New Jersey Department of Transportation Extreme Weather Asset Management Pilot Study

Overview

Prepared for:

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Presentation Overview

Brief Overview of Pilot Study focusing on:

- Study Approach
- Results/Findings/Lessons Learned
- Next Steps

Aerial View of Study Area: I-80

Pilot Overview

2017 selected with 5 other states - Arizona, Kentucky, Massachusetts, Maryland, & Texas, to participate in a Pilot Program focused on extreme weather, climate risks, and asset management

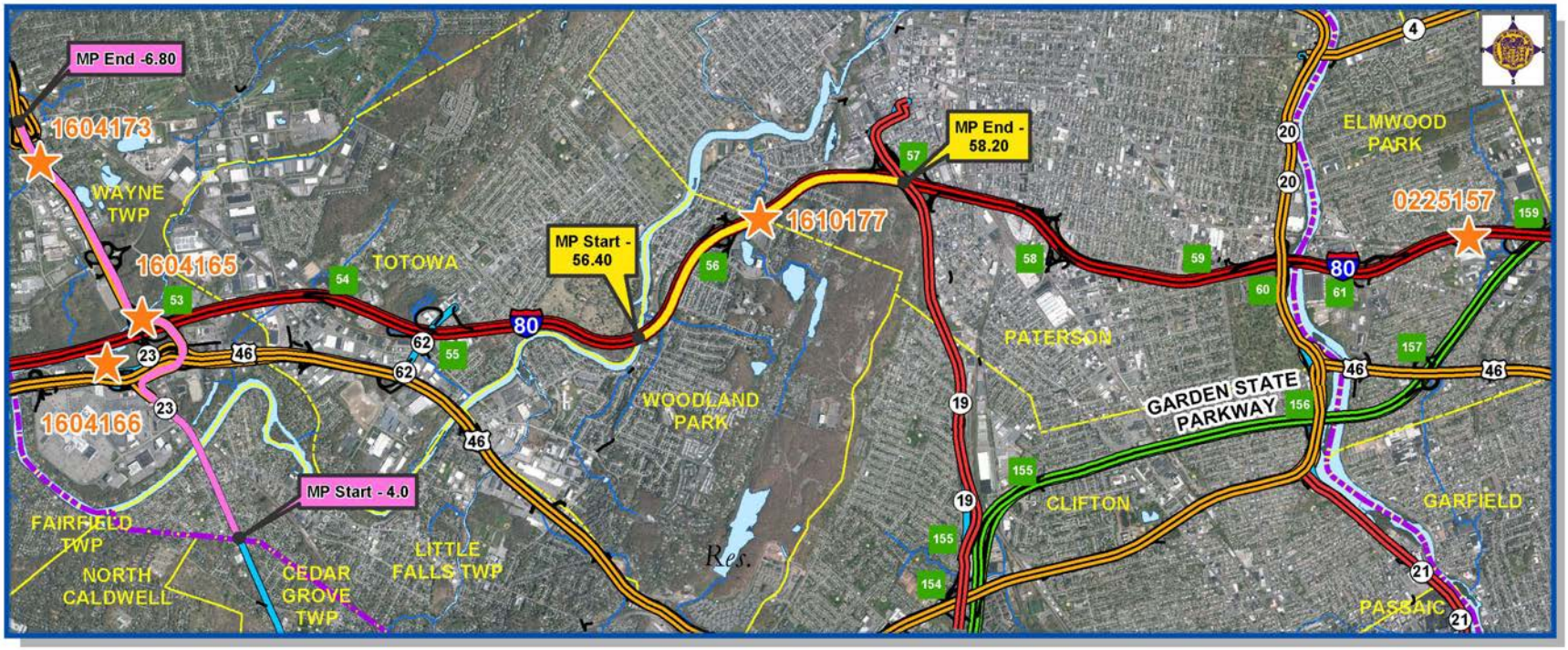
Aerial View of Study Area: I-80

Extreme Weather & Asset Management

- Original goal - determine how extreme weather conditions, precipitation, could affect culverts as the “asset class” in “Asset Management”
- Could not study the state’s entire culvert inventory so a focused study area was selected based on data that showed areas *vulnerable* to flooding – Drainage Management System (DMS)

