REGIONAL EXTREME HEAT ANALYSIS

Draft Results and Toolkit Resources for Transportation Planning in the Face of Extreme Heat

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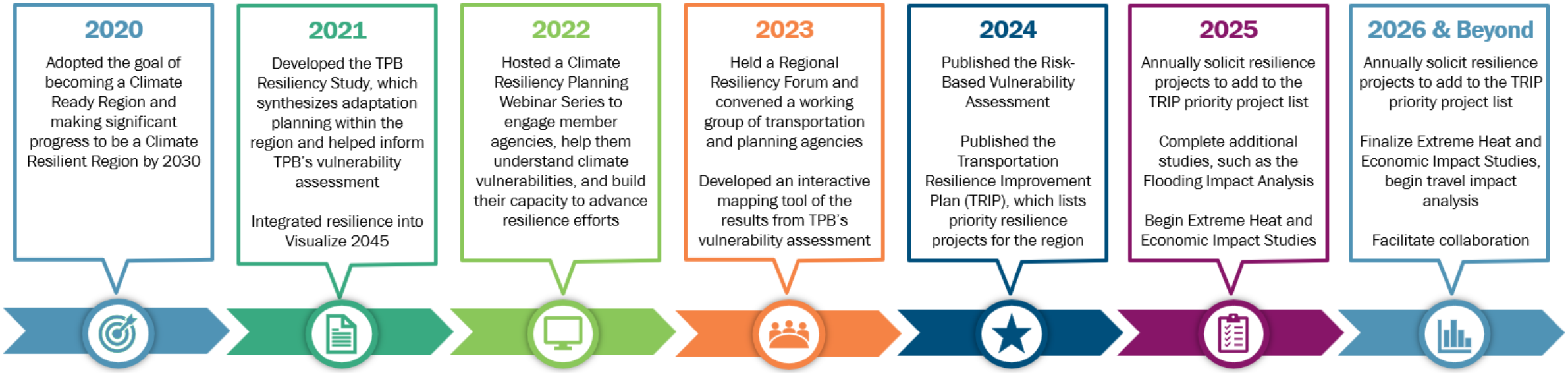
Transportation Planning Board
June 17, 2026

Agenda Item #10

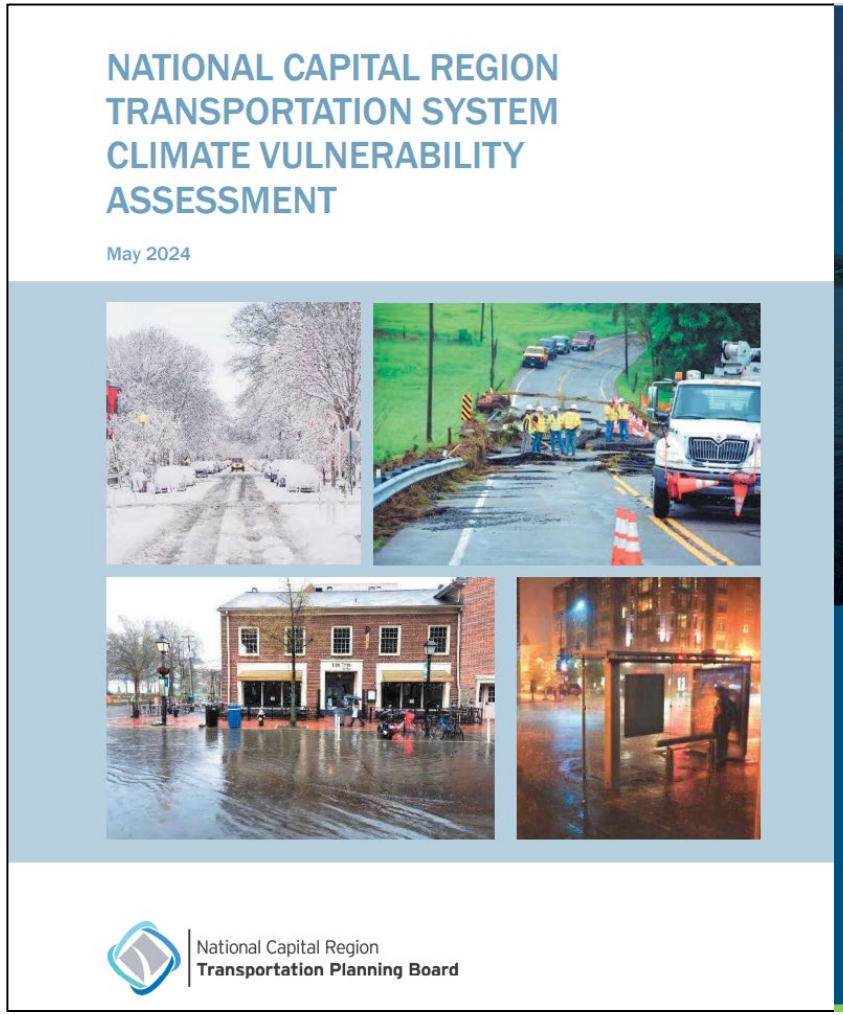
National Capital Region
Transportation Planning Board

