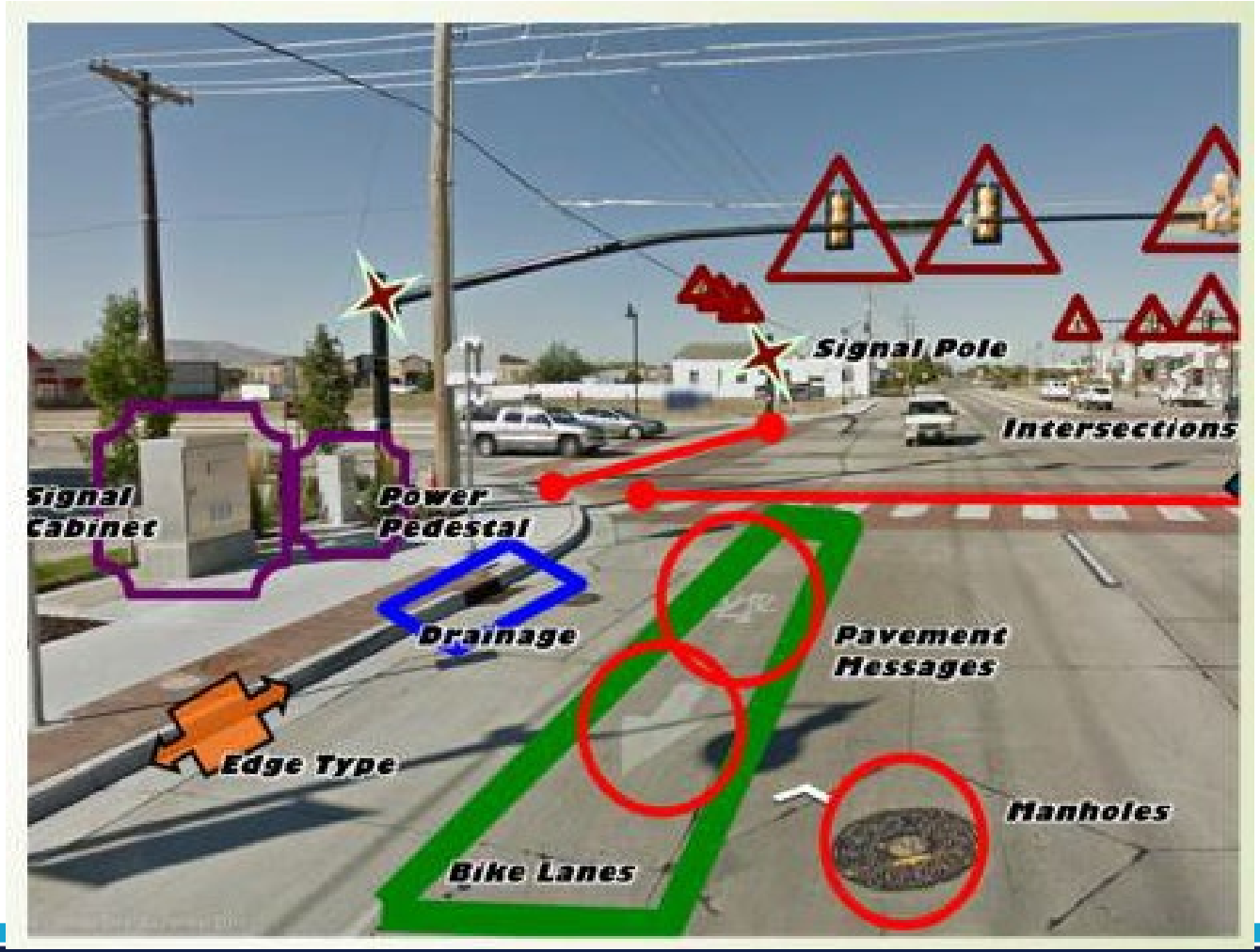
- Daily Maintenance Work Reporting
  - » Labor
  - » Equipment
  - » Materials
  - » Work Accomplishments)
- Time and Attendance Reporting
- Work Management
  - » Work Requests
  - » Work Orders
  - » Projects
- Signal Crew and Signal Lab Management
- AVL Integration
- Snow and Ice Operations
- Mobile Data Collection
- Secondary Assets

Source: Agile Assets, International User Conference 2016

Maintenance Management System

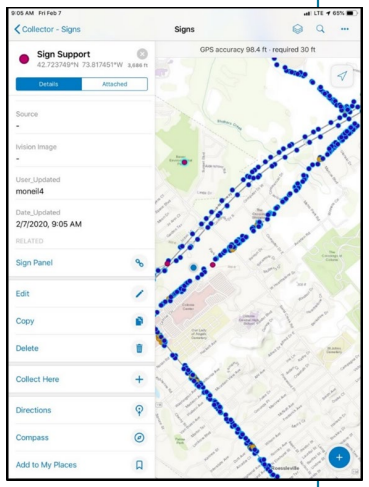
Source: Agile Assets, International User Conference 2016

Secondary (Roadside) Assets – authoritative location is geometry



- Drainage Systems (linear)
- Drainage Systems (point)
- Facilities
- Guiderails
- Sidewalks / Ramps
- Sign Supports and Panels
- Signals
- Small Culverts
- Audible Roadway Delineators
- Retaining & Noise Walls

Secondary Asset Workflow



ArcGIS Enterprise ELRS and System of Record

Transactional Geodatabase

System of Record (SoR)

ETL

Derive Current LRS Location

ArcGIS Enterprise for System of Engagement

Geospatial Data Warehouse

System of Engagement (SoE)

