Climate Vulnerability Assessment

Localized Flood Risk

Metropolitan Council Committee of the Whole

November 1, 2017

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Today's Discussion

- Overview
- Localized Flooding (Bluespot)
  - Approach and Limitations
  - Methodology
- Transportation &Transit
  - Analysis
  - Potential Strategies
- Mapping Tool
- Next Steps

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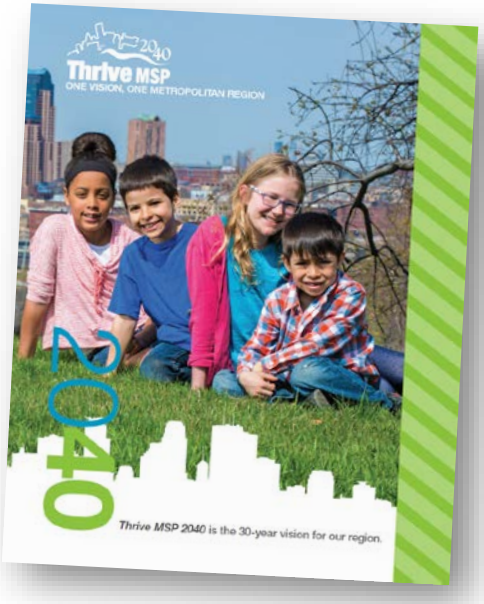
Climate and Regional Planning

- Guide the orderly and economical development of the region.
- Built environment as the primary contributor to climate change
  - Energy use in our buildings
  - Travel behaviors as **a result of our development patterns**
- Already experiencing climate change impacts in our region to which we need to adapt



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Why Conduct a Climate Vulnerability Assessment?

Sustainability Outcome

- Integrating climate mitigation, adaptation, and resilience into the Council's management of regional systems and supporting local governments in their planning and implementation.

Lead by Example

Building in Resilience Land Use Policy

- Develop local resiliency to the impacts of climate change. The Council will identify and address potential **vulnerabilities** in regional systems as a result of increased frequency and severity in temperature, precipitation, and extreme weather.

Collaborate Across the Region

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Assessing the Vulnerability of the Built Environment

Climate impacts related to:

- **Rain** Floodways and localized flooding
- **Temperature** Urban Heat Island (UHI)

Two pronged approach:

1. Assess our regional systems and assets
    - Strategies to address vulnerabilities
2. Develop tools & suggested strategies applicable for local governments

Why Rain & Heat?

Climate Change Trends in Minnesota through 2099

Hazard	*Projections Through 2099*	*Confidence in Projected Changes*
Warming Winters	Continued loss of cold extremes and dramatic warming of coldest conditions	**Highest**
Extreme Rainfall	Continued increase in frequency and magnitude; unprecedented flash-floods	
Heat Waves	More hot days with increases in severity, coverage, and duration of heat waves	**High**
Drought	More days between precipitation events, leading to increased drought severity, coverage, and duration	**Moderately High**
Heavy Snowfall	Large events less frequent as winter warms, but occasional very large snowfalls	**Moderately Low**
Severe Thunderstorms & Tornadoes	More “super events” possible, even if frequency decreases	

SOURCE: *MN DNR State Climatology Office.*

Project Timeline

2015

- CDC Work Plan Item

2016

- COW Climate Change Presentation
- Met Council Earth Day Presentation
- LUAC Scoping Discussion
- CDC Project Update

2017

- LUAC – Human Vulnerability Presentation
- COW – Update and Discussion

CONTINUED PROJECT DEVELOPMENT

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CVA is an Integrated Project

Core Team Members

- CD – Eric Wojchik
- ES – Emily Resseger
- CD – Paul Hanson

Technical Experts

- ES – Wastewater
- ES – Water Supply
- ES – Water Resources
- CD – Parks
- MTS
- MT – Rail and Bus Safety
- MT – Street Operations
- MT – Rail Operations
- MT – Track Department
- MT – Facilities
- Metro HRA

Additional Partners & Support

- Macalester College
- U of MN
- University of St. Thomas
- MAC
- MDH
- MnDOT
- City of Minneapolis
- White House Office of Science & Technology
- Ramsey County/St. Paul
- MN State Climatology Office

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What are We Assessing?

System or Focus	Assets	Council Role
Council-owned Housing	Housing	Owns & Maintains
Facilities	Buildings & Structures	Owns & Operates
Land Use	N/A	Planning & Collaboration with Stakeholders
Transit	LRT, Bus Network, Metro Mobility, & Commuter Rail	Owns & Operates; Collaboration with Stakeholders
Transportation	N/A	Planning & Collaboration with Stakeholders
Regional Parks & Trails	N/A	Planning & Collaboration with Implementing Agencies
Wastewater	Wastewater Treatment Plans, Interceptor Pipes, Lift Stations, Maintenance Holes	Owns & Operates
Water Quality	N/A	Planning & Collaboration with Stakeholders
Water Supply	N/A	Planning & Collaboration with Stakeholders

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Localized Flooding (Bluespot)

Approach and Limitations

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IMAGE SOURCE: City of St. Louis Park

Observation of Mega Rain Events* in MN

Over half of Mega Rain Events since 1866 occurred since 2002

Challenges

Most infrastructure planned for 5 to 10 year storm events

Under new modelling, the 100-year event has increased by 25%

*Defined as 6” or greater rains covering at least 1000sq mile and a peak amount of 8” or greater

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How to Assess Localized Flooding?

Danish Road Institute (Bluespot)

Uses existing GIS data

- Level 1 Screening
- Level 2 Rain Sensitivity
- Level 3 Modelling

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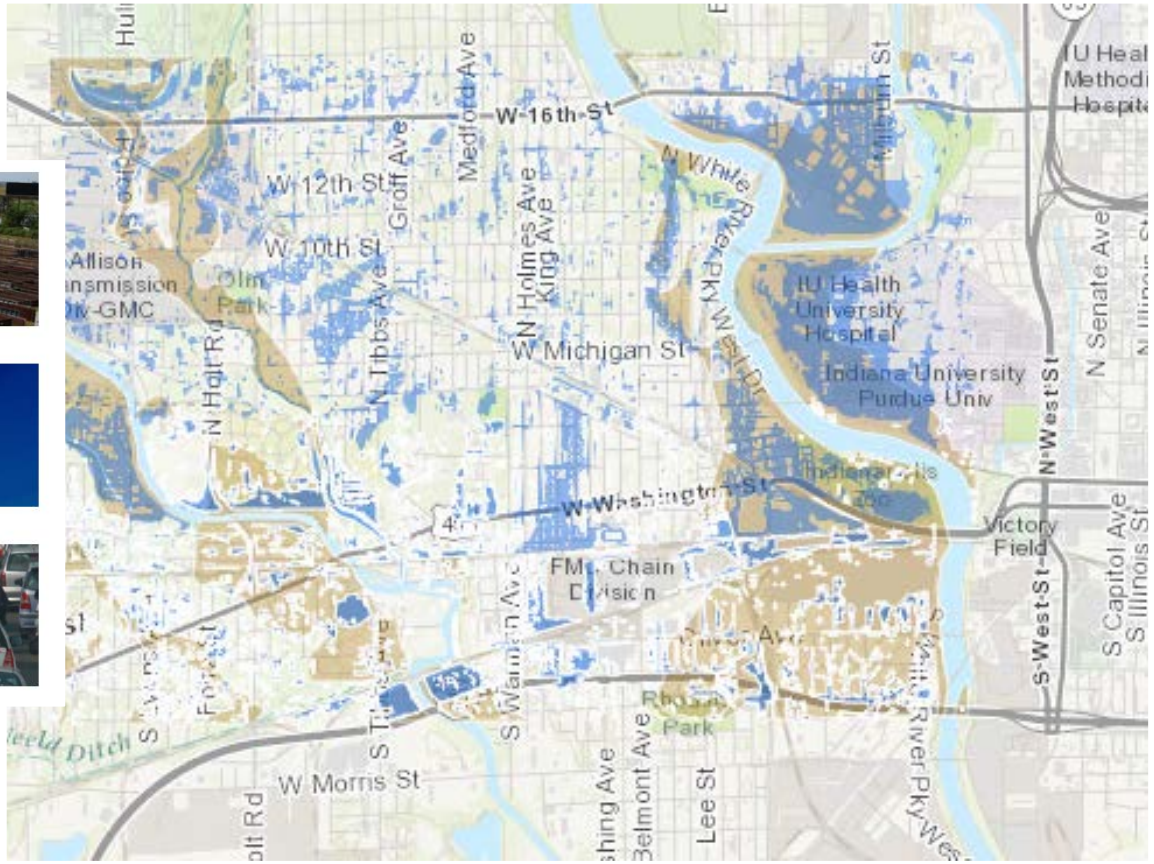
Indianapolis & Bluespot



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Localized Flooding (Bluespot)

Council Approach –

- Create localized flooding data layer from existing data
- Keep data simple to allow for broad application
- Group flood depth hazards to assist in screening Council assets

