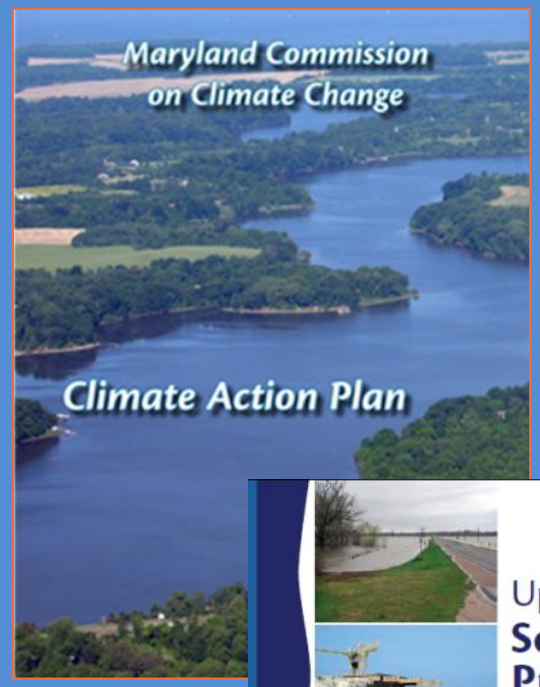
Field Data Collection in Support of a Vulnerability Assessment to Determine Potential Impacts of Sea Level Rise on Transportation Infrastructure and Associated Assets

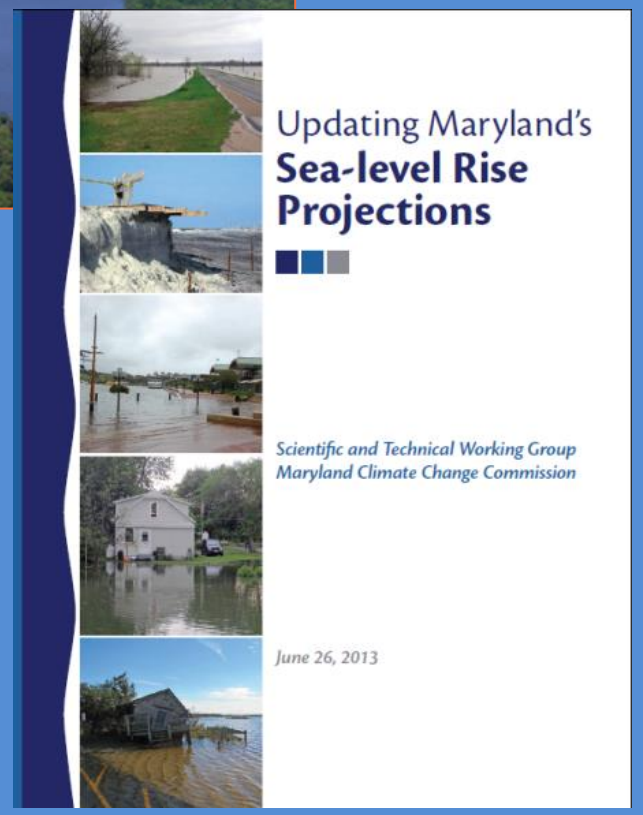
Floating Debris Lodged in a Bridge during Flood Event at Seneca Creek in Germantown, MD
Photo Source: (FEMA/Skolnik 2006)

SHA State Highway Administration
Maryland Department of Transportation

Maryland Climate Change Documents and Legislation

- Maryland Climate Action Plan
  - Required by Governor's Executive Order (January 2007) - Released August 2008
  - MD Commission on Climate Change Phase II Strategy for Reducing Vulnerability to Climate Change - 2011
- Updated Projections for Sea Level Rise in Maryland (June 2013)





Maryland Climate Change Documents and Legislation

- Maryland Greenhouse Gas Reduction Plan - October 2013
- Plan Maryland – MD Comprehensive Plan for Sustainable Growth & Development – December 2011
- “Coast Smart” Construction
  - EO - Requires 2 ft. freeboard from 100-yr floodplain for any State funded structure – “walled or roofed building” effective 7/1/2013
  - Infrastructure Siting and Design Guidelines – January 2014
  - HB 615 – Coast Smart Council & 2 ft. freeboard requirement for structures

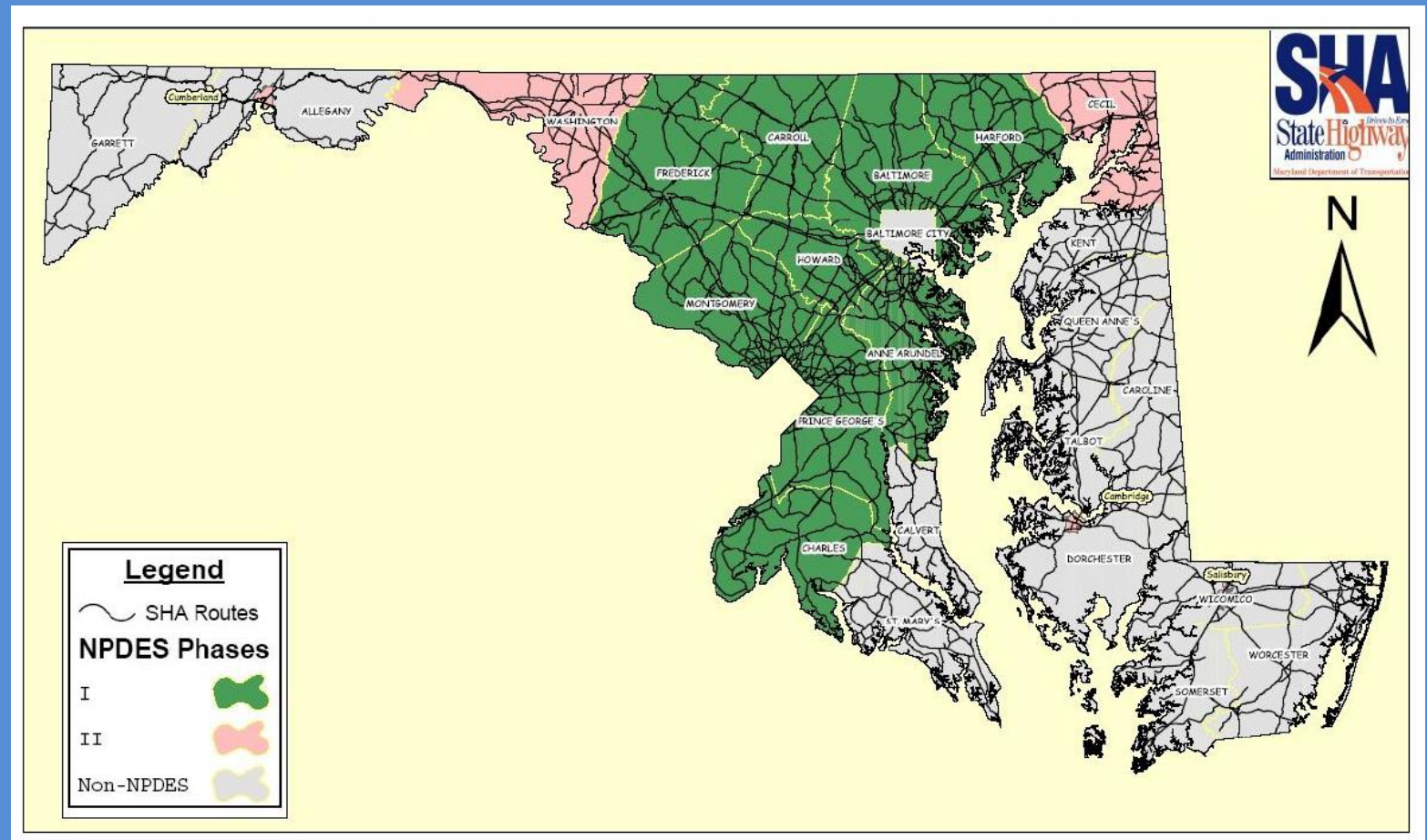
Vulnerability Assessment

- Salisbury University tasked to develop a Climate Change Vulnerability Assessment for SHA
- Acquired field data will be use to determine potential impacts to SHA infrastructure due to sea level rise.
- GPS collected horizontal and vertical locations to be used in a model for roadway and stormwater infrastructure vulnerability due to climate change and sea level rise.