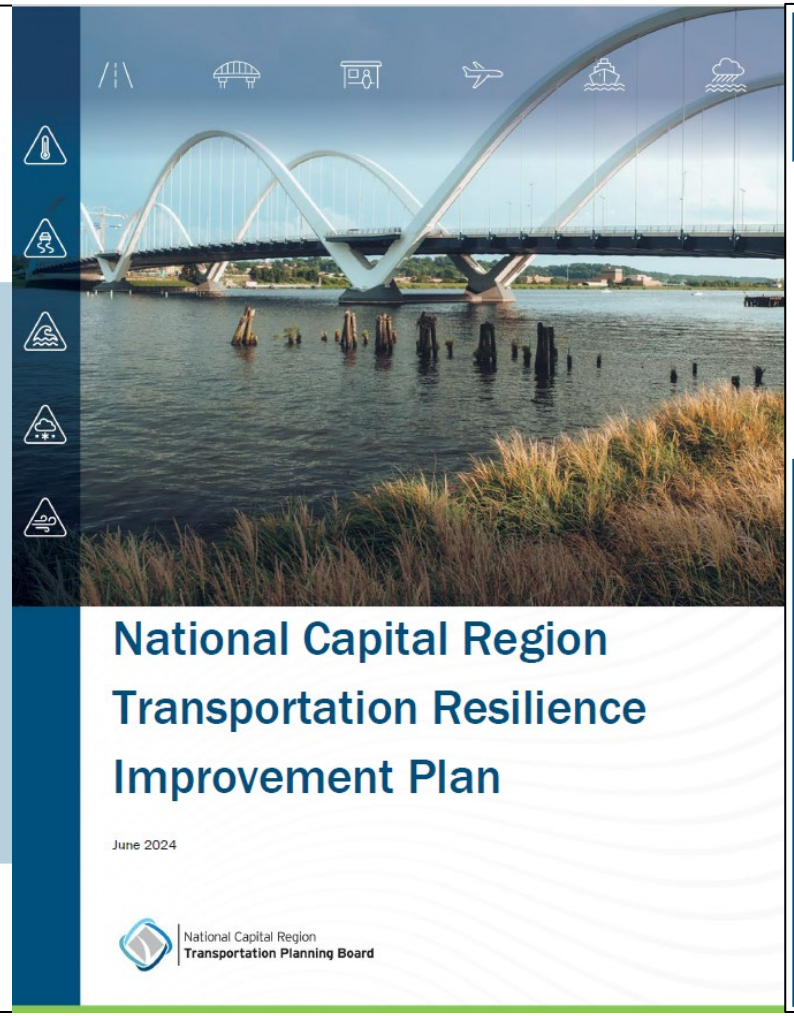
Regional Foundation for Transportation Resilience

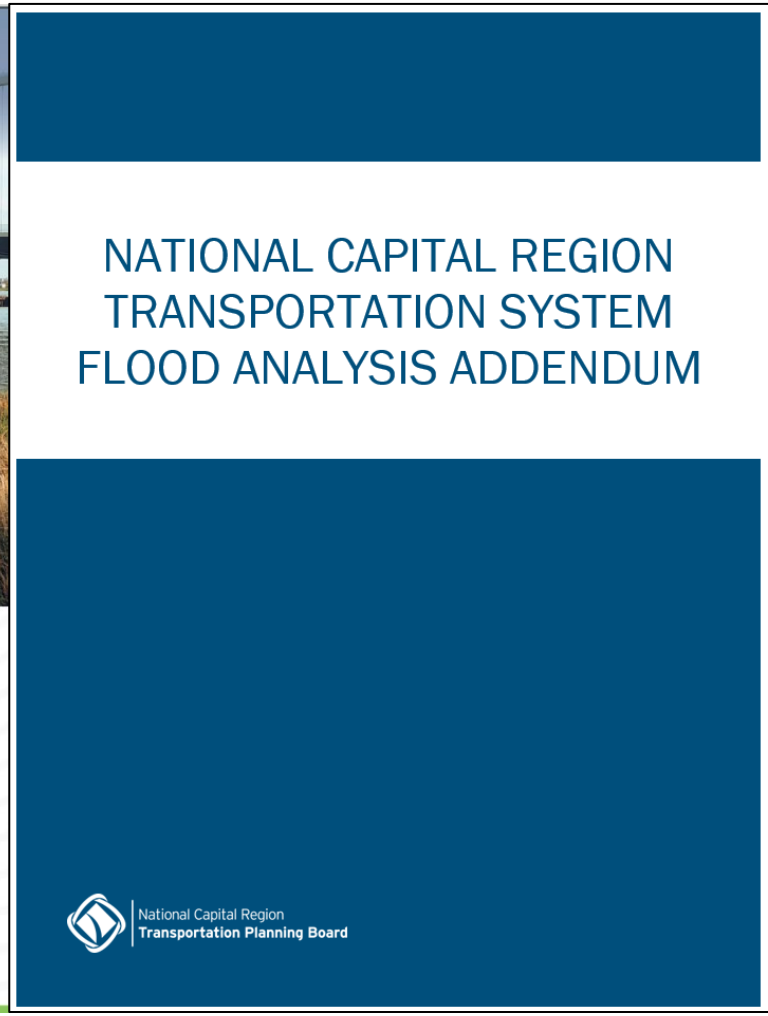
TPB's Road to Resilience



Major Studies to Date

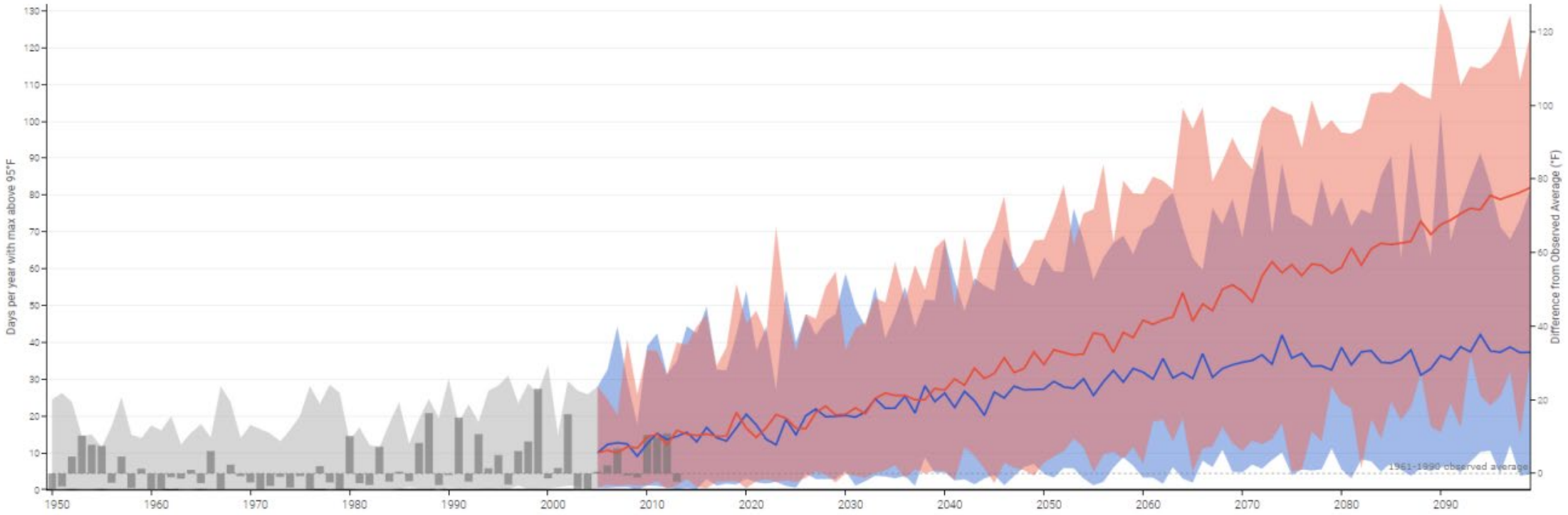






Extreme Heat in the National Capital Region

Days with extreme heat as identified by days with maximum temperatures above 95°F for Washington DC. Projections through 2100 given both low and high emissions are shown.



