

# TRANSPORTATION RESILIENCE PLANNING UPDATE

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## Natural Hazards, Climate Change, and Transportation Resilience Planning at TPB

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Transportation Planner

Community Advisory Committee Meeting  
February 15, 2024



National Capital Region  
**Transportation Planning Board**

# Today's Agenda

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Poll

Natural Hazards + Climate Change

Key Terms + Definitions

History of Resilience + Climate Work in the Region

What TPB is Doing Now

Wrap-Up, Q&A



# Poll

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Use code: 8365 0199



What does  
resilience mean  
to you?



National Capital Region  
**Transportation Planning Board**

# Natural Hazards to Transportation

- **Extreme heat causes**
  - Rails to overheat and expand, risking train derailments
  - Concrete roads to crack and asphalt to soften
  - Bridge joints to expand
- **Extreme winter conditions causes**
  - Freeze/thaw cycle that create roadway potholes and cracking
- **Extreme precipitation and flooding causes**
  - Erosion and collapse of roadways and supporting structures
  - Road closures during and immediately following a flood event

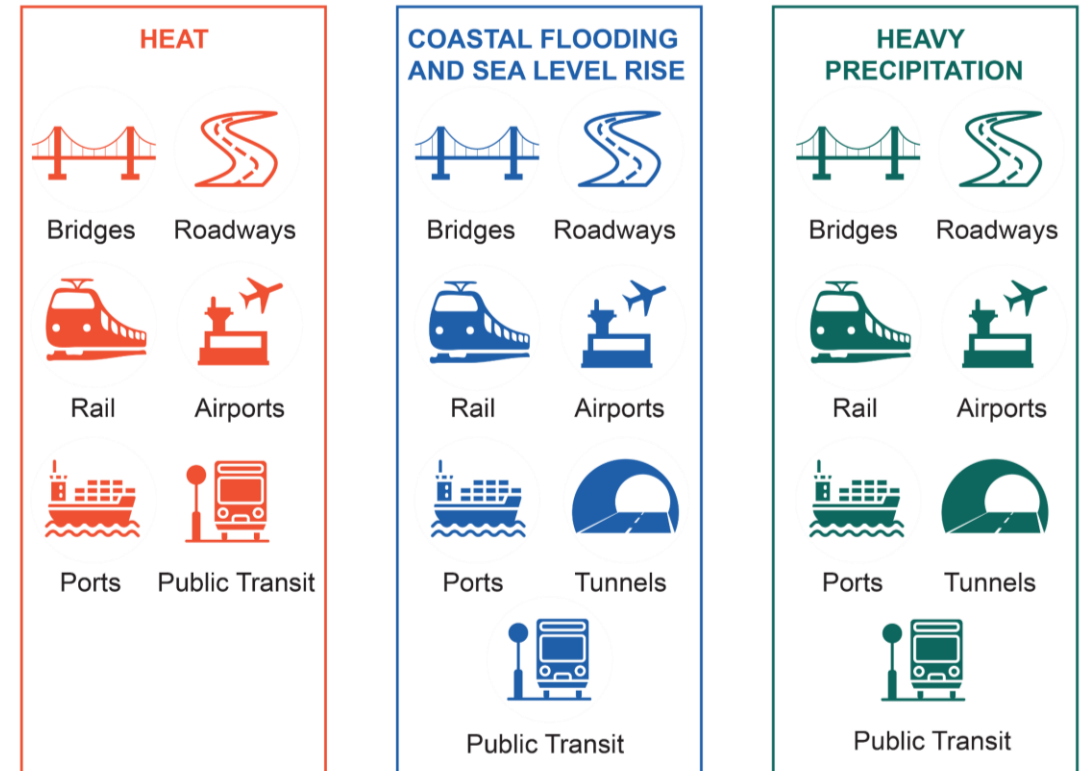
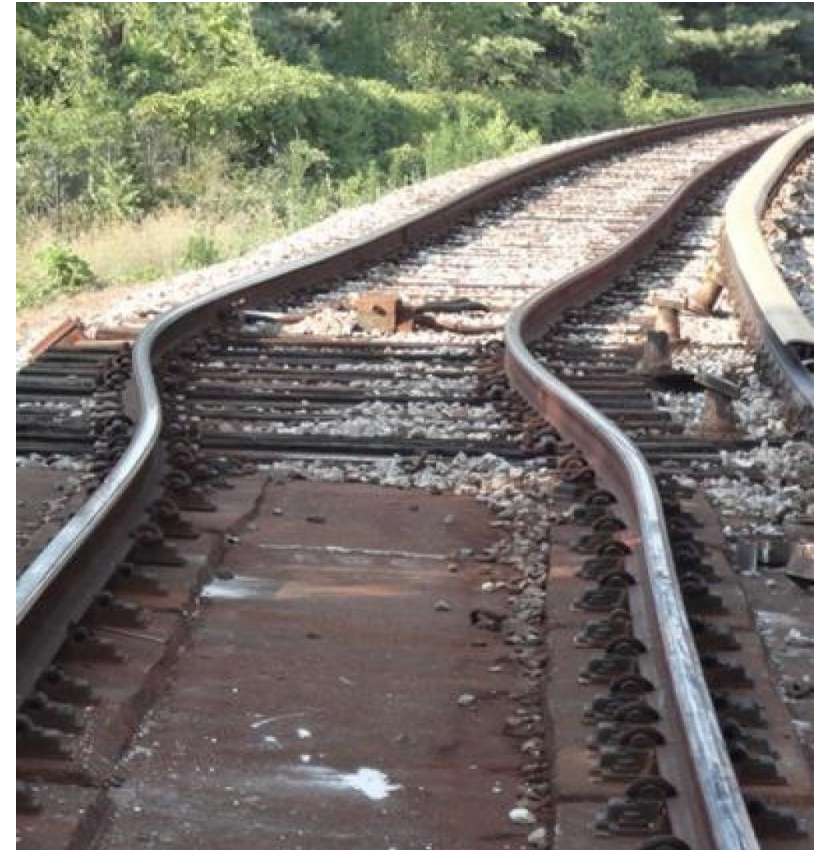


Figure: Fourth National Climate Assessment, Transportation Chapter



# Natural Hazards and Climate Change

- Climate change is accelerating over time and will continue over the design life of infrastructure
- Impacts to the transportation system have ripple effects on communities and the economy
- Some of these impacts disproportionately affect vulnerable populations