SHA Stormwater Data

- Initial effort included researching available datasets to be used as input to the analyses Salisbury was tasked to perform.

- SHA's National Pollution Discharge and Elimination System (NPDES) Program included stormwater Best Management Practice (BMPs) data, and associated drainage systems for all required MS4 counties (i.e. Areas shown in green on the map) only.



Field Data Collection

•The activities for this project are similar to SHA's NPDES Program, where stormwater Best Management Practices (BMPs) and drainage systems are inventoried and inspected; resulting in the completion of a drainage assets geo-database.

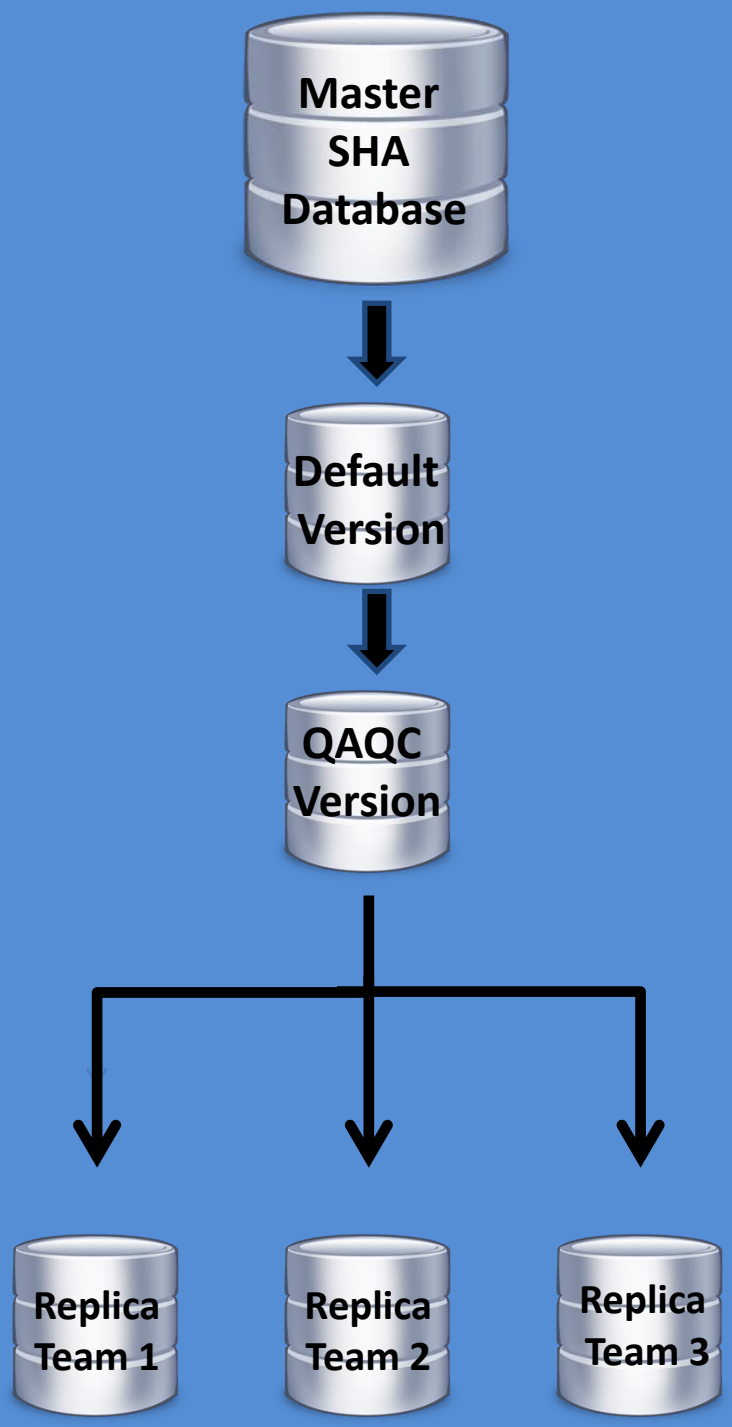
•Field data collection has been completed for Dorchester County and crews are currently collecting data in Somerset County.

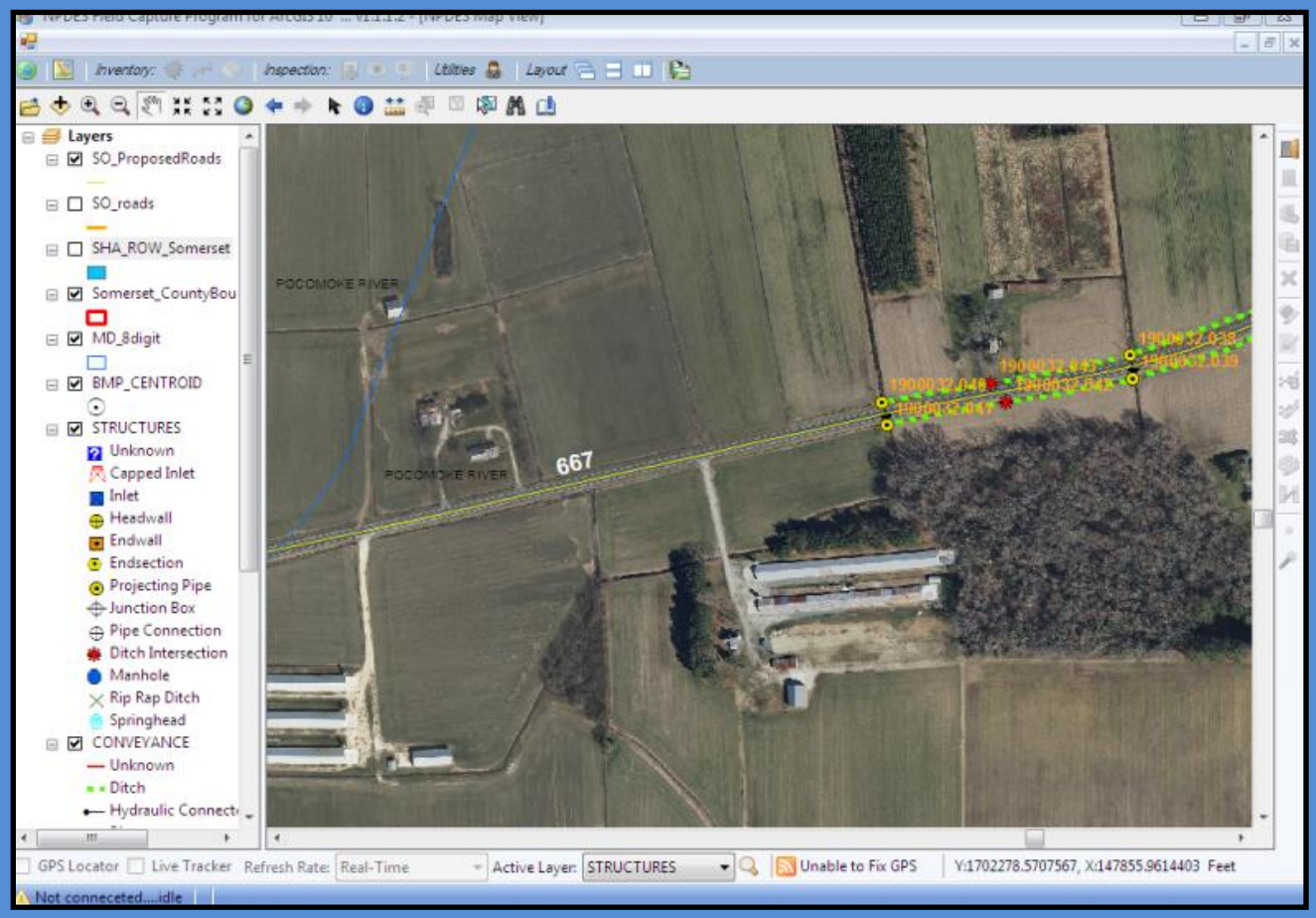
•Data collection is to occur in non-Phase I counties across the State. These are counties that are not required to maintain a MS4 permit.