The blue band (lower emissions) shows RCP 4.5, the red band (higher emissions) shows RCP 8.5.

Observations | Modeled History | Lower Emissions | Higher Emissions

Source: NOAA Climate Explorer

Extreme Heat Project Objectives

WHAT?

Understand potential impacts of extreme heat on transportation systems and users

WHERE?

Identify where transit systems and users might be the most exposed to extreme heat

HOW?

Provide resources that guide how the region might adapt to these impacts

Overview of Products

ITEM A – Transit Infrastructure Resilience Analysis

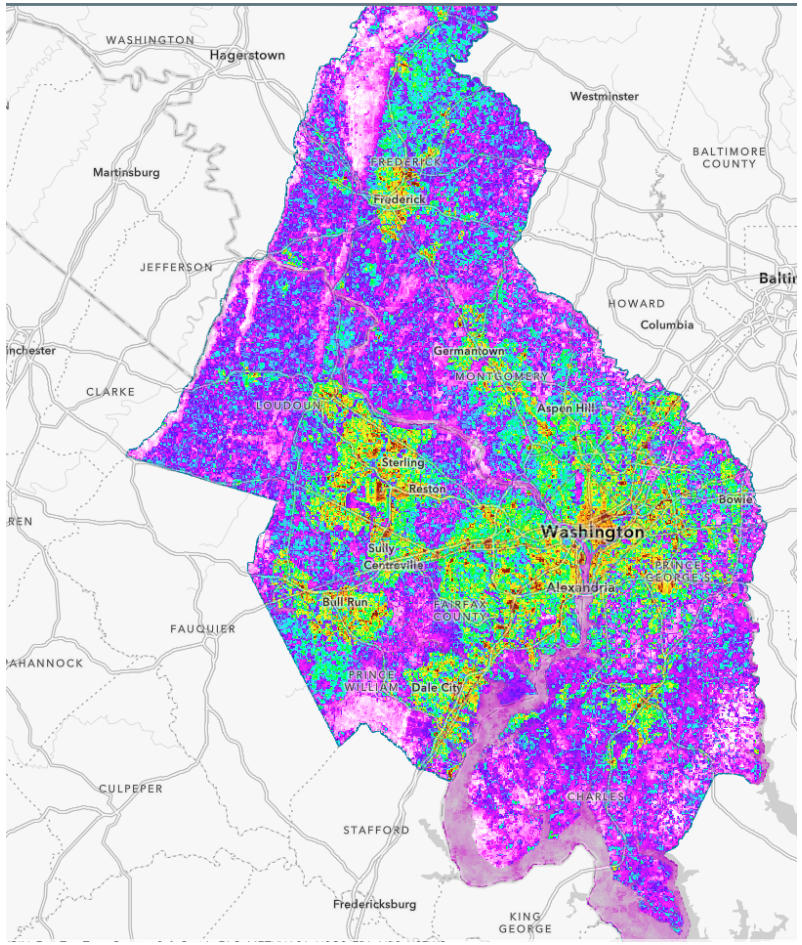
ITEM B – Best Practice Design Guidance

ITEM C – Grant Application Support

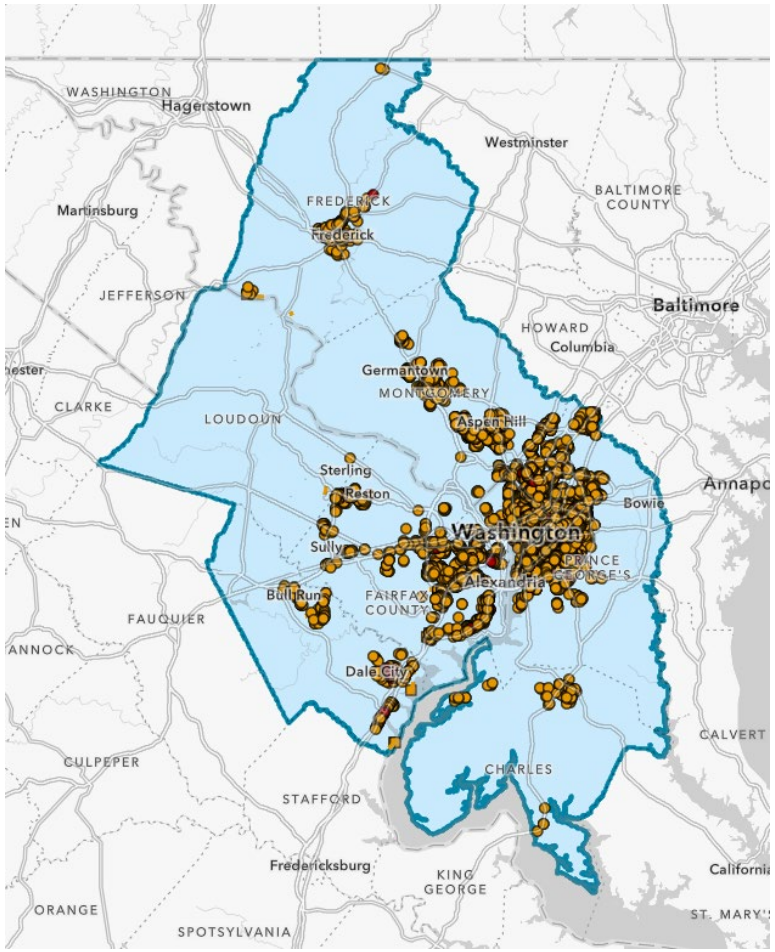
ITEM D – Policy, Planning, Guidance Use Cases