Source: [Washington Post](#), WMATA

# Natural Hazards and Climate Change

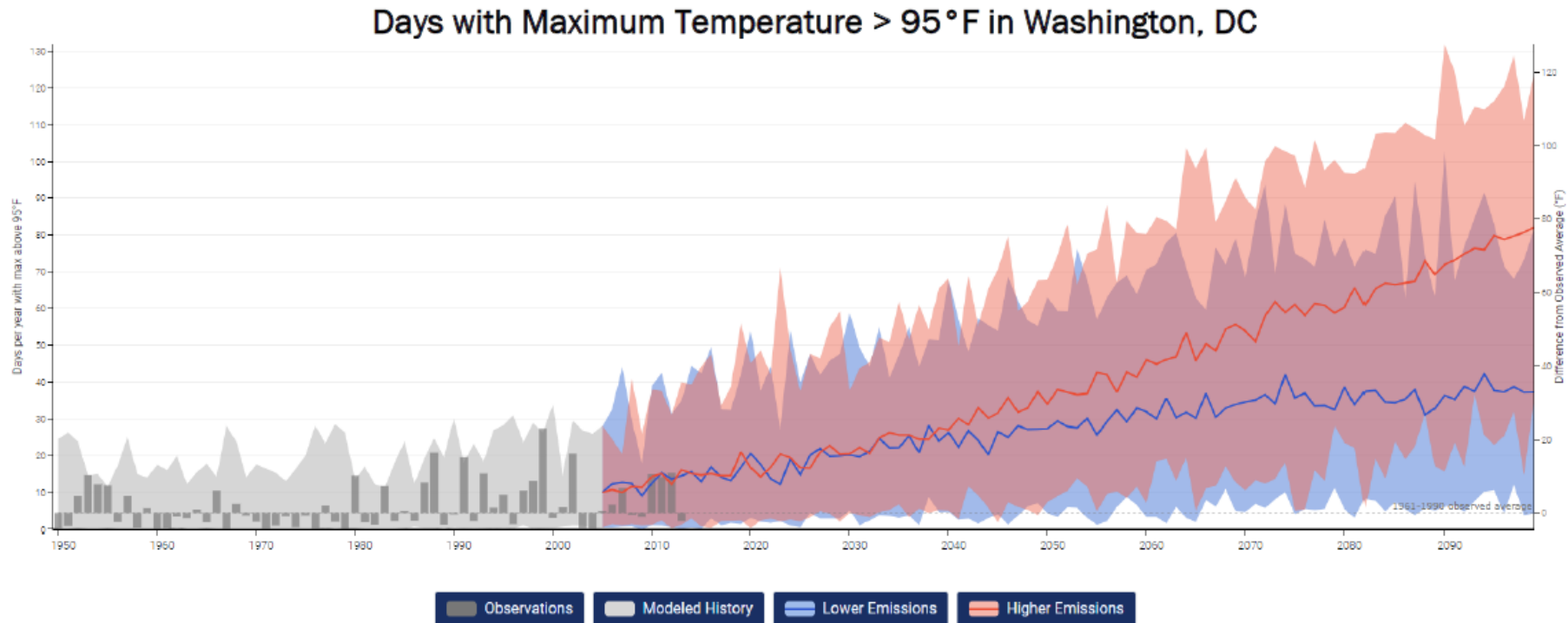


Figure 22. Days with extreme heat as identified by days with maximum temperatures above 95 °F. Projections given both low and high emissions are shown. Source: NOAA Climate Explorer.



# Natural Hazards and Climate Change

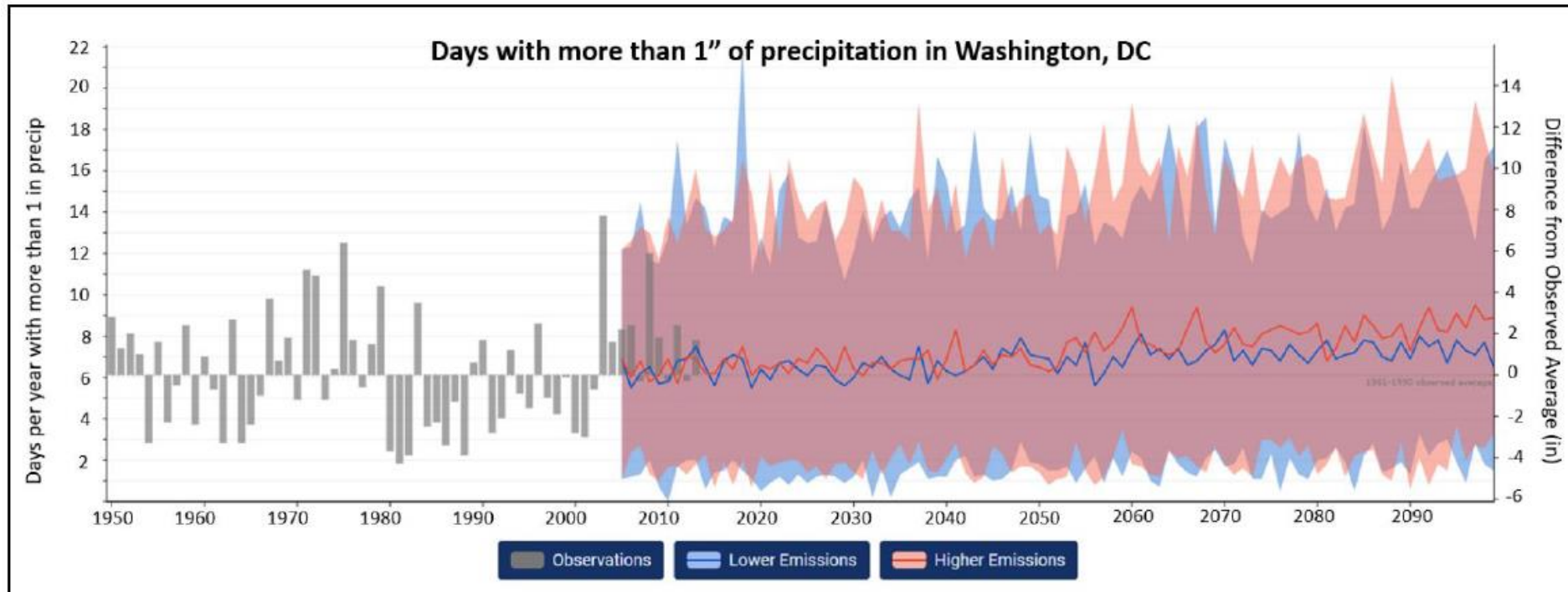


Figure 28. Days with more than one inch of precipitation based on low emissions and high emissions scenarios.

Source: NOAA Climate Explorer.



