Hillsborough MPO
Surface Transportation Resiliency Planning

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NASEM_TRB Listening Session
March 27, 2017
Hillsborough County, Florida

- 158 miles of coastline
- 4th Largest Population in Florida (1.3 Million)
- 25% of the population inside the FEMA floodplain
- Economic Hub of Tampa Bay Metropolitan Region
- Largest seaport in Florida
- Major cruise homeport
- Home to US Central Command & Special Operations Command Center
- Tampa General Hospital – Regional Burn Center
Surface Transportation Assets

- 800 Freeways & Toll Road Lane Miles
- 3,300 Arterial & Collector Lane Miles
- 3 Major Bridges Across Tampa Bay /Evacuation Routes
- Tampa International Airport
- Container, Bulk Cargo & Cruise Ship Terminals
- 9 Transit Centers & 243 Vehicle Fleet
- Heritage Streetcar System
- Class I Rail Lines & Intermodal Yard
Let’s Design Hillsborough’s Future

A collaboration of the Planning Commission and the Metropolitan Planning Organization for Transportation
What do we mean by Reducing Vulnerability?

Debbie 2012

Hermine 2016
Performance Measures

Preserve the System
- Road resurfacing schedule
- Bridge repair schedule
- Vehicle replacement schedule

Reduce Crashes & Vulnerability
- Total crashes, fatal crashes, and walk/bike crashes
- Economic impact of a major storm

Manage Traffic for Drivers & Shippers
- Peak-hour travel time reliability
- Affected truck trips

Real Choices for Non-Drivers
- People & jobs served by the bus system and trail/sidepath network
Evaluation Process

Data Collection
- SLR - USGS
- Storm Surge - SLOSH
- Flooding (FEMA)

Analysis
- Mapping (ArcGIS)
- Modeling (TBRPM)

Seek feedback
- LMS Group
- Emergency Mgt.
- FDOT
- Port Tampa Bay
- Aviation Authority

Economic Analysis
- Econometric Modeling-REMI (delay & duration: lost GRP, income, work hrs.)

Evaluation Process
Local Mitigation Strategy Working Group- Prioritization of Assets
Assets Studied

- Memorial Highway (Segment)
- South 20th/22nd (Segment)
- Selmon Expressway (Ramps)
- Gandy Boulevard (Segment)
- Courtney Campbell Causeway (Segment)
- I-75 over Alafia River (Bridge)
Risk Scenario

- Simulated Category 3 storm surge
  - Same category, trajectory as 1921 Tarpon Springs storm
  - High tide
  - Addition of sea level rise (2040)
# Vulnerability Reduction Investment Assumed in 2040 Plan

<table>
<thead>
<tr>
<th>Investment Level</th>
<th>Benefits and Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario 1</strong></td>
<td><strong>$31 Million per year</strong></td>
</tr>
<tr>
<td><strong>Level 1</strong></td>
<td>Continue today's stormwater drainage improvement programs</td>
</tr>
<tr>
<td><strong>Category 3 storm impacts:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 8 weeks major roads may be unusable</td>
</tr>
<tr>
<td></td>
<td>- $266 million economic loss</td>
</tr>
</tbody>
</table>

| **Scenario 8b** | **$39 Million per year** |
| **Level 3**     | Continue today's stormwater drainage, plus: |
|                 | raise road profiles, enhance base, protect shorelines from wave damage |
| **Category 3 storm impacts:** | |
|                   | - 3 weeks major roads may be unusable |
|                   | - $119 million economic loss (cut in half!) |

**Economic losses cut in half**

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**Legend**
- Disrupted Network (Group 2)
- Disrupted Network (Group 1)
- Disrupted Network (Full Impact)
- 2040 Roadway Network
- Surge
Pilot Project Follow-Up Study (2016)

- Gandy Boulevard critical segment in 2014 Vulnerability Assessment
  - 1/3-mile segment connecting bridge to planned expressway
  - $1.9M estimated for strategies
Inundation Profile – Gandy Blvd (segment)