GIS Services

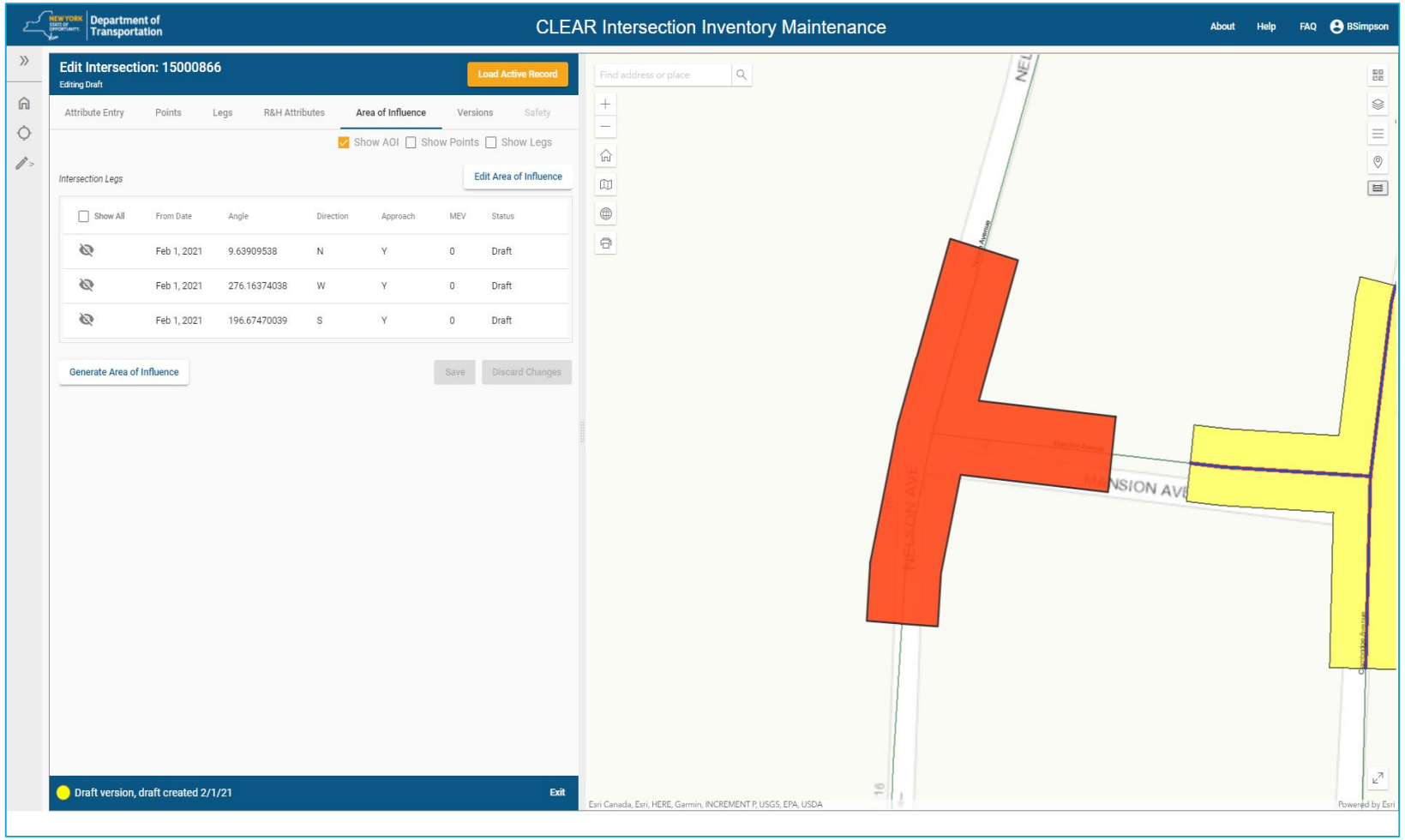
AgileAssets Enterprise Asset Management

AgileAssets EAM DB

Crash Location, Evaluation, Analysis and Reporting (CLEAR) ELRS integration

- Using a annual report version of the Enterprise Linear Referencing System.
- Crashes are automatically located on the Milepoint LRS network based on the date of the crash.
- The roadway inventory is used to apply roadway and traffic information to each crash to support evaluation, analysis and reporting.
- A subset of the roadway inventory attributes are dissolved to form the network of “facility types” as specified in the FHWA Highway Safety Manual methodology.

Crash Location, Evaluation, Analysis and Reporting (CLEAR)



Milepoint LRS network provides the basis for intersection maintenance

Defines new intersections

Used to define intersection approaches and associate supporting inventory and traffic data.

CLEAR, MIRE, and the LRS

Integration of the ELRS and CLEAR inside of the RDM will allow for MIRE reporting

MIRE FDEs	Total Miles 113,916	Non Local Paved Roads[1] 36,982						Local Paved Roads[2] 66,902						Unpaved Roads 10,032					
		Completion Percentage - State Maintained[3]			Completion Percentage - Non State Maintained			Completion Percentage - State Maintained[3]			Completion Percentage - Non State Maintained			Completion Percentage - State Maintained[3]			Completion Percentage - Non State Maintained		
	Miles -	15,698			21,284			726			66,176			64			9,968		
ROADWAY SEGMENT	Data Source	% Rptd	Coverage Miles	% Actual	% Rptd	Coverage Miles	% Actual	% Rptd	Coverage Miles	% Actual	% Rptd	Coverage Miles	% Actual	% Rptd	Coverage Miles	% Actual	% Rptd	Coverage Miles	% Actual
Segment Identifier (12)	TSM can derive from HDSB, LRS or TSM data?	100						100			100			100			100		
Route Number (8)	HDSB	100	15675	100.0	100	795	100.0												
Route/Street Name (9)	HDSB	100	15698	100.0	100	21284	100.0												
Federal Aid (21) /Route Type (22)	TSM can derive from HDSB data	100																	
Rural/Urban Designation (20)	TSM can derive from HDSB data	100						100			100								
Surface Type (23)	HDSB	100	15698	100.0	99..8	21284	100.0	31.4	693	95.5	99.5	66161.0	100.0						
Begin Point Segment Descriptor (10)	TSM derived from LRS MP?	100						100			100			100			100		
End Point Segment Descriptor (11)	TSM derived from LRS MP?	100						100			100			100			100		
Segment Length (13)	TSM derived from LRS MP?	100																	
Direction of Inventory (18)	TSM	100																	
Functional Class (19)	HDSB	100	15698	100.0	100	21284	100.0	100	726	100.0	100	66176	100.0	0	64	100.0	0	9968	100.0
Median Type (54)	HDSB - HPMS/MIRE attribute differences	99.8	15688	99.9	98.7	21022	98.8												
Access Control (22)	TSM can derive from HDSB data	100																	
One/Two Way Operations (91)	TSM can derive from HDSB data	100																	
Number of Through Lanes (31)	HDSB	100	15698	100.0	100	21284	100.0	100	726	100.0	100	66176	100.0						
Average Annual Daily Traffic (79)	HDSB TSM - Local paved roads AADT TBD	99.1	15610	99.4	84.3	17956	84.4	24.9	128	17.6	16.8	11196	16.9						
AADT Year (80)	HDSB	99.1	15610	99.4	84.3	17956	84.4	N/A - Why not?											
Type of Governmental Ownership (4)	HDSB	100	15698	100.0	100	21284	100.0	100	726	100.0	100	66176	100.0	0	64	100.0	0	9968	100.0
INTERSECTION																			
Unique Junction Identifier (120)	TSM Derived	100																	
Location Identifier for Road 1 Crossing Point (122)	LRS MP?																		
Location Identifier for Road 2 Crossing Point (123)	LRS MP?																		
Intersection/Junction Geometry (126)	TSM	100																	
Intersection/Junction Traffic Control (131)	TSM	100																	
AADT for Each Intersecting Road (79)	HDSB TSM - Local paved roads AADT TBD	40.4	?	?	40.4	?	?												
AADT Year (80)	HDSB TSM - Local paved roads AADT TBD	40.4	?	?	40.4	?	?												
Unique Approach Identifier (139)	TSM Derived																		
INTERCHANGE/RAMP		1,798	1775			24		CL Miles											
Unique Interchange Identifier (178)	TSM Derived	100																	
Location Identifier for Roadway at Beginning of Ramp Terminal (197)[5]	LRS MP?	100																	
Location Identifier for Roadway at Ending Ramp Terminal (201)[5]	LRS MP?	100																	
Ramp Length (187)	HDSB	100	1775	100.0	100	24	100.0												
Roadway Type at Beginning of Ramp Terminal (195)[5]	Can TSM derive from HDSB data? Freeway?	100																	
Roadway Type at End Ramp Terminal (199)[5]	Can TSM derive from HDSB data? Freeway?	100																	
Interchange Type (182)	TSM	100			100														
Ramp AADT (191)	HDSB	80.4	1640	92.4	59.7	10	41.7												
Year of Ramp AADT (192)	HDSB	80.4	1640	92.4	59.7	10	41.7												
Functional Class (19)	HDSB	100	1775	100.0	100	24	100.0												
Type of Governmental Ownership (4)	HDSB	100	1775	100.0	100	24	100.0												

HDSB Collects this data - Some data items may be slightly different then the MIRE requirements. Other may need simple translation

This data should be able to be derived/translated from HDSB, LRS, or TSM data

TSM to collect/develop this data

This data is not collected and plans have not been developed to collect/derive it

Current Values less then 100%

Summary

- The Enterprise Linear Referencing System is realizing its vision as a common location reference for the agency…over time, through persistence and coordination
- A cooperative data governance structure is helping guide investments in NYSDOT's mission critical programs and systems
- A System of Engagement Program generates interest and support for investments in better enterprise data management
- Give authoritative data back to end users in a meaningful way

U.S. Department of Transportation
Federal Highway Administration

Question & Answer

Pat Kemble
Highway Data Section Supervisor

Kevin Hunt
Geographic Information Systems Manager, Transportation

U.S. Department of Transportation
Federal Highway Administration

Florida Department of Transportation

Paul O'Rourke
Manager, Spatial Data & Analytics

AGENDA

- Overview of the FDOT data governance initiative: ROADS
- Description of the current state of the LRS
- Description of the future state of the LRS
- How current and future states relate to the spatial data governance components

ROADS: Background

2014: Agency-Wide Analysis

IT Strategic Plan – FDOT undertook an initiative to develop an enterprise-wide Information Technology Strategic Plan.