IMAGE SOURCE: Twitter, Lowry Ave, NE Minneapolis, 7/5/2016

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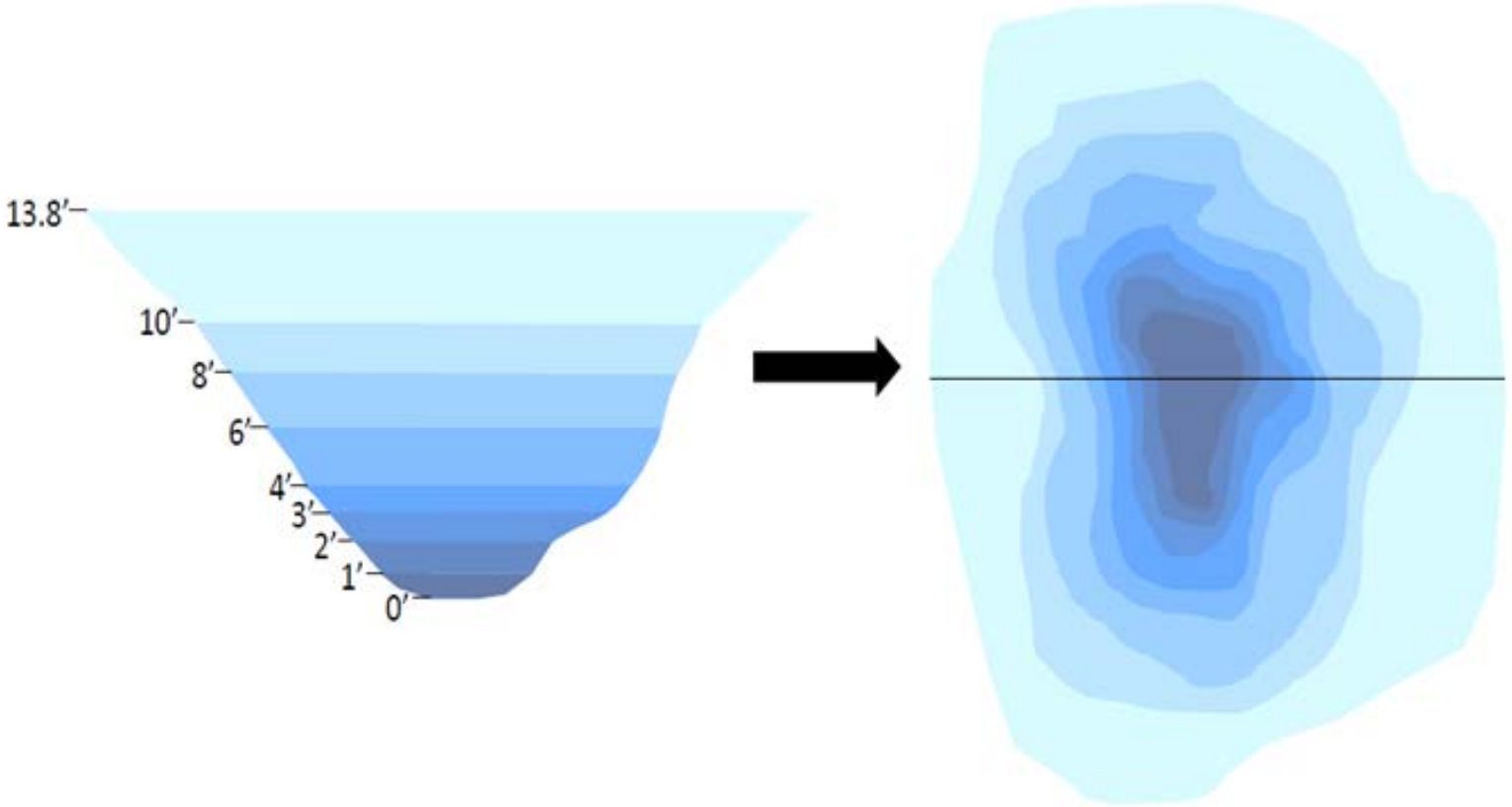
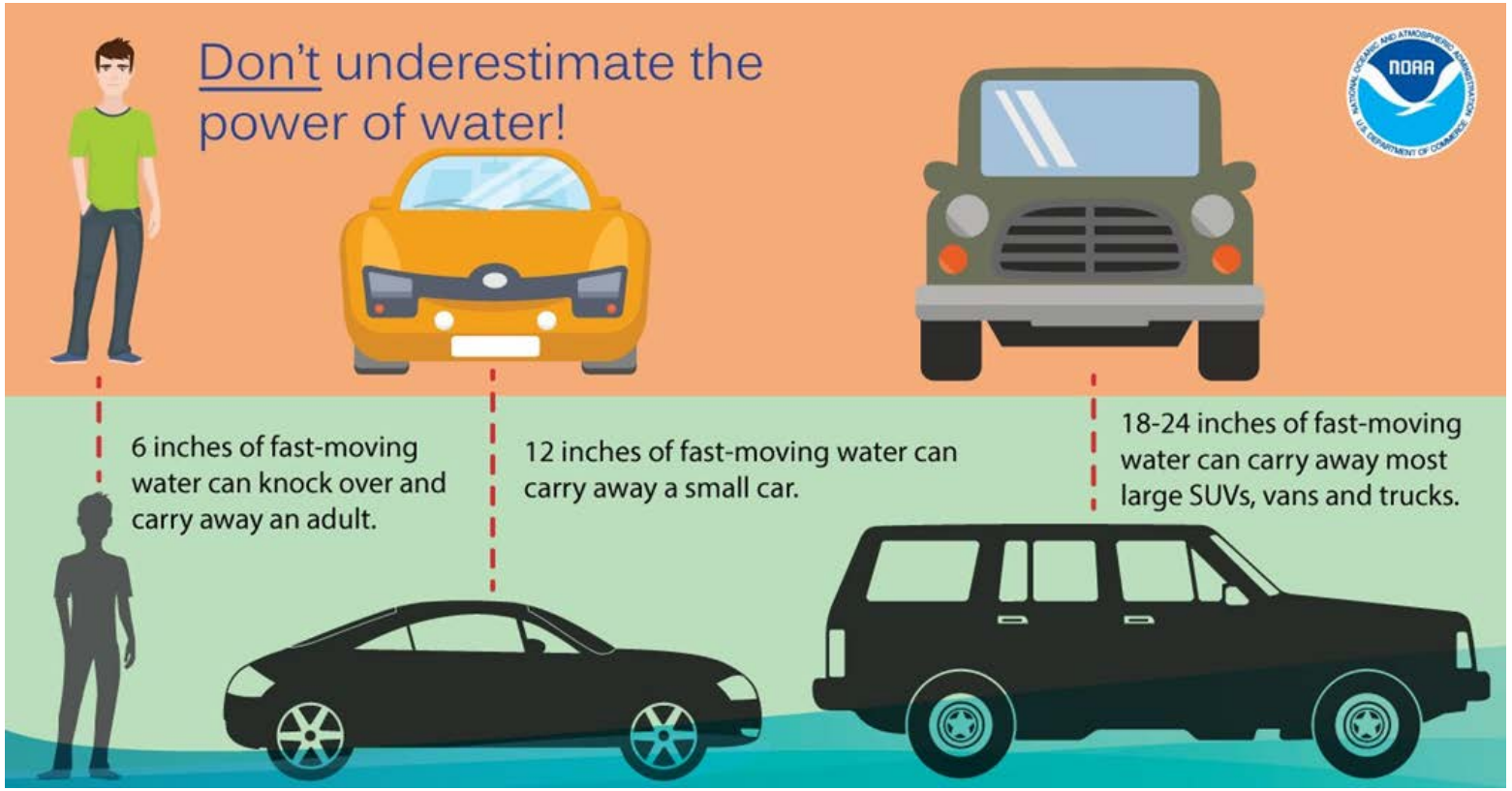
Localized Flooding

Example Cross-section of a Bluespot



Flood Hazards



SOURCE: National Weather Service, 2017

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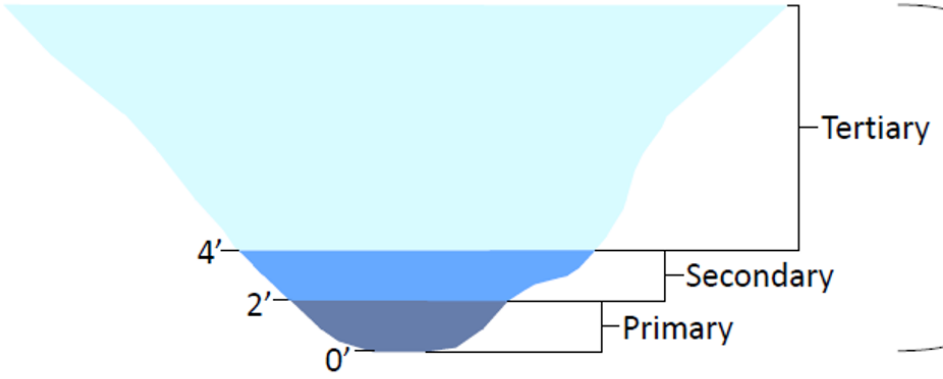
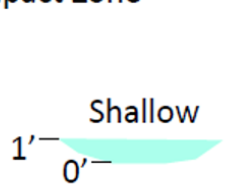
Council Bluespot Categorization

Bluespot Depth	Flood Hazard Category	Bluespot Symbology
3in -1 foot	Shallow	
0-1 feet	Primary	
1-2 feet	Primary	
2-3 feet	Secondary	
3-4 feet	Secondary	
4-6 feet	Tertiary	
6-8 feet	Tertiary	
8-10 feet	Tertiary	
>10 feet	Tertiary	

Isolated 3in – 1ft Bluespots

Flood Impact Zone (FIZ)





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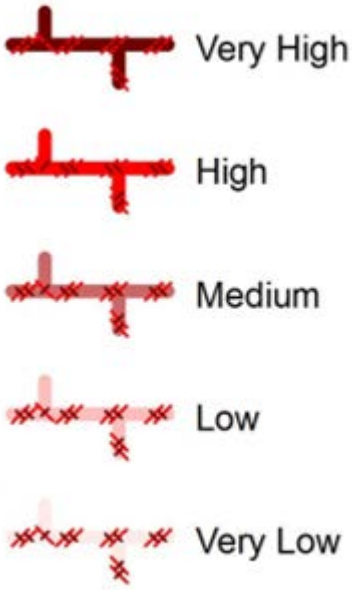
How is Potential Vulnerability Shown?

