

2016 Esri User Conference

Managing Highway Infrastructure with GIS: MA Turnpike Case Study

Tran Systems

EXPERIENCE | Transportation

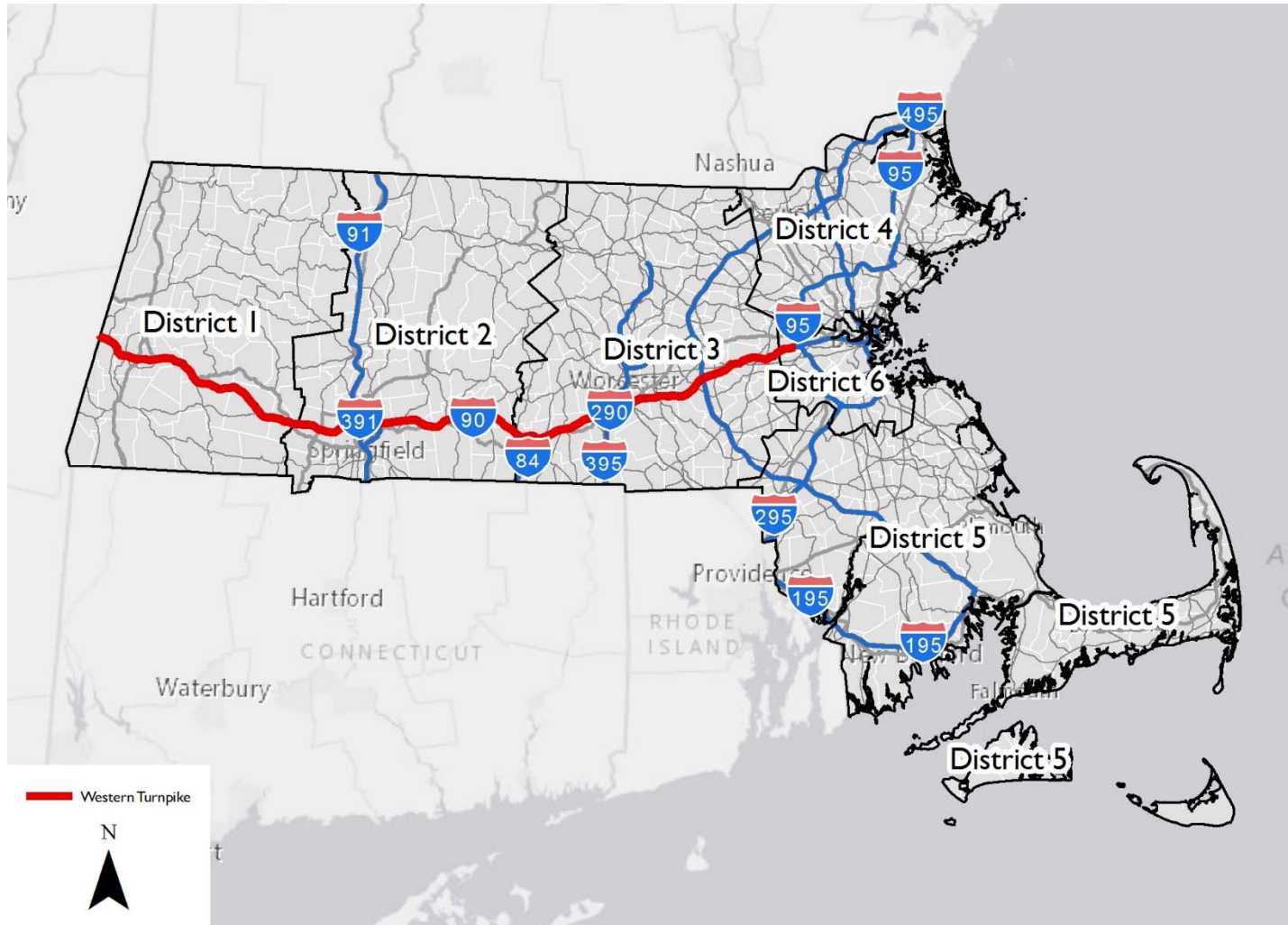
massDOT
Massachusetts Department of Transportation