Note: Profile shown is that of the Florida Digital Elevation Model. Elevations of bridges and other manmade structures may not be accurately reflected.
Evacuation

• Total travel delay across all bridge crossings decreases

• Evacuation times improve for Tampa Bay overall

• Congestion and delays are reduced on Gandy Boulevard

• Total travel delay for Gandy Boulevard Area residences reduces by approximately 33%
Strategy Refinement for Implementation

• Refined strategies appropriate Selmon Elevated extension at Gandy Blvd.

• Developed conceptual designs & specific pre-engineering cost estimates
  • Within limit of $1.9M budget
  • Assume strategy mainstreaming as part of a project

• Offer low-risk, high benefit solutions to incorporate into elevated expressway extension PD&E proposal.
## Adaptation Options

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost Differential</th>
<th>Level of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do nothing</td>
<td>None initially. Reconstruction cost is $3,312,000</td>
<td>Highest Risk. Required if roadway is destroyed.</td>
</tr>
<tr>
<td>Upgrade to full-depth concrete pavement</td>
<td>$676,000</td>
<td>Medium Risk. Road damage possible if inundation occurs.</td>
</tr>
<tr>
<td>Raise Profile</td>
<td>$1,119,000</td>
<td>Low Risk. Inundation from storm surge, rain or tide related flooding.</td>
</tr>
<tr>
<td>Erosion control via vegetation</td>
<td>$104,544</td>
<td>Low Risk. Embankment damage or washout if inundation occurs.</td>
</tr>
<tr>
<td>Pier protection via vegetation</td>
<td>$30 per pier (total depends on design)</td>
<td>Low Risk. Pier scour or damage possible if surge occurs.</td>
</tr>
</tbody>
</table>
Rising sea levels require unified effort

By Dan McCracken
Published: Monday, March 23, 2015

The sea level rose more than 3 feet during the 20th century, and scientists predict a rise of another 1 to 4 feet during the 21st century. This rise is already having a significant impact on coastal communities around the world. In Florida, the state where the Tampa Bay region is located, the sea level has risen 10 inches since 1850. This has caused erosion of shorelines and infrastructure damage. In addition, rising sea levels have increased the frequency and severity of floods, storms, and other natural disasters. It is clear that we need to take action now to address this issue.

Climate adaptation on planners’ radar

By Steve Kretlow
Published: Monday, March 23, 2015

The world is facing a significant challenge in adapting to the effects of climate change. This includes rising sea levels, which are already causing damage in coastal communities. The Florida Department of Environmental Protection is working to develop plans to mitigate the effects of sea-level rise. In addition, the US Army Corps of Engineers is conducting studies to determine the best course of action for protecting coastal infrastructure.

Hillsborough governments building sea-level rise into development plans

By Christopher O’Donnell
Published: March 23, 2015

The Tampa Bay region is home to many coastal communities that are vulnerable to the effects of sea-level rise. In order to protect these communities, local governments are building sea-level rise into their development plans. This includes designing infrastructure that can withstand higher water levels and developing strategies to manage stormwater runoff.
Addressing Climate Issues Regionally

Tampa Bay Climate Science Advisory Panel (CSAP)
Unified Projection of Sea-Level Rise in Tampa Bay Region

TBRPC ONE BAY Resilient Communities

- Pinellas County Climate Team
- Hillsborough County EPC Workgroup
- Manatee County Green Team
- Pasco County
Local Comprehensive Plans

**TA CM Policy 1.3.7:** Develop strategies to identify and address issues related to climate adaptation in cooperation with the EPC, the Planning Commission, and other agencies.

**TT LU Policy 1.4.3:** The City shall develop strategies to identify and address issues related to climate adaptation in cooperation with the EPC, the Planning Commission and other agencies.