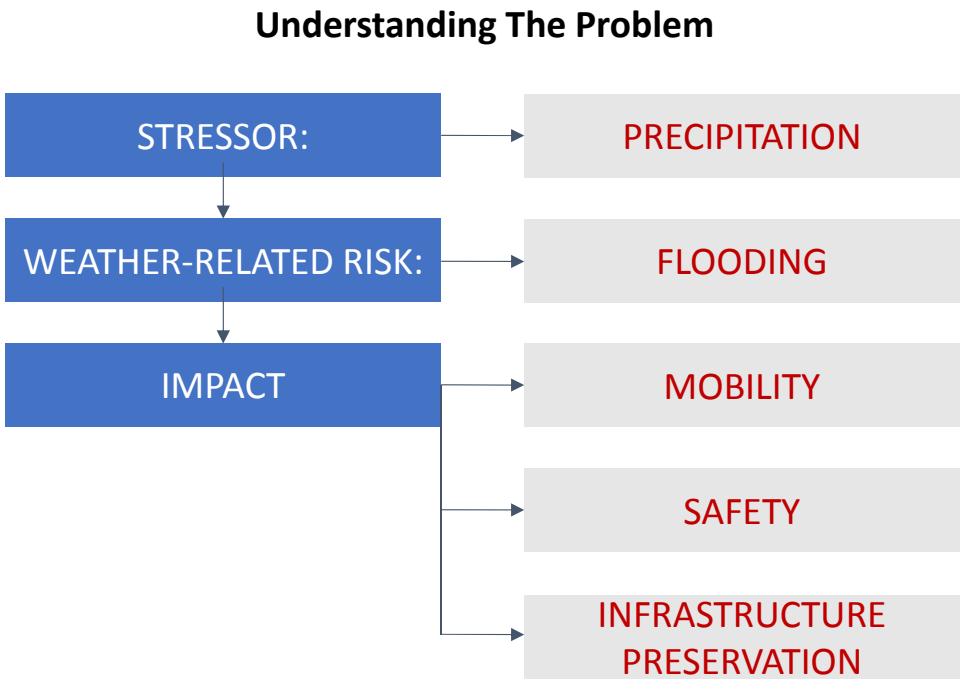
I-80 Culvert (located at MP 57.35 on Westbound direction)

Case Study Area



Linking Extreme Weather and Asset Management

- Asset Management, Extreme Weather, and Proxy Indicators Pilot
  - The research refocused to identify root cause(s) of flooding in the targeted area to develop the most cost-effective risk management mitigation to be considered in lifecycle planning



Compile & Integrate Data

Internal Sources:

- Drainage Management System (DMS)
- Maintenance Management System (MMS)
- Culvert Inspection Reports (Bureau of Structural Evaluation and Bridge Management, SEBM)
- Operations Region's Input
- Crash Data (Bureau of Transportation Data and Safety, BTDS)

External Sources:

- Concept Development Reports from Design Team (Louis Berger)
- NOAA

Other:

- GIS

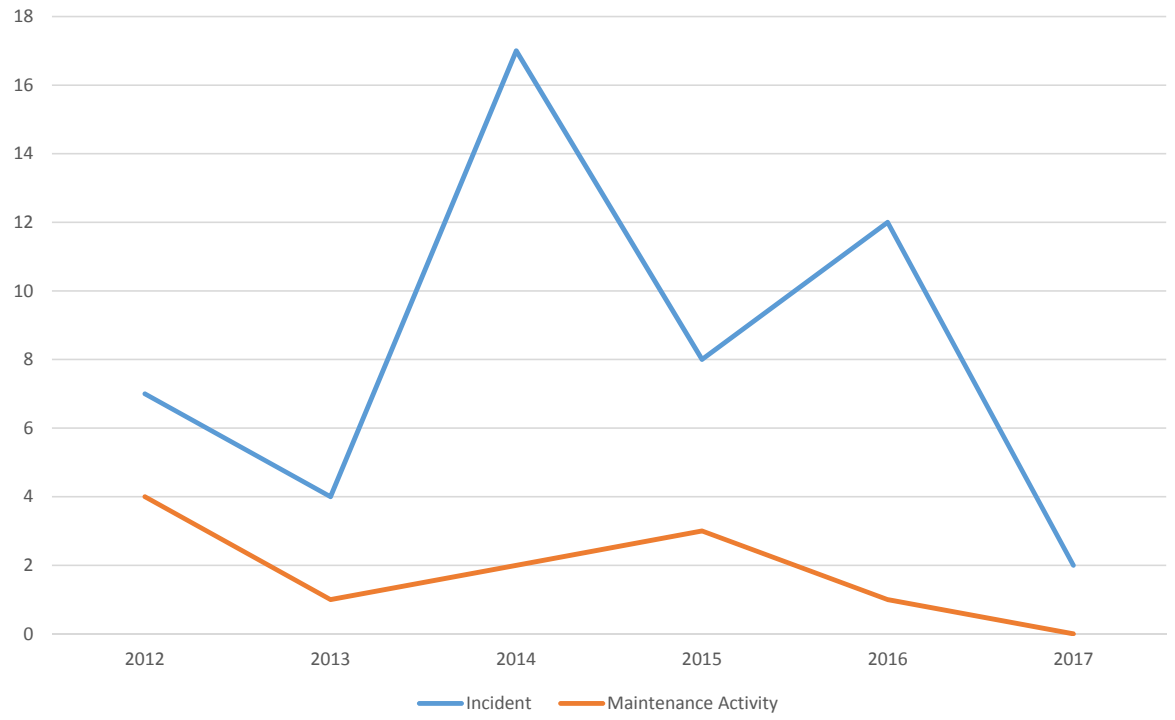
RANKING Rank Number	STD ROUTE Identifier	Begin MP	End MP
1	00000080_	56.43	58.22
2	00000035_	44.5	45.89
3	00000287_	35.7	36.6
4	00000017_	20.5	20.62
5	00000280_	13	14.4
6	00000040_	59.6	63.8
7	00000018_	36.6	36.7
8	00000280_	9.5	9.67
9	00000046_	61.75	63
10	00000078_	56.3	57.5
11	00000287_	3	3.2
12	00000017_	17.6	17.68
13	00000208_	5.3	6
14	00000023_	4	7