MES GIS Specialist staff collecting GPS coordinate information for a stormwater pipe in Somerset County.

MES Environmental Specialist staff performing maintenance inspection on a storm drain inlet and recording the information in hard and in electronic copy.

Data Management





- SQL Server supporting a versioned SDE distributed geodatabase.
- QAQC version of master database
- Version controlled replicas for each team checked in and out on a weekly basis and QAQCed

<u>Office Inventory Tool</u>

- Net Framework 2+
- Net Support option for ArcGIS
- Versioned 10.0
- ArcEditor+

Field Equipment

•Pole mounted handheld Trimble GeoX7 with H Star and Floodlight technology.

•Units use mobile WIFI hotspots from Verizon Blackberry to access VRS network.

•In ideal conditions, unit specs yield +/-10cm accuracy.

•Units are set to not collect a point unless this level of accuracy is achieved.

•Pathfinder Office version 5.6 is used to calculate DOP values.

•Data collected using VRS network is not post processed.

•Maryland State Plane Feet

•Geoid12A – NAVD88

•MES GIS Specialist and Environmental Specialist staff collecting control points at a National Geodetic Survey monument to ensure accuracy.

•Control points are collected several times a day.

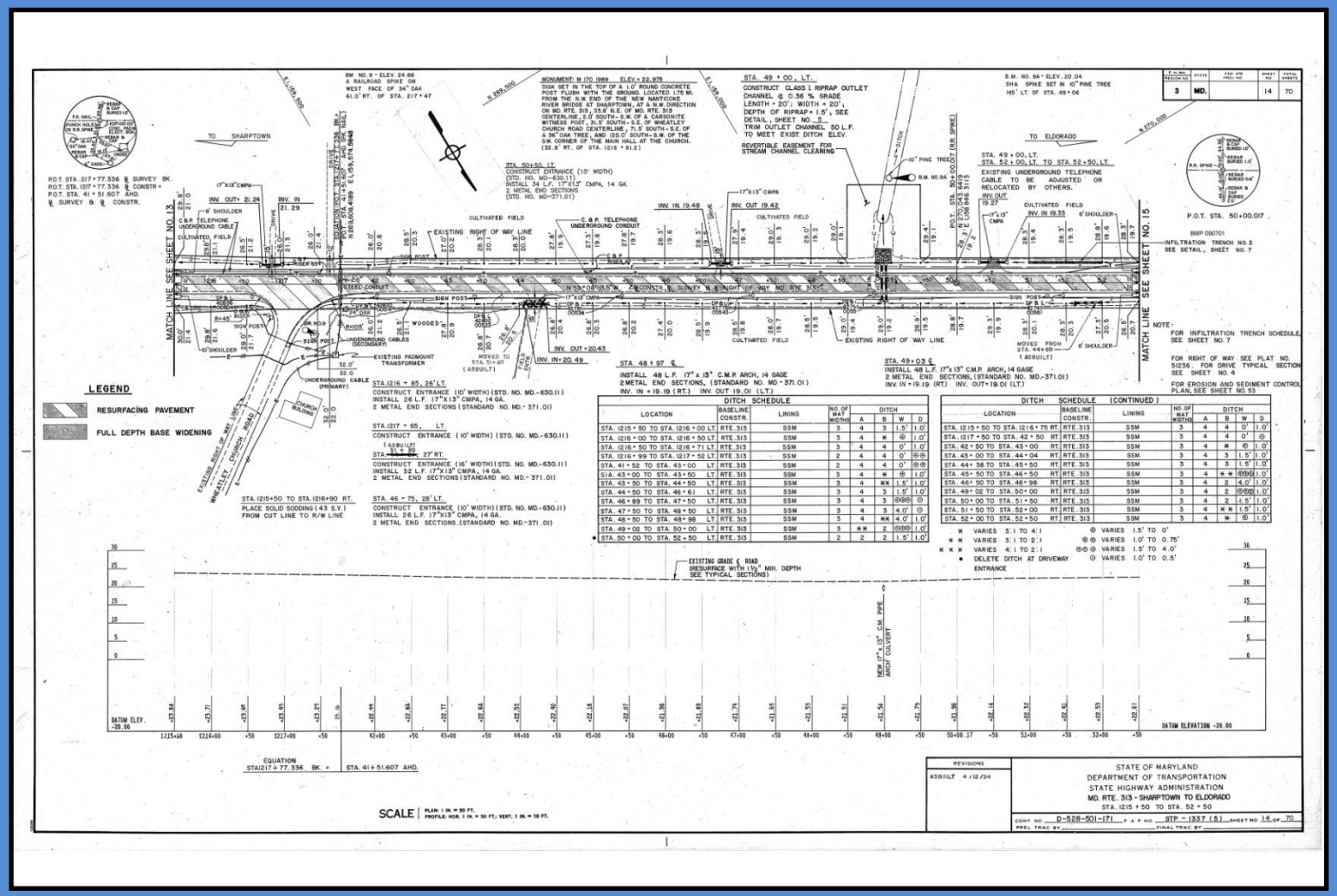
Field Editor Tool (FET) –The Field Tool requires the following components to operate correctly:

•.Net Framework 2+

•ArcEngine Runtime 10.0

•Valid ArcEngine 10.0 license

Contract and Plan Review



GIS data acquisition includes:

- GIS Data for BMPs, storm drains, hydraulic structures (inlets, manholes), cross culverts, some open conveyances and outfalls Major Outfalls identified
- Stormwater BMP inspections
- Outfall stability inspections
- Immediate reporting to SHA if illicit discharges are visually discovered;
- Digital field photographs to document the sites

Field Data Collection Workflow

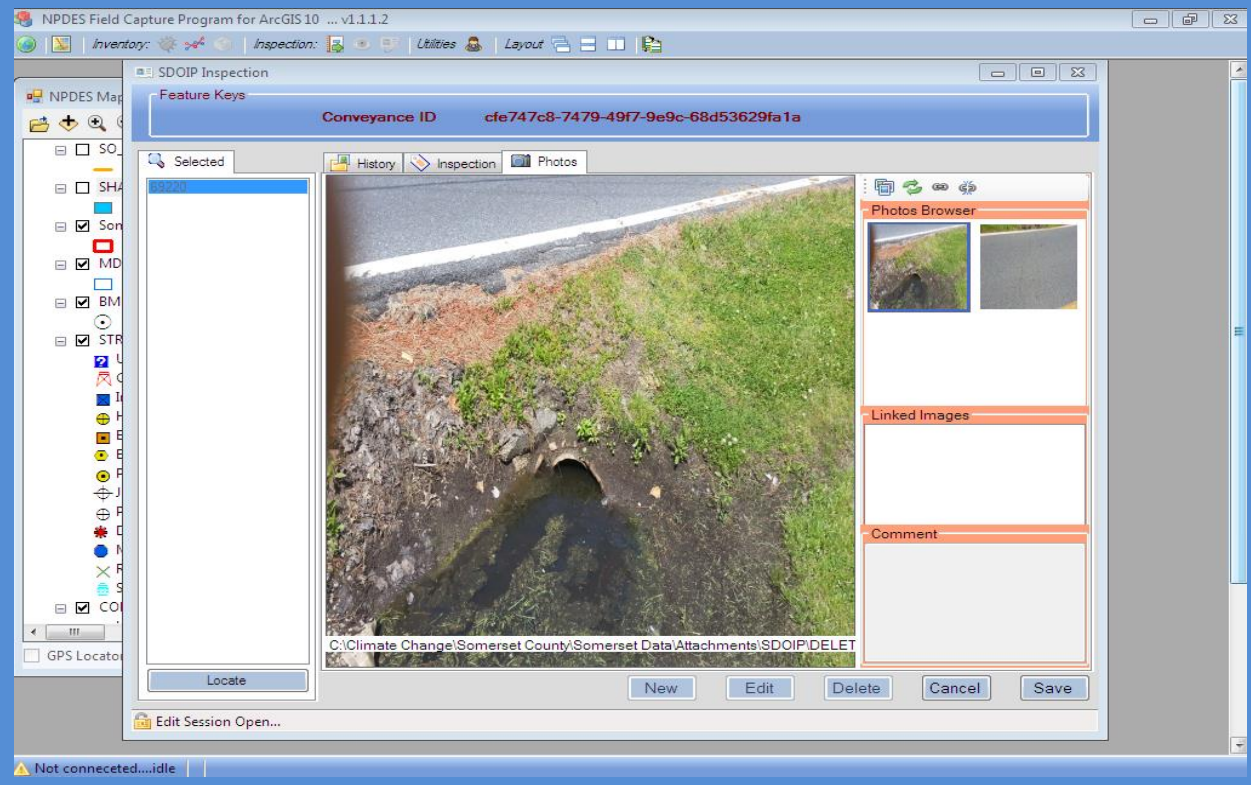
•At the beginning of the day each unit is verified against a NGS monument for accuracy.