IT Assessment - The Office of Information Technology (OIT) sponsored a critical assessment of the Department's information technology capabilities, personnel and infrastructure.

Technology Alignment - The intent of the process was to align the Department's technology assets with its functional business units.

2015: ROADS Introduction

ROADS - In March 2015, the Reliable, Organized, and Accurate Data Sharing (ROADS) Initiative began.

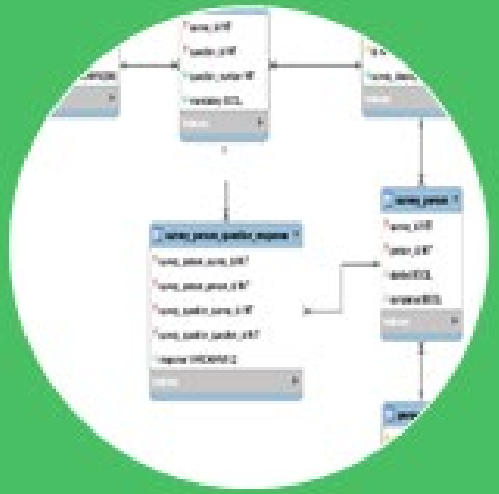
Goal – The goal of the ROADS Initiative is to improve data reliability and simplify data sharing across FDOT to have readily available and accurate data to make informed decisions.

Person-to-Person Sharing

A heavy reliance on getting data from individual(s) instead of accessing data directly from applications and reporting tools

Extensive Manual Processing

A prevalence of manual, home grown processes for copying and transferring data (ex. spreadsheets)



Limited or No Standardization

The extensive amount of effort required to match up information from multiple data sources.

Lack of Sustainability

A data driven agency (ex. Big Data) poses new challenges.

ROADS: Gaps Analysis

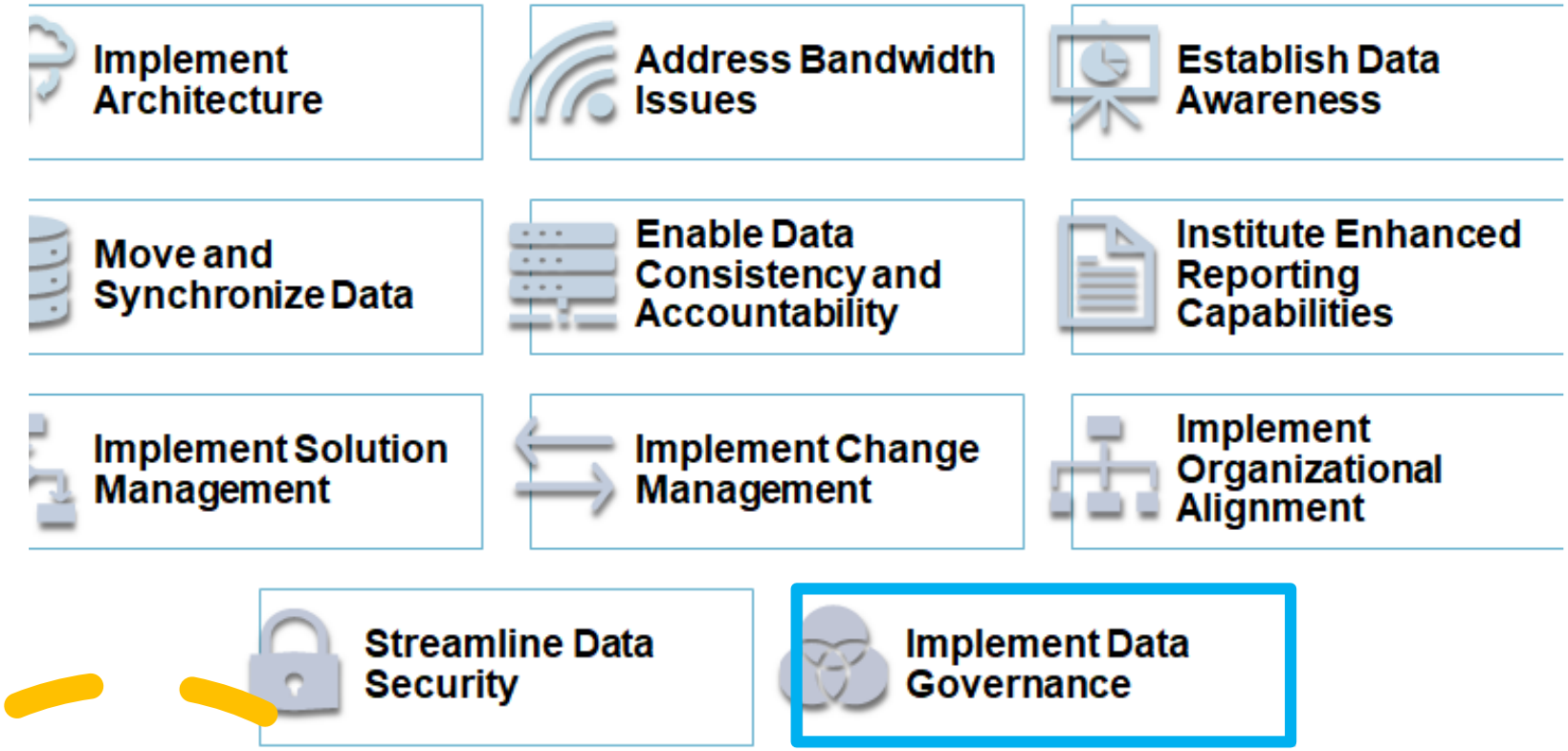
ROADS: Benefits to Enterprise Governance

Reliability	Ensuring information is secure, accurate, reliable and at the appropriate level to empower you do your job better.
Accessibility	Providing the ability to access relevant business data more quickly and efficiently by knowing where to find it.
Timeliness	Reducing the amount of time to locate the data you need and more time to analyze the data.
Productivity	Effectively sharing information across our organization to enable better and faster decisions.
Integration	Enabling a greater capability to link data together from different Districts, the FTE, functional areas and systems.
Sharing	Removing barriers currently in place that prevent the efficient sharing of information.