‘In’ or ‘Out’ Vulnerability

Weighted Vulnerability



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Limitations of Localized Flooding Analysis

- **Data**
  - Limited data
    - No regional stormwater infrastructure data
  - No information on locally-owned infrastructure
  - Detention basins and stormwater ponds included
  - Analysis is static
    - represents a snapshot in time
  - Elevation data is from 2011


IMAGE SOURCE: MC Staff, 38th Street & Stevens Ave, 6/11/2017

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Limitations of Localized Flooding Analysis

- **Discretion**
  - Flood Impact Zones based on Council assets
- **Therefore:**
  - The data is best used for screening and prioritization, should be considered as ***potential*** vulnerability in the event of stormwater infrastructure failure
  - More site-specific analysis should incorporate other data

IMAGE SOURCE: MC Staff, 38th Street & Stevens Ave, 6/11/2017

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Transportation & Transit

Analysis

Proposed Actions

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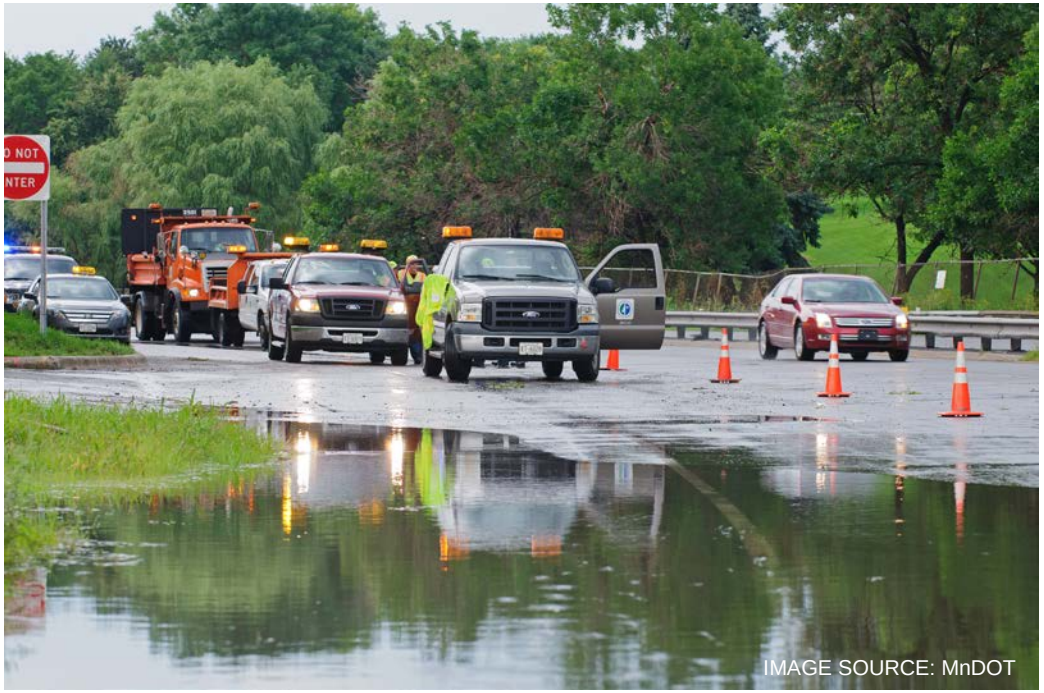
Transportation & Transit

Format for Analysis of Each Asset

- ❑ Asset Overview
- ❑ Local Example

Rationale
GIS Methodology
Analysis
Considerations
Existing Strategies
Proposed Strategies
    MC Strategies
    Local Strategies



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Transportation & Transit

Method

Transportation-Transit Asset	Low	Medium	High
Bus Routes by Type	*Express*	*Local*	*Hi Frequency*
Bus Routes by Number Affected	*1 route*	*2-3 routes*	*≥ 4 routes*
Bus & Transit Stops*, by Routes Served	*1 route*	*2-3 routes*	*≥ 4 routes*
Roadways, by Functional Class	*Local & Collector*	*All other Arterials*	*Principal Arterials*
Rail Lines, Airport Runways, Bicycle Network	*- Sensitivity/Exposure defined by Flood Impact Zone only. Primary, and in some cases Shallow/Primary, represent the highest vulnerability.*		

Transit stops include Rail Stations, bus stops within 1/8 mi. of rail stations, park and ride facilities, and Transit Center facilities.

Flood Hazard		Vulnerability		
		Low*	**Medium***	**High***
Flood Impact Zone	Shallow	*Very Low*	*Low*	*Medium*
	Primary	*Medium*	*High*	*Very High*
	Secondary	*Low*	*Medium*	*High*
	Tertiary	*Very Low*	*Low*	*Medium*

This extra step is performed for Bus Routes, Transit Stops, and Roadways. The Low, Medium, or High from Table 1 is inputted into this matrix to determine vulnerability when intersected with the Flood Hazards.

Transportation & Transit

82.6% of Assets Outside Flood Impact Zone

			Flood Impact Zone % for Assets in a FIZ				
Asset	Total	Total Assets in FIZ*	Primary	Secondary	Tertiary	FIZ Average Max. Depth**	Shallow
Bus Routes	5,976 mi.	17.4%	36.3%	27.3%	25.3%	4.76ft	11.1%
LRT/Commuter Lines	111 mi.	9.6%	47.5%	25.2%	18.4%	3.75ft	8.9%
All Transit Stops	19,422 stops	12.8%	46.6%	12.4%	12.9%	3.39ft	28.1%
All Roadways	44,266 mi.	12.8%	38.1%	25.2%	24.2%	3.87ft	12.5%
Regional Highways	24,584 mi.	16.2%	34.9%	26.4%	27.1%	4.28ft	11.6%
Bicycle Routes	6,773 mi.	15.5%	34.2%	26.6%	27.5%	4.02ft	11.6%

**Refer to Total Asset in FIZ column to determine total exposure to potential localized flooding for each asset. More than 80% of all Council assets are outside of a FIZ.*

***FIZ Average Maximum Depth refers to Primary, Secondary, and Tertiary FIZ. It does not include Shallow.*

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Transportation & Transit

Overview Findings

Asset	Total	Total Assets in FIZ*	Flood Impact Zone % for Assets in a FIZ				
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Transportation & Transit

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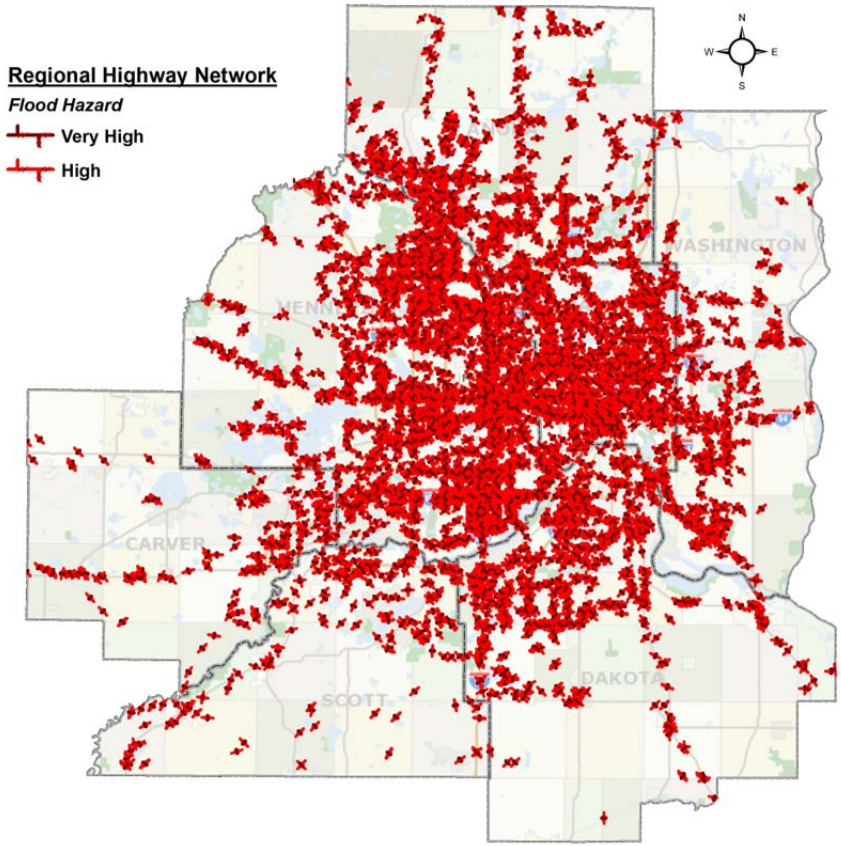
Regional Highway System

Overview Analysis

High & Very High Potential Flood Vulnerability
Arterial Centerline Miles by County

ANOKA	102.01 miles
CARVER	19.14 miles
DAKOTA	137.47 miles
HENNEPIN	652.78 miles
RAMSEY	239.85 miles
SCOTT	19.24 miles
WASHINGTON	61.27 miles
7-County Total	**1231.76 miles**