**PC LU Policy 6.1.4:** Develop strategies to identify and address issues related to climate adaptation in cooperation with EPC, the Planning Commission and other agencies.
Florida Peril of Flood Act - 2015

Amends s. 163.3178, F.S.; specifying requirements for the coastal management element required for local comprehensive plans.
• Continue work in 2045 LRTP update
• Coordinate with local jurisdictions on mainstreaming adaption options for projects.
• More work to be done...
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detailed back up material
## Estimated Impact of Disruption

### Candy Blvd (2040)

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Attribute</th>
<th>Daily Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure Travel</td>
<td>Auto - VMT</td>
<td>80,395</td>
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<tr>
<td></td>
<td>Auto - VHT</td>
<td>24,474</td>
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<td></td>
<td>Auto - Delay</td>
<td>21,352</td>
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<tr>
<td></td>
<td>Auto - Lost Trips</td>
<td>0</td>
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<tr>
<td>Commute Auto Travel</td>
<td>Auto - VMT</td>
<td>49,660</td>
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<tr>
<td></td>
<td>Auto - VHT</td>
<td>10,751</td>
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<tr>
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<td>Auto - Delay</td>
<td>9,153</td>
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<tr>
<td></td>
<td>Auto - Lost Trips</td>
<td>0</td>
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<tr>
<td>Business/On-the-clock</td>
<td>Auto - VMT</td>
<td>69,495</td>
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<tr>
<td></td>
<td>Auto - VHT</td>
<td>12,248</td>
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<tr>
<td></td>
<td>Auto - Delay</td>
<td>10,378</td>
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<tr>
<td></td>
<td>Auto - Lost Trips</td>
<td>0</td>
</tr>
<tr>
<td>Truck</td>
<td>Truck - VMT</td>
<td>10,055</td>
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<tr>
<td></td>
<td>Truck - VHT</td>
<td>2,994</td>
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<tr>
<td></td>
<td>Truck - Delay/Idling</td>
<td>2,746</td>
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<tr>
<td></td>
<td>Truck - Lost Trips</td>
<td>0</td>
</tr>
</tbody>
</table>

### Estimated weekly losses

- **Gross Regional Product:** $1.55 MM
- **Income:** $1.0 MM
- **Work Hours:** 29,000
What can we get if we invest in **Reduced Vulnerability**

**Based on illustrative Cat 3 storm occurring in next 20 years**

**Investment Level 1** – $988 M (current spending trend x 20 years, in YOE $)
- Routine drainage improvements
- Up to 8 weeks of road network disruption with sample Cat 3 storm
- Economic loss to Hillsborough County: $266 M

**Investment Level 2** - $1,025 M (in YOE $)
- Interstates only: drainage improvements, shoreline armoring & wave attenuation
- Up to 6 weeks of road network disruption with sample Cat 3 storm
- Economic loss to Hillsborough County: $153 M or 42% less
- $31 M investment results in $113 M benefit

**Investment Level 3** – $1,159 M (in YOE $)
- Interstates & arterials: drainage improvements, shoreline armoring & wave attenuation
- 3 weeks of road network disruption with sample Cat 3 storm
- Economic loss to Hillsborough County: $119 M or 55% less
- $112 M investment results in $147 M benefit

Estimated avoided losses are based on making highway segments less vulnerable to storm & flood damage
## Typical Costs for Reduced Vulnerability

<table>
<thead>
<tr>
<th>Risk Mgmt. Strategy</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Base/Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raise profile/strengthen base*</td>
<td>Lane mile</td>
<td>$268,883</td>
<td>$268,883</td>
<td>$20,854,540</td>
<td>$68,807,075</td>
</tr>
<tr>
<td>Wave attenuation (WADs)</td>
<td>1 Unit</td>
<td>$750</td>
<td>$750</td>
<td>$3,887,400</td>
<td>$17,628,600</td>
</tr>
<tr>
<td>Shoreline protection (riprap)</td>
<td>Lin. ft.</td>
<td>$350</td>
<td>$350</td>
<td>$5,442,360</td>
<td>$24,680,040</td>
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<tr>
<td>Drainage improvements*</td>
<td>CL mile</td>
<td>$14,737</td>
<td>$14,737</td>
<td>$816,566</td>
<td>$816,566</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>$31,000,866</td>
<td>$111,932,281</td>
</tr>
<tr>
<td><strong>TOTAL plus contingency</strong></td>
<td>20%</td>
<td></td>
<td></td>
<td>$37,201,039</td>
<td>$134,318,738</td>
</tr>
</tbody>
</table>