•Teams then travel to designated routes and locate stormwater features.
•Features are collected for both routes with and without contract plans.

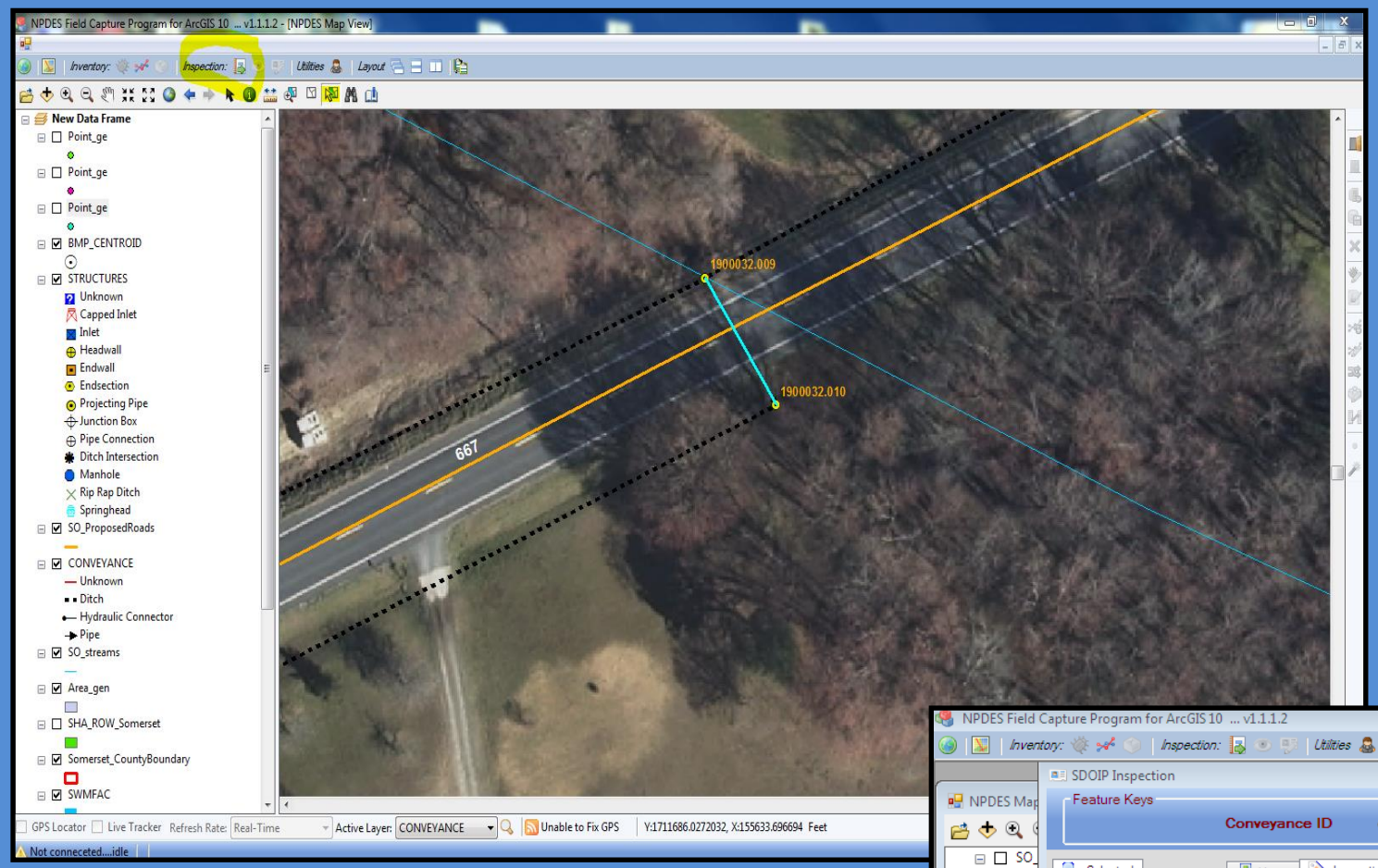
Field Data Collection Workflow

•When collecting data, field crews wait for the Trimble unit to reach 10 cm vertical and horizontal accuracy before creating a point.

• An inspection, including photographs, is then completed at each structure using the Field Editing Tool software using the Toughbook computers.