Potential Flood Vulnerability



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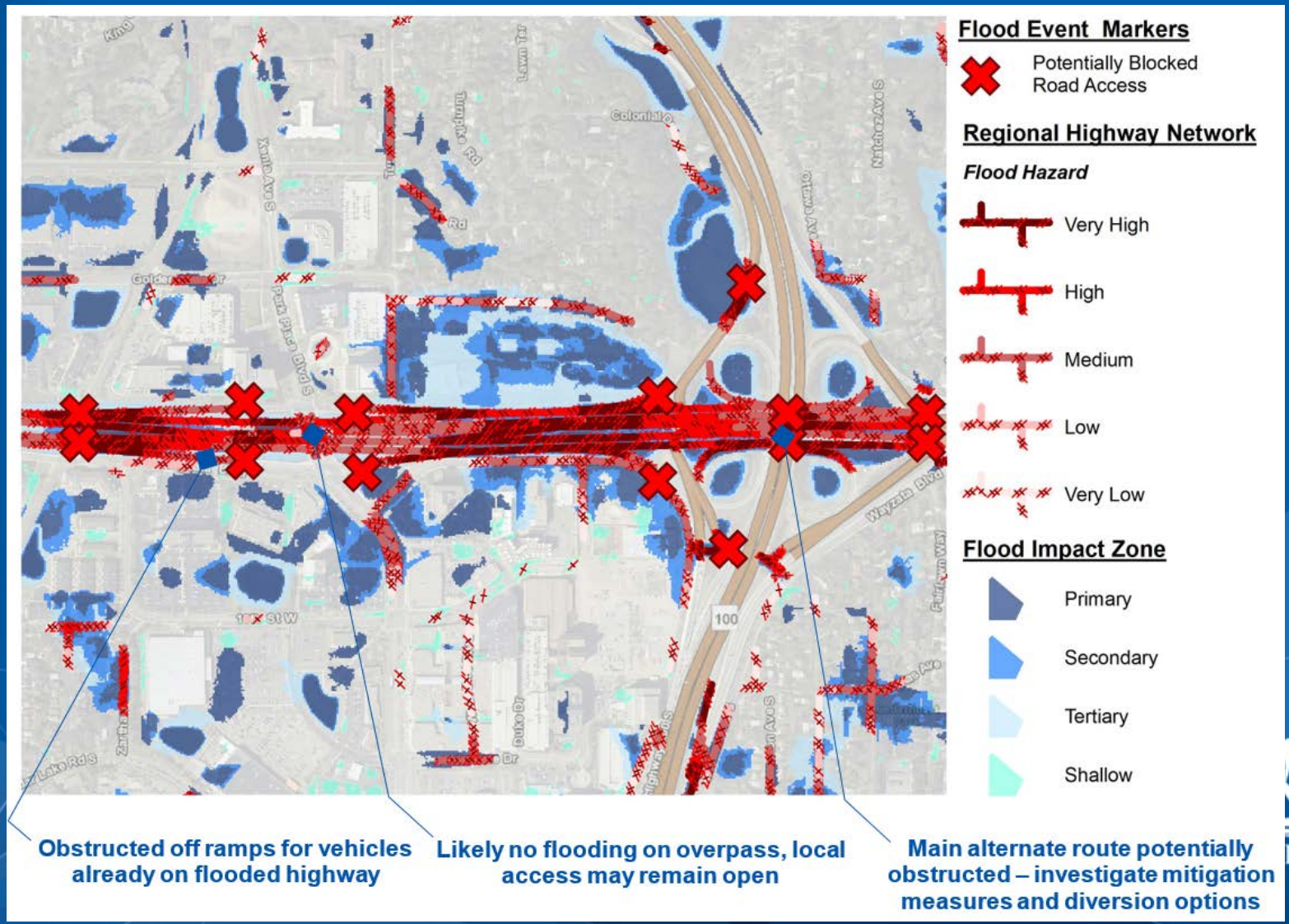
Regional Highway System

Local Example

Potential Localized Flood Vulnerability at Major Regional Junction



Regional Highway System

Proposed Strategies

- Council to conduct arterial assessment of vulnerable areas through collaboration with relevant road authority and stakeholders
- Council to collaborate with relevant authorities and stakeholders to increase surface water infiltration, through green infrastructure practices where possible, in potential vulnerable areas
- Council to plan for re-routing and alternative routes with agency and community partners
- Council to facilitate creation of a regional notification of road re-routing, similar to the Hennepin County Transportation Map

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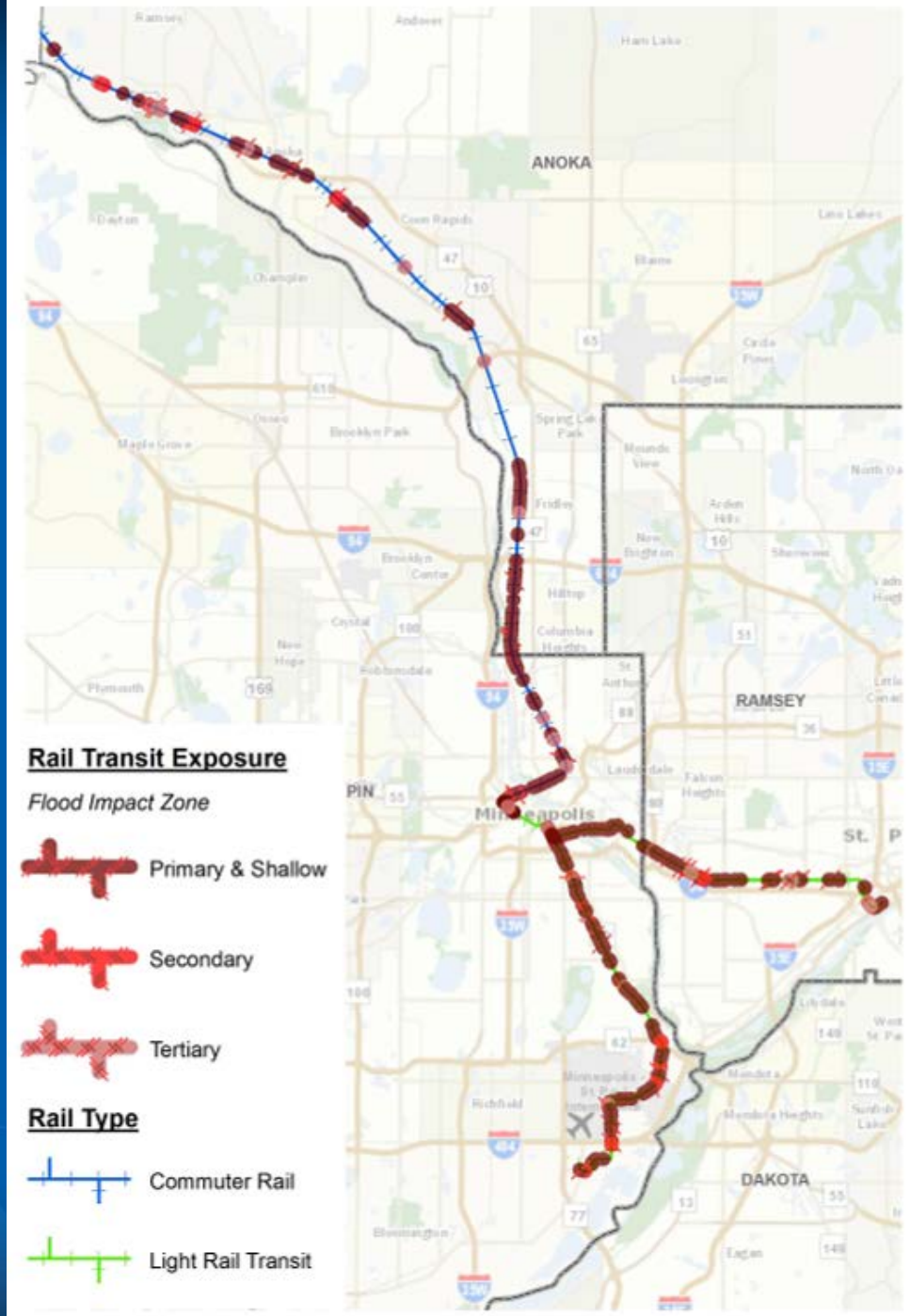
LRT/Commuter Rail