Photo Source: Pierre Gaunaurd

Extreme Heat in the National Capital Region



Median historical land surface temperature data for National Capital Region, Landsat 2018-2022 average



Bus stops, rail stops and rail lines scored as medium and high-risk to the impacts of extreme heat in TPB's Vulnerability Assessment, 2024

Transit Infrastructure Resilience Analysis

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

- **A retrospective analysis** using historical high heat days and transit ridership data to understand how heat thresholds may impact ridership
- **A future analysis** using climate projections to anticipate high heat trends and the potential future impacts on ridership
- **A qualitative impacts analysis** of downstream consequences

Transit Infrastructure Resilience Analysis

Beyond just ridership loss, extreme heat impacts transit users and owners in other ways:

Access & Health

- **Adverse health risks**
- **Challenges reaching essential services**

Service & Operations

- **Infrastructure damage**
- **System disruptions**
- **Travel patterns & mode shifts**

Economic Impacts

- **Lost fare revenue**
- **High operational costs**
- **Regional impacts**

Transit Infrastructure Resilience Analysis: WMATA

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1 Identify case studies

June 20-23, 2024:
- 3 days > 95F, heat emergency activated
- Record-breaking temperatures, hottest since Aug 2016
- Climatologically abnormal for time of year

July 13-17, 2024:
- Daily highs of 95 to 103F, high nighttime lows
- Excessive heat warning
- Record-breaking high temperatures

June 23-26, 2025:
- 4 days > 95F, heat index > 105F
- Climatologically abnormal for time of year

metro

Transit Infrastructure Resilience Analysis: WMATA

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Identify case studies
2. Determine impact to ridership

June 20-23, 2024:
- Baseline daily ridership: 334k
- High heat daily ridership: 308k
- Percent change: **8%** ↓

July 13-17, 2024:
- Baseline daily ridership: 336k
- High heat daily ridership: 329k
- Percent change: **2%** ↓

June 23-26, 2025:
- Baseline daily ridership: 506k
- High heat daily ridership: 504k
- Percent change: **0.4%** ↓

Transit Infrastructure Resilience Analysis: WMATA

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Identify case studies
2. Determine impact to ridership
3. Determine fare revenue lost

June 20-23, 2024:
- Daily fare revenue lost: **$82k**

July 13-17, 2024:
- Daily fare revenue lost: **$22k**

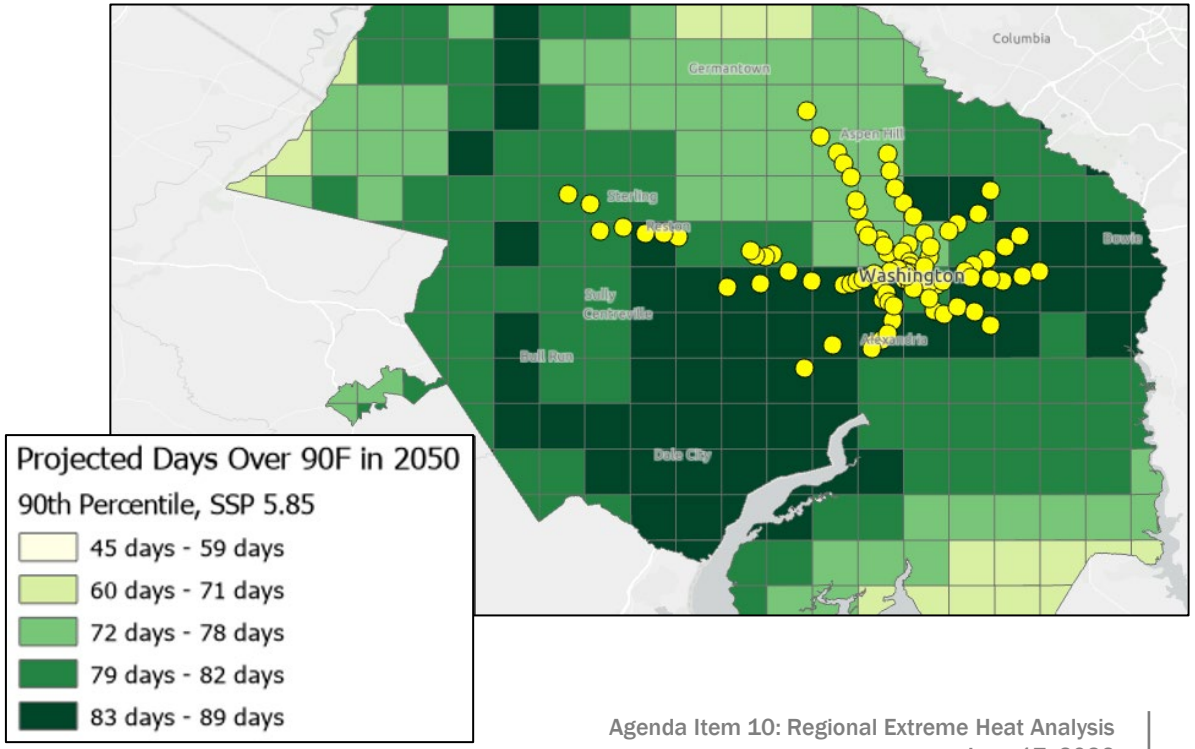
June 23-26, 2025:
- Daily fare revenue lost: **$6k**

Transit Infrastructure Resilience Analysis: WMATA

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Identify case studies
2. Determine impact to ridership
3. Determine fare revenue lost
4. Project future loss

- **2030** 65 high heat days/year → **$2.8M annual fare revenue lost**
- **2050** 87 high heat days/year → **$4.6M annual fare revenue lost**



Transit Infrastructure Resilience Analysis: VRE

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Identify case studies
2. Determine impact to ridership
3. Determine fare revenue lost
4. Project future loss

- **2030** 65 high heat days/year → **$67k annual fare revenue lost**
- **2050** 87 high heat days/year → **$167k annual fare revenue lost**

VRE is a commuter line and only runs on weekdays, so we completed an additional analysis focused on determining the **operating and time savings cost associated with delays from heat-related slow orders and warnings.**

Transit Infrastructure Resilience Analysis: VRE

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Quantify riders impacted
2. Determine frequency of delays
3. Calculate user (rider) and owner (operator) costs
4. Project future loss

	Delay Duration (min)	Riders Impacted	Commuter Train Operating Costs ($/delay)	Value of Person Time for Personal Travel ($/p-hr)
Low	1	4	$ 11	$ 13
Avg	10	431	$ 109	$ 1,486
High	47	1229	$ 503	$ 11,461

Transit Infrastructure Resilience Analysis: VRE

Assess the past, projected, and downstream impacts of extreme heat on rail operations and ridership, to inform future resilience efforts.