Project Background

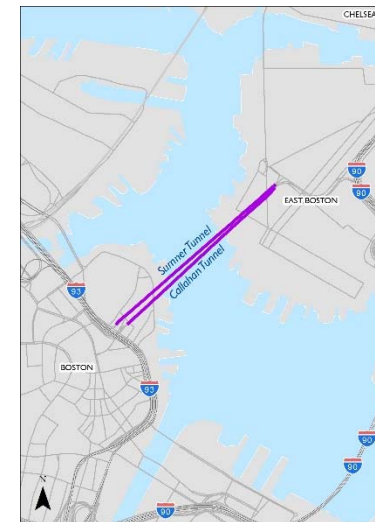
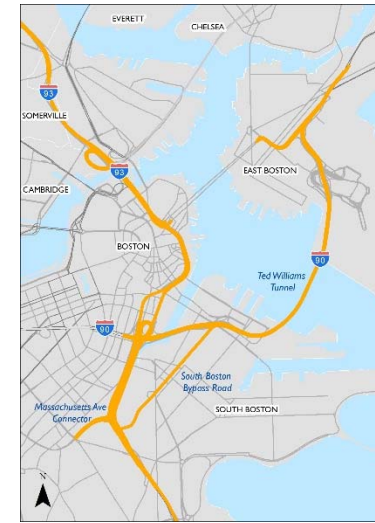
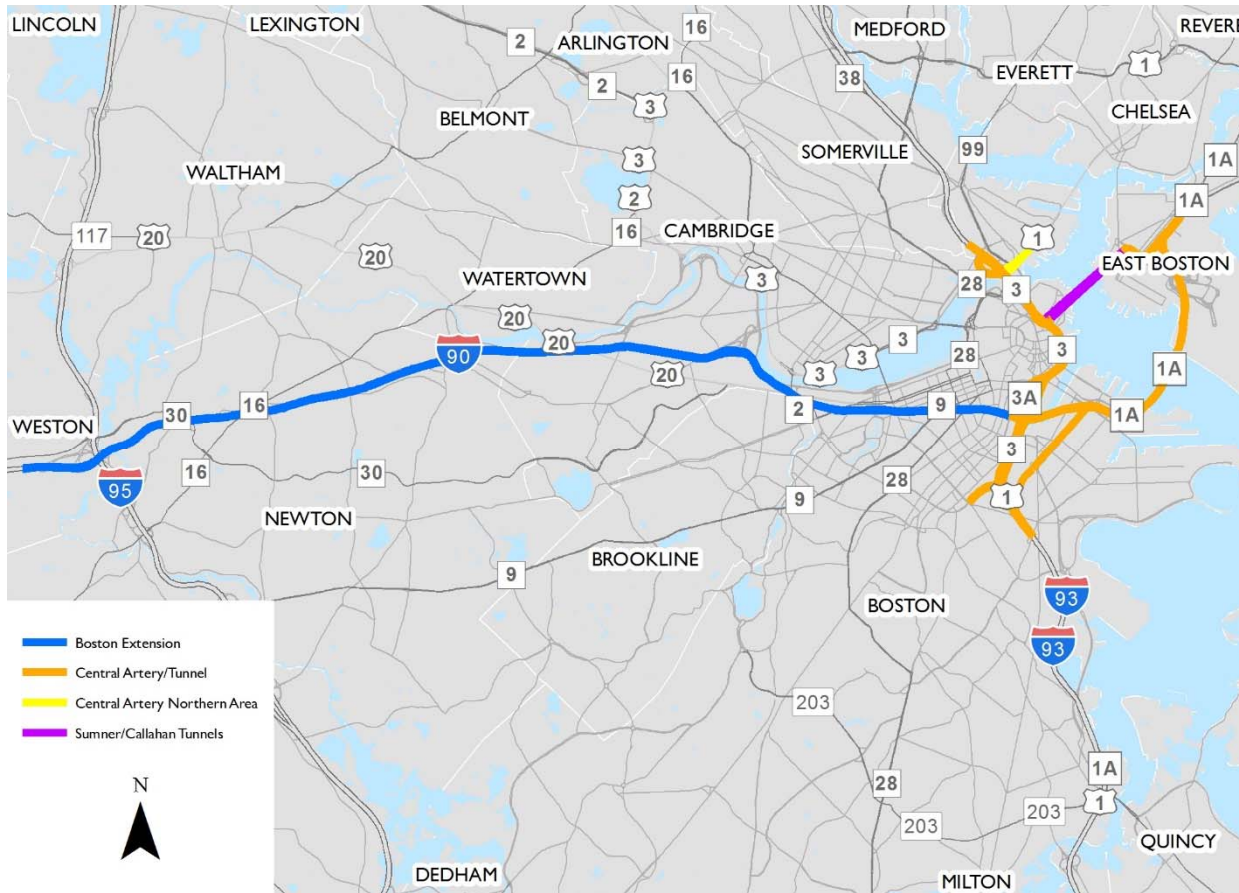
- **MA Turnpike spans entire state, NY to Boston**
- **Inspected every three years**
- **Project overview – 2 Phases**
 - Phase A – 8 weeks to complete the schedule
 - Phase B – Completing GIS map of all data, final deliverables
- **Questions answered:**
 - What turnpike assets meet State of Good Repair (SOGR) criteria, and what is the cost to maintain that?
 - What assets fall short?
 - What is the capital cost to get there and the recurring cost to maintain?