Overview Analysis

LRT & Commuter Rail – Potential Flood Vulnerability



Metro Blue LRT

Potential Flood Vulnerability

Flood Impact Zones on Rails

- Primary & Shallow
- Secondary
- Tertiary

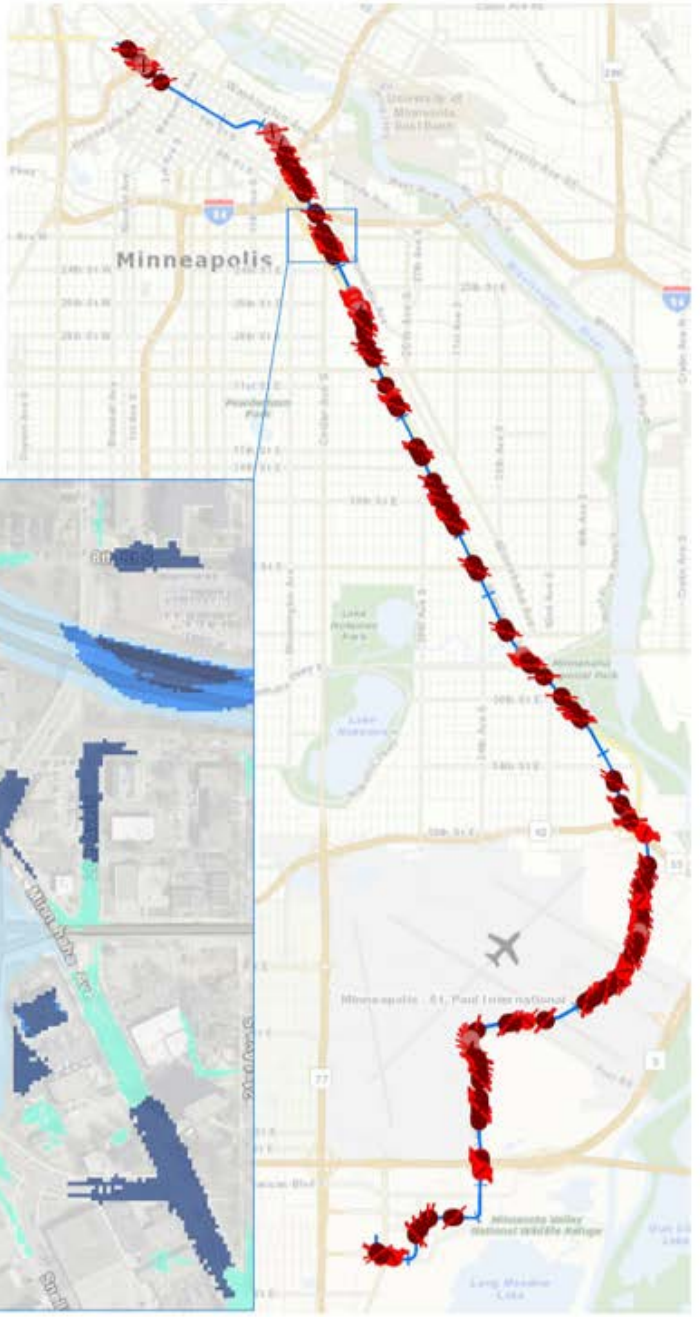
All Flood Impact Zones

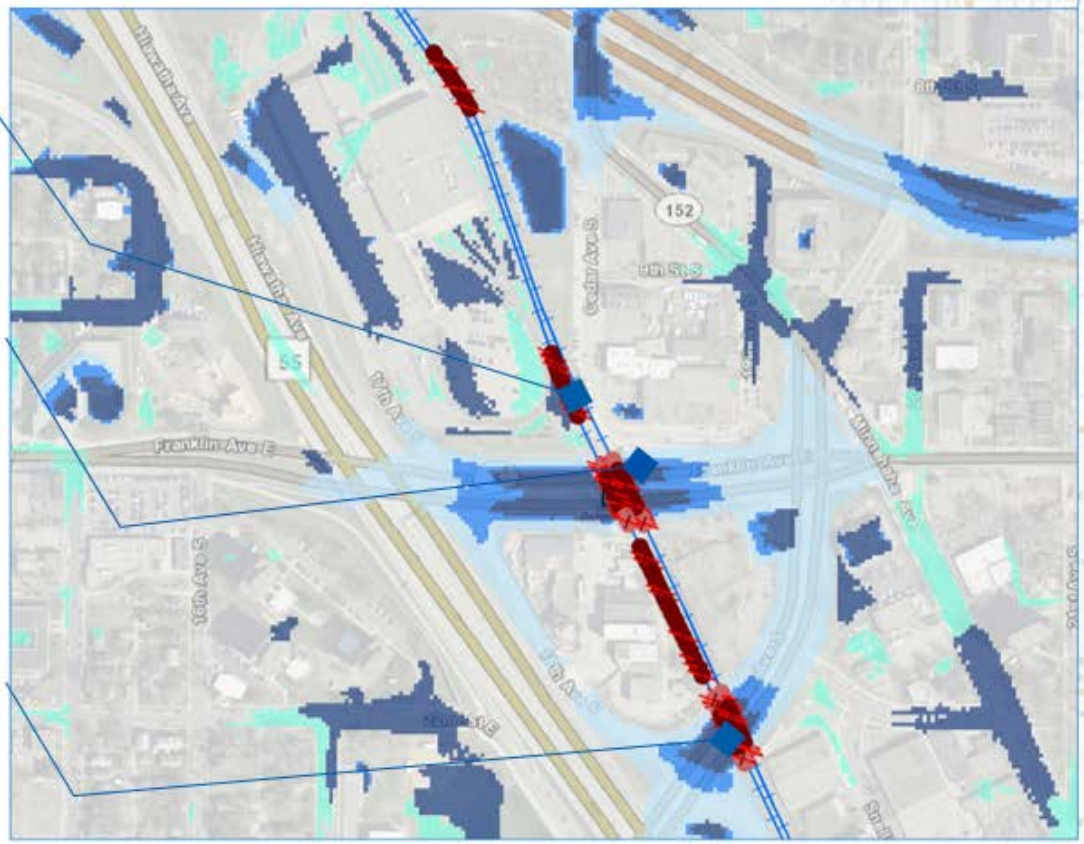
- Primary
- Secondary
- Tertiary
- Shallow

Investigate: flood risk may reach only southbound track

Elevator access to station in Primary Flood Impact Zone

Rails run above potential flooding at some crossings



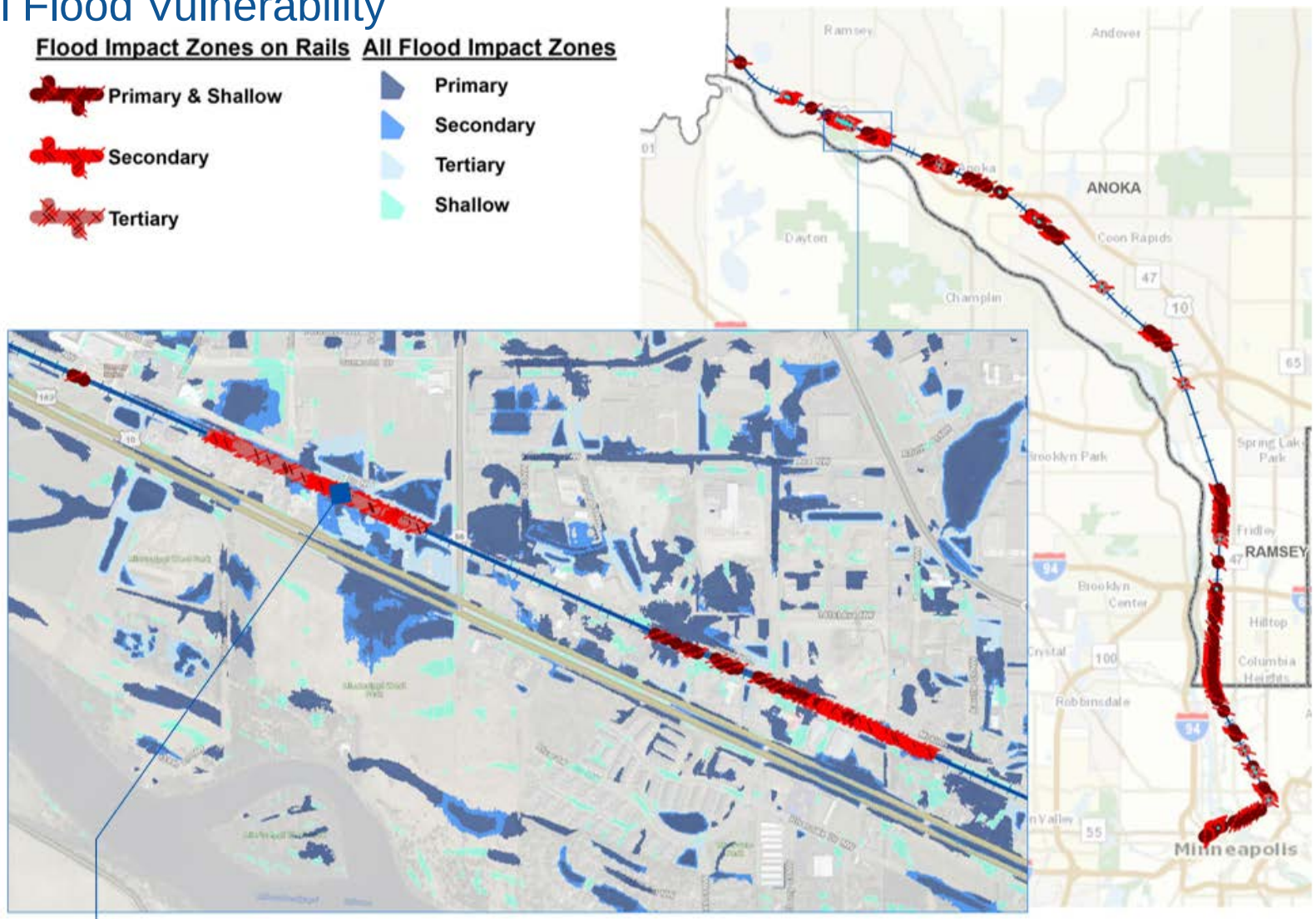


Metro Green LRT

Potential Flood Vulnerability

Northstar Commuter Rail

Potential Flood Vulnerability



LRT/Commuter Rail

Proposed Strategies

- Metro Transit/BNSF to perform site review and audit of all Shallow & Primary rail segments
- Metro Transit staff to document all flood areas that disrupt LRT operations and compare these to localized flooding data
- Metro Transit to enact protocols for relief transit vehicles in advance of forecasted severe storms
- Metro Transit to assess localized flooding impacts on rail operations hardware using technical structure specifications for water infiltration
- Metro Transit to work with local jurisdictions and stakeholders to enact stormwater best management practices and ongoing maintenance in jurisdiction's right-of-way along LRT and Commuter transit corridors
- Metro Transit to prioritize vulnerable station areas to communicate localized flooding potential to riders in a variety of formats and languages