FDOT ROADS IN ACTION
RELIABLE, ORGANIZED, ACCURATE DATA SHARING

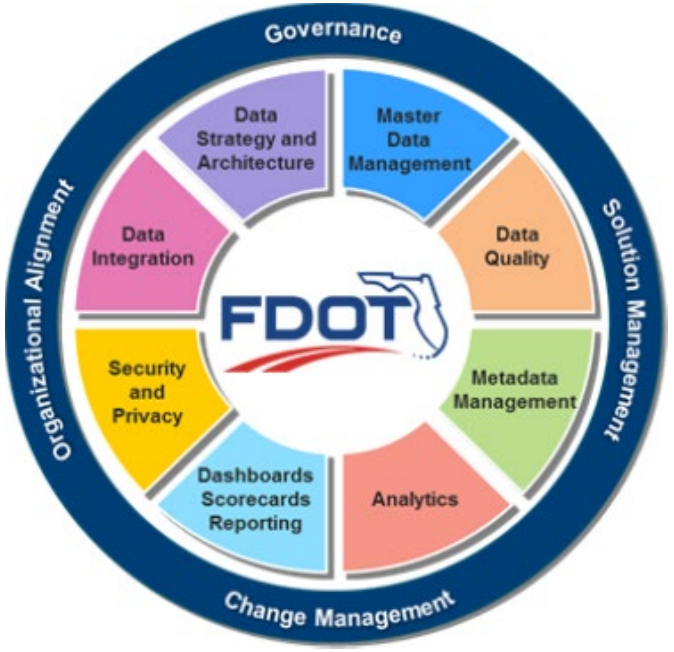
FDOT ROADS IN ACTION
RELIABLE, ORGANIZED, ACCURATE DATA SHARING

ROADS: Solutions



ROADS: Data Governance Components

FDOT



Component Model

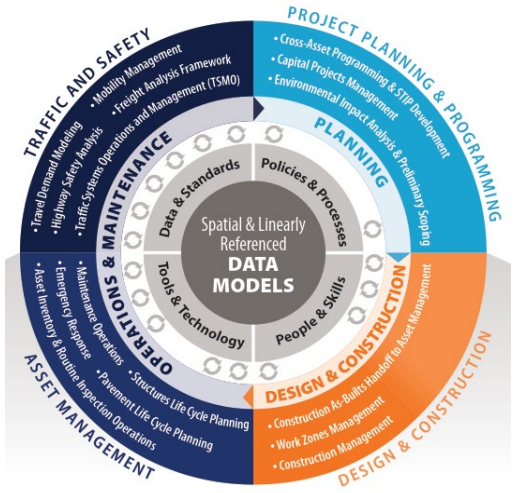
Effective data governance programs have many processes

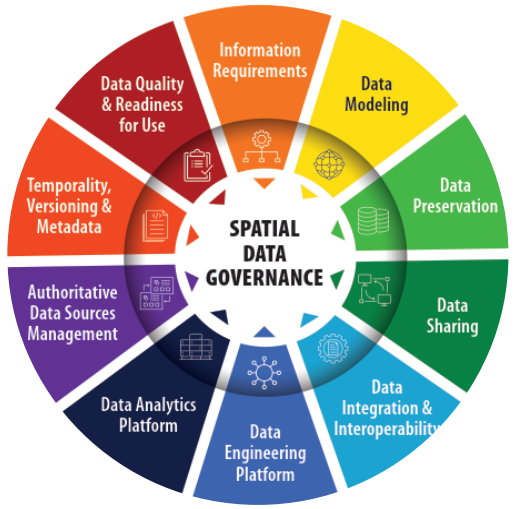
Each component is critical to the overall success of the program

The inner components are related

To achieve success, all components must be addressed

FHWA





FDOT ROADS IN ACTION
RELIABLE, ORGANIZED, ACCURATE DATA SHARING

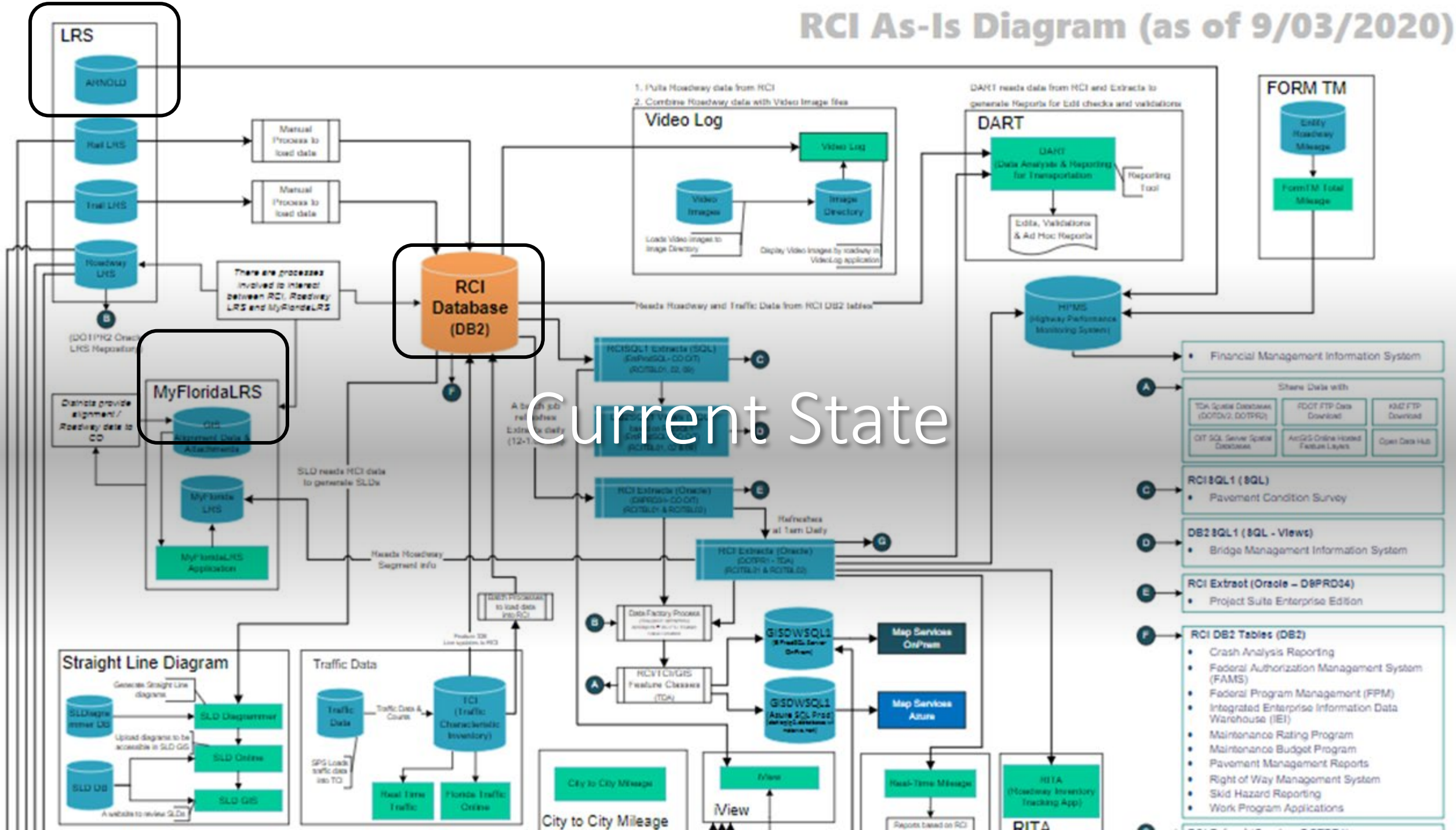
ROADS: Projects

ROADS: Projects

BI/DW	The Business Intelligence/Data Warehouse provides the tools and ca improve the quality and accessibility of FDOT's data.
ECTS	The Enterprise Correspondence Tracking System, powered by GovQ online requests, report issues and access self-help resources.
EDMS	The Electronic Document Management System, powered by eDOCS storage, searching, and retrieval of documents and associated metac
IAMG	The Identity Access Management and Governance will help to ensure to resources across our diverse technology environments.
IRAIS	The Integrated Roadway Asset Identification System will incrementall Roadway Characteristic Inventory, technical architecture and busines
SoE	The System of Engagement provides a single enterprise view where partners can consume, analyze and contribute to enterprise data.
WCMS	The Website Content Management System provides authoring, collab administrative tools to create and manage website content.
WPII	The Work Program Integration Initiative is a commercial-off-the-shelf support the FDOT work program.