# Natural Hazards and Climate Change

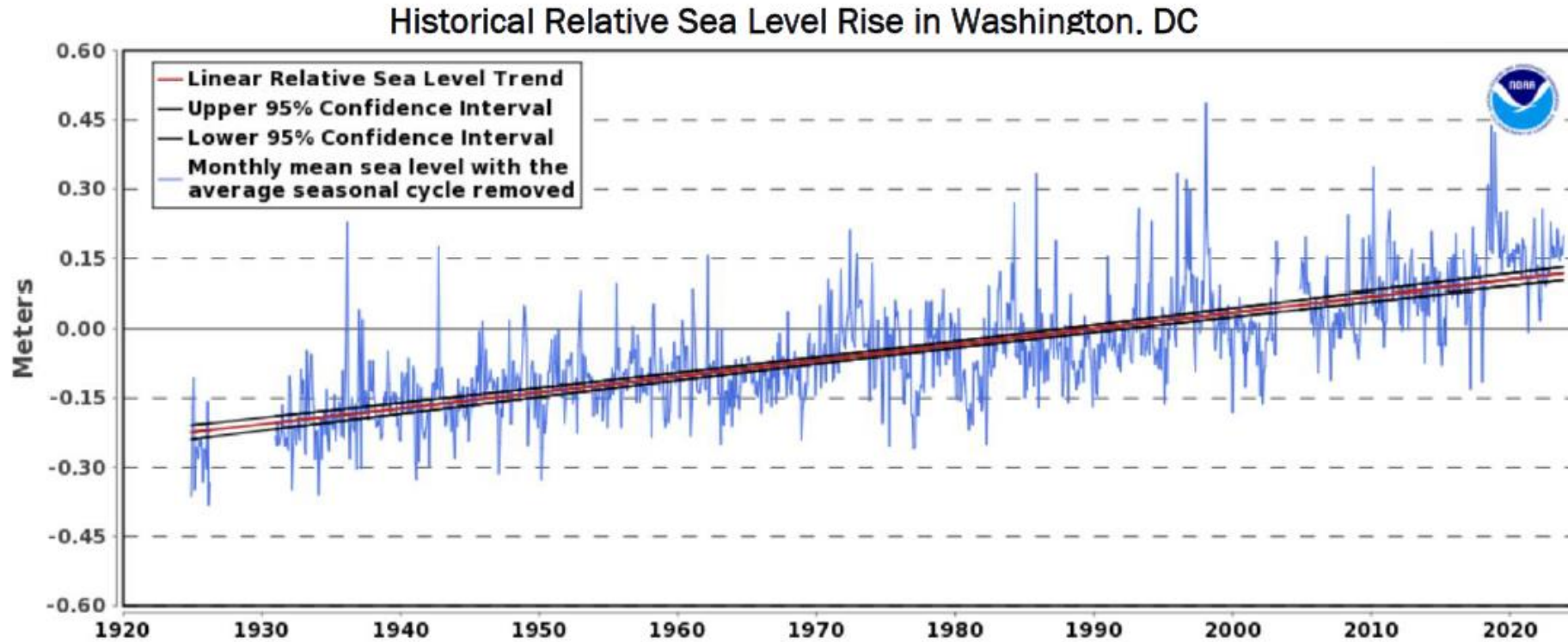


Figure 29. Relative sea level trend in Washington, DC. Source: NOAA Tides and Currents.





# Resilience

- Resilience is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions from natural hazards.



Motorists stranded on a section of Canal Road in Washington DC due to flash flooding on July 8, 2019 (WTOP, 2019)



# Vulnerability + Sensitivity

- **Vulnerability** is the degree to which a system **is susceptible to, or unable to cope with adverse effects** of natural hazards.
- **Sensitivity** is the **degree to which an asset is affected by exposure** to a climate hazard. If an asset has high sensitivity to a climate hazard, it will experience more severe impacts from the hazard than assets with low sensitivity.



Flooding at Greenbelt Metro Station, August 2022. Source: Washingtonian



# Mitigation

- **Mitigation** is a decrease in a possible harmful effect. Climate change mitigation is the **reduction in greenhouse gas emissions that drive global climate change.**



Source: TPB Climate Change Mitigation Study of 2021



# Climate Adaptation

- **Climate Adaptation** is the process of **adjusting to the effects of climate change to build long-term resilience.** Adaptation may include changing behavior, adapting infrastructure, supporting natural systems, and more.



DURING: This photo was taken while construction was underway on the Gleason Beach realignment over Scotty Creek on the Sonoma County coast, which was threatened by rapidly eroding coastal bluffs. (Photo by John Husebay/Caltrans)



# Impacts - Some Examples



Fallen trees and broken power lines after the severe storm in 2023. Source: The Washington Post.



Romancoke Pier in Maryland was destroyed by Hurricane Isabel, 2003. Source: MyEasternShore.



Route 50 in Prince George's County flooded after heavy rains in 2020. Source: WTOP News.



# Group Exercise: 5-10 minutes

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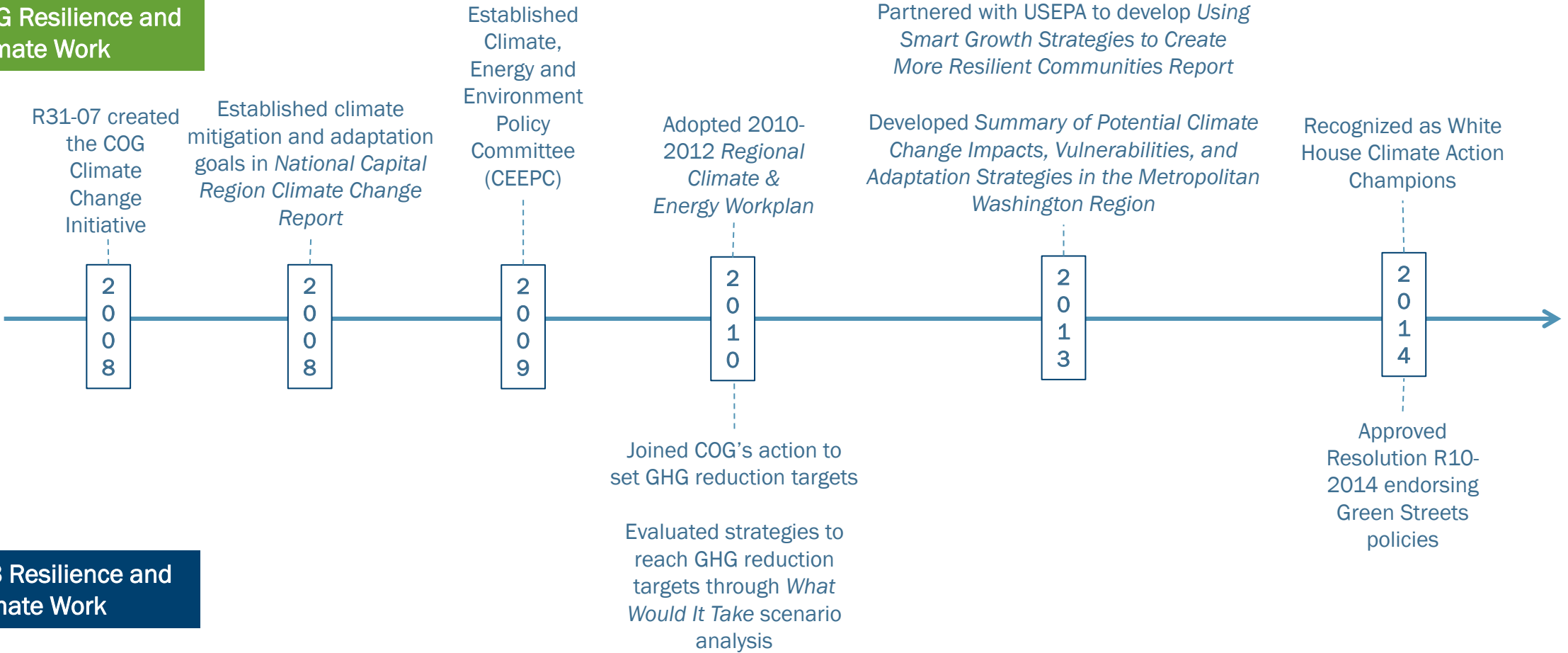
**Prompt: What climate events do you remember that have impacted your/your community's transportation system?**