2016 DMS Rankings Snapshot

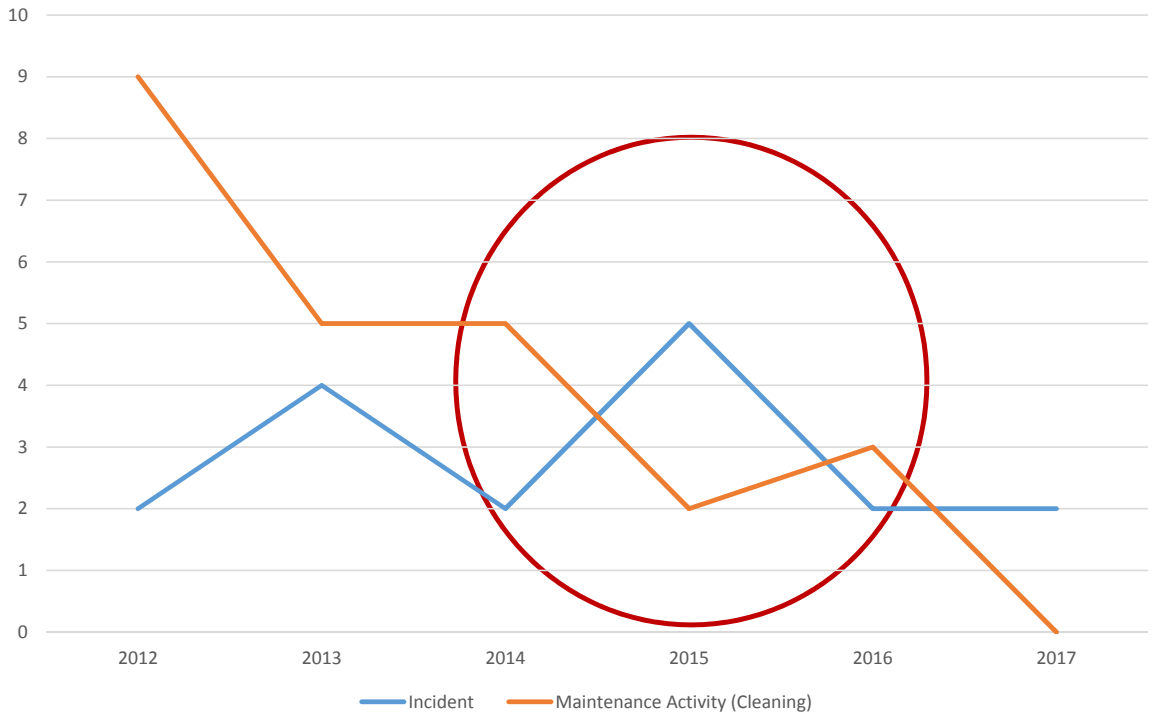
Data Analysis

- Data from DMS was sorted by year and location (mile post).
- Factors considered:
  - Total number of recorded flooding incidents in five-year period (2012-2017)
  - Number of recorded incidents by year
  - Number of recorded incidents by month
  - Repeated locations
  - Frequency of Maintenance Activities in the respective corridors
- Purpose: determine critical mile posts within case study area, lanes affected, other common/repeated factors.