Project Background – Western Turnpike



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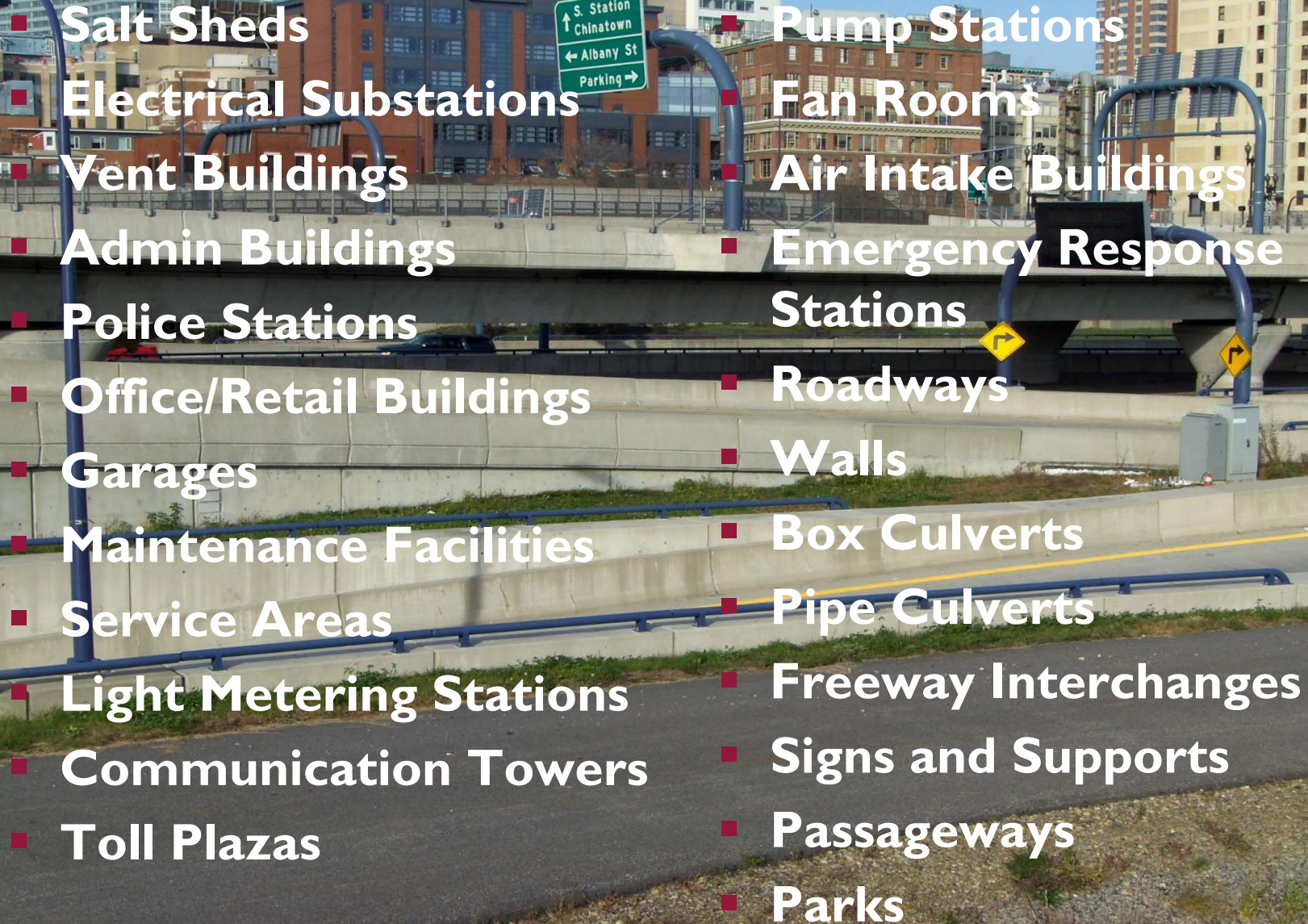
Project Background – Metropolitan Highway System (MHS)



Scope of Work

- Perform inspection on a sample of each of 24 different types of assets
- Calculate infrastructure deterioration rate from historical data
- Use deterioration rate to estimate condition of non-inspected assets
- Present findings in a report
- Create consolidated GIS database of present and historical inspection data
- Public hearings

Asset Types for Inspection

- 
- Salt Sheds
 - Electrical Substations
 - Vent Buildings
 - Admin Buildings
 - Police Stations
 - Office/Retail Buildings
 - Garages
 - Maintenance Facilities
 - Service Areas
 - Light Metering Stations
 - Communication Towers
 - Toll Plazas
 - Pump Stations
 - Fan Rooms
 - Air Intake Buildings
 - Emergency Response Stations
 - Roadways
 - Walls
 - Box Culverts
 - Pipe Culverts
 - Freeway Interchanges
 - Signs and Supports
 - Passageways
 - Parks

Reaching State of Good Repair – Action Plan

Action Plan is based on recommended performance target for each asset category; lays out steps and costs required to reach and maintain a State of Good Repair over 5, 10, 20 years.