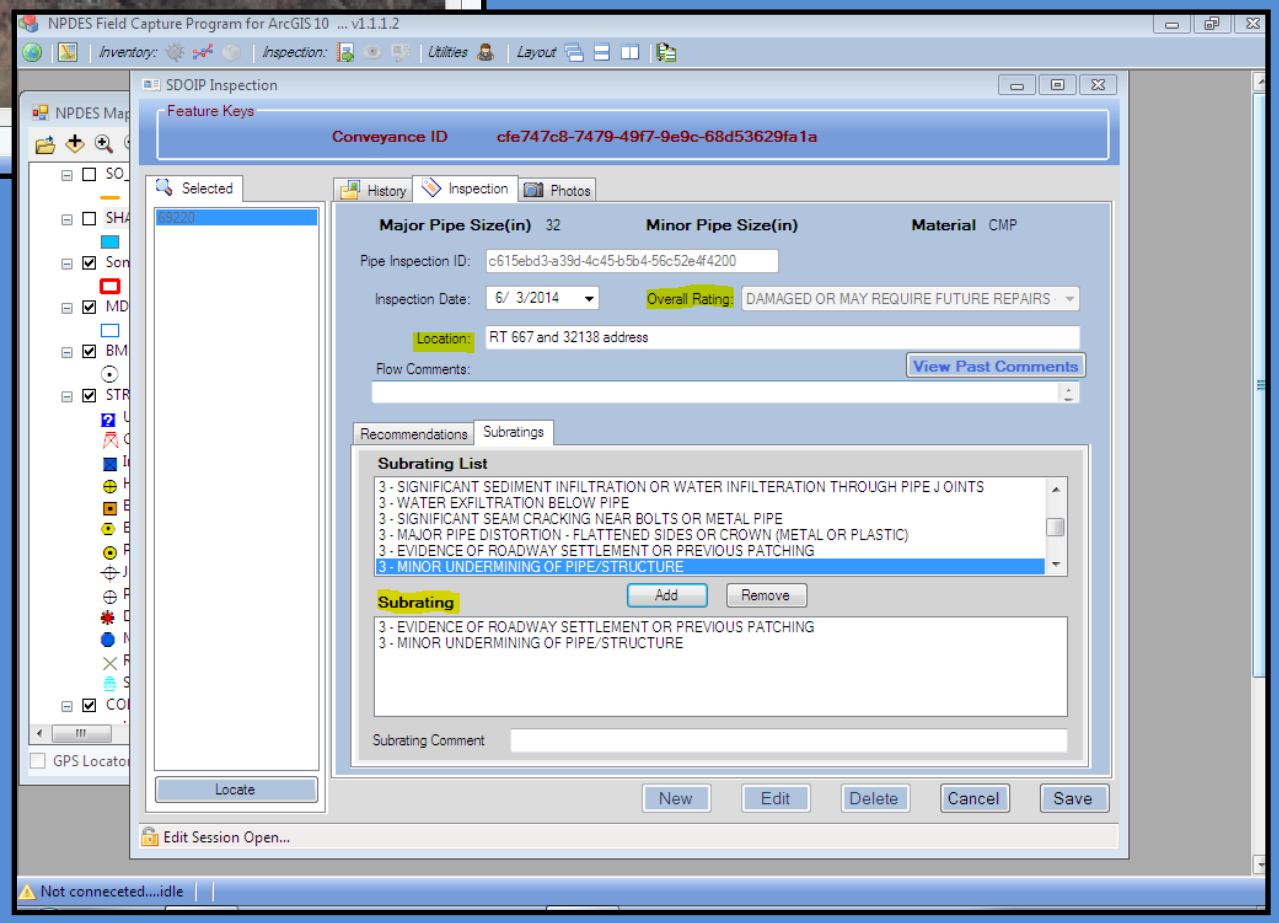


Field Data Collection Workflow

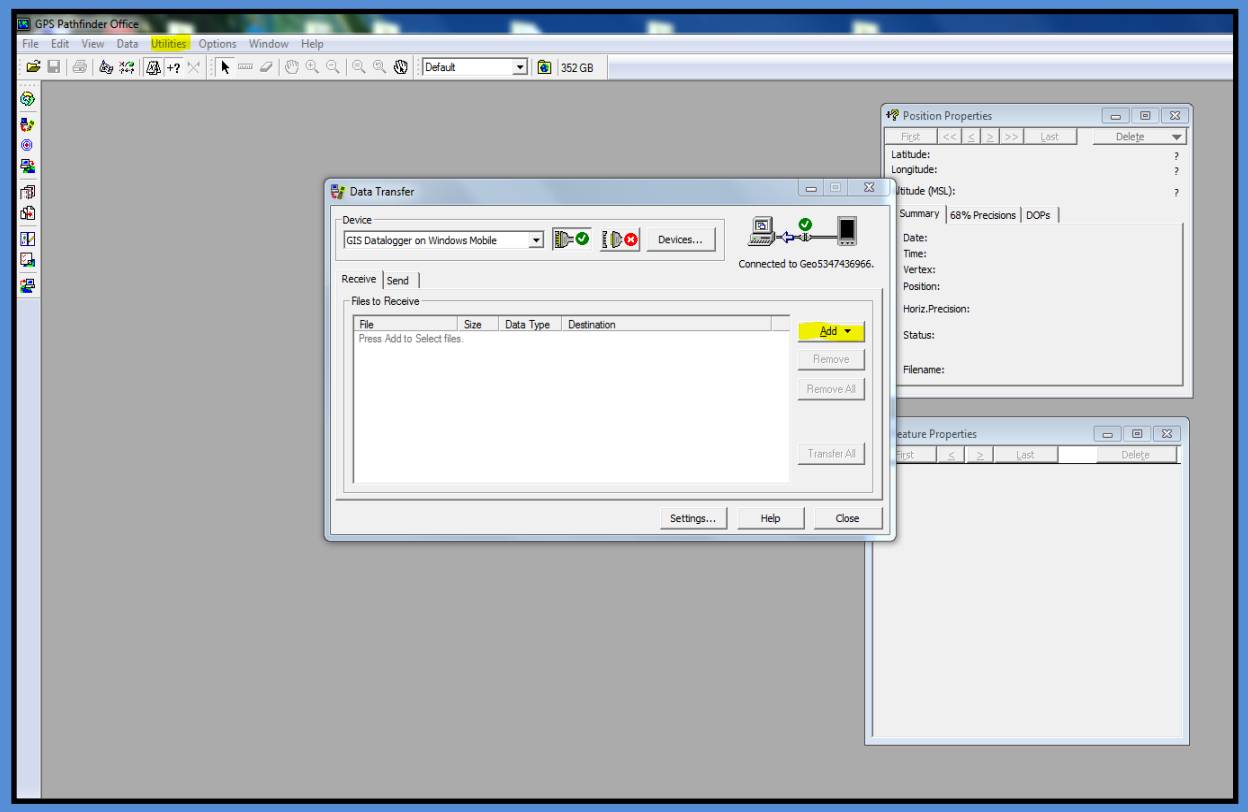


- Contract
- Owner
- Condition
- Material
- Size
- Elevation
- Flow direction
- Overall Rating

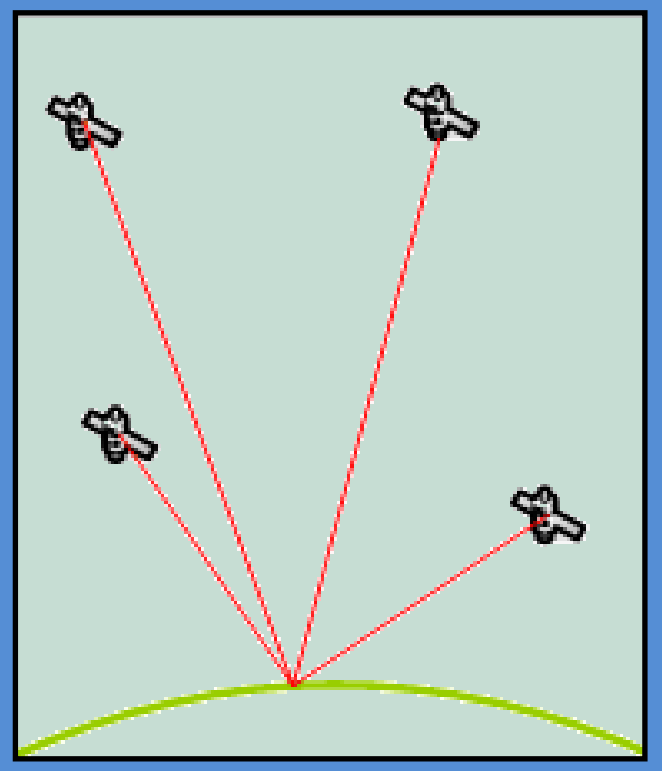
- Detailed inspection data is collected at each structure and BMP and are entered into the database.



Field Data Collection Workflow

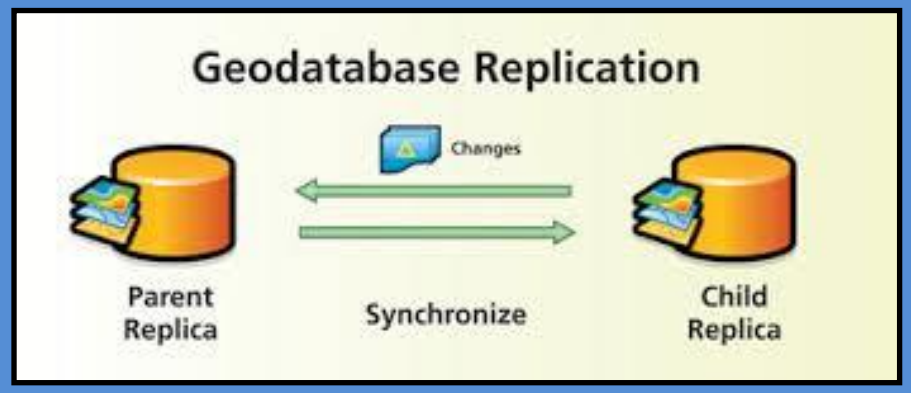


- At the end of each workday, data is projected and transferred to a shapefile using Pathfinder Office.
- Field crews then post process the data and perform QAQC.
- Photos of BMPs and structures are uploaded and linked to inspections.