FDOT ROADS IN ACTION
RELIABLE, ORGANIZED, ACCURATE DATA SHARING

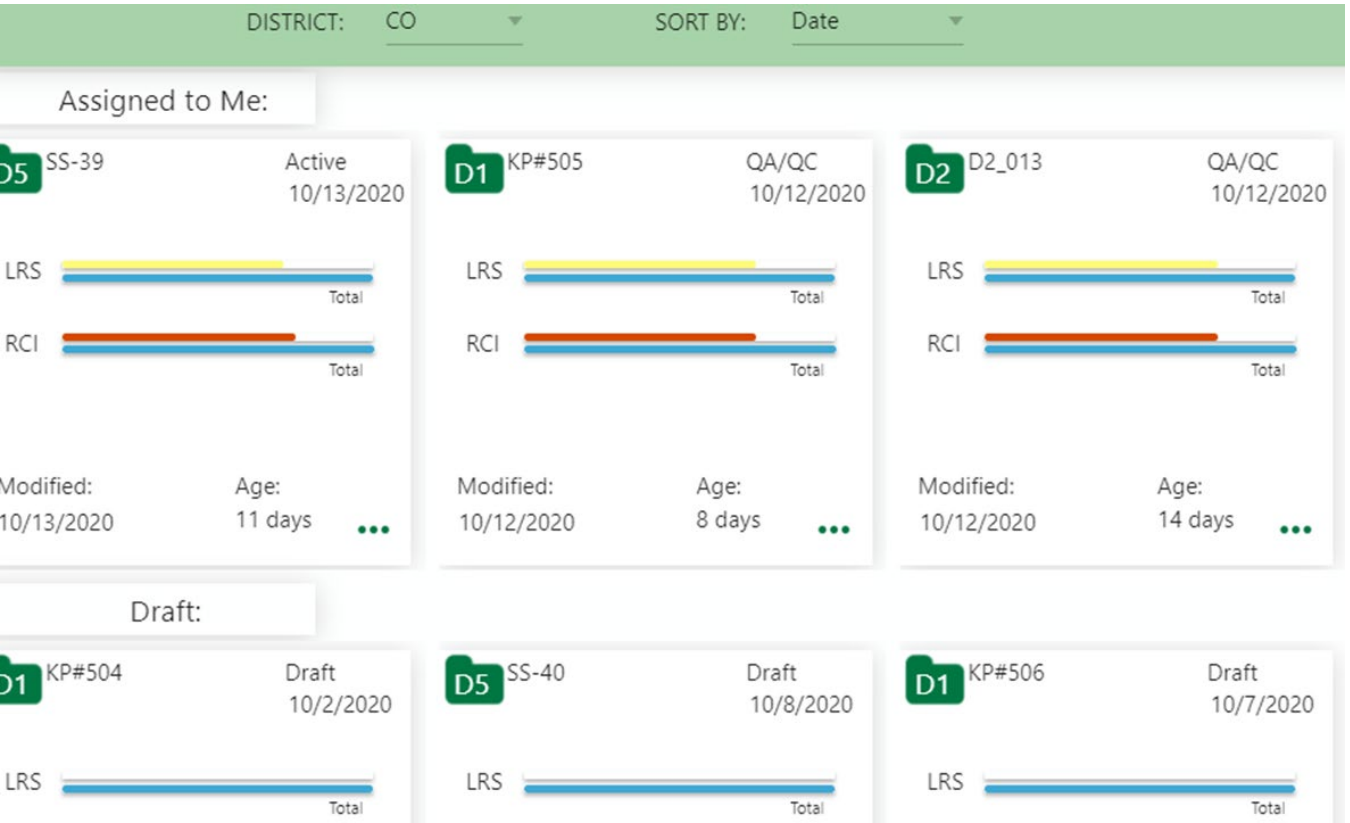
RCI As-Is Diagram (as of 9/03/2020)

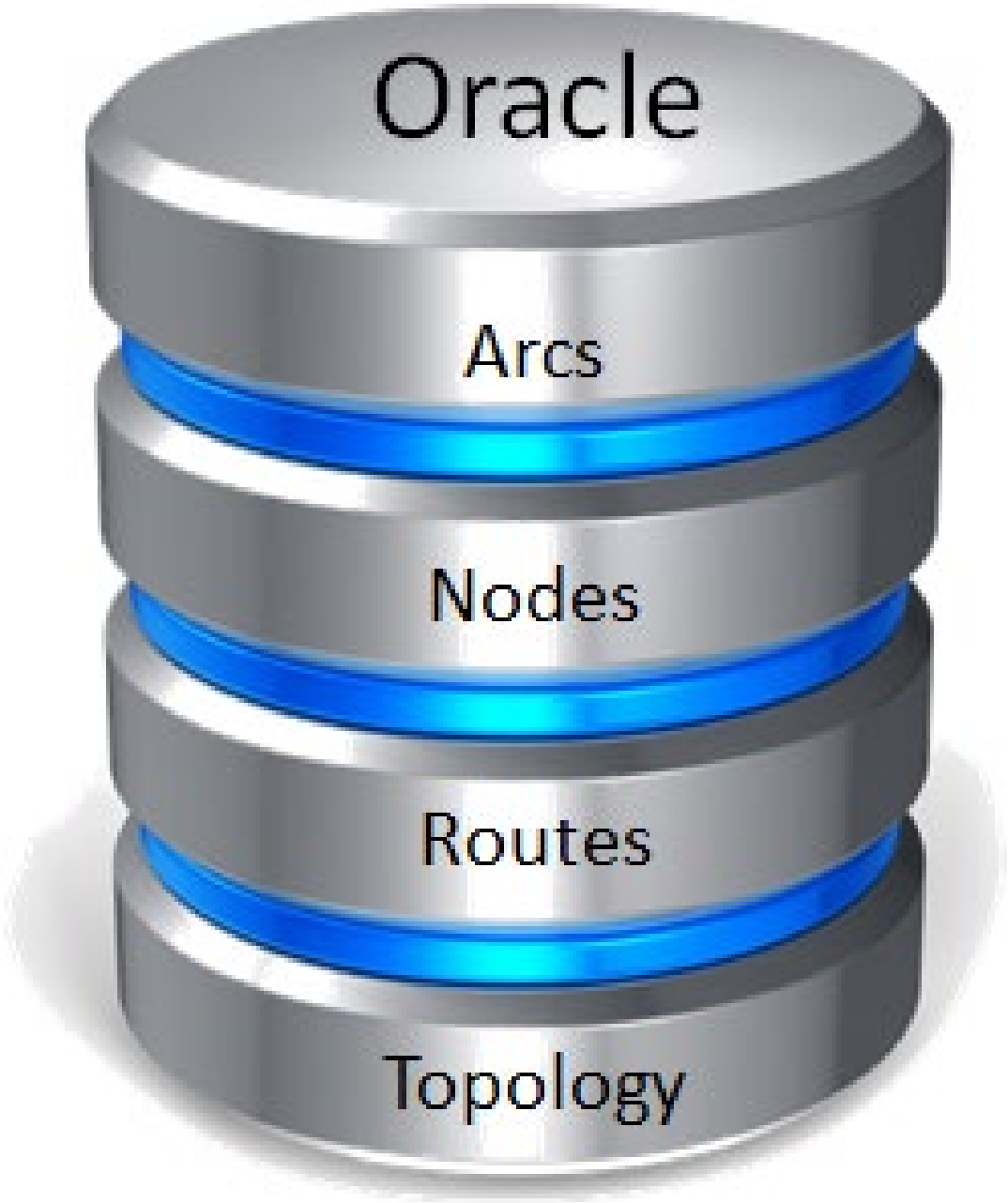


Current State

Linear Referencing System (LRS)