- **Costs Presented in 3 Categories**
 - Modernization
 - Capacity
 - State of Good Repair
- **Development of Costs**
 - Based Upon Existing Asset Condition
 - Industry Recommended Maintenance/Replacement Practices
 - Scheduled MassDOT Projects

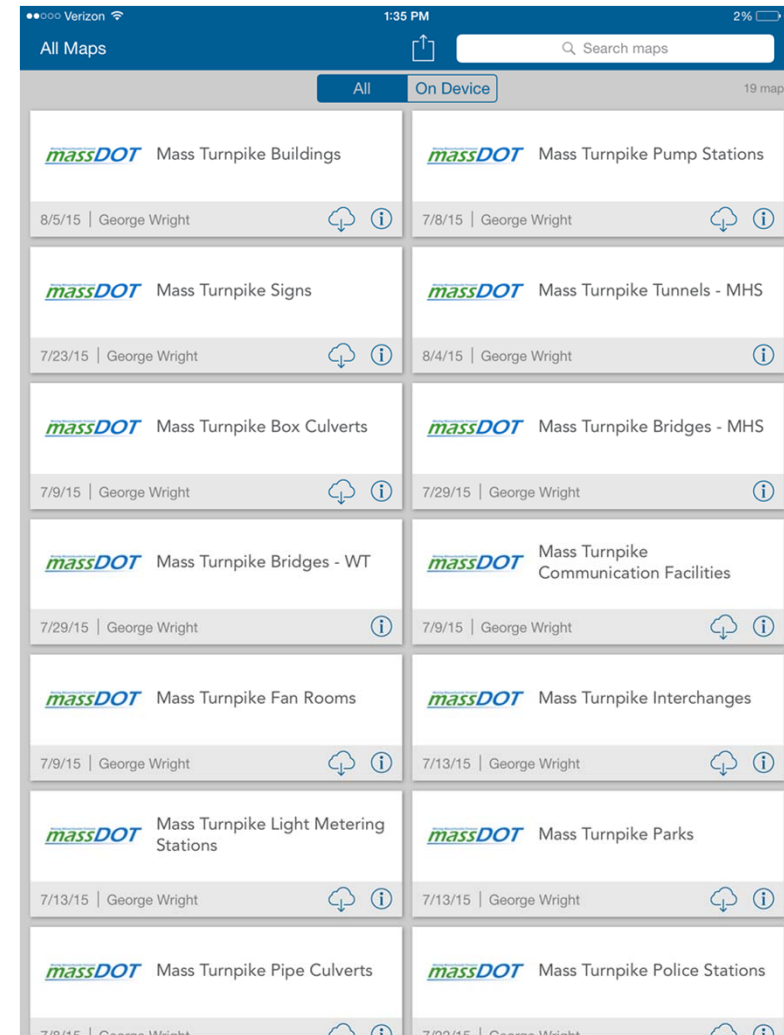
Inspection Methodology

- **Inspection Consisted of the Following**
 - Representative Sample Set from Each Asset Class
 - Two-person Inspection Team Utilizing a Tablet to Record Condition of Asset
 - GIS (Latitude/Longitude) Data Gathered
 - Condition Assessment Based on Scale from 0 to 9



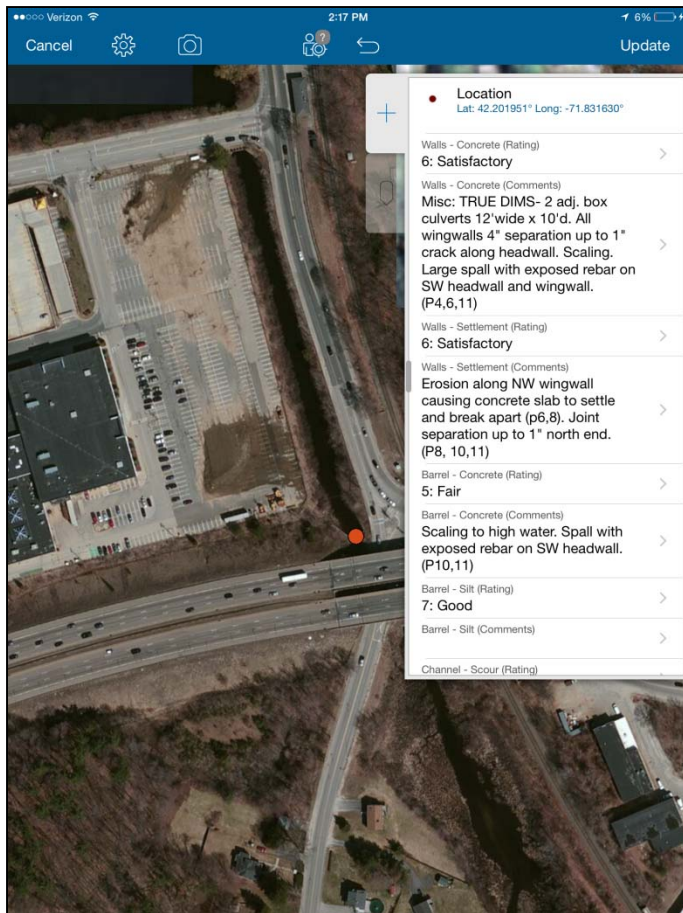
Collector Application Setup

- **MassDOT requested all inspections to be completed electronically in GIS format**
- **TranSystems approach:**
 - Collector for ArcGIS app
 - ArcGIS for Server (SDE)
 - 18 feature classes
 - 39 related tables
 - Hosted attachment link
 - ArcGIS Online (with access by external stakeholders)