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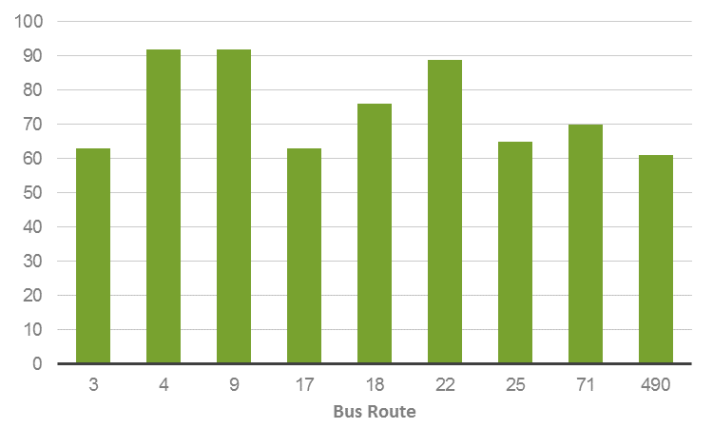
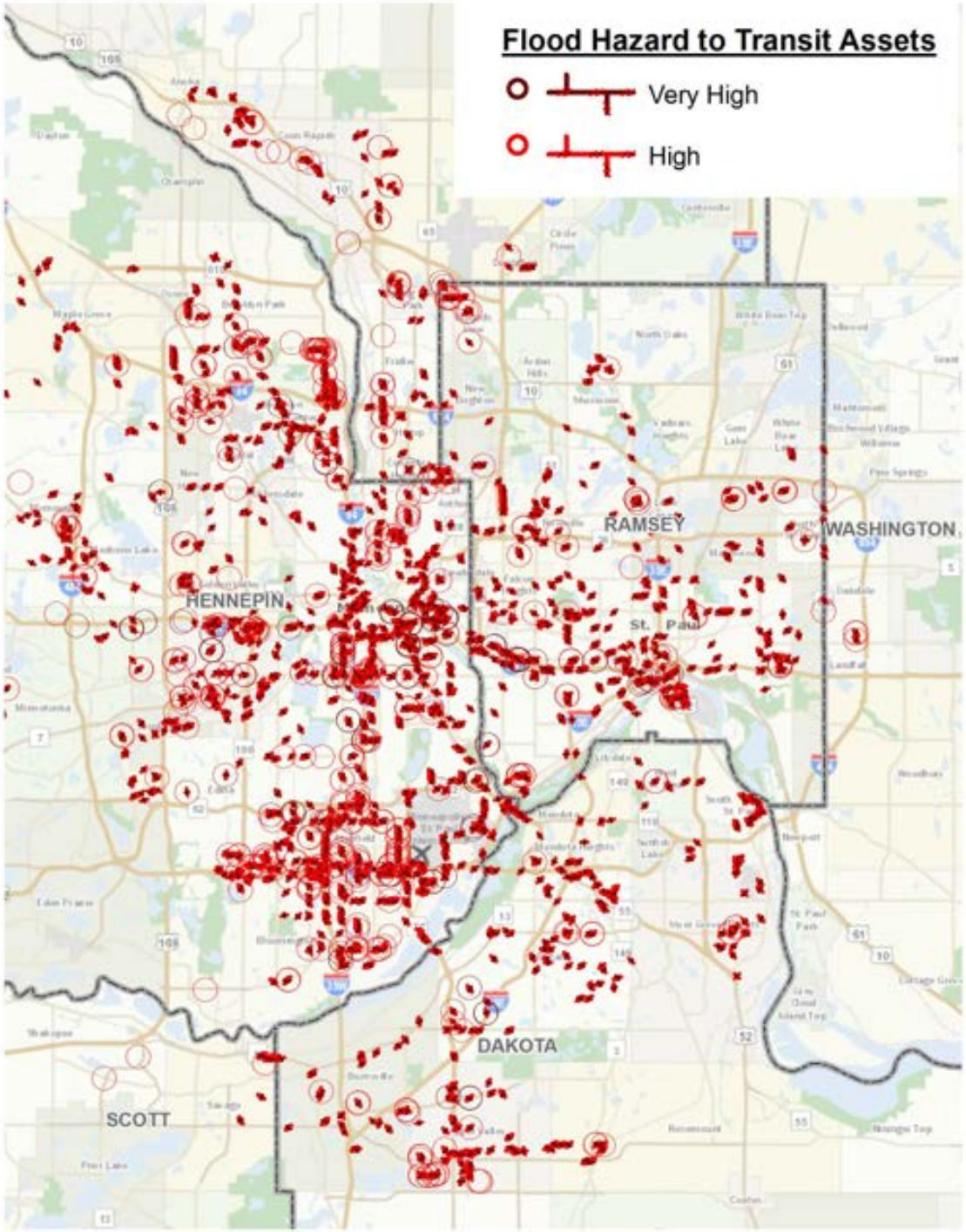
Bus Transit

Overview Analysis

Bus Routes & Stops - Potential Flood Vulnerability

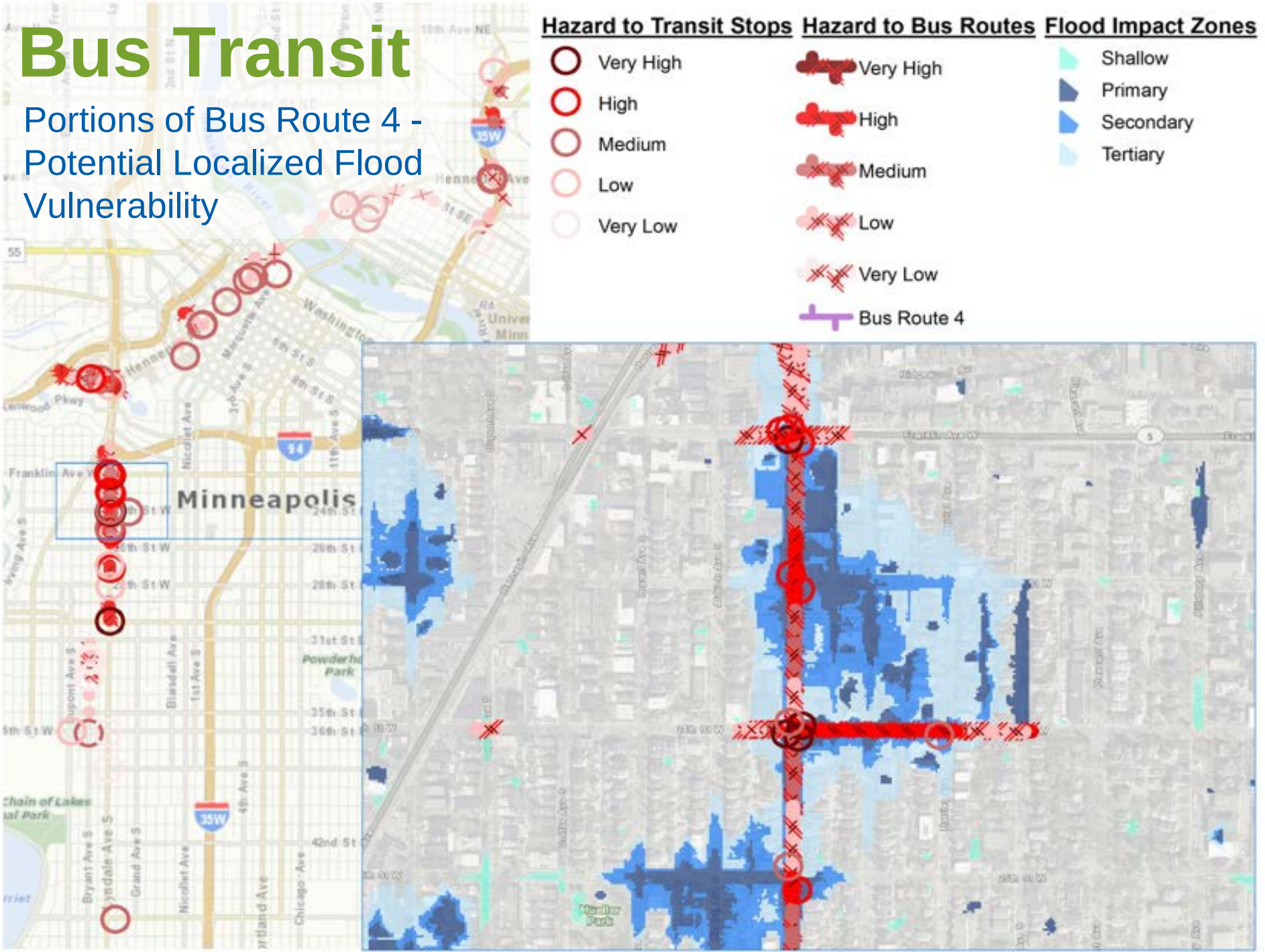


High Vulnerability Bus Routes by Number of Stops in Flood Impact Zones



Bus Transit

Portions of Bus Route 4 - Potential Localized Flood Vulnerability



Bus Transit

Proposed Strategies

- Metro Transit to conduct a more detailed analysis and prioritization of all vulnerable routes and stops across the network
- Metro Transit to develop re-routing plans for potential vulnerable areas on a route-by-route basis
- Metro Transit to leverage local knowledge of experienced drivers for re-routing and temporary stop planning
- Metro Transit to work with relevant local stakeholders to institute volunteer adopt-a-drain programs for local bus stops, using vulnerable routes and bus stop areas for prioritization
- Metro Transit to prioritize vulnerable routes and bus stops to communicate localized flooding potential to riders in a variety of formats and languages

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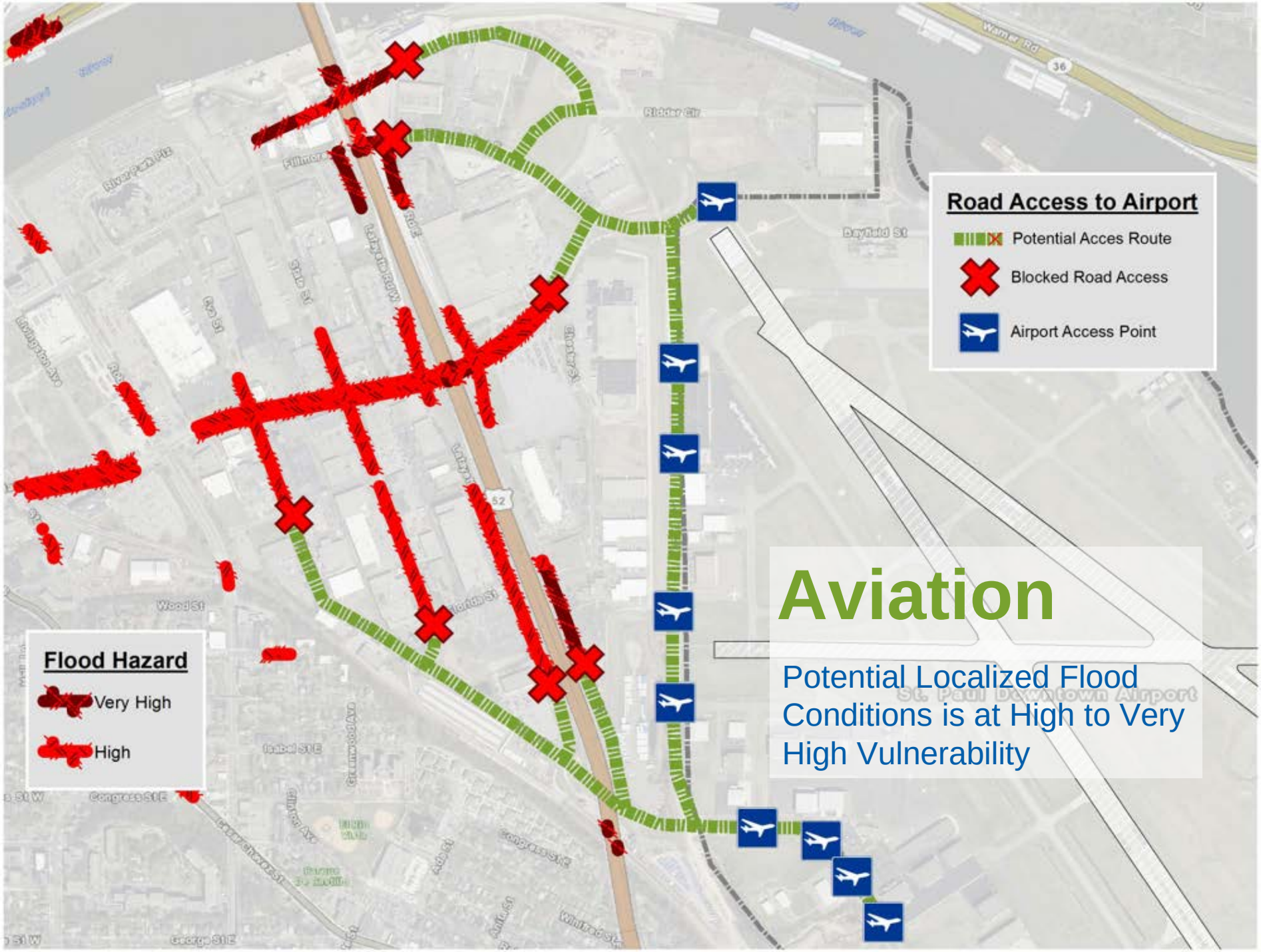
Road Access to Airport
Potential Acces Route
Blocked Road Access
Airport Access Point
Flood Hazard
Very High
High
Aviation
Potential Localized Flood Conditions is at High to Very High Vulnerability

