

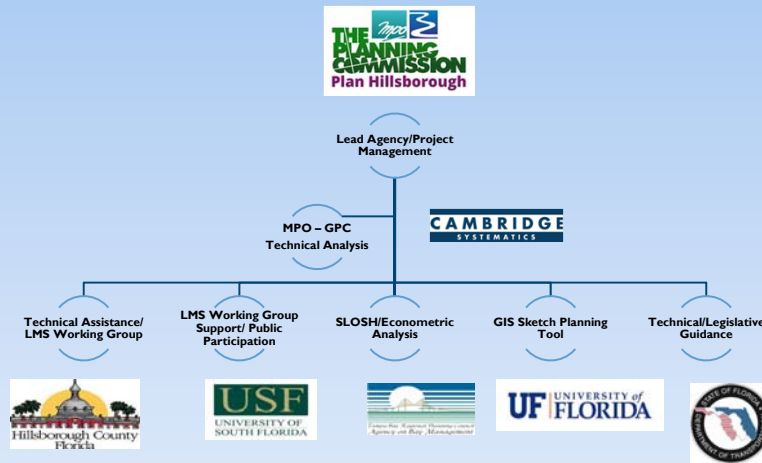


Project background

- **FHWA Pilot:** Climate change vulnerability assessment and adaptation analysis, focused on the transportation sector.
 - » *Sponsored by the Federal Highway Administration (competitive grant)*
- **L RTP update:** Reduce Crashes & Vulnerability investment program
- Both led by HC MPO/Planning Commission, with partners
- Final Report – October 2014

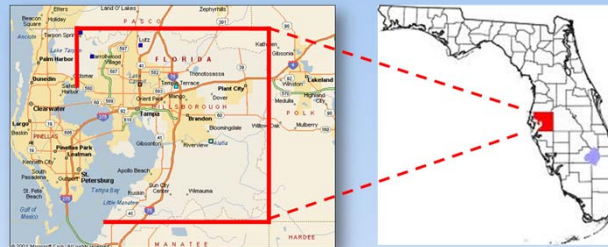
<http://www.planhillsborough.org/hillsborough-transportation-vulnerability-assessment-pilot-project/>

Project Partners



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Hillsborough County, Florida



- 136 square miles
- 158 miles of coastline
- 3rd Largest Population in Florida (1.2 Million)
- 22% of the population lives in a flood prone area
- Economic Hub of Tampa Bay Metropolitan Region
- Largest seaport in Florida
- Home to US Central Command & Special Operations Command Center
- Tampa General – Regional Burn Center



Bayshore Boulevard – Hurricane Debby

- ❖ Tampa dubbed “ most vulnerable & overdue” city for a direct hurricane hit. – 2013 Weather Channel Meteorologist Survey
- ❖ No direct hit in over 90 Years
- ❖ Recent Flooding – 2012 Tropical Storm Debby (20”)
- ❖ Corresponds with the 2040 Long Range Transportation Plan Update
- ❖ Opportunity to incorporate work into LRTP, Countywide Post Disaster Redevelopment Plan, and Local Mitigation Strategy

Surface Transportation Assets

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



Pilot Scope/Assessment Process

- ④ *Collect data, identify potential extreme weather vulnerabilities (sea level rise, storm surge, and flooding)*
- ④ *Identify critical, vulnerable infrastructure (5-10 high-risk assets) for adaptation*
- ④ *Develop adaptation (risk mitigation) strategies for a selection of high-risk assets*
- ④ *Assess economic impact of disruption & avoided lost w/ mitigation*
- ④ *Document findings, recommendations, feedback to FHWA*

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LRTP Scope/Assessment Process

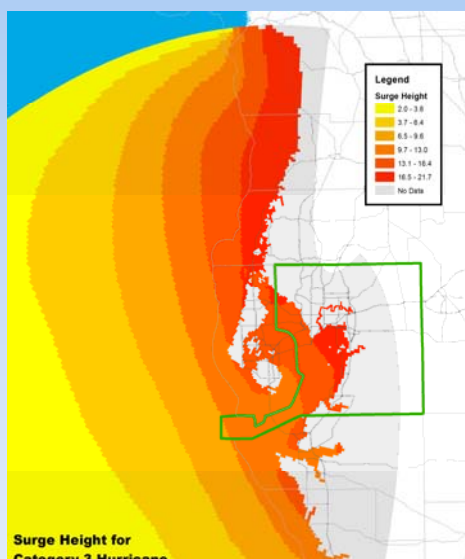
- ④ *Develop risk scenario (storm surge)*
- ④ *Assess potential disruption impacts*
- ④ *Develop adaptation (risk mitigation) scenarios*