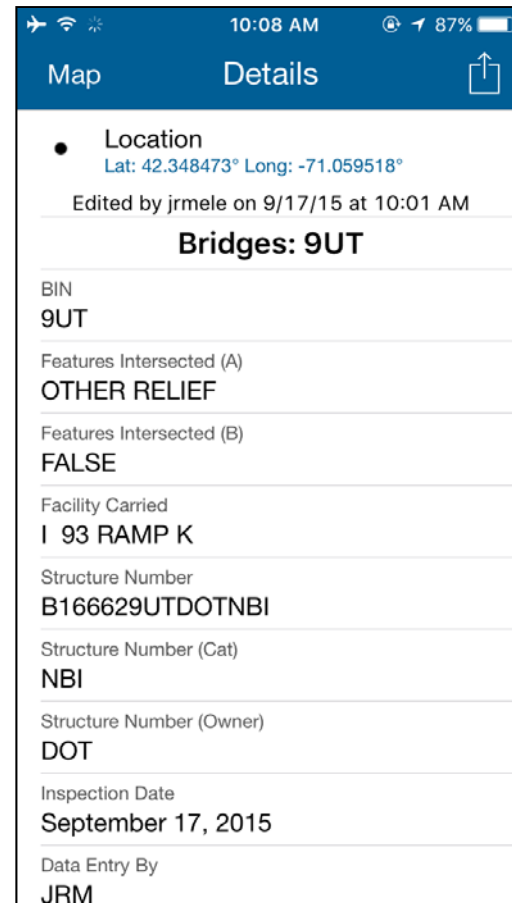


Collector Sample

iPad



iPhone



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ArcGIS Online maps

Home ▾ Mass Turnpike Buildings - Public New Map ▾ Douglas ▾

Details | Basemap | Share | Print | Measure | Find address or place

About | Content | Legend

Legend

Buildings

- Administration/Service Building
- Air Intake
- Emergency Response Station
- Garage
- Maintenance Facility
- Mechanical/Electrical Substation
- Office/Retail Building
- Salt Shed
- Vent Building

Buildings: MHS-ERS-002

Region MHS
 Building Type ERS
 Serial Number 002
 Building Name Emergency Response Station No. 10
 Inspection Date August 13, 2015
 Data Entry By AS
 Weather Sunny
 Temperature 80
 Team Leader WL
 Team Member AS
 Team Member 1
 Team Member Zoom to
[Show Related Records](#)

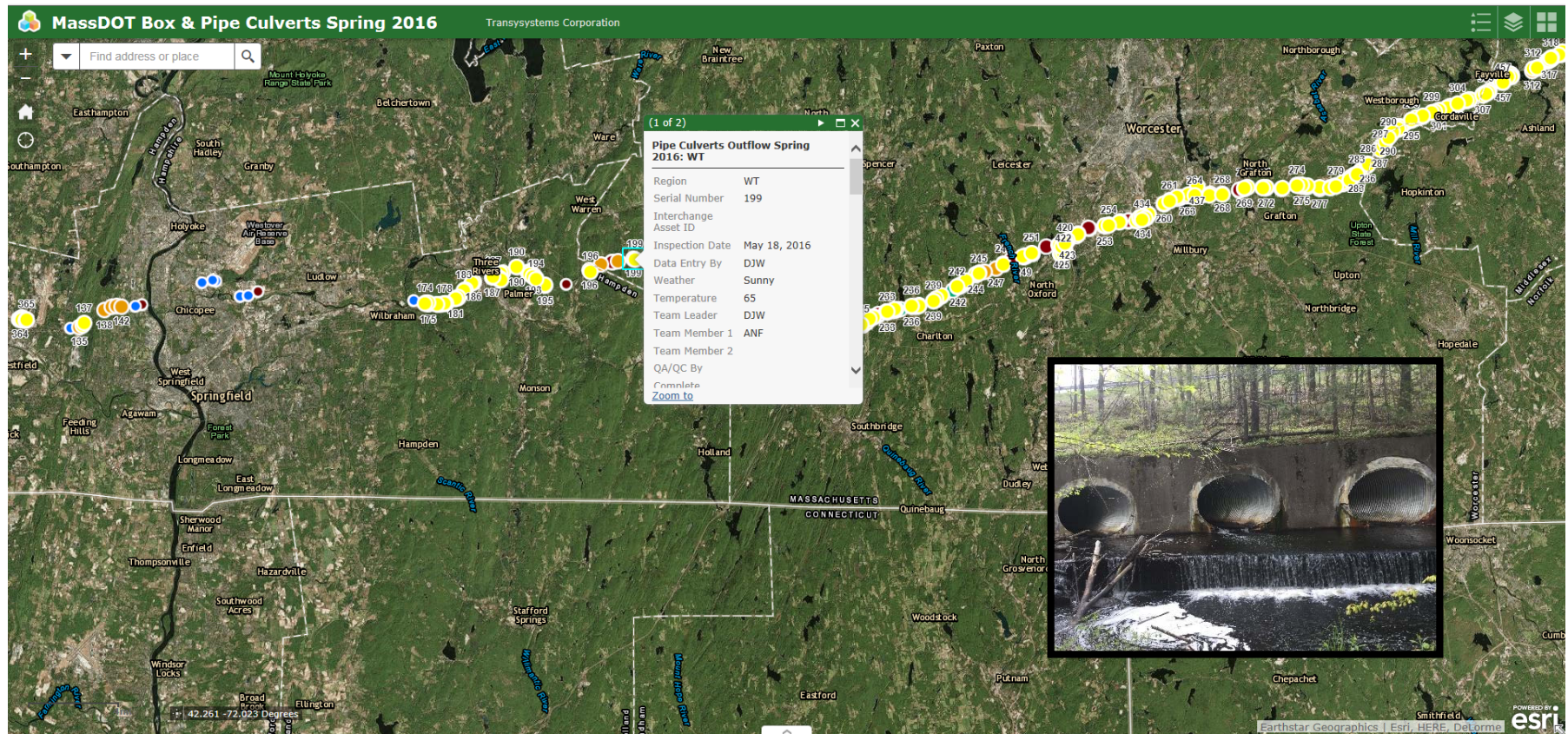
Bldg Interior Inspection (1 feature)