1. Quantify riders impacted
2. Determine frequency of delays
3. Calculate user (rider) and owner (operator) costs
4. Project future loss

2030 65 high heat days/year →

Owner Cost
- Low: $700
- Avg: $7k
- High: $33k

User Cost
- Low: $800
- Avg: $97k
- High: $745k

2050 87 high heat days/year →

Owner Cost
- Low: $900
- Avg: $9k
- High: $44k

User Cost
- Low: $1k
- Avg: $129k
- High: $997k

*These values reflect the average **cost per delay for one train** and will be multiplicative when more than one train is impacted.*

Toolkit of Resources for Addressing the Impacts of Extreme Heat on Transportation System

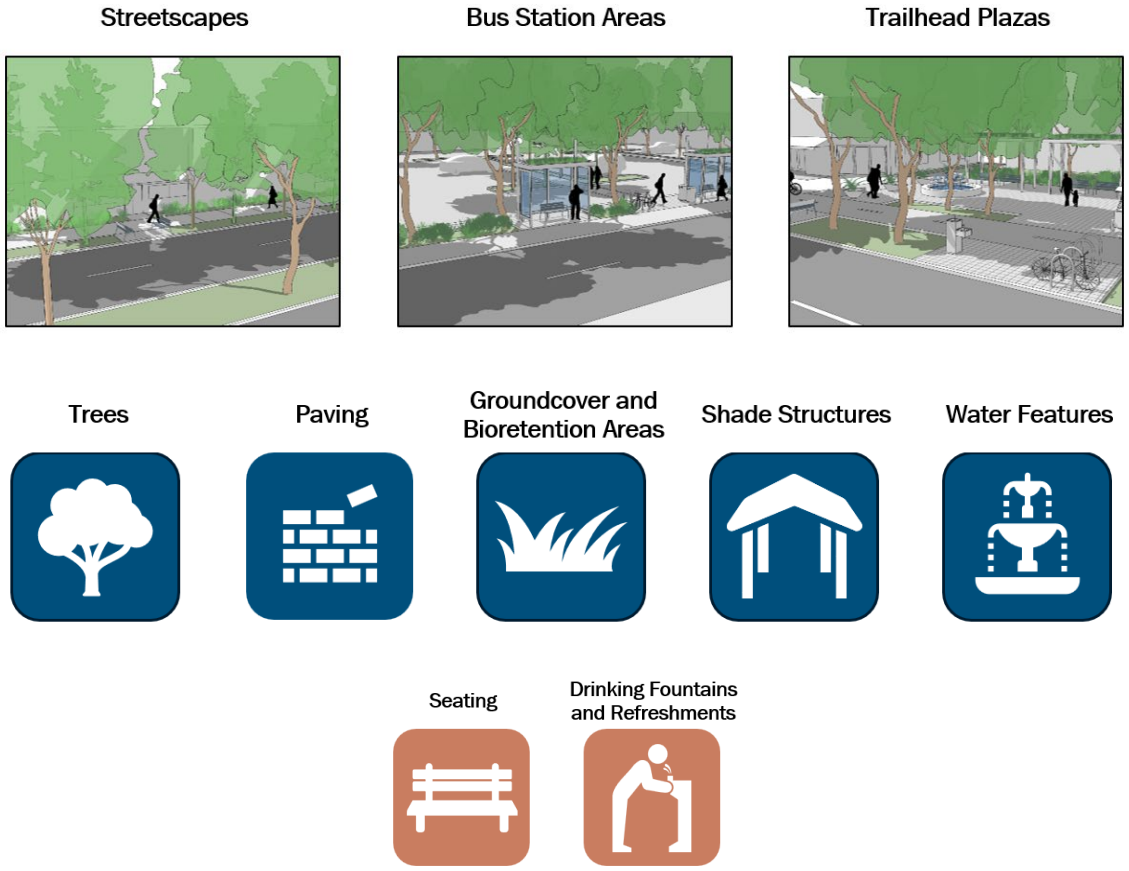
Best Practice Design Guidance

Best practices and design guidelines for cooling solutions, with region-specific examples.

- Examination of **3 typologies** with **4 cooling interventions** for each
- Three-dimensional simple block diagrams of each typology
- **Region-specific design and implementation considerations** and backing references for each cooling element

Goals:

- Identify **strategies to reduce heat exposure and impact** on people navigating the public realm
- Focus on **first-last mile connections to transit and active transportation**