I-80 Number of Incidents vs. Maintenance Activities (Cleaning) by Year (2012-2017)



Route 23 Number of Incidents vs. Maintenance Activities (Cleaning) by Year (2012-2017)



Comparison of Case Study Areas (2012-2017 Yr. Period)

	I-80	**Route 23**
Study area location:	MP. 56.43 to MP 58.22 (1.79 miles)	MP. 4.0 to MP 7.0 (3 miles)
DMS ranking (2016 data):	#1	#14
AADT in one direction:	62,515	29,092
Number of recorded incidents:	50	17
Critical areas:	WB between MP 57 – 57.5	SB between MP 6.8 – 62.82
Total number of maintenance activities in 5-yr. period:	18	42
- Cleaning activities (inlets/manholes/channels ditches/pipes):	11	27

Top Project Findings:

1. Understanding the root cause is key to developing cost-effective lifecycle management mitigation strategies and improve resilience – analysis showed lack of maintenance activities had a direct correlation with increased flooding occurrences increased maintenance activities can achieve a desired state of good repair

2. Current locations at risk may not encompassed by climate change predictions/projections – climate weather scenarios did not affect study area, flood inundation model did not impact study area but frequency and severity of rain events now and the immediate future will

3. Isolating asset classes may not provide an accurate representation of problems

How about the culverts ??

- As builts and inspection reports noted culverts were not contributing factors to flooding, drainage issues, not culverts….inlet spacing,
- Although designed and constructed some time ago without “extreme weather” considerations, function ok today, as long as they are maintained
- Reaffirms need to identify possible root causes of flooding, before strategies are developed to address risks of extreme weather

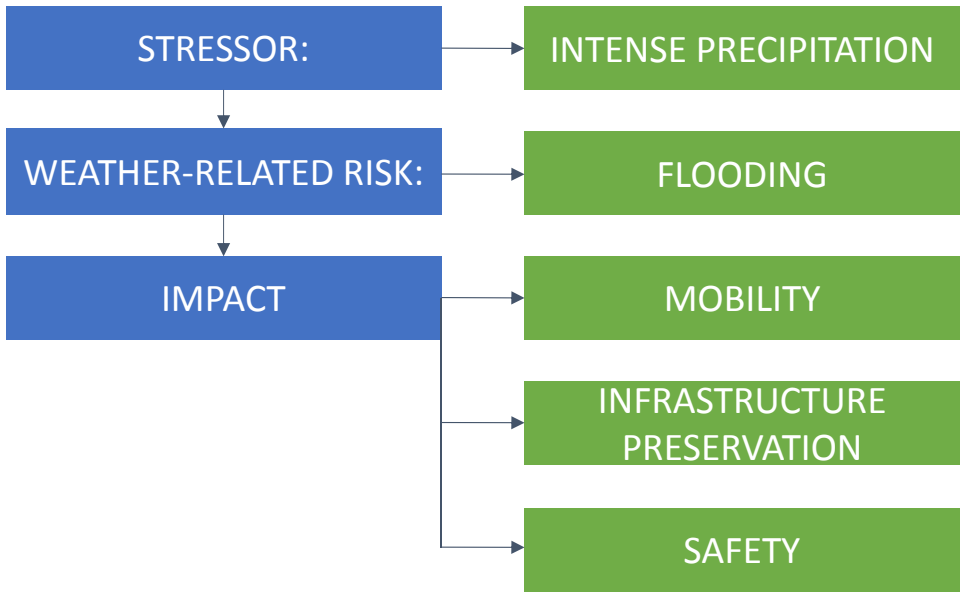
I-80 Culvert (located at MP 57.35 on Westbound direction)

Lessons Learned: Positives

1. Enhanced communication and coordination between internal and external stakeholders

2. Understanding relationships: Established clear relationships between stressor, weather-related risk, and impact(s) to the roadway.