Item	Item	Item	Item	Item	Item	Item	Item	Item	Item	Item	Item	Item	Item	Item
62h.116 Ceiling (Rating)	62h.116 Ceiling (Comments)	62h.117 Beams (Rating)	62h.117 Beams (Comments)	62h.118 Columns (Rating)	62h.118 Columns (Comments)	62h.119 Interior Walls (Rating)	62h.119 Interior Walls (Comments)	62h.121 Windows (Rating)	62h.121 Windows (Comments)	62h.122 Louvers (Rating)	62h.122 Louvers (Comments)	62h.123 Doors (Rating)	62h.123 Doors (Comments)	62h.124 Floor (Rating)
5: Fair	There are scattered water-stained ceiling tiles	7: Good		H: Hidden/Inaccess		7: Good		7: Good		7: Good		7: Good		6: Satisf

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Web App Builder Application



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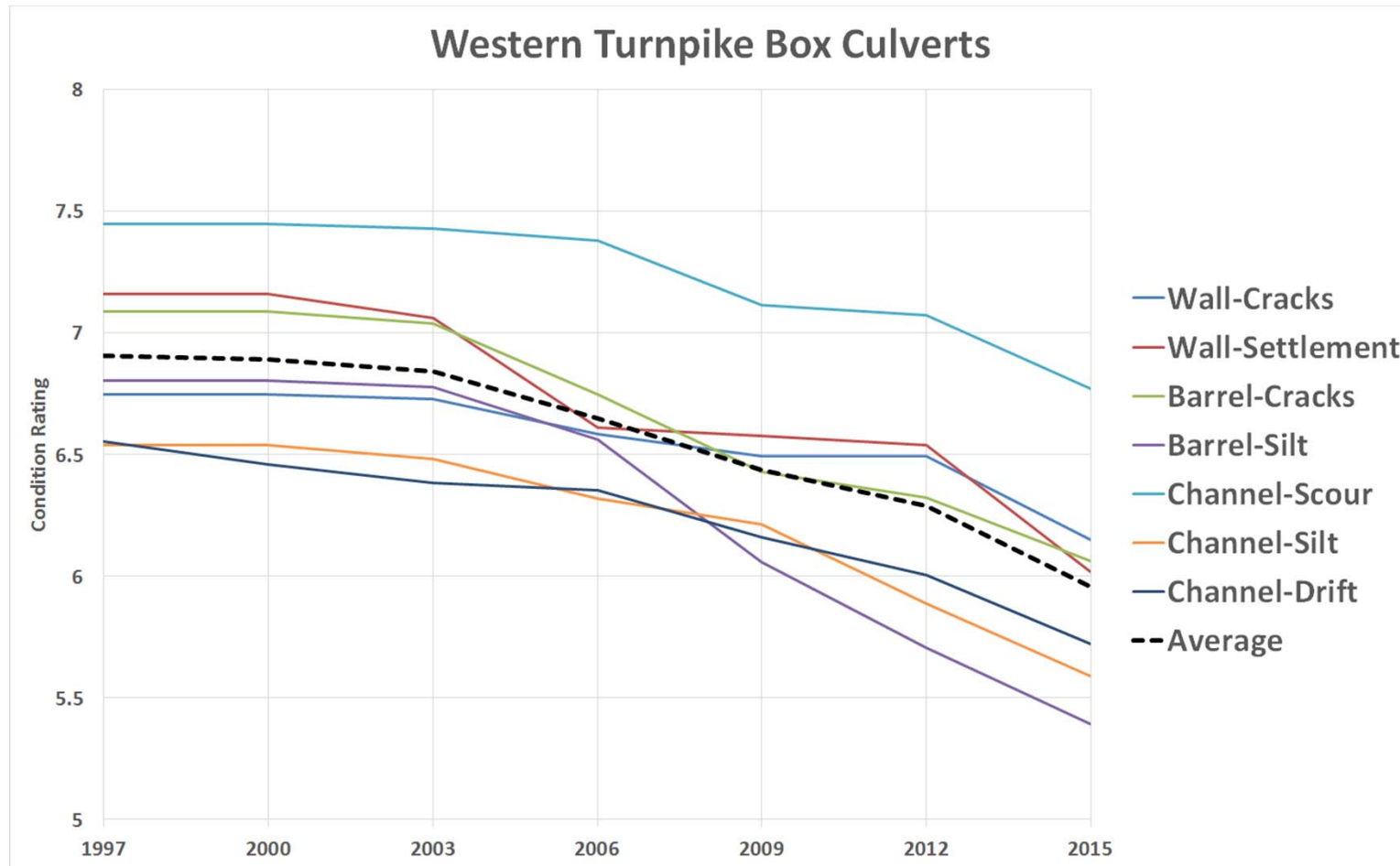
Deterioration Calculation / Cost Estimates