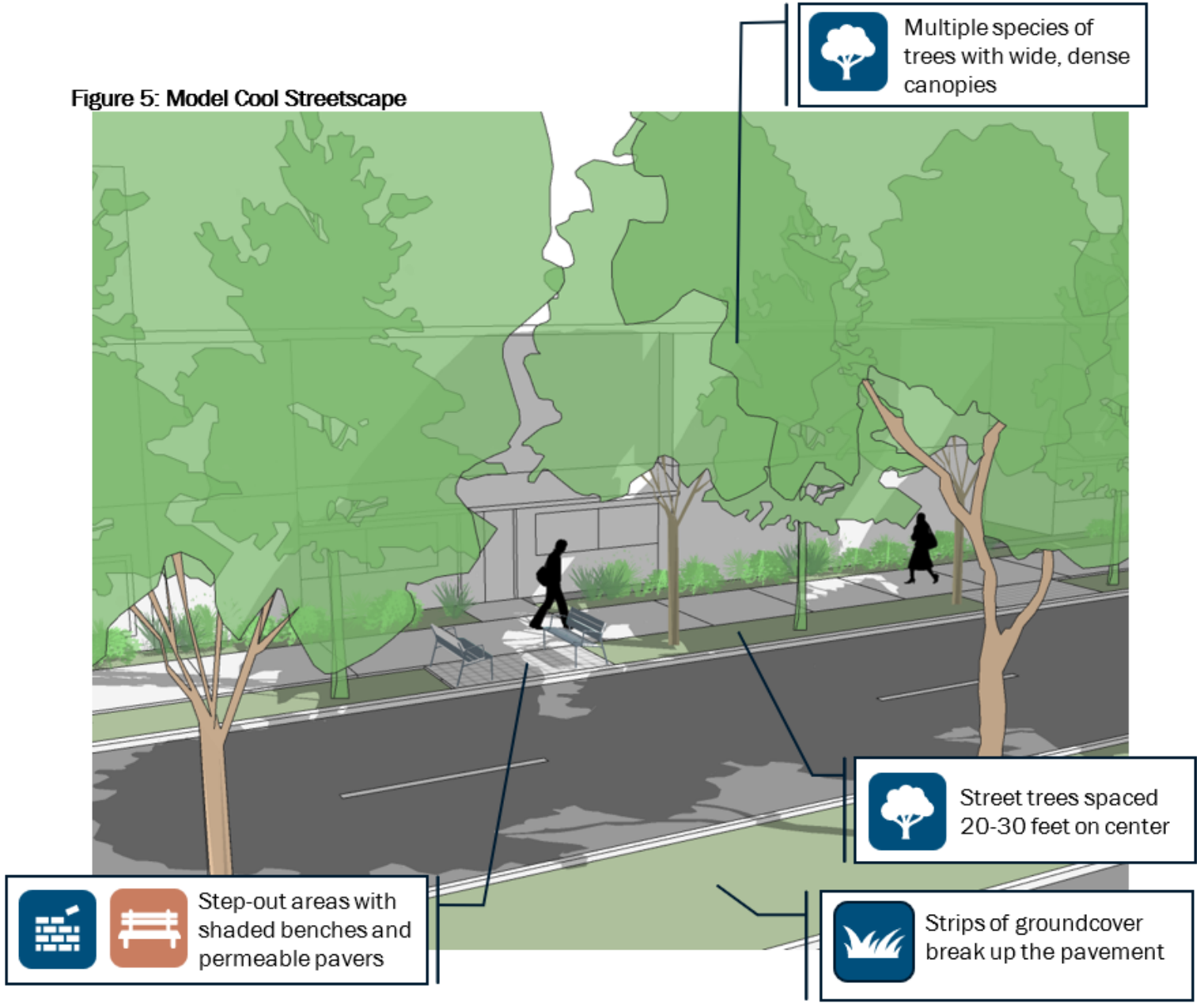


Best Practice Design Guidance

Streetscapes:

- Trees
- Paving
- Groundcover
- Seating

Figure 5: Model Cool Streetscape

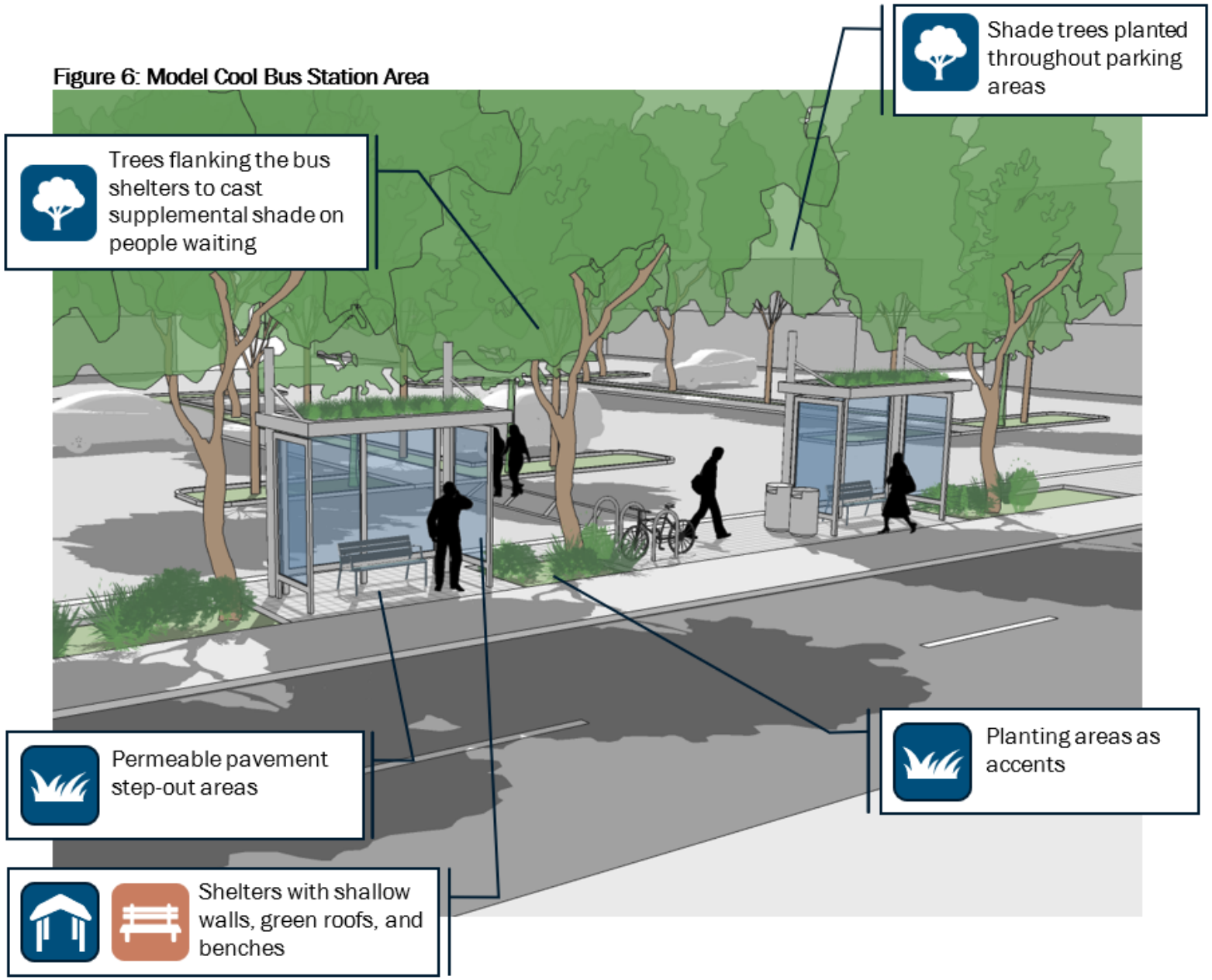


Best Practice Design Guidance

Bus Station Areas:

- Trees
- Groundcover
- Shade Structures
- Seating

Figure 6: Model Cool Bus Station Area

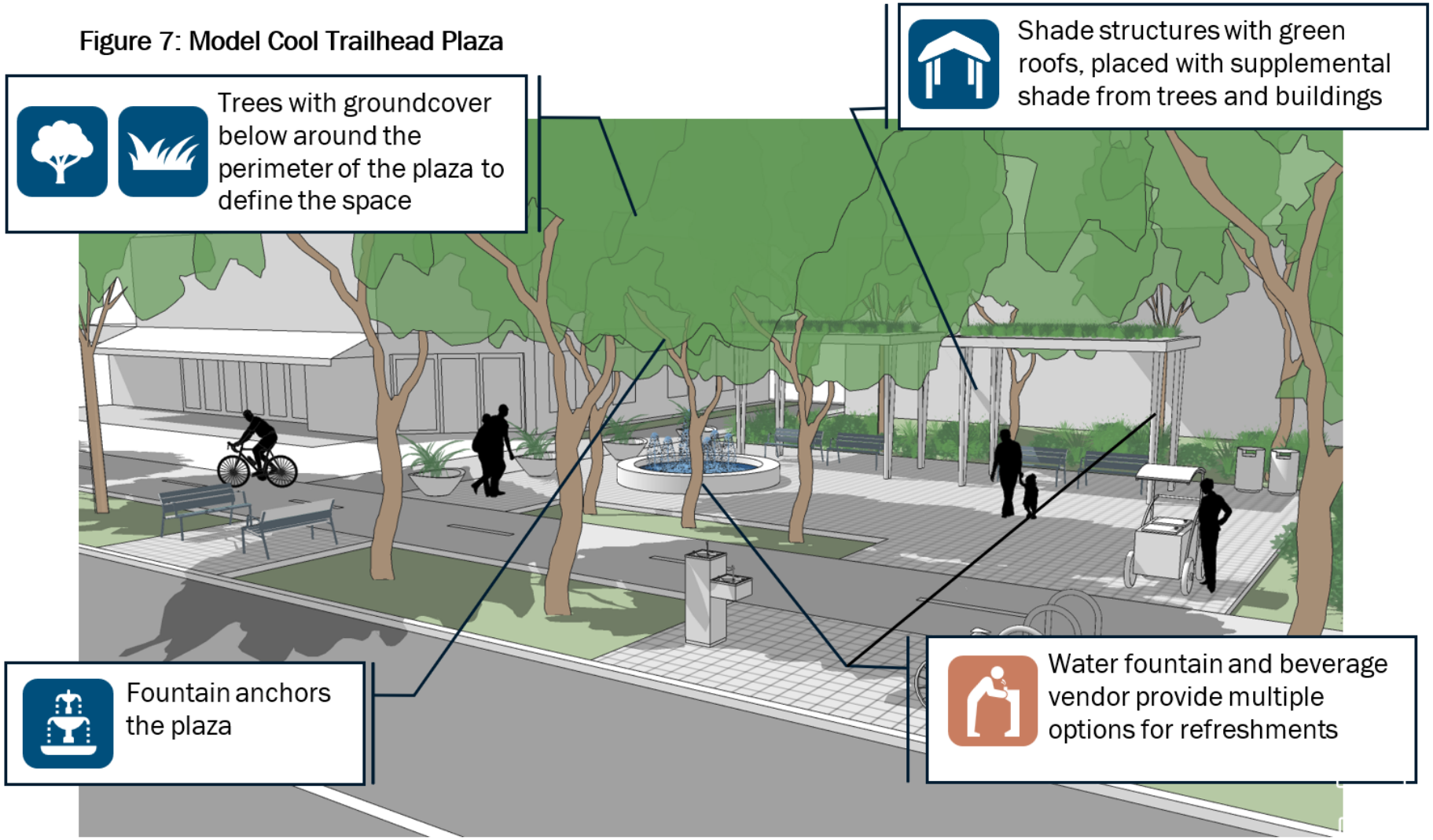


Best Practice Design Guidance

Trailhead Plaza:

- Trees
- Shade Structures
- Water Features
- Drinking Fountains and Refreshments

Figure 7: Model Cool Trailhead Plaza

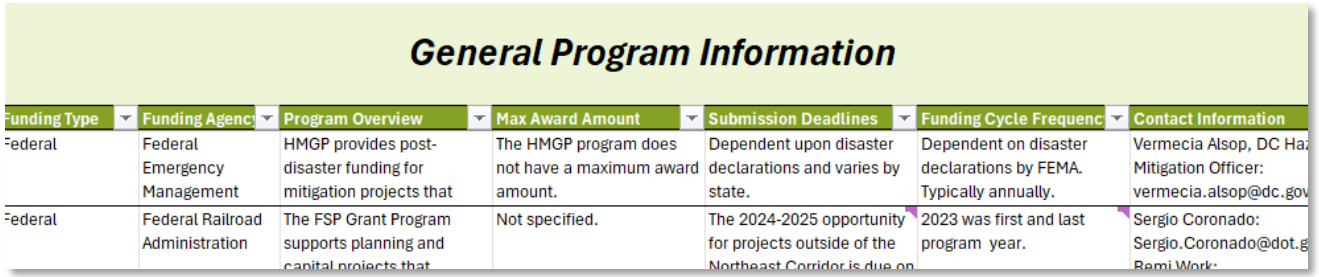


Grant Application Support

Grant matrix to help agencies identify and develop strong applications for funding opportunities.