- Participate by raising your hand and you will be called on, or feel free to place your comment into the chat



# Resilience Work in TPB Region

## COG Resilience and Climate Work



## TPB Resilience and Climate Work



# Resilience Work in TPB Region

## COG Resilience and Climate Work

Updated Climate Energy and Environment Policy Committee Final 2013-2016 Action Plan Resource Guide

2015

Support local resilience planning, such as DC's Climate Ready and 100 Resilient Cities initiatives (ongoing)

Developed *Metropolitan Washington 2030 Climate and Energy Action Plan*

2016

Published Environmental Justice Toolkit

2017

Named a Regional and Metro Scale Climate Leader by the Global Covenant of Mayors for Climate and Energy

2019

Developed and a *Metropolitan Washington 2030 Climate and Energy Action Plan*

2020

Met global standards for climate planning

2021

## TPB Resilience and Climate Work

Identified types of projects, programs, and policies with the greatest potential to reduce GHGs of the transportation sector (TPB Multisector Working Group)

Published TPB Climate Change Mitigation Study of 2021

Developed TPB Resiliency Study





# What's TPB Doing?

- Developing a **Transportation Resilience Improvement Plan (TRIP)** in collaboration with member organizations that will:
  - Contribute to member organizations' understanding of and planning for climate change risk and resilience
  - Identify priorities for resilience investment
  - Better position the region for federal funding and match reduction under a new(ish) program called PROTECT
- **The TRIP must include several required elements, including but not limited to:**
  - Address immediate and long-range planning activities and investments related to resilience
  - Demonstrate a systemic approach to resilience
  - Include risk-based assessment of vulnerabilities to current and future weather events and natural disasters



Damage to Hunter Mill Road in Fairfax County from Tropical Storm Lee (Flicker/VDOT, 2011)



# Phase 1: System-Level Analysis

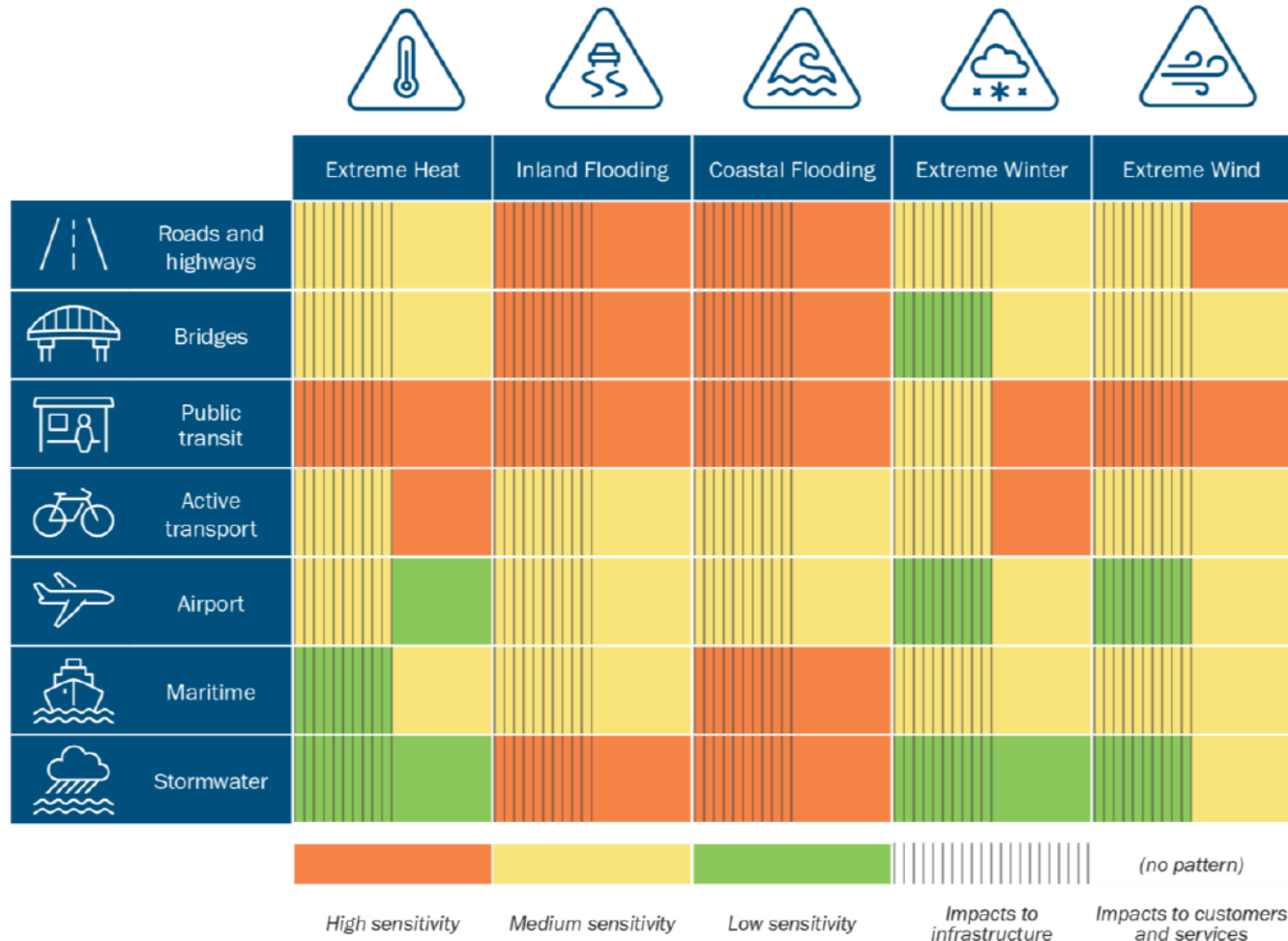







Figure 2. System-level analysis results (Infrastructure impacts on left; service and customer impacts on right).



# Phase 1: System-Level Analysis

Table 3. Highly sensitive asset/hazard pairs.

Hazard	Asset Groups				
	Public transit	Roads and highways	Active transportation	Bridges	Stormwater
 Extreme Heat	✓		✓		
 Inland Flooding	✓	✓		✓	✓
 Coastal Flooding	✓	✓		✓	✓
 Extreme Winter	✓		✓		
 Extreme Wind	✓	✓			



## Phase 2: Asset-Level Analysis (Literature Review)

For flagged Phase 1 pairs not well suited to a GIS analysis, we completed a qualitative literature review, with a focus on:

- Historical trends and future conditions for each hazard
- Previous events and impacts for each pair

Literature Review Pairs	
<ul style="list-style-type: none"><li>• Inland flooding:<ul style="list-style-type: none"><li>• Stormwater</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Extreme winter:<ul style="list-style-type: none"><li>• Public transit</li><li>• Active transportation</li></ul></li></ul>
<ul style="list-style-type: none"><li>• Coastal flooding<ul style="list-style-type: none"><li>• Stormwater</li><li>• Maritime</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Extreme wind:<ul style="list-style-type: none"><li>• Roads and highways</li><li>• Public transit</li></ul></li></ul>