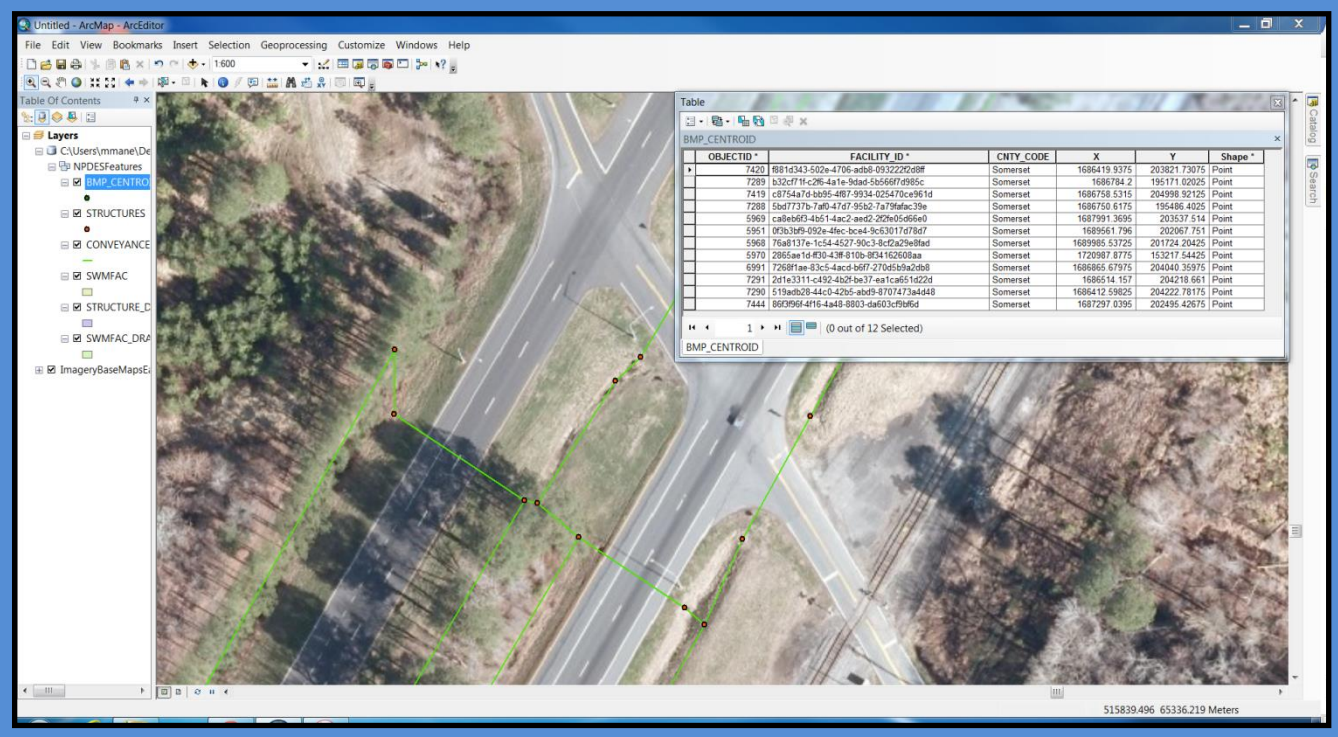
- GPS data is checked for DOP values and accuracy

Data Management



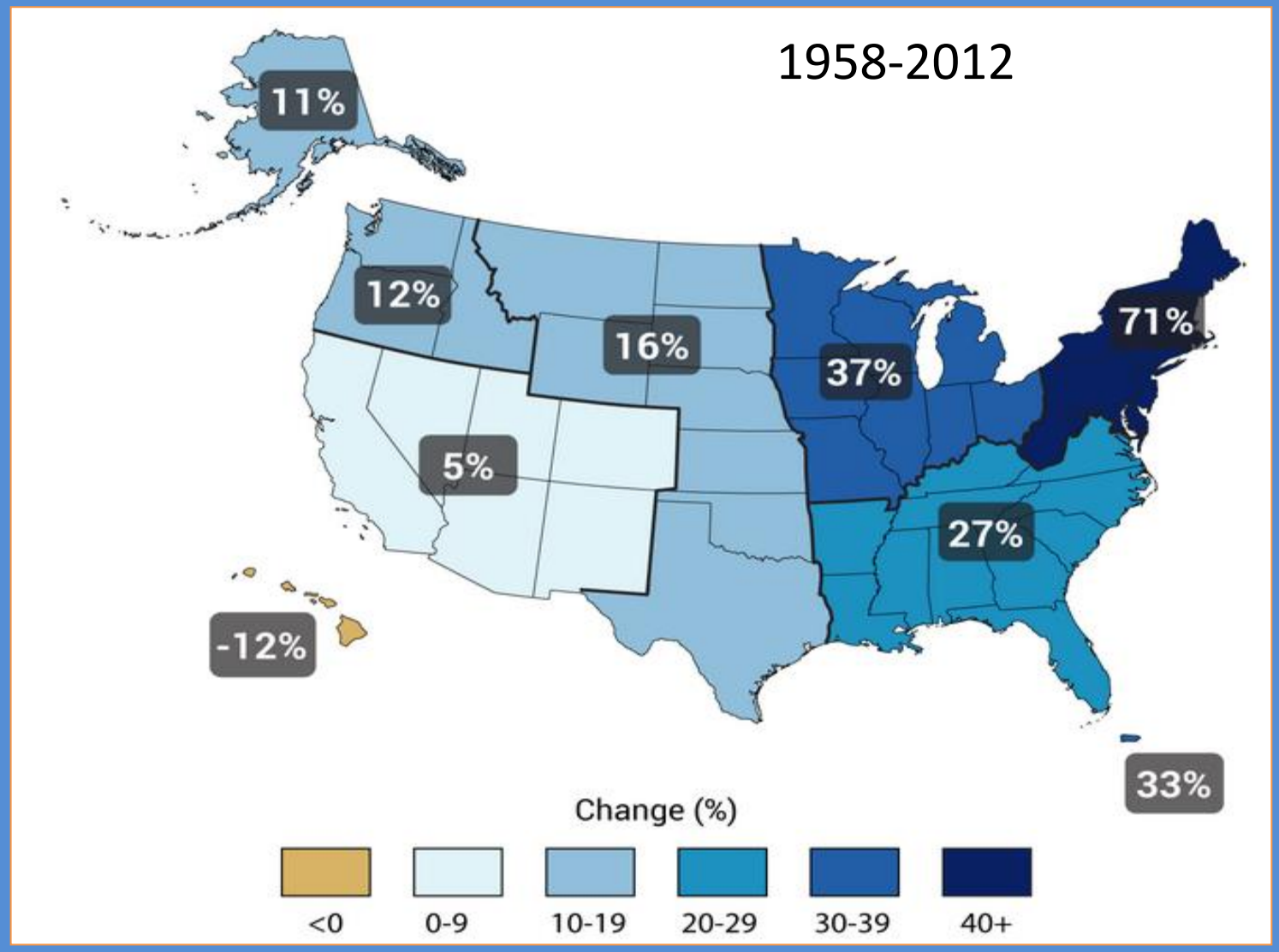
- Completed replicas are submitted at the end of each week and checked into the versioned QAQC database.
- Edits are synchronized, reconciled and posted to Production database.
- New replicas are created which contain the data from each child replica from the week before.
- Data is then QAQCed by the database administrator.