Relationships



Lessons Learned: Challenges

1. Data collection efforts and data processing
   - Gaps in collection of road closure data/gaps in data management systems
   - Difficulty in obtaining weather-related incidents
2. Need for integration of management systems within NJDOT
   - Similar data currently housed in several management systems that do not communicate with one another
3. Direct integration of extreme weather into asset management practices

Overcoming Challenges

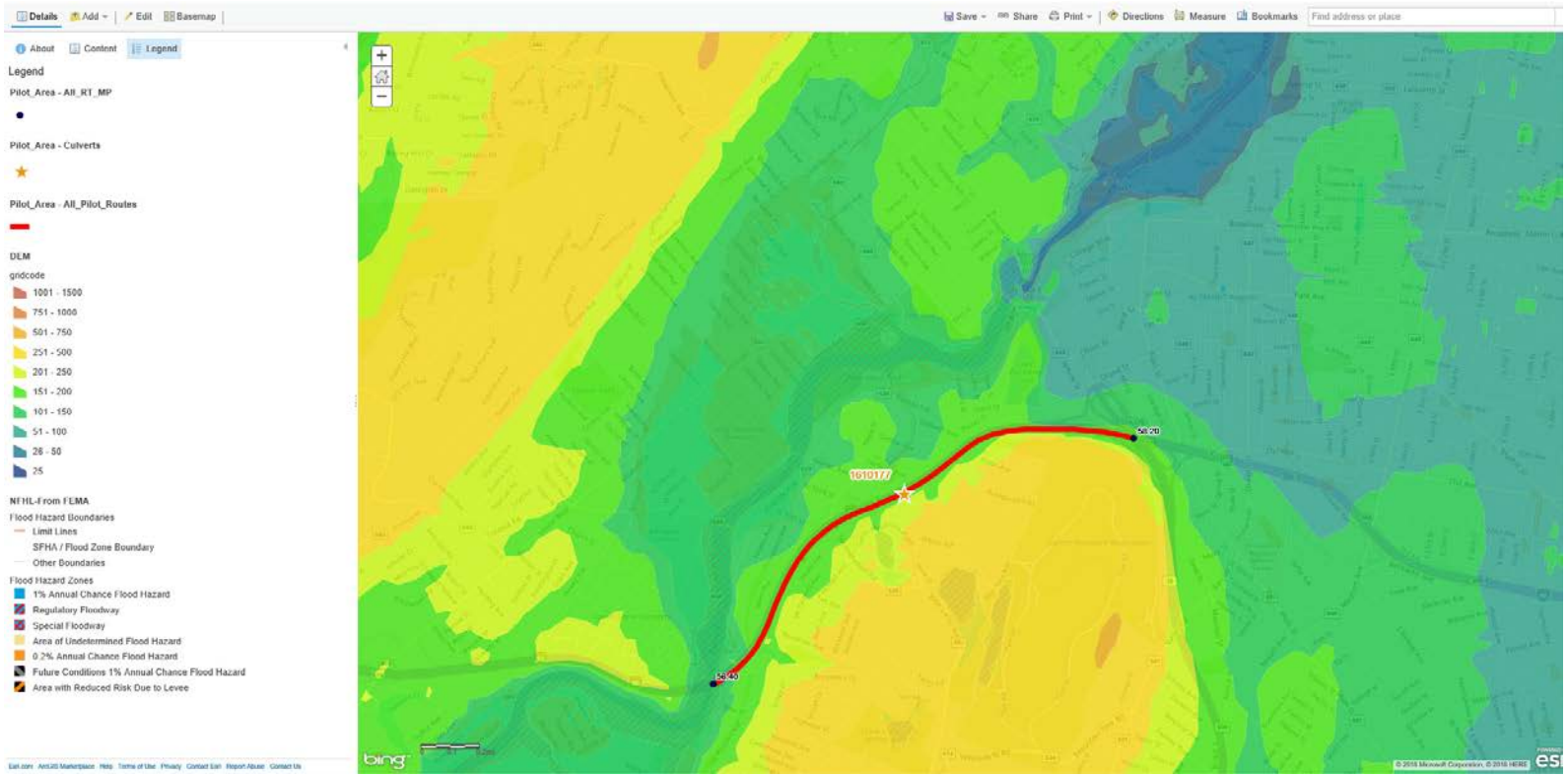
- Study team used best available data to integrate, analyze and carry study approach
  - Using current practices in NJDOT helped to determine gaps and provide enhancements to processes
- The use of GIS served as a great tool to integrate and visualize data, as well as propose enhancements and future uses in NJDOT's asset management practices