- **Used SQL queries to combine data from 182 separate MS Access databases, comparing the ratings of each asset longitudinally from 1997-2015**
- **Exported data to MS Excel for visualization and analysis**
- **Created “apples-to-apples” comparison of each asset year-over-year**

Deterioration Output

InspYear	AssetID	WindowR	WindowC	PaintR	PaintC	DoorsR	DoorsC	SidingR
1997	WT-SERV-001			7		7		
2000	WT-SERV-001			7	PAINT PEELING	7		
2003	WT-SERV-001			7	PAINT PEELING	7		
2006	WT-SERV-001	8		8		8		9
2009	WT-SERV-001	8	MINOR	7	MINOR PAINT I	8		7
2012	WT-SERV-001	8	• SOME CAULKI	7	• MINOR PAIN	8		7
2015	WT-SERV-001	7		7	Peeling paint a	7	Minor rust at b	7
1997	WT-SERV-002			6		7		
2000	WT-SERV-002			6	PAINT EXHIBITI	7	DOOR FRAME F	
2003	WT-SERV-002			11		11		
2006	WT-SERV-002							11
2009	WT-SERV-002							11
2012	WT-SERV-002							11
1997	WT-SERV-003			7		7		

Deterioration Output



Inspection Reports – Automated GIS Data Import Process

massDOT Massachusetts Department of Transportation		2015 Massachusetts Turnpike Triennial Inspection		TranSystems	
Asset Information					
Location	Location				
Milemarker	Mile				
Inspection Information					
Date	InspDate	Weather		Weather	
Team Leader	TeamLeader		Temperature	Temperature	
Team Member 1	TeamMember1		Data Entry By	DataEntryBy	
Team Member 2	TeamMember2				
Inspection Ratings					
Detail					
Building Exterior Inspection					
Windows	ExtWindowR	ExtWindowC			
Paint	ExtPaintR	ExtPaintC			
Doors	ExtDoorsR	ExtDoorsC			
Siding	ExtSidingR	ExtSidingC			
Roof	ExtRoofR	ExtRoofC			
Sidewalks	ExtSidewalkR	ExtSidewalkC			
Cleanliness	ExtCleanlinessR	ExtCleanlinessC			
Miscellaneous	ExtMiscR	ExtMiscC			
Building Interior Inspection					
Paint	IntPaintR	IntPaintC			
Floors	IntFloorsR	IntFloorsC			
Walls	IntWallsR	IntWallsC			
Fixtures	IntFixturesR	IntFixturesC			
Heating	IntHeatingR	IntHeatingC			
Plumbing	IntPlumbingR	IntPlumbingC			
Electrical	IntElectricalR	IntElectricalC			
Ceiling	IntCeilingR	IntCeilingC			
Miscellaneous	IntMiscR	IntMiscC			
Page Footer					
Date()	="Page " & [Page] & " of " & [Pages]		TranSystems Corporation, 2015		



massDOT Massachusetts Department of Transportation		2015 Massachusetts Turnpike Triennial Inspection		TranSystems	
Asset Information					
Location	SERVICE AREA - IE				
Milemarker	8.53				
Inspection Information					
Date	08/11/2015	Weather		2	
Team Leader	DL	Temperature	70		
Team Member 1	TS	Data Entry By	DL		
Team Member 2					
Inspection Ratings					
Building Exterior Inspection					
Windows	7	No comments provided.			
Paint	7	Peeling paint at rear of visitor center (photo 2). Paint peeling in scattered locations of main building.			
Doors	7	Minor rust at bottom of electrical disconnect doors on main building south side. Minor scratches to doors at east side of main building. Entry door to visitor center has rusted hinges at the base. Minor rust to visitor center roof fascia and overhang.			
Siding	7	Paint peeling and some minor scratches at scattered locations.			
Roof	7	East side of main building has several loose shingles (photo 7). Minor rust to visitor center roof fascia.			
Sidewalks	6	Some spalling, cracking, and deterioration of sidewalks around visitor center and main building. Curbs are separating from sidewalk concrete in a few places.			
Cleanliness	7	No comments provided.			
Miscellaneous	7	Missing light fixtures on rear of visitor center. Visitor center is nonoperational and closed (photo 1). Minor concrete coating deterioration at foundation wall of visitor center.			
Building Interior Inspection					
Paint	7	Isolated areas of peeling paint in the public restaurant area.			
Floors	7	Isolated chipped/cracked floor tiles near the restrooms.			
Walls	7	No comments provided.			
9/25/2015					
Page 1 of 6		TranSystems Corporation, 2015			