# Phase 2: Asset-Level Analysis (GIS Analysis)

- For pairs with available data: Completing an asset-level GIS analysis using asset-specific data, exposure indicators, and criticality indicators

## GIS Pairs

- Extreme heat:
  - Public transit
- Inland flooding:
  - Roads and highways
  - Bridges
  - Public transit
- Coastal flooding:
  - Roads and highways
  - Bridges
  - Public transit

## Key Climate Datasets

Hazard	Dataset
Temperature	Land Surface Temperature
Inland Flooding	FEMA 100/500 Year Floodplain Maps
Sea Level Rise	NOAA Digital Coast 2 Ft Sea Level Rise

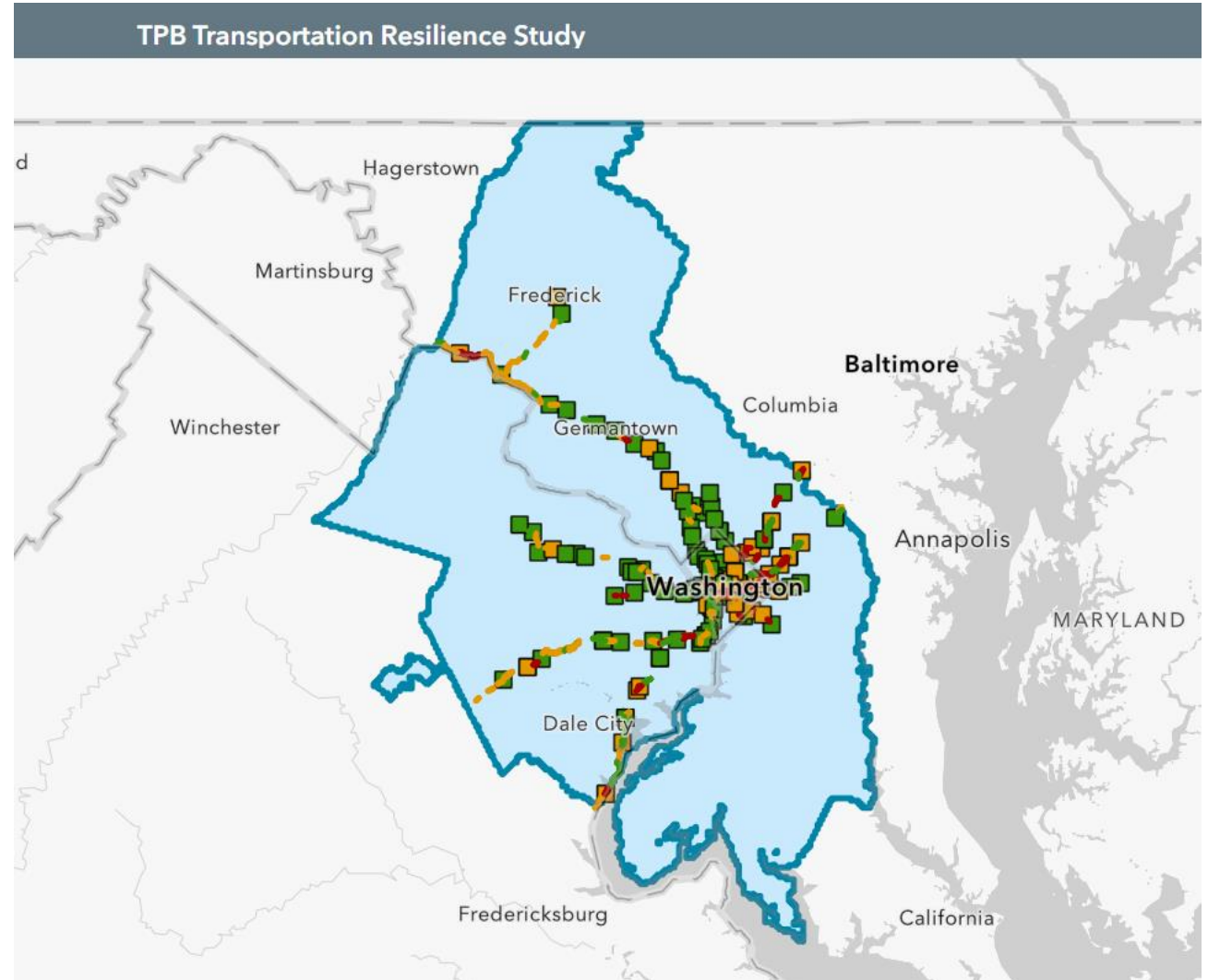
## Key Criticality Elements

Criticality Element
MWCOG Equity Emphasis Areas (for all pairs)
Functional Class (for roads and bridges)
Detour Length (for bridges)

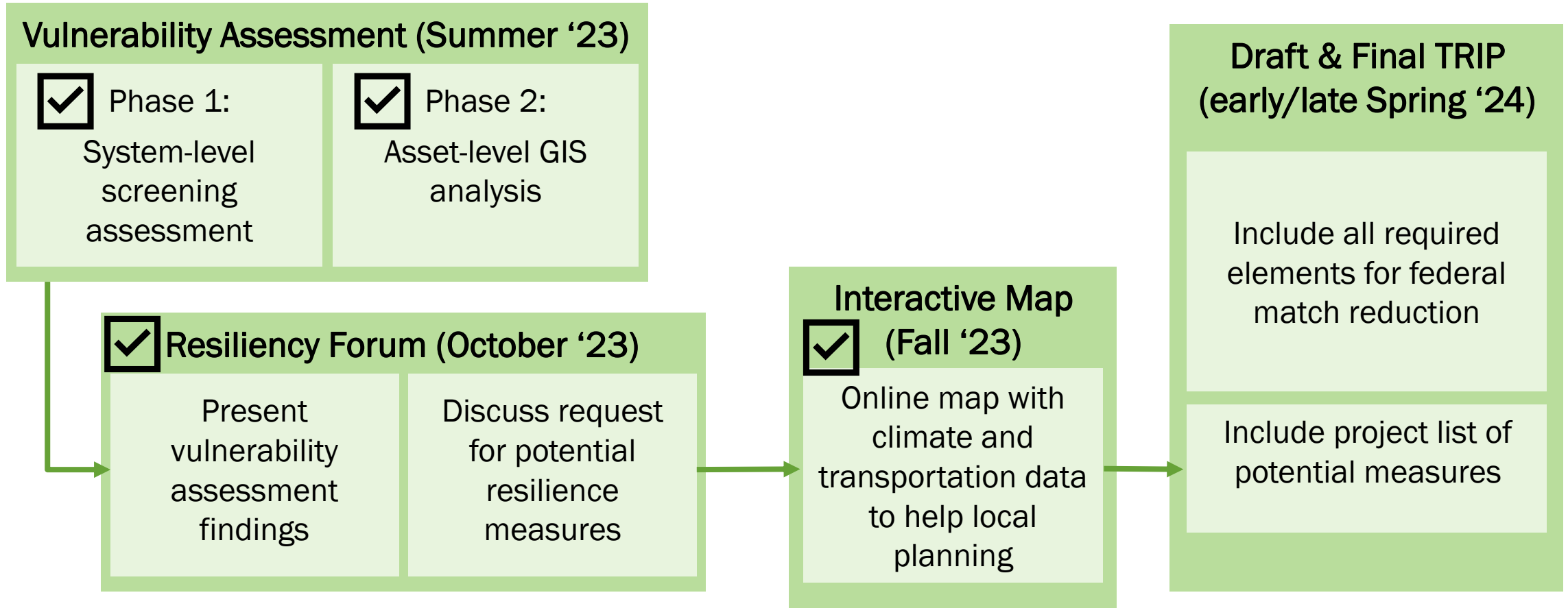


# Interactive Mapping Tool

- The results of the Vulnerability Assessment have been integrated into an [Interactive Mapping Tool](#) on the TPB ArcGIS website
- The Mapping Tool layers transportation asset, climate, and equity spatial data to identify highly vulnerable assets
- Agencies can use the Mapping Tool to evaluate their assets and services