GIS Progress - Where we want to go

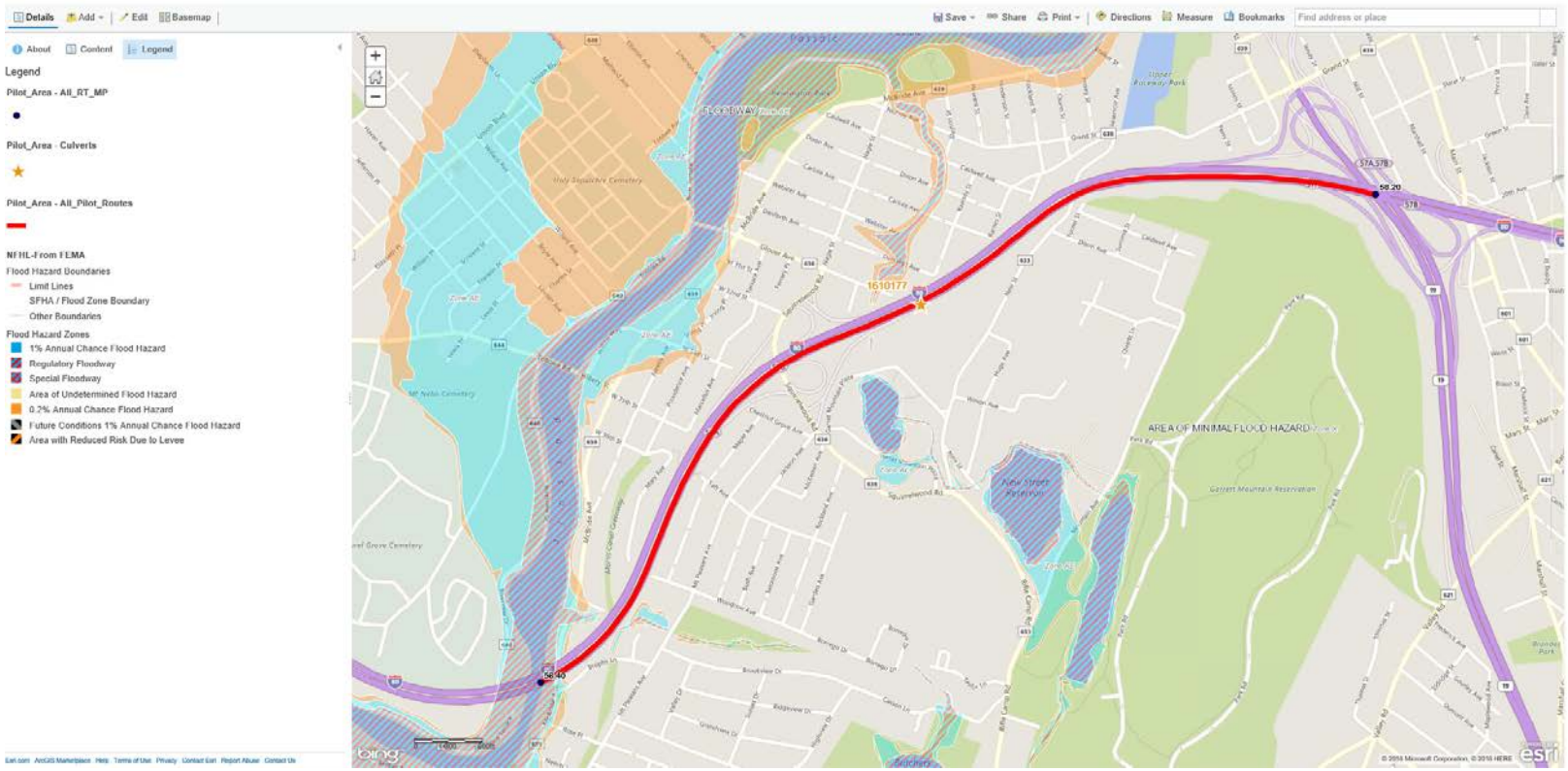
Developing a "Resilience Management Tool/System" to identify vulnerabilities

- Digital elevation model (DEM) layer.
- National flood hazard layer from FEMA.
- Soil hydrologic group layer.
- In progress: precipitation historical data and projections, and maintenance activities.
- Data shows:
  - Project case study areas are in low terrain (between 50' – 200').
  - Case study area soil group = low permeability.
  - Route 23 within 100-yr flood zone.