Step I: Develop Risk Scenario

» Simulated Category 3 storm surge

- Same category, trajectory as 1921 Tarpon Springs
- High tide
- Addition of sea level rise (2040)



2040 & 2060 SLR Scenarios

2040 Sea Level Rise		2060 Sea Level Rise	
Scenarios	Depth (in)	Scenarios	Depth (in)
MHHW	30	MHHW	42
MLW	2	MLW	15

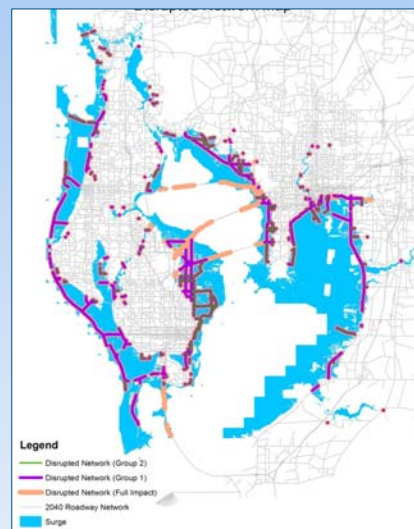
Simulated Storm Parameters

Parameter	Value
Simpson-Saffir Hurricane Category	3 (111-129 mph winds, up to 21 foot surge depths)
Trajectory	Tarpon Springs Hurricane (1921), observed track
Sea Level Rise	High, 2040 (current Mean Sea Level + 14")
Tidal Datum	Mean Higher High Water (projected MSL + 16")

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Step 2: Assess Potential Disruption Impacts

- » **Simulation of phased recovery (post-storm surge)**
- » **Simulate travel disruption using TBRPM**
- » **Derive daily change in**
 - Hours of delay
 - Miles travelled
 - Trips (lost)
- » **Estimate range of potential disruption**



Step 2: Assess Potential Disruption Costs

● Model economic costs of disruption

- » Using REMI econometric model

● Impacts are measured in terms of WEEKLY:

- » Work hours
- » Income;
- » Gross Regional Product.

● Results of full disruption (one week)

- » \$109 million lost GRP
- » \$66 million lost income
- » 2+ million lost work hours

Step 3: Risk Mitigation Investment Scenarios

Strategy Type	Illustrative Mitigation Measures		
	Baseline	Tier 1 (Interstates)	Tier 2 (Interstates & Arterials)
Limit Exposure	Maintain/manage as usual	Raise roadway profile	
Mitigate Sensitivity		Elevate profile, enhance crown	
Enhance Adaptive Capacity (recovery)		Shoreline protection Wave attenuating devices Enhance roadway base	
		Increase drainage capacity Upgrade to flanking inlets, increase conveyance capacity	

Sample Strategy

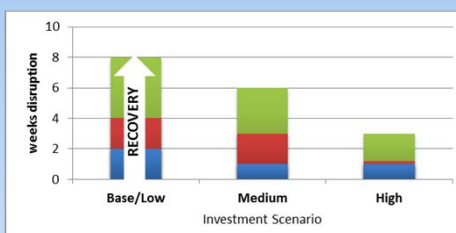
Wave Attenuating Devices (WADs)



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Estimated Risk Mitigation Benefits

Illustrative result:
\$35 - \$82 million net benefit



Moderate Scenario	Base/Low Investment Level	Medium Investment Level	High Investment Level
Economic Loss	\$ 266,094,000	\$ 153,141,000	\$ 119,203,200
Avoided Loss	\$ -	\$ 112,953,000	\$ 146,890,800
Strategy Cost		\$ 31,000,866	\$ 111,932,281
Net	\$ -	\$ 81,952,123	\$ 34,958,508

Not NPV

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Critical Assets for Pilot Assessment

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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)*

* Not vulnerable under any studied flooding scenario

Memorial Highway

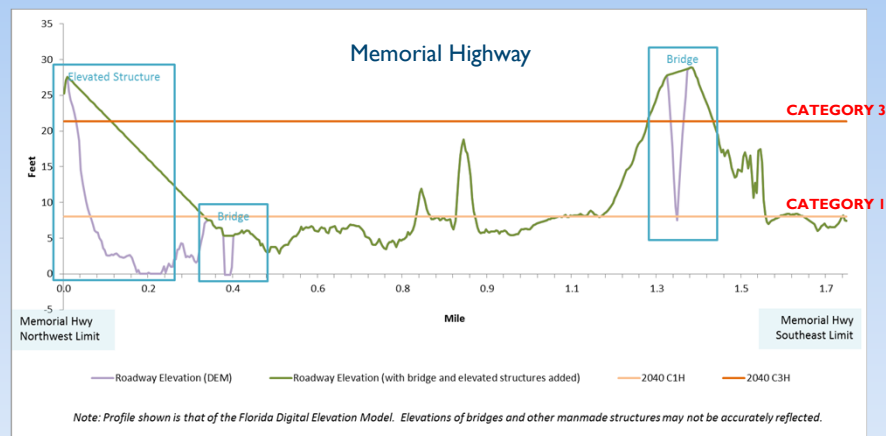


Current Condition	Multi-modal corridor between Pinellas and Hillsborough Counties
Estimated Age (Lifespan)	1964, 2005, 2010
Use / Ridership	158,000 AADT
Estimated Replacement Cost	Approx. \$164M*

*Estimated cost is based on 2010 project, which was larger in scope than the 1.76 miles studied here.