# Process and Timeline





Flooding at Greenbelt Metro Station, August 2022. Source: Washingtonian

## Future Improvements

- Improving flood risk mapping for whole region
- Enhancing consideration of equity impacts
- Analyzing and mapping historical closures associated with natural hazard impacts
- Monetized understanding of risks posed to transportation assets posed by climate change
- Compiling/creating asset elevation data to refine understanding of flood risks based on projected depth of flooding
- Conducting deeper-dive asset-level analysis for select pilot locations to refine the understanding of vulnerability and potential for developing cost-effective solutions





# Poll



Please go to [www.menti.com](https://www.menti.com)

Use code: 6586 6171



Have your thoughts changed after this presentation? **What does resilience mean to you (round 2)?**

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# Additional Slides

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# Preliminary Results

Table 20: Assets with medium-high vulnerability.

	Bus	Rail Line	Rail Stop	Roads	Bridges
Number of assets with medium-high vulnerability to multiple hazards	140	13 miles	1	7.3 miles	N/A



Figure 7. Summary of assets with high vulnerability to inland flooding (light blue) and sea level rise (medium blue). Bridge flood vulnerability was based on condition data (dark blue). Some assets are vulnerable to both hazards and are counted in both categories.

Vulnerability of Rail Lines to Extreme Heat

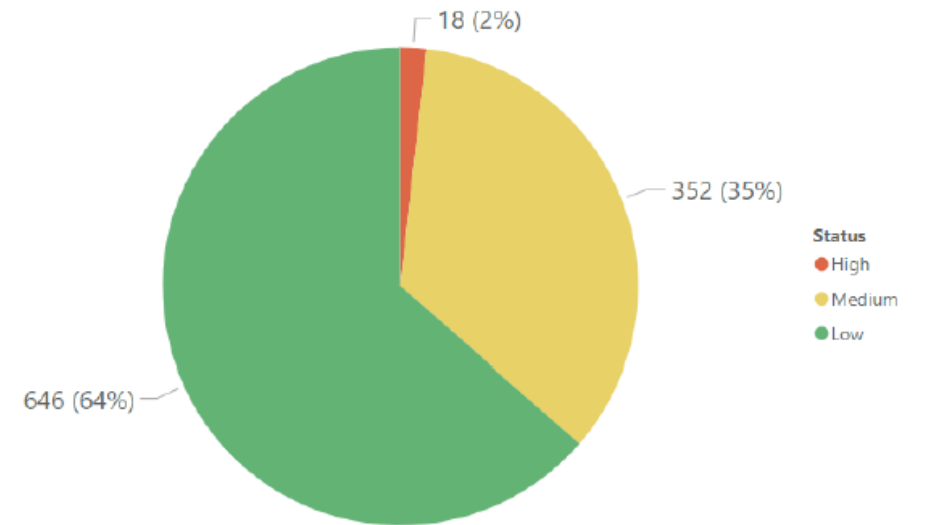
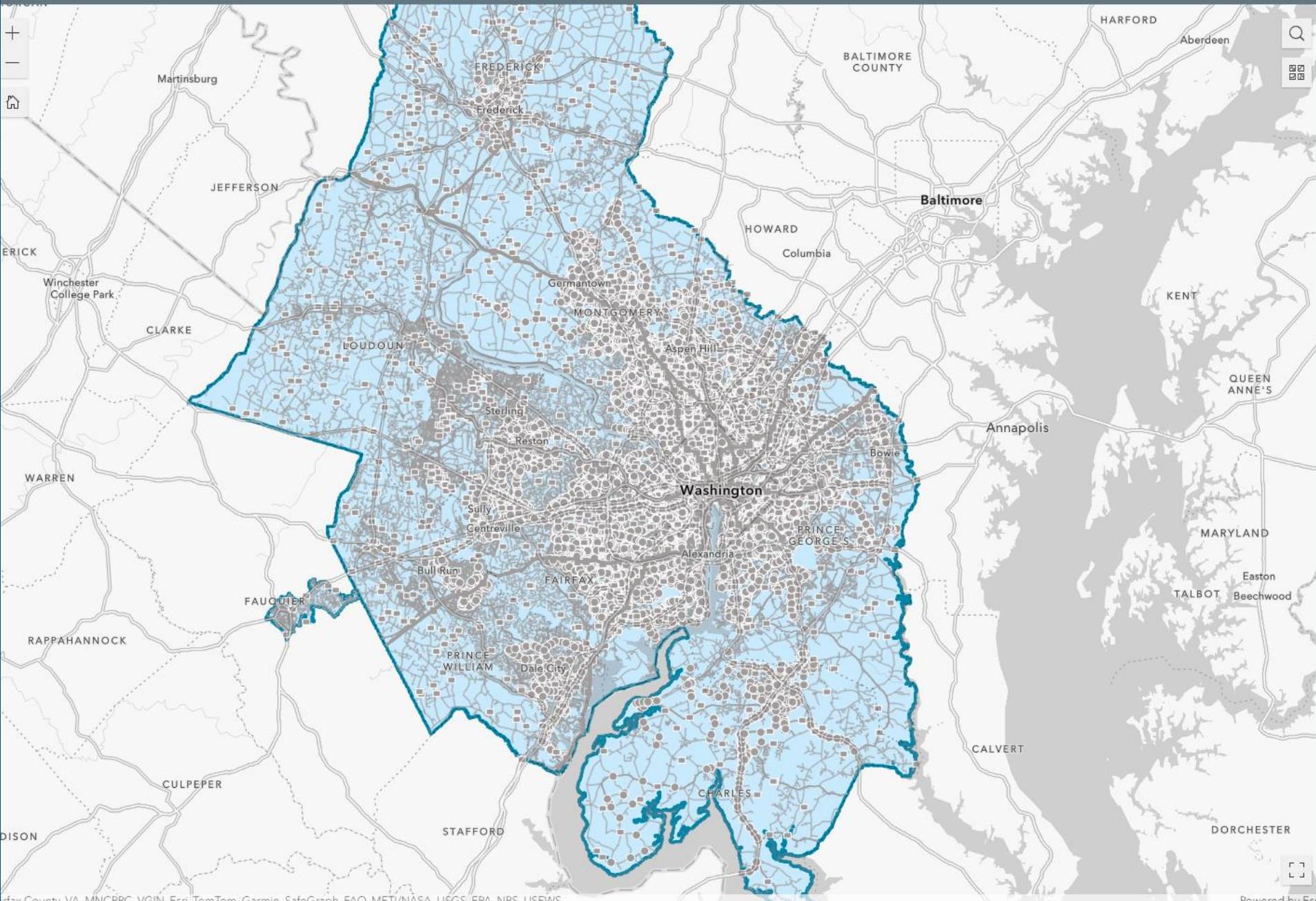


Figure 2. Breakdown of rail lines with low, medium, and high vulnerability to extreme heat.