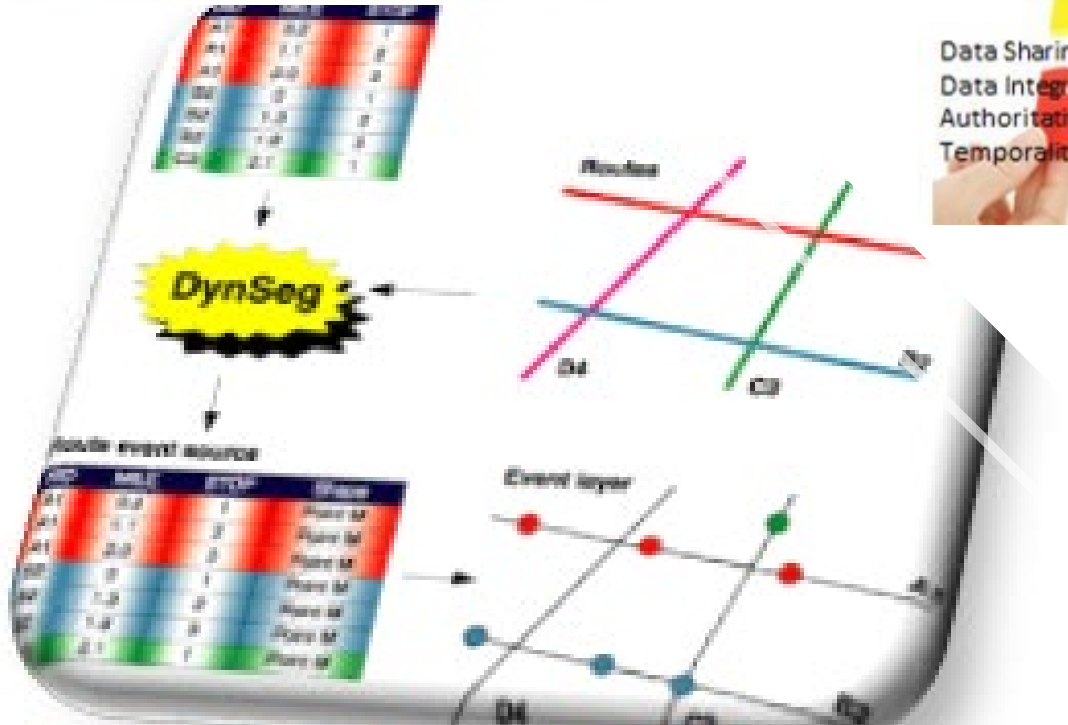
- Feature dataset in Oracle
- Maintained with custom tools in ArcMap
- Edits coordinated with the FDOT District offices using MyFloridaLRS





ArcGIS Onlir

Spatial Data Factory



Utilizations of the LRS

- **Planning** – Use the LRS in conjunction with future alignments
- **Traffic** – Locate traffic data by roadway ID and milepoint using the LRS
- **ITS** – Uses the HERE network
- **Safety** – Locate crashes by roadway ID and milepoint using the LRS and the HERE network
- **Travel Demand Forecasting and Modeling** – Considering which network(s) to use (LRS, ARNOLD, HERE)

Additional Use Cases

- Local Agency Program Programming Freight Network Project Prioritization
- Multimodal Data Analytics
- Freight Facility Analysis
- Truck Parking
- Quality Assurance
- Pavement Condition Survey
- RCI Inventory
- Emergency Management
- Asset Management
- Designations and Transfers

ARNOLD

Merger of the current LRS with the latest Census TIGER data into one dataset

Integration with External Sources

here

EV

INRIX

IHS Markit®

Bureau of Transportation Statistics

Analysis of Infrastructure Projects

Analysis of Current Events

CORE ALRS

At a minimum, a StatewideRoutes LRS Network is recommended. More LRS Networks may be designed based on DOT need.

Simple feature class
Calibration_Point

Geometry: Point
Contains M values: No
Contains Z values: Yes

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
From_Date	Date	Yes					
To_Date	Date	Yes					
Network_ID	Short Integer	Yes					
Route_ID	String	Yes					
Measure	Double	Yes					
SHAPE	Geometry	Yes					

Simple feature class
Centerline

Field name	Data type
OBJECTID	Object ID
Centerline_ID	Guid
SHAPE	Geometry
SHAPE_Length	Double

Table
Centerline_Sequence

Field name	Data type	Allow nulls
OBJECTID	Object ID	
From_Date	Date	Yes
To_Date	Date	Yes
Network_ID	Short Integer	Yes
Route_ID	String	Yes
Centerline_ID	Guid	Yes

Simple feature class
Statewide_Routes

Geometry: Polyline
Contains M values: Yes
Contains Z values: Yes

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
From_Date	Date	Yes			0	0	8
To_Date	Date	Yes			0	0	8
Route_ID	String	Yes					255
County	String	Yes					2
Section	String	Yes					6
SHAPE	Geometry	Yes					
SHAPE_Length	Double	Yes			0	0	

Future State

Event
Federal_System

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
From_Date	Date	Yes			0	0	8
To_Date	Date	Yes			0	0	8
Event_ID	String	Yes			0	0	38
Route_ID	String	Yes					255
From_Measure	Double	Yes			0	0	
To_Measure	Double	Yes			0	0	
Federal_Highway_Code	String	Yes		Federal_Highway_Code			2
National_Highway_Connector	String	Yes					1
Old_Federal_Highway	String	Yes		Old_Federal_Highway			2
Special_Systems	String	Yes		Special_Systems			2
Strategic_Highway_Network	String	Yes		Yes_No			1
Travel_Way	String	Yes		Travel_Way			1
Data_Source	String	Yes					50
Data_Year	Short Integer	Yes		Data_Year	0		
Loc_Error	String	Yes					50
From_Referent_Method	Short Integer	Yes		dReferentMethod	0		
From_Referent_Location	String	Yes					255
From_Referent_Offset	String	Yes					50
To_Referent_Method	Short Integer	Yes		dReferentMethod	0		
To_Referent_Location	String	Yes					255
To_Referent_Offset	String	Yes					50

Event
Managed_Lane

Field name	Data type	Allow nulls	Default value	Domain
OBJECTID	Object ID			
From_Date	Date	Yes		
To_Date	Date	Yes		
Event_ID	String	Yes		
Route_ID	String	Yes		
From_Measure	Double	Yes		
To_Measure	Double	Yes		
Ownership	String	Yes		
Data_Source	String	Yes		
Data_Year	Short Integer	Yes		Data_Year
Loc_Error	String	Yes		
From_Referent_Method	Short Integer	Yes		dReferentMethod
From_Referent_Location	String	Yes		
From_Referent_Offset	String	Yes		
To_Referent_Method	Short Integer	Yes		dReferentMethod
To_Referent_Location	String	Yes		
To_Referent_Offset	String	Yes		

Event
Ownership

Field name	Data type	Allow nulls	Default value	Domain
OBJECTID	Object ID			
From_Date	Date	Yes		
To_Date	Date	Yes		
Event_ID	String	Yes		
Route_ID	String	Yes		
From_Measure	Double	Yes		
To_Measure	Double	Yes		
Ownership	String	Yes		Ownership
Data_Source	String	Yes		
Data_Year	Short Integer	Yes		Data_Year
Loc_Error	String	Yes		
From_Referent_Method	Short Integer	Yes		dReferentMethod
From_Referent_Location	String	Yes		
From_Referent_Offset	String	Yes		
To_Referent_Method	Short Integer	Yes		dReferentMethod
To_Referent_Location	String	Yes		
To_Referent_Offset	String	Yes		