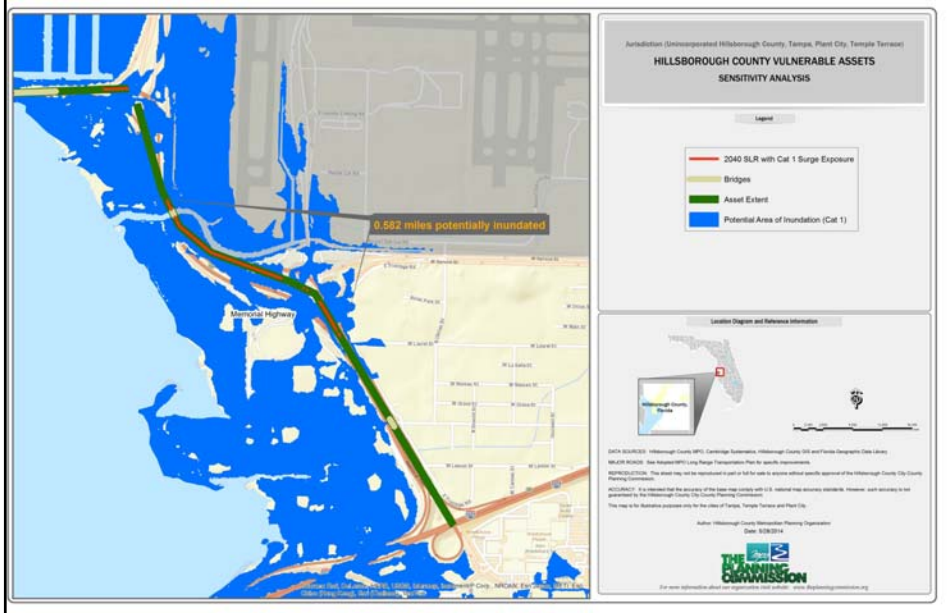
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Inundation Profile