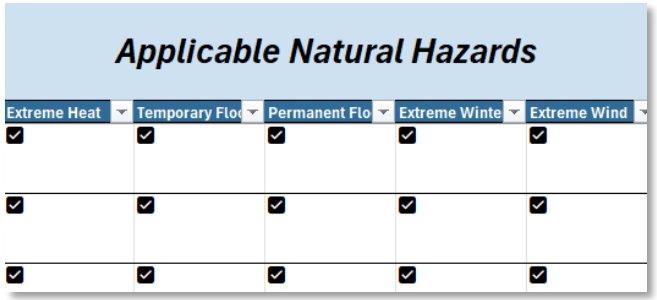
Key features:

- Critical deadlines, evaluation criteria, applicant requirements, project requirements
- Win themes for each funding source to support a strong application



General Program Information

Funding Type	Funding Agency	Program Overview	Max Award Amount	Submission Deadlines	Funding Cycle Frequenc	Contact Information
Federal	Federal Emergency Management	HMGP provides post-disaster funding for mitigation projects that	The HMGP program does not have a maximum award amount.	Dependent upon disaster declarations and varies by state.	Dependent on disaster declarations by FEMA. Typically annually.	Vermecia Alsop, DC Haz Mitigation Officer: vermecia.alsop@dc.gov
Federal	Federal Railroad Administration	The FSP Grant Program supports planning and capital projects that	Not specified.	The 2024-2025 opportunity for projects outside of the Northeast Corridor is due on	2023 was first and last program year.	Sergio Coronado: Sergio.Coronado@dot.g Remi Work:

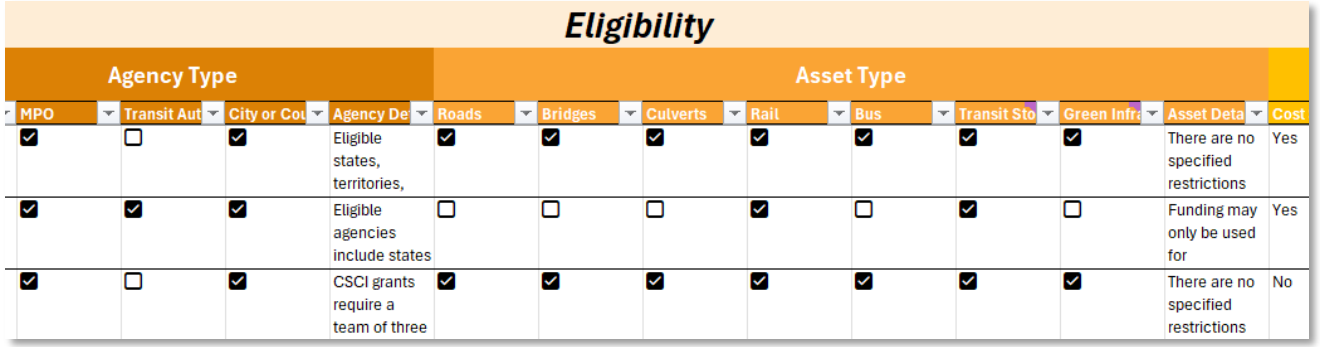


Applicable Natural Hazards

Extreme Heat	Temporary Floo	Permanent Flo	Extreme Winte	Extreme Wind
☑	☑	☑	☑	☑
☑	☑	☑	☑	☑
☑	☑	☑	☑	☑

Applicant Resources

iteria	Past Awards	Win Theme
n evaluation criteria are the State/Territory Grantee unt for alignment with state	Not publicly available	Applications should ad climate hazard vulnera regional hazard mitigat
n review and selection sts of an eligibility review, iew, steering committee	For FY 2022 - 2023, 25 projects in the northeast corridor were awarded over $16.4 billion, and 10 projects outside of	Applications should inc railroad data and quali accessibility improven
re evaluated on seven	All past award recipients are posted on	Applications should ad



Eligibility

Agency Type				Asset Type								
MPO	Transit Aut	City or Cou	Agency De	Roads	Bridges	Culverts	Rail	Bus	Transit Sto	Green Infra	Asset Deta	Cost
☑	☐	☑	Eligible states, territories,	☑	☑	☑	☑	☑	☑	☑	There are no specified restrictions	Yes
☑	☑	☑	Eligible agencies include states	☐	☐	☐	☑	☐	☑	☐	Funding may only be used for	Yes
☑	☐	☑	CSCI grants require a team of three	☑	☑	☑	☑	☑	☑	☑	There are no specified restrictions	No

Policy, Planning, and Design Considerations

Policy, planning, and design guidance considerations to promote the use of cooling strategies.

Five use cases for extreme heat policy, planning, and guidance updates, including examples from other jurisdictions:

- Integrating extreme heat preparedness language into **goals and vision statements**
- Developing language for **land use and zoning policies** that encourage preserving or expanding the tree canopy
- Updating **design standards and manuals** to help mainstream the use of cooling strategies
- Updating **worker safety policies and protocols** to include extreme heat safety measures.
- Developing **contracting and procurement language** to encourage use of cooling strategies in project design and implementation

Moving from Analysis to Implementation

Review the analysis and resources through a local lens – what TPB members can do:

- Explore applicable design guidelines and policy recommendations
- Identify projects that could benefit from resilience funding, work towards pursuing those funding opportunities
- Incorporate heat resilience into ongoing planning and capital programs by referencing guidance use cases and local examples
- Share successes and challenges with regional partners
- Help identify where a regional approach could provide additional value – TPB can help facilitate coordination, information sharing, regional initiatives or workshops

How to Use this Toolkit of Resources

ITEM A – Transit Infrastructure Resilience Analysis

ITEM B – Best Practice Design Guidance

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ITEM D – Policy, Planning, And Guidance Use Cases

Use the results to determine that it is worth constructing shade structures at unsheltered transit stops, given the increasing heat-related burden on riders at those stops.

How to Use this Toolkit of Resources

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Refer to the design guidelines to scope out and design your project.

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Use the database to determine what funding opportunities might be available to support the type of project you have in mind.

How to Use this Toolkit of Resources

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ITEM D – Policy, Planning, And Guidance Use Cases

Refer to this guidance for use cases and sample language to support your efforts to mainstream your heat resilience projects and priorities.

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