Event
HOV_Lane

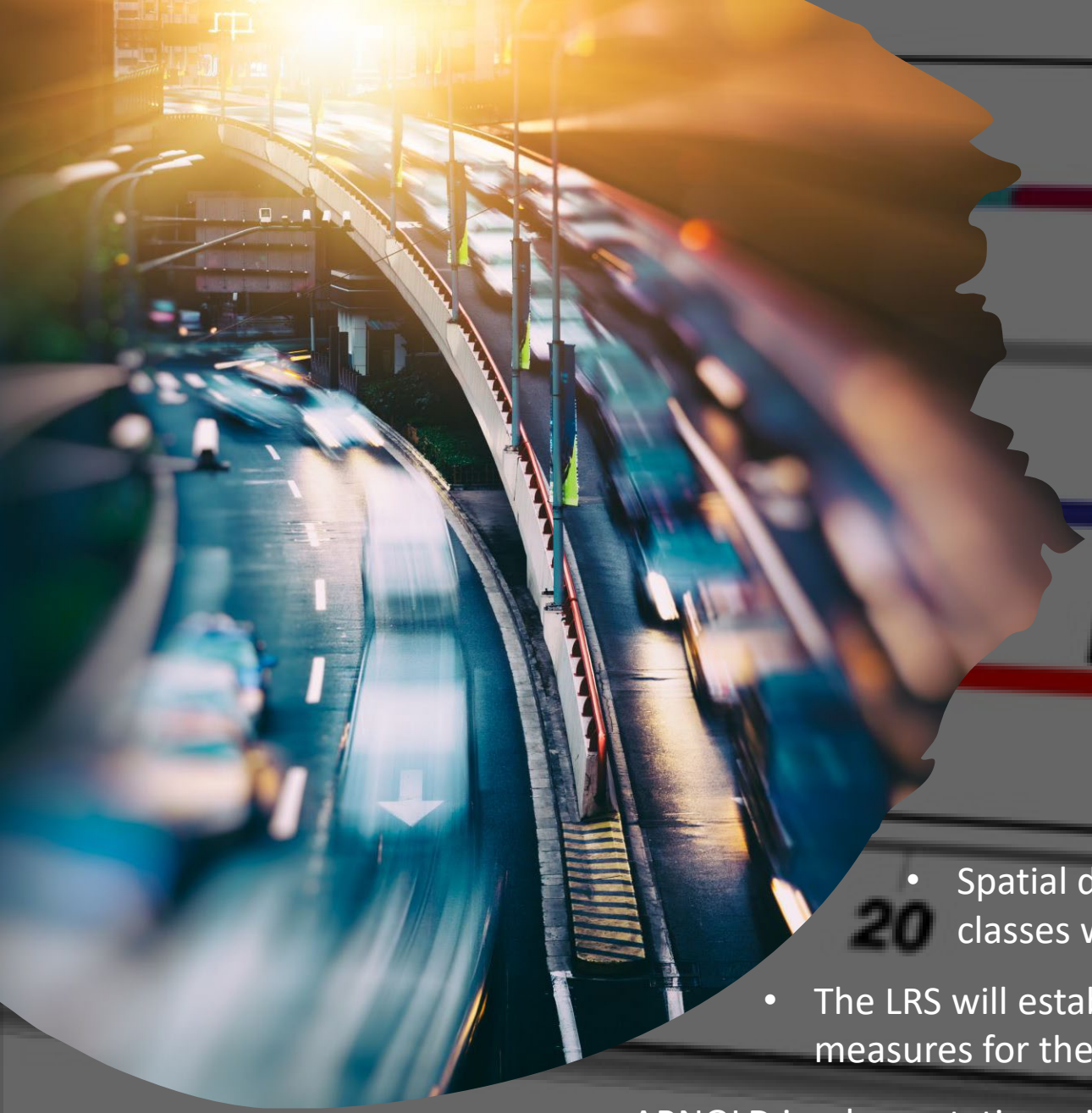
Field name	Data type	Allow nulls	Default value	Precision	Scale	Length
OBJECTID	Object ID					
From_Date	Date	Yes		0	0	8
To_Date	Date	Yes		0	0	8
Event_ID	String	Yes				38

Zoom

1 of 1

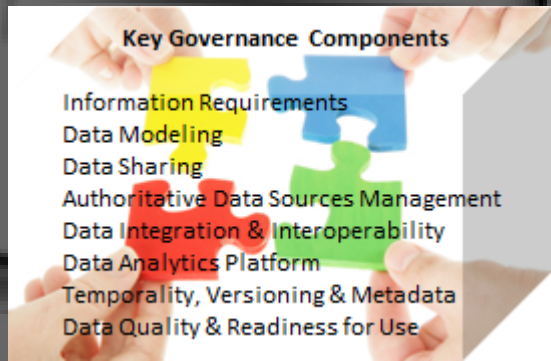
Event
Roundabout

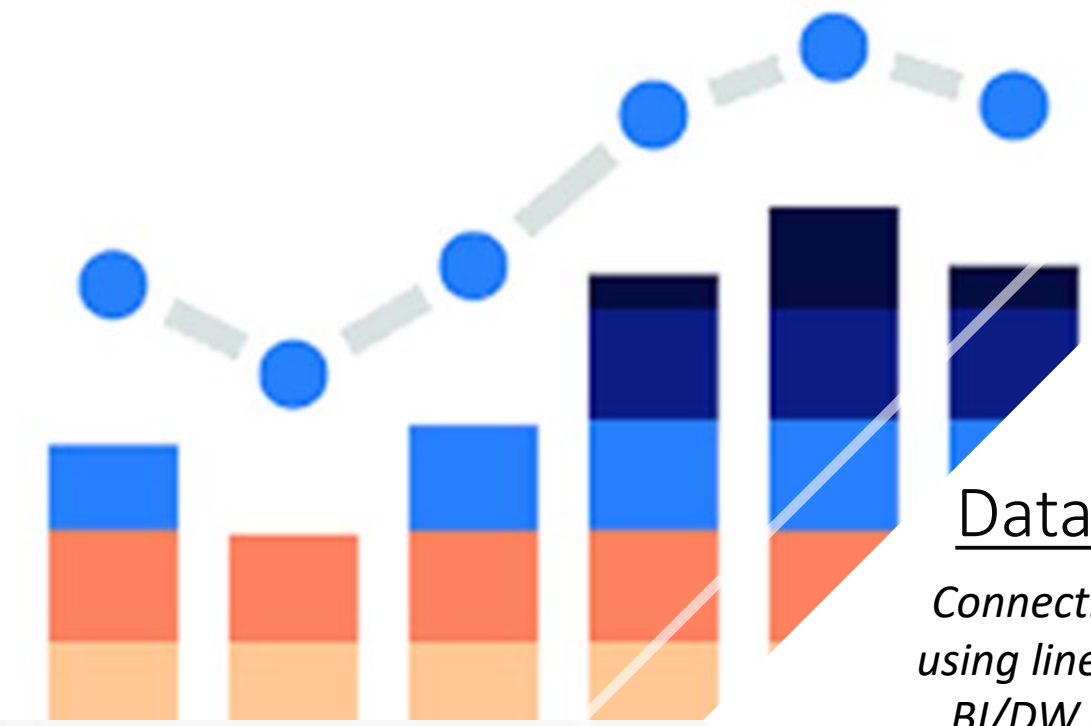
Field name	Data type	Allow nulls	Default value	Domain
OBJECTID	Object ID			
From_Date	Date	Yes		



Esri Roads & Highways

- Spatial data will be comprised of feature classes within Roads & Highways.
- The LRS will establish the milepoint measures for the events.
- ARNOLD implementation within Roads & Highways is possible in the future.