Aviation

Proposed Strategies

- Council and MAC to incorporate localized flood planning with existing riverine flood plans
- Council and MAC to work with local road authorities to reduce peak vulnerability on one or more access roads at St. Paul Downtown Airport

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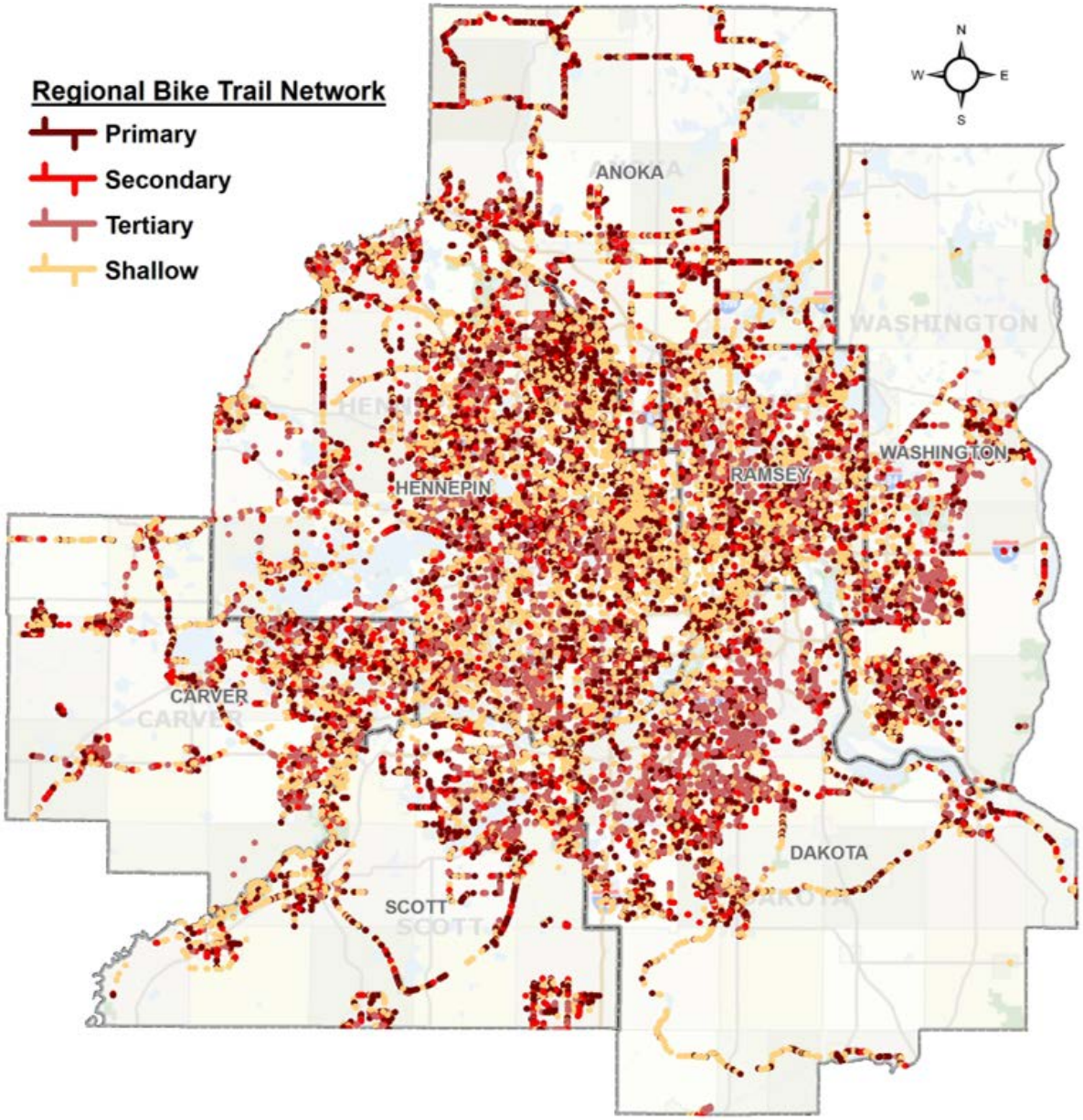

Regional Bicycle Transportation Network

Overview Analysis

Regional Bicycle Transportation Network - Potential Flood Vulnerability

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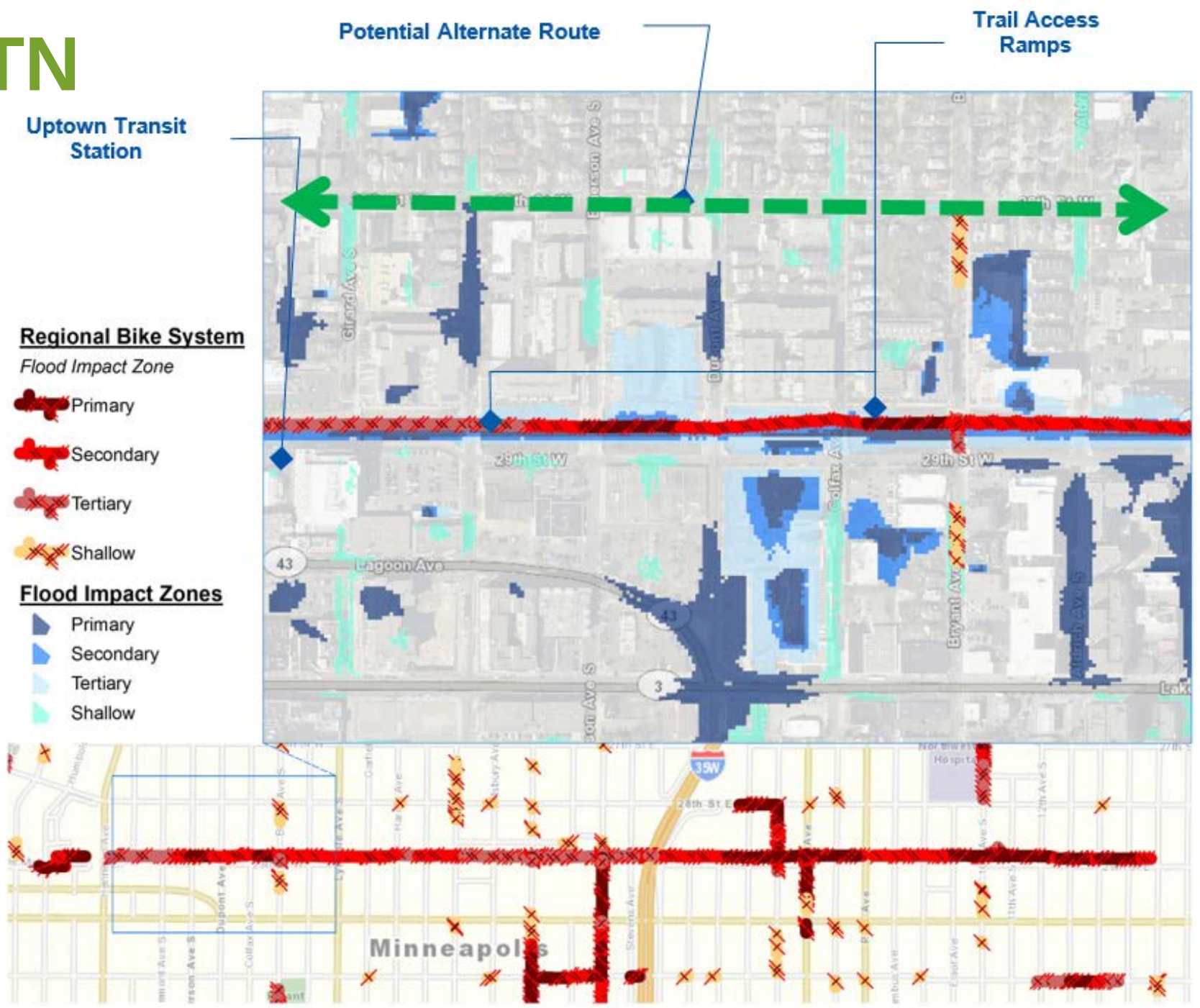
RBTN