- Data is checked for:
  - Completeness
  - Accuracy
  - Topology
  - Flow Direction
  - Linked photographs
  - Consistency



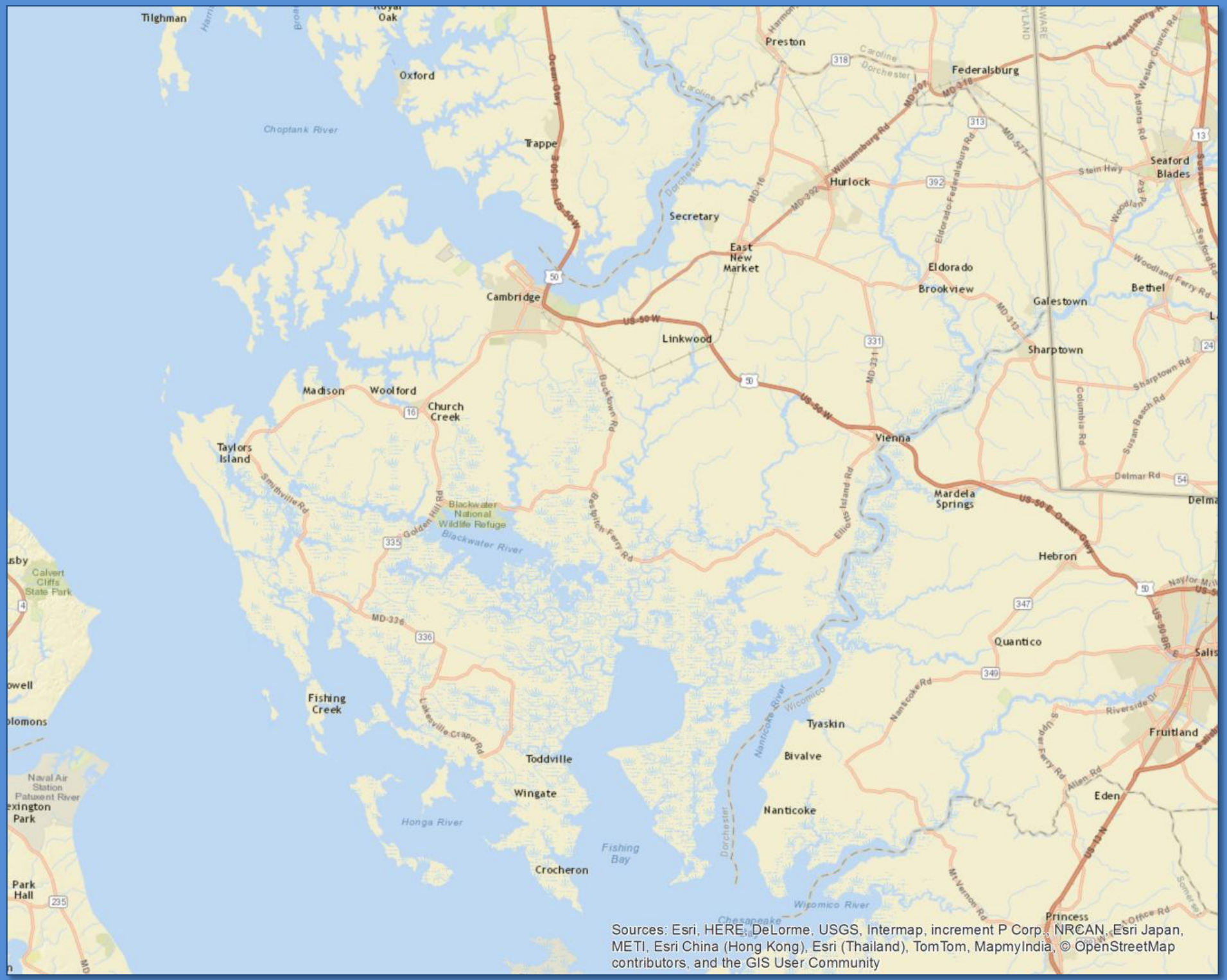
Increased Precipitation Intensity and Frequency

- Down Scaled Data Obtained from C-MIP Climate Data Processing Tool for Each Pilot County



Data Source: National Climate Assessment (2014)))

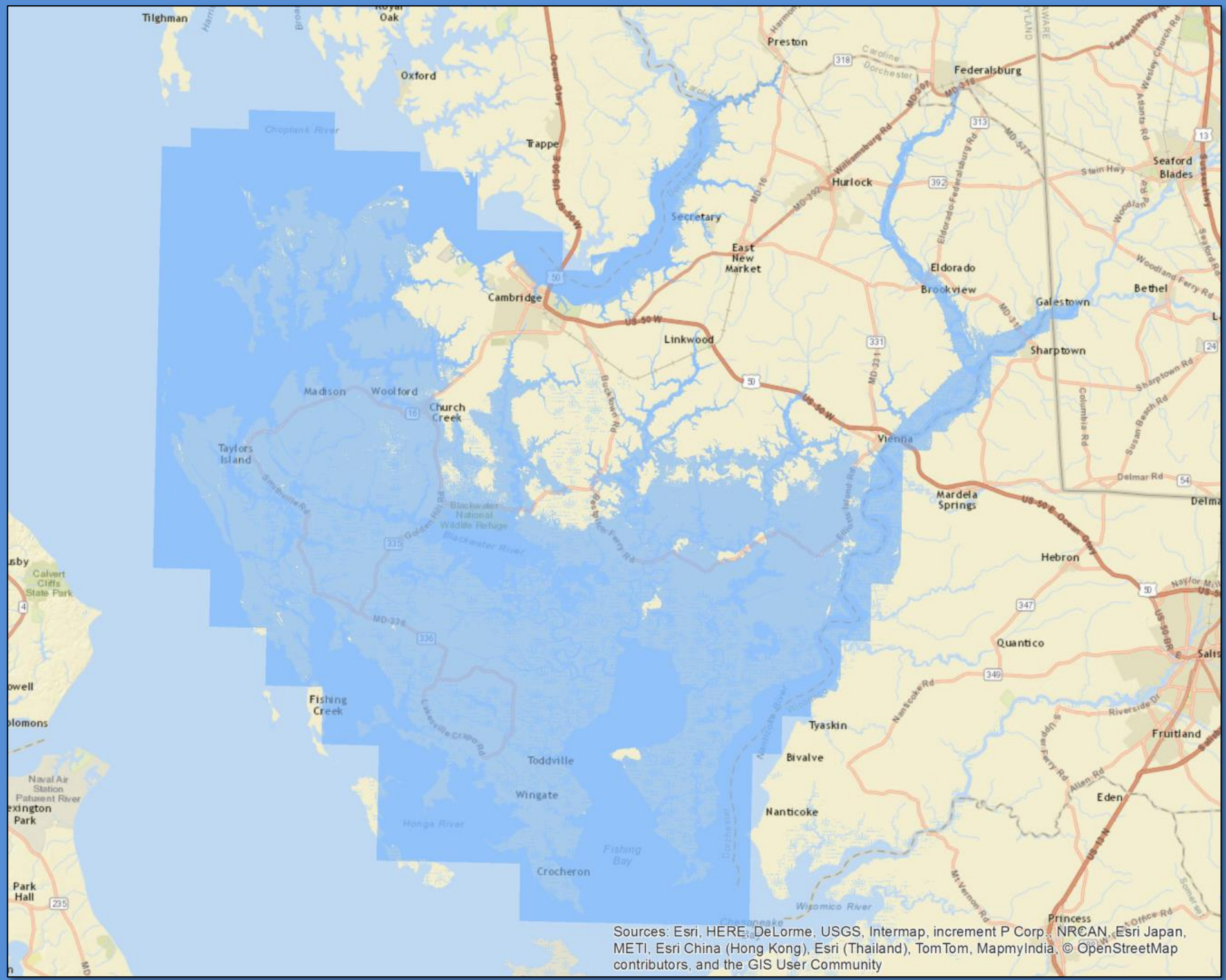
Vulnerable Land
Dorchester County Maryland