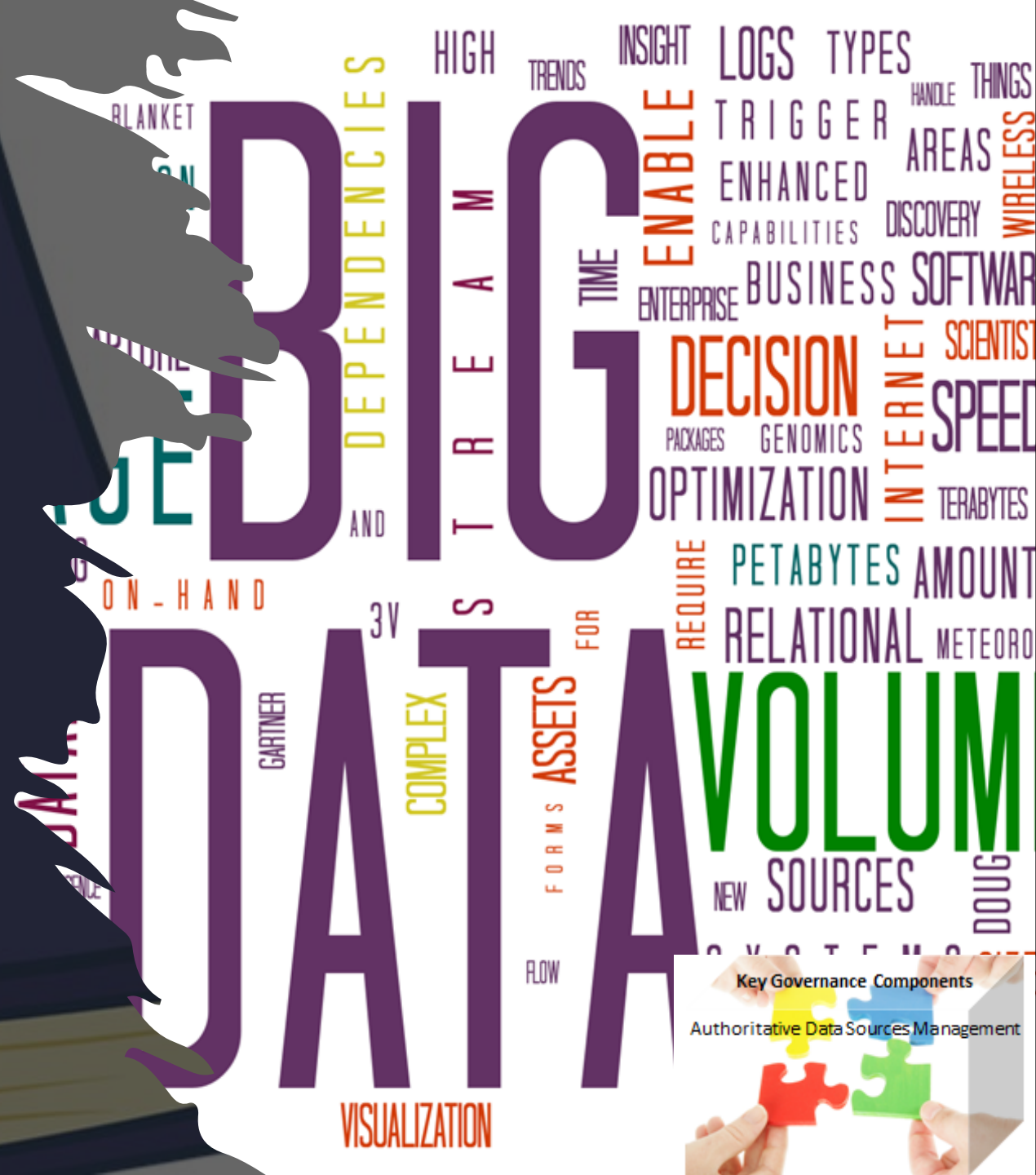


Data Warehouse

Connecting business areas using linear referencing and BI/DW e.g., construction plans.

Event data may be stored in the Department's new data warehouse.

Enterprise Data Management Handbook



Part of an agency-wide initiative to provide guidance for the data life cycle. Due for publication in 2021.

Conclusion

- There is a *lot* going on at FDOT! ROADS, BI/DW, IRAIS.
- The ROADS initiative continues to promote data governance throughout the Department. We have a *great* foundation upon which to build.
- The FDOT LRS is going to change; this would be the time to ensure spatial data governance in support of the ROADS initiative.
- The pooled fund study can help ensure that FDOT is implementing the necessary components for spatial governance while providing insight into Roads and Highways.

ROADS IN ACTION

GANIZED, ACCURATE DATA SHARING

U.S. Department of Transportation
Federal Highway Administration

Question & Answer

Paul O'Rourke
Manager, Spatial Data & Analytics

U.S. Department of Transportation
Federal Highway Administration

Next Steps

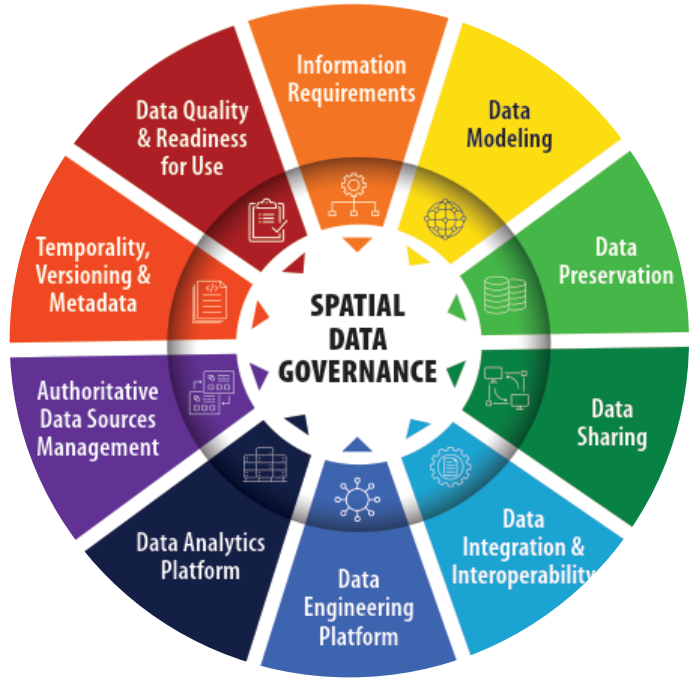
Joseph Hausman
Federal Highway Administration
Office of Planning

Abhishek Bhargava
Data Scientist
WSP USA

Lisa Saldin
Public Involvement Coordinator
WSP USA

Next Steps: AEGIST Events & Goals in 2021

	Feb	Mar	Apr	July	Aug	Sep	Nov	Dec
Spatial Data Governance & Management	Webinar 1 *(Today)*				Webinar 2			PFS States Peer Exchange
Spatial Data Modeling		PFS States QTR Meet	GIS-T 2021 Workshop *(Aligned with HPMS, BIM Governance workshops)*					
Spatial Data Integration & Engineering				PFS States QTR Meet			PFS States QTR Meet	
Spatial Data Analytics			GIS-T Session Present			PFS States QTR Meet		



AEGIST is a Multi-Year FHWA & States led PFS Project focused on Enhancement of Spatial Data Management and Governance Practices at Transportation Agencies

Event Details: *www.gisintransportation.com*

Status of Activities as of: Feb 10th, 2020

AEGIST Implementation Activities at PFS States

	CA	CT	GA	ID	TN	PA	OH	KS	AZ	NC
Spatial Data Governance, Management *Strategy, Roadmap, Metadata, Data Portfolio & Library, Workshops*			✓	✓	✓	✓	✓		✓	✓
Spatial Data Modeling										
Roads Data Modeling & Business Rules *DOT, Federal, Local: HPMS, ARNOLD, NG911*	✓					✓		✓		
Intersections Data Model *HPMS 9.0, MIRE, GDF, IFC Roads Based*			✓							
Data Quality Automation *HPMS, MIRE & Assets*		✓								
Spatial Data Integration and Engineering										
Roads Data Integration, Authoritative Data Mgmt. *DOT, Federal, Local Roads Data Sharing & Federation*	✓									
Road Network and Events Data Publication: Pilots *Data Model for Data Warehouses. Data Models & Engineering in Data Hubs*		✓								
Spatial Data Analytics										
Spatial Statistics, Econometrics, AI/ML, Optimization *Descriptive, Diagnostics, Predictive and Prescriptive Analytics; Image Analysis*						✓				