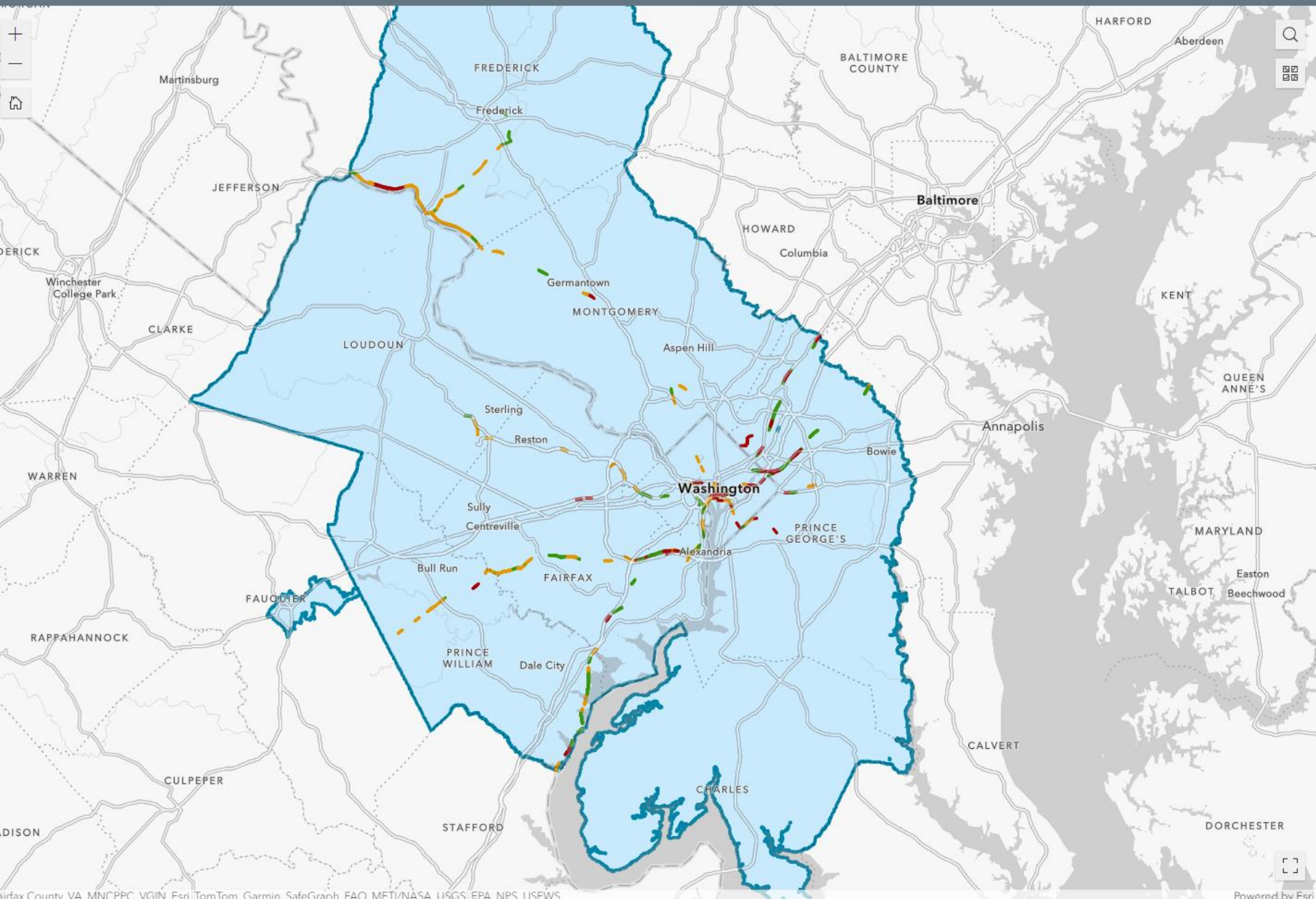





Layers	Legend
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<input type="checkbox"/>	SLR Risk Score - Rail Routes ...
<input type="checkbox"/>	Temperature Risk Score - Rail Routes ...
<input checked="" type="checkbox"/>	<b>Rail Routes</b> ...
<input type="checkbox"/>	Inland Flooding Risk Score - Rail Stops ...
<input type="checkbox"/>	Temperature Risk Score - Rail Stops ...
<input checked="" type="checkbox"/>	<b>Rail Stops</b> ...
<input type="checkbox"/>	Inland Flooding Risk Score - Bridges ...
<input checked="" type="checkbox"/>	<b>Bridges</b> ...
<input type="checkbox"/>	Inland Flooding Risk Score - Bus Stops ...
<input type="checkbox"/>	Temperature Risk Score - Bus Stops ...
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<input type="checkbox"/>	SLR Risk Score - Roads ...
<input checked="" type="checkbox"/>	<b>Roads</b> ...
<input checked="" type="checkbox"/>	<b>Active Transportation</b> ...
<input type="checkbox"/>	Inland Flooding Zones - Hazard ...
<input checked="" type="checkbox"/>	<b>Median Surface Temperature (°F) - Hazard</b> ...
<input type="checkbox"/>	Strong Wind Events (NRI) - Hazard ...
<input type="checkbox"/>	Sea Level Rise (ft.) - Hazard ...
<input type="checkbox"/>	Tree Canopy Coverage (MRLC) ...

Click the button below to add data to the map. Once the data layer is added, click the layer's 'Actions' button and 'Add to map'.