* Counts marginal costs only. All costs are approximate
Weeks of Disruption in Network, Post-Event

“Base Case” Investment Scenario Narrative

Coastal Interstates, particularly Bay crossings, suffer washouts at approaches and experience minor structural damage, yielding the equivalent of 2 weeks of capacity loss (includes debris removal and inspections). Washouts and erosion on coastal arterials are prevalent, a substantial portion of saturated roadway base requires replacement, and some bridges experience severe scouring and approach washouts, yielding the equivalent of 4 weeks of capacity loss. Local facilities experience similar, but more prevalent impacts and are generally designated for repair and clearance last, yielding the equivalent of 8 weeks of capacity loss.
Memorial Highway Project

- Cost Feasibility based on FDOT Strategic Intermodal System (SIS) 2040 Plan:
  - Part of SR 60/I-275 interchange reconstruction
  - $193 M cost (in YOE)
- Vulnerable area: 0.6 – 1.1 mi. based on Cat 1-Cat 3 storm surge
- Replacement cost: $100 M +
- Protection cost: $4.2 M
- Potential to incorporate into SIS project

Memorial Highway – 158,000 ADT
Adaptation Strategies - Drainage

• Permeable Pavement
  • Applicable for low speed and low volume roads

• Enhanced Drainage
  • Gandy Blvd existing constraints
  • Areawide watershed study
Adaptation Strategies – Harden Road

• Harden surface or base layers
  • Avoid potential washouts
• Full depth concrete
• New materials and concepts
  • Research underway
Adaptation Strategies – Raise Profile

• Gandy Blvd bridge has low elevation
  • Bridge has longer life than road
  • Eastbound/westbound different elevations

• Several options:
  • Raise Gandy Blvd to match lowest elevation
  • Consider raising one side only
  • Consider raising as companion (or after) bridge project
Adaptation Strategies – Erosion Control

• Wave Attenuation Device
  • Consider in longer term; Protection from Tampa Bay
• Living Shoreline
  • Consider in longer term; Environmental coordination
• Rivetments – Riprap or Vegetation
  • Recommend vegetation (specialty grasses or shrubs)
• Pier / Column Protection
  • Recommend vegetation (specialty grasses or shrubs)
  • Hardened solutions (e.g., concrete, double-wall construction)
Gandy Blvd – West End Segment
Gandy Blvd – East End Segment
Simulated Cat 3 storm surge in 2040 and inundated roadway network
## SAFETY AND SECURITY

**Goal: Improve Recovery Reduction**

<table>
<thead>
<tr>
<th>Current Level</th>
<th>Annual Stormwater &amp; Flooding Investments</th>
<th>Weeks of Disruption</th>
<th>Economic Loss of a Typical Category 3 Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$31 Million</td>
<td>$31 Million</td>
<td>8 Weeks</td>
<td>$266 Million</td>
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<table>
<thead>
<tr>
<th>Target Level</th>
<th>Annual Stormwater &amp; Flooding Investments</th>
<th>Weeks of Disruption</th>
<th>Economic Loss of a Typical Category 3 Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$39 Million</td>
<td>$39 Million</td>
<td>3 Weeks</td>
<td>$119 Million</td>
</tr>
</tbody>
</table>

- Increased Mitigation Investment
- Decreased Economic Impact
- Decreased Weeks of Disruption