Potential Alternate Route
Trail Access Ramps
Uptown Transit Station
Regional Bike System
Flood Impact Zone
Primary
Secondary
Tertiary
Shallow
Flood Impact Zones
Primary
Secondary
Tertiary
Shallow
29th St W
Lagoon Ave
Bryant Ave
Dupont Ave S
Girard Ave S
Emerson Ave S
Colfax Ave S
Fremont Ave S
Lyndale Ave S
43
3
35W
Minneapolis

RBTN

Proposed Strategies

- Council to convene a regionwide stakeholder planning group to assess the potential impacts of localized flooding on the RBTN network to inform current maintenance and future planning

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Desired Outcomes

- Prioritize operations and asset management through verification of localized flooding vulnerability
- Manage stormwater locally, on site, as much as possible through grey and green infrastructure approaches
- Ensure that localized flooding takes place only where it does the least damage
- Ensure that public safety information is available for riders
- Convene a regional stakeholder group and continue collaboration

Next Steps with Transportation & Transit

- Relevant work units to perform more in-depth analysis of high vulnerability system assets
- Go beyond hazard mitigation
- Build equity into policies and strategies
- Consider this data for the next iteration of *Thrive MSP 2040*

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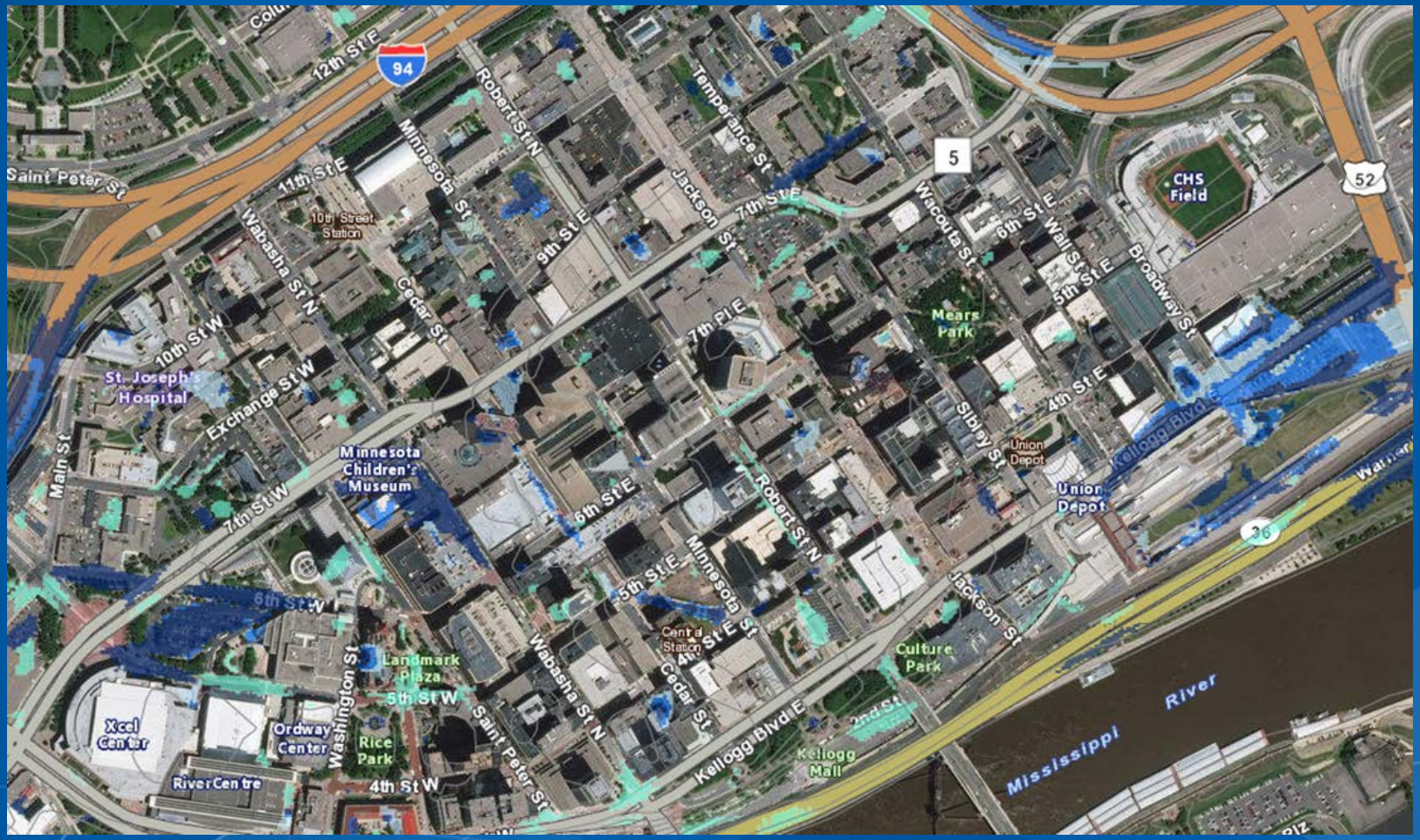
Mapping Tool



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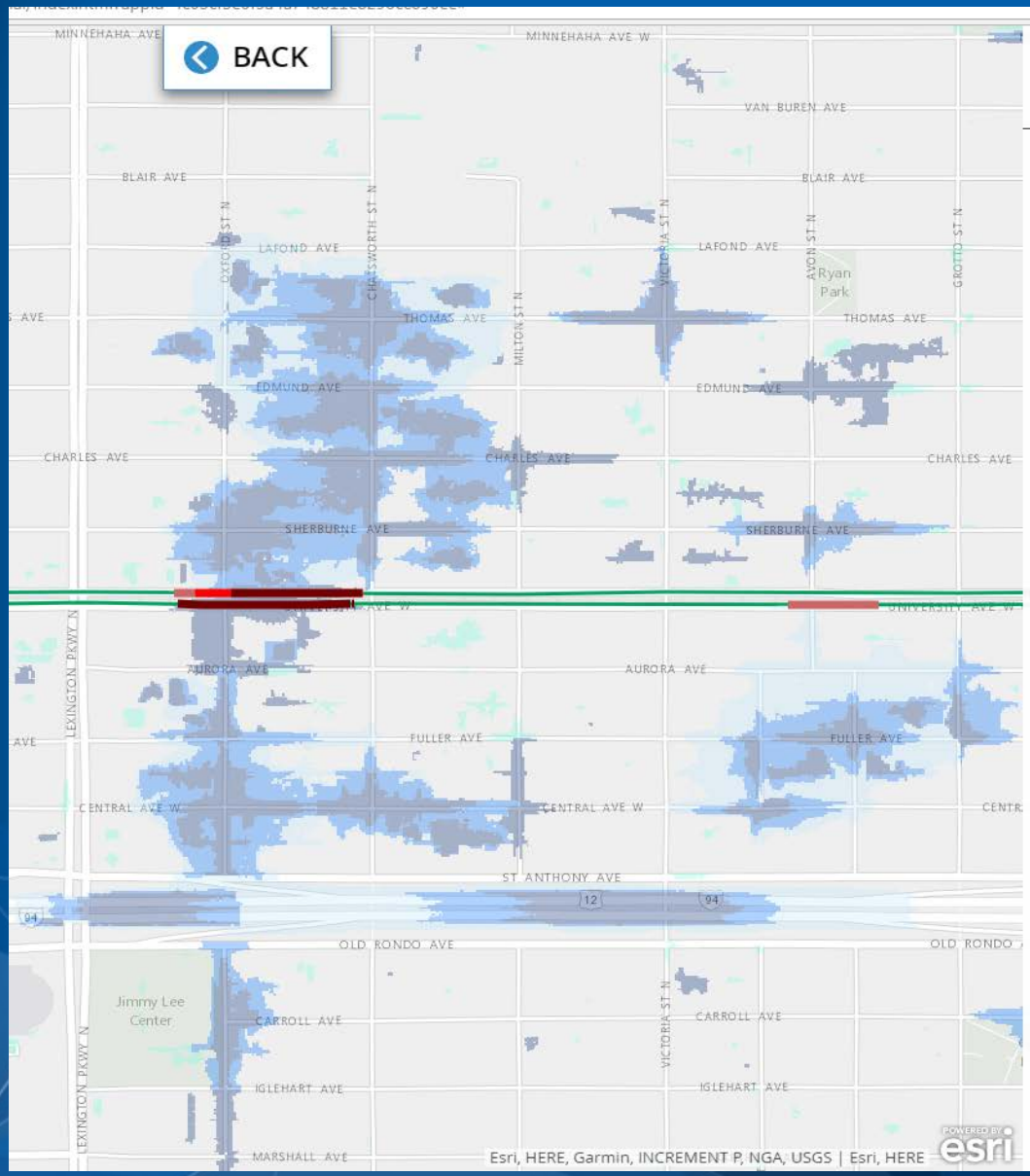
Story Map



Metropolitan Council Environmental Se...

Climate Vulnerability Assessment

Green Line

- **18.01 mi** of track
- **12.7 million trips** in 2016
- Connects Minneapolis and St. Paul downtowns
- Serves: University of Minnesota and home facilities of every major Minnesota professional sports franchise

- **3.52 mi** of line subject to bluespot flooding
- **54.5%** of bluespots are highest category risk
- Frequent intersection (similar to blueline), but **less severe**

Passengers wait as a METRO Green Line train pulls up to the Raymond Avenue Station.

Local Example - Click to Zoom to Analysis

- **Large potential flood events** could complicate alternative service and emergency planning
- **High obstruction risk** between stations

Next Steps

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Complete Project Work

- Additional Localized Flooding CVA (Chapters) Forthcoming:
  - Regional Parks
  - Facilities and Council Housing
  - Wastewater and Water Resources
- Part 2: Extreme Heat
- Part 3: Human Vulnerability
- Other Deliverables:
  - Finalized Mapping Tool (Localized Flooding & Extreme Heat)
  - Story Map

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Additional Direction

- Are we on the right track?
- Additional strategies to consider?
- How would you like to see future chapters?
- Other questions?

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Any Questions?

THANKS!

Project Manager

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