GIS – I-80 Digital Elevation Model

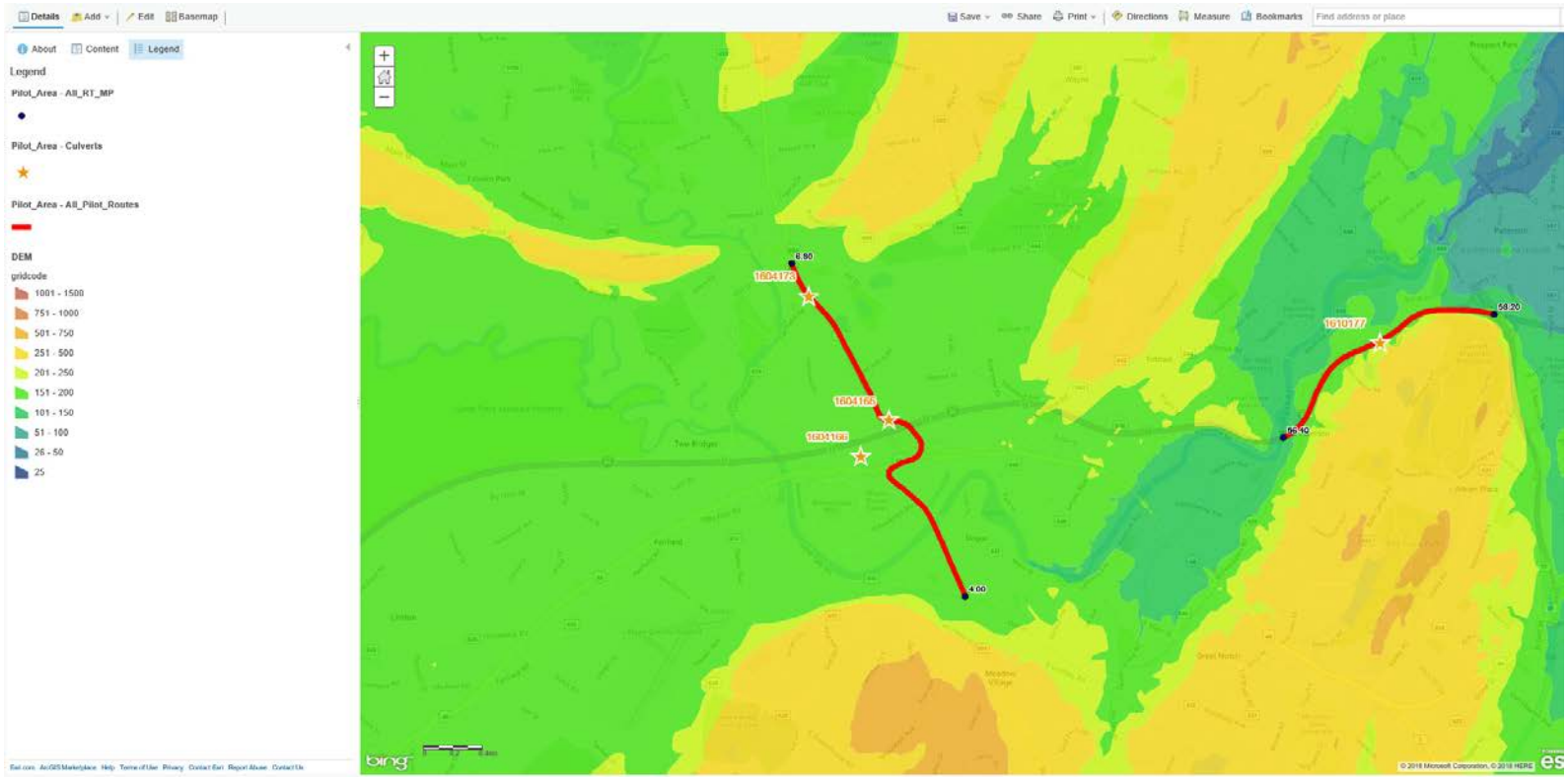


GIS – I-80 Flood Hazard Zones



GIS – I-80 Soil Groups

GIS – Rt. 23 Digital Elevation Model



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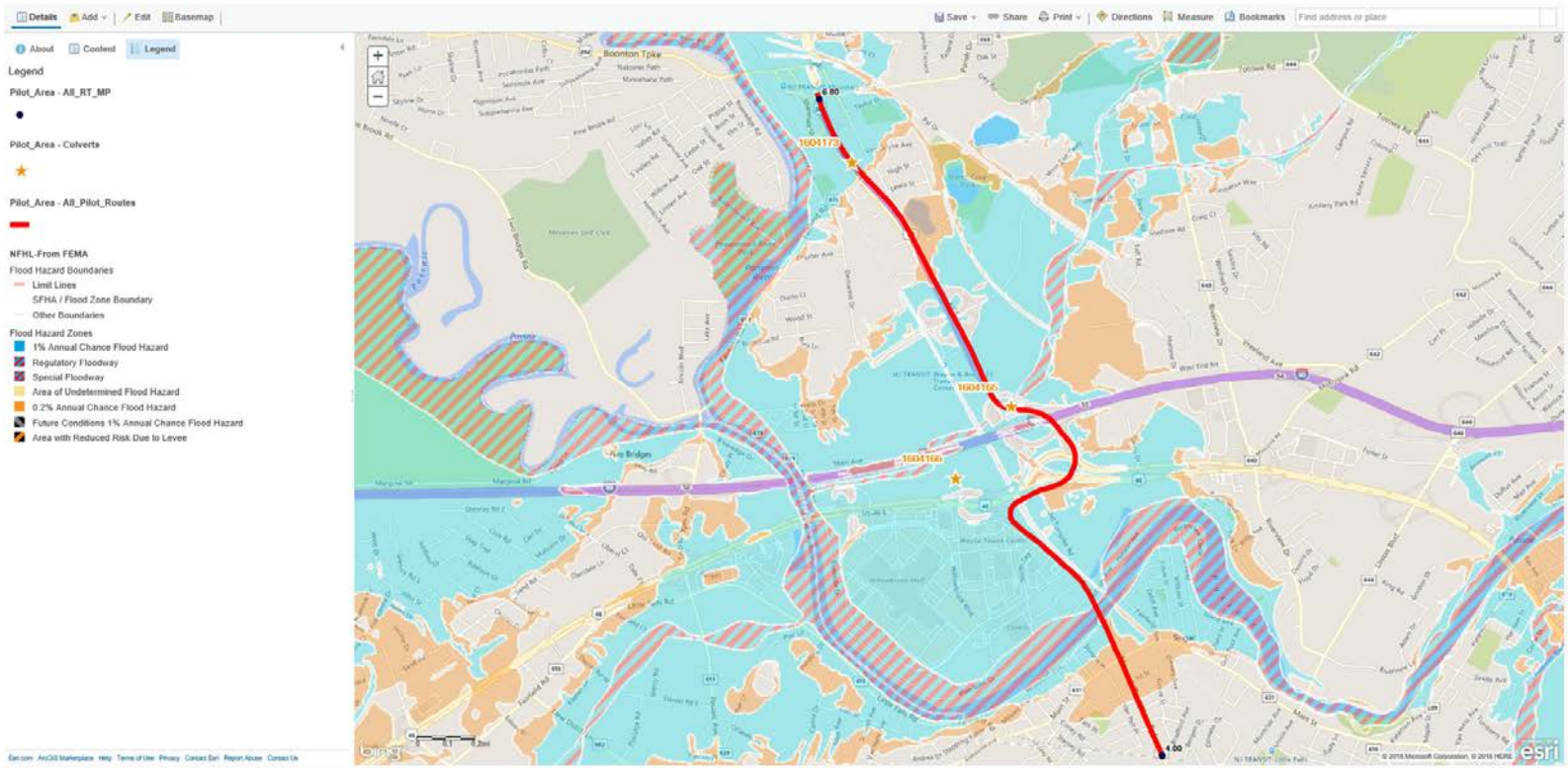

GIS – Rt. 23 Soil Groups

For Final Report:

1. Continue data integration efforts to enhance GIS tool:
   - Culvert inventory data
   - NJTPA's Passaic River Basin Study – Inundation projection models in I-80 case study area

NJDOT Actions/Continued integration of findings into asset management practices:

1. Use root cause analysis method in this study in other locations experiencing frequent flooding to identify cost-effective mitigation strategies
2. Increase maintenance activities at highly vulnerable locations; addressing current problems may increase resilience at these locations
3. Enhance technology tools and implement use of GIS tool during different stages of NJDOT's project delivery process

NJDOT Actions – Remaining gaps and needs:

4. Strengthen data collection methods/process related to extreme weather impacts to the roadway (road closures) "Weather Savvy Roads – EDC 5" ….
5. Consider conducting hydrologic studies at the facility-level on assets located in vulnerable sites that are under-capacity, have high social exposure (high traffic volumes/long detour routes/employment/population/access to critical facilities) and are not planned for reconstruction/replacement. Develop problem statements for the critical assets identified to feed project delivery process
6. Conduct facility-level adaptation assessments on projects identified within vulnerable areas; consider the use of climate change projection data
    1. Recommendation to use I-80 reconstruction project as a pilot in resiliency building in NJDOT. The Westbound Widening/Reconstruction project, could serve as an example to measure the benefits of resiliency building in New Jersey.

Incorporating Study Results into Asset Management

- Root cause analysis identifies a method to evaluate and develop risk mitigation actions
- Better understanding of relationship between stressor, roadway system performance and cause of problem
- Incorporate study's recommendations into lifecycle planning in the planning, design/engineering, and maintenance/operations phases
- Enhance/implement the use of GIS as a "Resiliency Management System" to be incorporated into NJDOT's current process