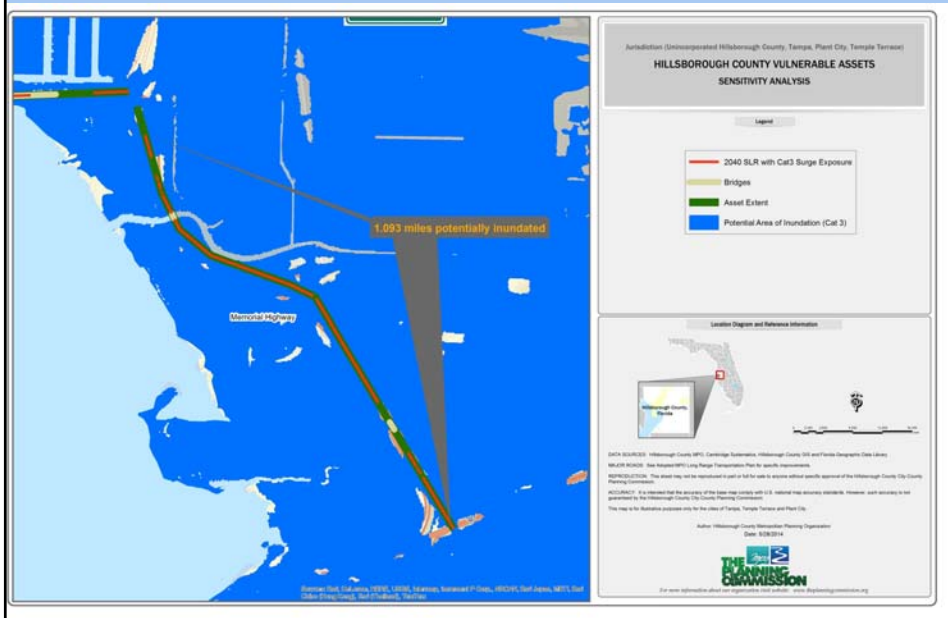


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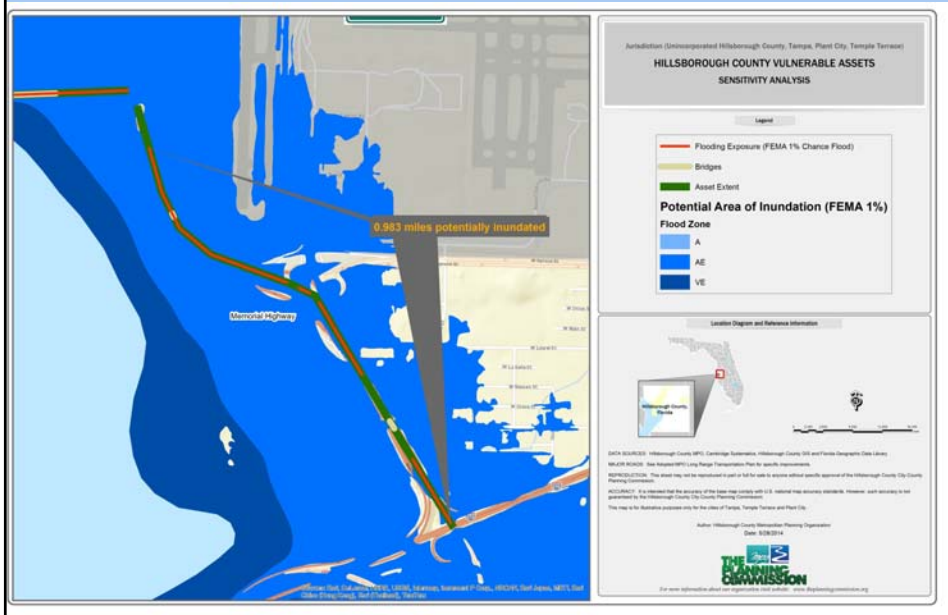
Inundation with Cat I Surge



Inundation with Cat 3 Surge



Inundation with FEMA 1% Chance Flood



Estimated Impacts of Disruption

Memorial Highway (Segment)

Trip Type	Attribute	Daily Change
Leisure Travel Data	Auto - VMT	68,409
	Auto - VHT	274,029
	Auto - Delay	266,660
	Auto - Lost Trips	0
Commute Auto Travel Data	Auto - VMT	51,313
	Auto - VHT	104,898
	Auto - Delay	99,977
	Auto - Lost Trips	0
Business/On-the-clock	Auto - VMT	100,049
	Auto - VHT	111,230
	Auto - Delay	106,929
	Auto - Lost Trips	0
Truck	Truck - VMT	7,495
	Truck - VHT	38,641
	Truck - Delay/Idling	37,626
	Truck - Lost Trips	0

Estimated weekly losses

Gross Regional Product:

\$15.8 MM

Income:

\$8.0 MM

Work Hours:

223,000

Potential Impacts and Mitigation Strategies

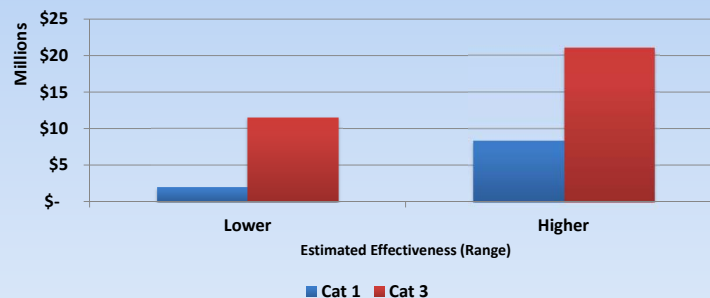
Scenario	Extent (miles)	Potential Impacts	Potential Mitigation Strategies
SLR	0.0	• n/a (unlikely)	• n/a
Cat 1	0.58		• Drainage improvements • Raise profile/crown • Force attenuation (WADs)
Cat 3	1.09	• Disruption (overtopping, ponding) • Washouts, erosion	• Existing condition: established shoreline vegetation (<u>stabilizing/attenuating</u>)
DFIRM (A /AE)	0.98		\$4.2 MM (marginal illustrative cost)
DFIRM (V /VE)	0.0	• n/a (unlikely)	• n/a

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Memorial Highway Preliminary Results

Estimated Avoided Net Losses

Category 1: \$2.1 – \$8.4 MM
 Category 3: \$11.6 – \$21.0 MM
 Tipping Point: 1.3 days avoided disruption*



* Point after which strategy "pays for itself" (not time-value adjusted)

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Contact Information

Allison Yeh, AICP, LEED GA
Hillsborough County MPO/
City- County Planning Commission
tel: 813-272-5940

yeha@plancom.org



www.planhillsborough.org

Rich Clarendon, AICP
Hillsborough County MPO
tel: 813-273-3774 x368

Clarendonr@plancom.org