Recommended Action Plan

- **Facilities: Performance Targets**

- 100% in Overall Satisfactory or Greater Condition
- No Elements Less Than Fair Condition

- **Steps Required to Achieve and Maintain Performance Targets:**

- Perform Routine and Preventative Building Maintenance
- Perform Routine and Preventative Site Maintenance



Triennial Review Summary

- **Inspection Findings**

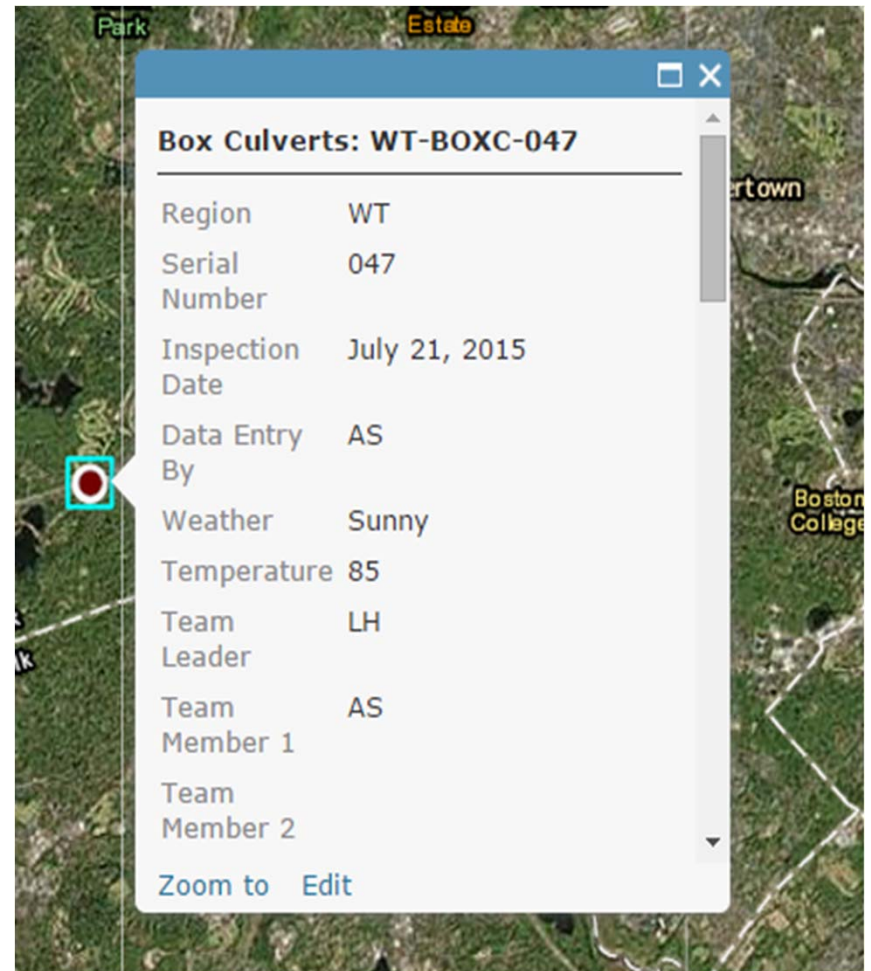
- Inspections showed a wide range in asset condition from Excellent to Poor, with many assets trending downward
- TranSystems developed an Action Plan based on asset condition and what work needs to be done to reach SGR across all asset categories and based on known market costs
- Provided range of data estimated value of repairs, snapshot views of how assets compare to each other, identify capital improvement costs/prioritization of need

- **Recommendations**

- TranSystems' recommendation is a \$134 -\$142 million investment level from 2016-2020 to reach and maintain a State of Good Repair
- Approx. \$135 million each year to reach and maintain a State of Good Repair over a 20 year period.

Time Savings, Value-Adds

- **No need for manual entry of static asset information**
- **Automated SQL queries to compile historical data**
- **Real-time report generation and management**
- **Photos automatically associated with assets**
- **Real-time access to inspection data for QA/QC**



TranSystems Deliverables to MassDOT – Phase A

- 1. 2015 Inspection Report**
- 2. Capital Plan**
- 3. Consolidated GIS Database, Collector Application, and Web App Builder/AGOL**

Potential Future Enhancements

- **Real-time dashboards of inspection progress**
- **QA/QC process manager**
- **Integrate cost estimate and SOGR calculations into SQL queries**
- **Web-based report generation and viewing**

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QUESTIONS?

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