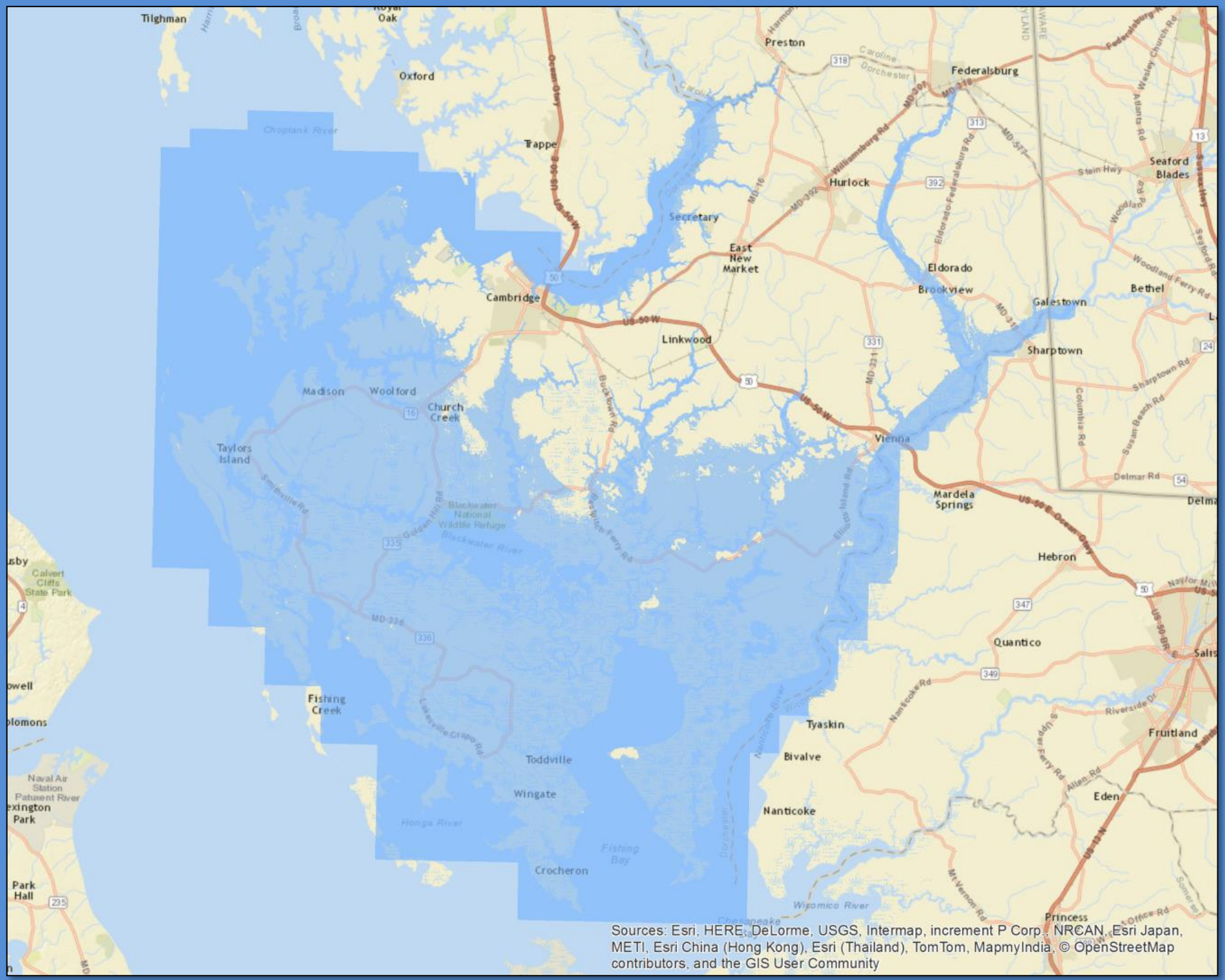
Vulnerable Land
Dorchester County Maryland
2050 Mean Sea Level

Vulnerable Land
Dorchester County Maryland
2050 Mean Higher High Water

Vulnerable Land
Dorchester County Maryland
2100 Mean Sea Level

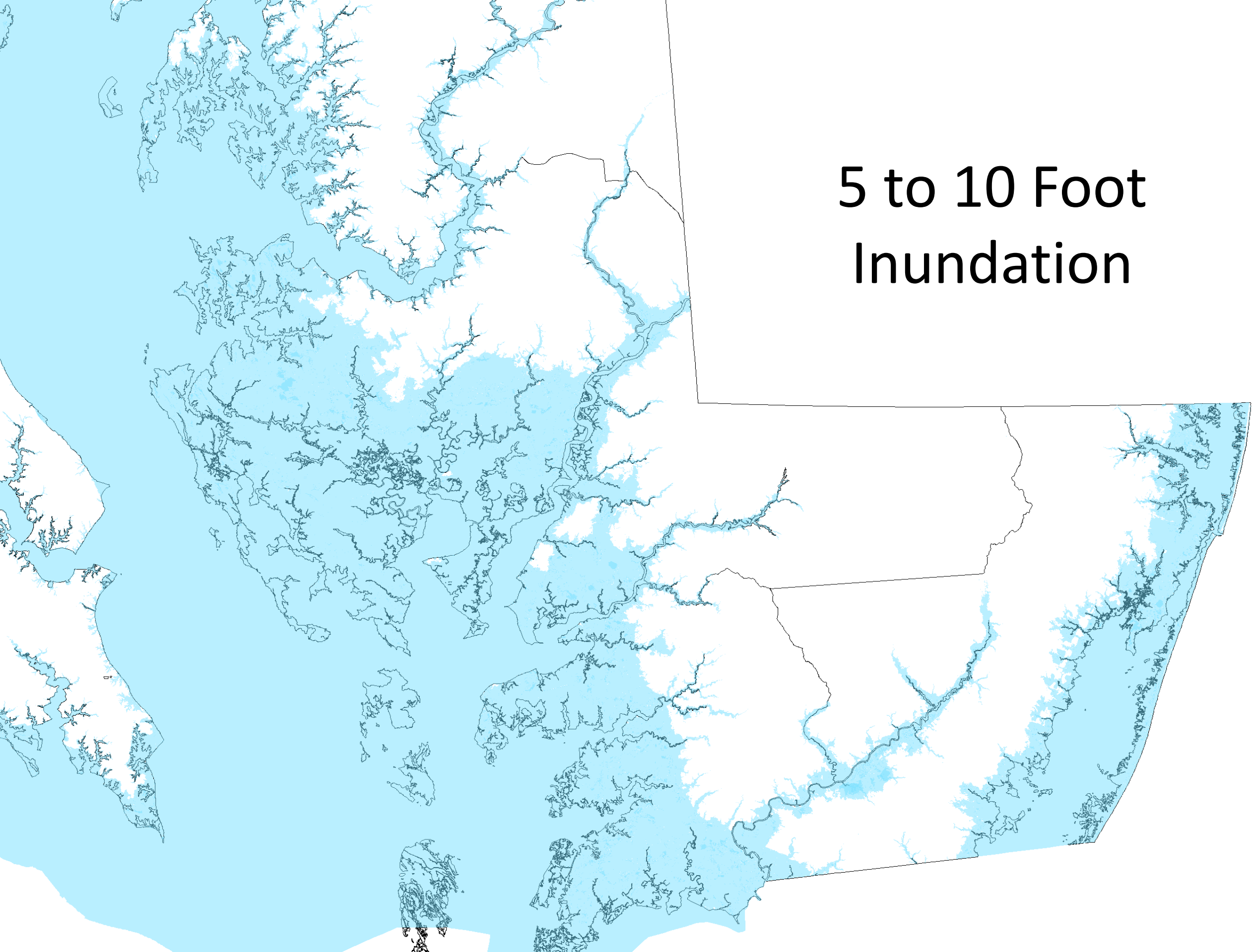


Vulnerable Land
Dorchester County Maryland
2100 Mean Higher High Water



Current Maryland Eastern Shore

5 to 10 Foot Inundation



Highway System Vulnerability

Infrastructure requiring further evaluation for impacts due to SLR

Sea Level Rise	State Roads Impacted	State Structures Impacted
2 feet	156 miles – 2%	93 structures – 3.5%
5 feet	371 miles – 4.5%	132 structures – 5%
10 feet	792 miles – 10%	196 structures – 7.5%

Prioritization of assets must consider emergency evacuation planning, resiliency and system redundancy

Federal Emergency Management Act (FEMA) 100-Year Floodplain indicates 28% of SHA Structures (includes culverts) need further impact evaluation

State Maintained Roadways -

103 miles in 500-year floodplain I 413 miles in 100-year floodplain

What This Means for Projects

- Projects will consider future climate change now
- Siting and Design Guidelines could change where and how we need to build
- Projects may have climate change alternatives
- Impacts may be greater

Contact Information

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