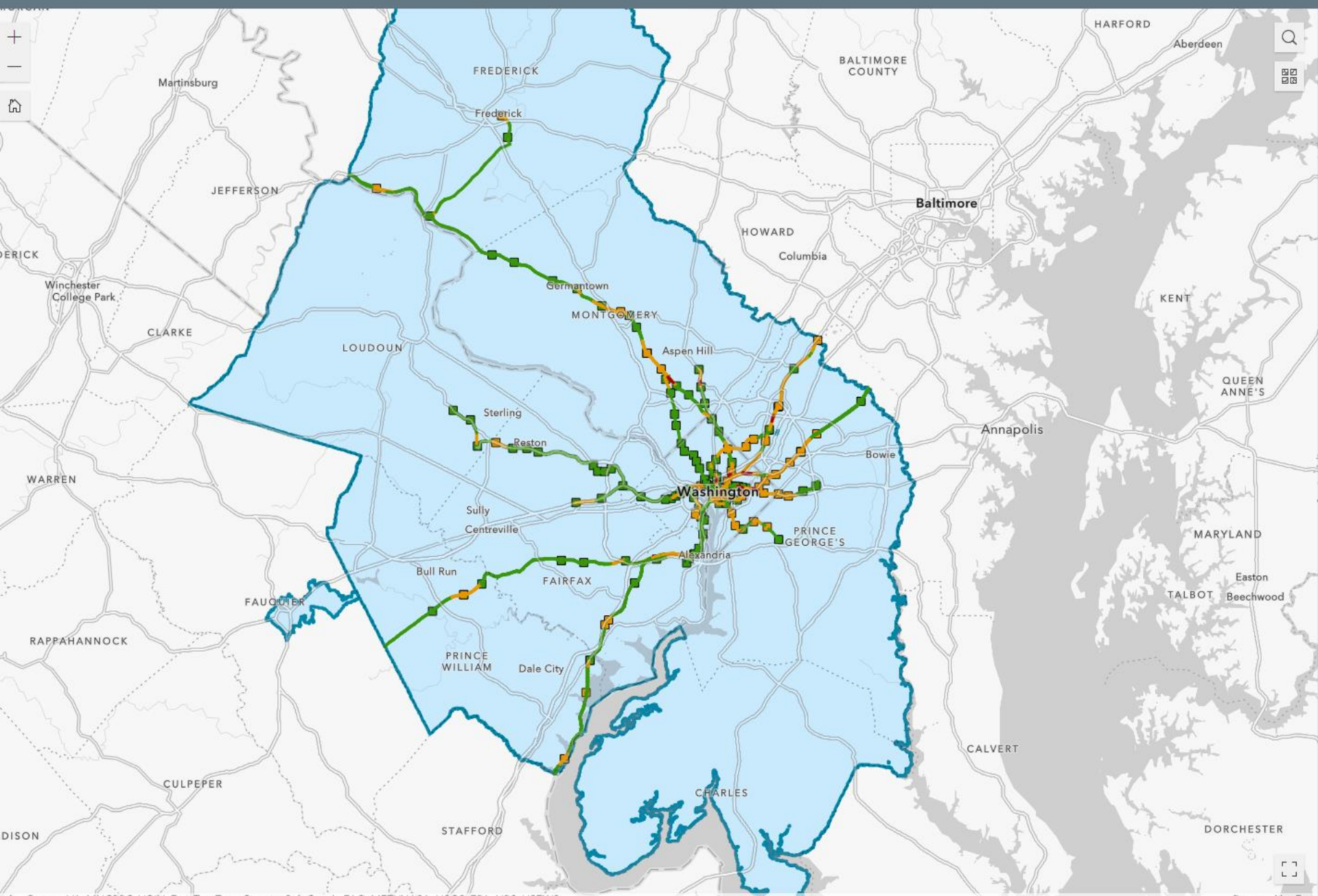
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<input type="checkbox"/>	Bridges ...
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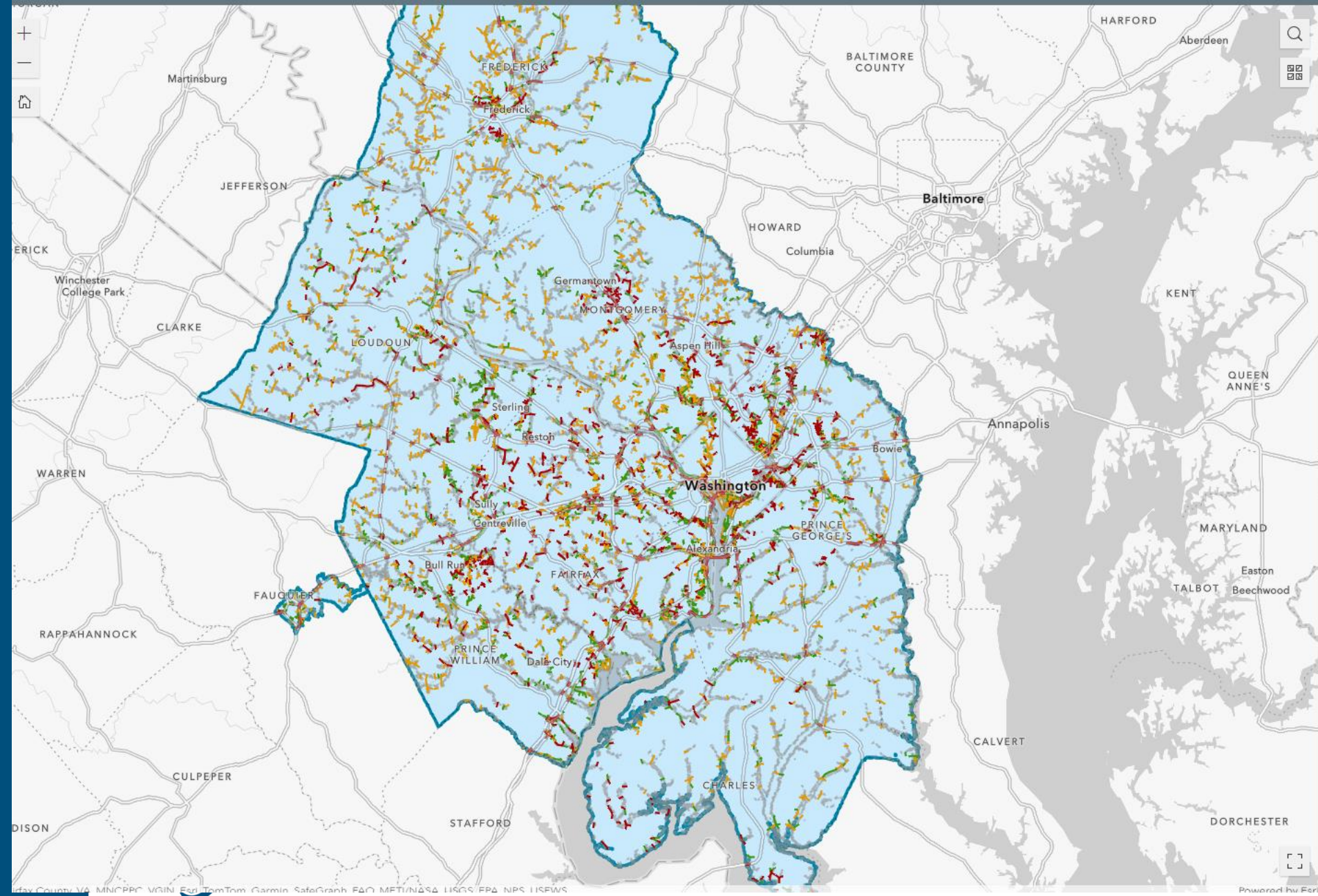
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<input type="checkbox"/>	Sea Level Rise (ft.) - Hazard ...
<input type="checkbox"/>	Tree Canopy Coverage (MRLC) ...
<input type="checkbox"/>	Equity Emphasis Areas ...
<input checked="" type="checkbox"/>	Transportation Planning Board (TPB) Boundary ...



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