

Using Cost-Effectiveness to Prioritize Highway Projects for Improvement of Evacuation

Presented to

“Using risk assessment tools to analyze cost and benefits of action versus inaction” Panel
of “Quantifying Climate Change Adaptation: The Economic Approach” Workshop

at USDOT, Washington, DC

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Panel Synopsis

- Panel Topic: “[Climate change] transportation impacts that can be quantified include **loss of use, replacement, and retrofit.**”
- “This panel will consider:
 1. How are assessment tools integrating quantification of the costs and benefits of climate impacts utilized by the public and private sector generally?
 2. **What tools are being used to address transportation costs and benefits, including delays, loss of use/disruption, and replacement/retrofit?**
 3. How can quantification tools augment traditional assessment tools measuring such impacts as sea level rise and storm surge?
 4. What are the challenges to using public and private data, such as the use of metrics and proprietary data, to populate models?”
- Although my tool **does not** measure the cost of future climate change, it **does** address the 2nd question above in that it is a **climate-related cost tool that considers delay.**

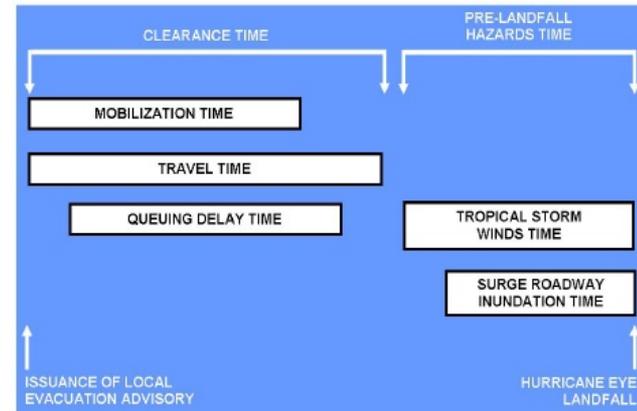
Impetus for 2014 HRTPO Study

- It is possible that **only a portion** of people living in homes in low-lying areas will have time to evacuate.

- It may take **36 hours** for an evacuation (cat. 3)

- Due to **path uncertainty**, evacuation may not begin 36 hours before storm arrival

- “it will be rare to have the lead time needed”



- **No existing list** of prioritized hurricane projects, hence: *Prioritizing Highway Projects for Improvement of Evacuation* (HRTPO, Mar. 2014).

Purpose of Study

- To identify highway projects with the greatest evacuation improvement **cost effectiveness**.
 - Note: The need for these highway improvements is based on the hurricane flooding threat associated with **today's sea level**, not on a forecast of future sea level. Therefore, even if the climate stopped changing, my region has a need for hurricane-related highway improvements.

Method

- A. Determine Need: **highway segments** with a large need for evacuation improvement
- B. Identify Projects: projects that would improve evacuation **on needy segments**
- C. Calculate Cost Effectiveness: **for these projects** calculate “bang-for-the-buck” (vs. B/C ratio)

A. Determination of Need

- Clearance times on “31 Critical Roadway Segments”:
 - Hours that a **queue will exist** at subject chokepoint

– Source:

- Abbreviated Transportation Model (ATM) of *Virginia Hurricane Evacuation Study* (VDEM/USACE/FEMA, May 2008)

Hurricane Evacuation Study Transportation Analysis, Commonwealth of Virginia Coastal Jurisdictions

CLEARANCE TIMES

Phase 1 Jurisdictions
York - Poquoson - Hampton - Newport News - Portsmouth - Chesapeake - Norfolk - Virginia Beach - Isle of Wight - Suffolk - Surry

MAP ID	Modeled/Critical Roadway Segment	Times with Heavy Background Traffic									
		Cat 1		Cat 2		Cat 3		Cat 4		Cat X	Cat X
		low occ	high occ	low occ	high occ	low occ	high occ	low occ	high occ	low occ	high occ
R1	US 17 nb out of region	4.8	4.8	6.9	6.8	6.9	7.1	8.8	8.1	8.8	8.1
R2	US 58 wb out of region	6.0	6.2	8.3	8.2	8.3	8.5	10.2	9.5	10.2	9.5
R3	US 460 wb out of region	6.7	7.1	13.6	14.4	21.9	22.8	35.0	35.9	35.0	35.9
R4	Va Route 10 wb out of region	5.0	5.7	8.0	8.3	10.6	10.8	14.7	15.0	14.7	15.0
R5	I-64 wb out of region - Newport News	11.5	13.0	21.1	23.3	33.1	35.5	58.0	60.5	58.0	60.5
R6	US 17 nb out of region	4.9	5.2	7.2	7.7	10.2	10.8	15.2	15.8	15.2	15.8
R7	VA Bch expwy wb east of I-64	4.4	4.8	6.5	7.1	8.0	8.7	11.5	12.1	11.5	12.1
R8	Hampton Roads Bridge Tunnel - Norfolk to Hampton	6.9	7.9	12.7	14.3	21.5	23.2	37.0	38.8	37.0	38.8
R9	I-64 nb through York County	11.2	12.5	20.0	22.0	30.9	33.1	53.7	56.0	53.7	56.0
R10	I-64 wb east of US 58/US 460	4.7	5.0	7.8	8.3	13.0	13.5	20.7	21.2	20.7	21.2
R11	I-264 wb east of US 58/US 460	5.5	5.9	10.7	11.4	15.8	16.5	25.4	26.2	25.4	26.2
R12	US 58 northern Bypass around Suffolk	8.7	9.6	19.7	21.1	34.3	35.8	66.9	68.5	66.9	68.5
R13	US 60 nb along I-64 (out thru York Co.)	5.0	5.3	6.9	7.4	9.2	9.7	13.8	14.3	13.8	14.3
R14	VA 168 south of I-64	4.4	4.5	4.9	5.0	8.4	8.6	9.5	9.7	9.5	9.7
N1	I-64 between I-664 and W Mercury Blvd	8.2	8.8	11.8	12.7	17.4	18.3	24.5	25.4	24.5	25.4
N2	I-64 between Hampton Roads Center Pkwy and J Clyde Morris Blvd	8.4	8.9	12.3	13.1	17.8	18.6	26.6	27.4	26.6	27.4
N3	I-64 between Colonial National Pkwy and Merrimac Trail	11.2	12.3	18.0	19.7	26.3	28.0	40.4	42.3	40.4	42.3
N4	Mercury Blvd between Fox Hill Rd and Lasalle Ave	10.3	10.4	15.2	15.3	15.6	15.7	16.6	16.7	16.6	16.7
N5	J Clyde Morris Blvd/OW Memorial Hwy between I-64 and Victory Bl	12.5	13.1	17.5	18.3	23.9	24.8	34.0	34.9	34.0	34.9
N6	Fox Hill Rd between Woodland Rd and Mercury Blvd	11.8	11.9	16.3	16.4	16.4	16.5	17.2	17.3	17.2	17.3
S1	I-64 between W Bay Ave and I-564	7.7	8.0	12.5	14.4	20.4	22.4	35.4	37.5	35.4	37.5
S2	I-64 between I-464 and G W Hwy	6.3	6.4	7.4	7.5	18.7	18.8	20.8	20.8	20.8	20.9
S3	I-264 between I-464 and Effingham St	6.4	7.2	9.5	10.7	22.8	24.1	40.3	41.7	40.3	41.7
S4	Park Ave between Princess Anne Rd and Brambleton	7.2	8.2	8.7	10.1	16.2	17.7	32.6	34.3	32.6	34.3
S5	460/Monticello between E Brambleton Ave and I-264	7.3	8.0	9.9	11.0	26.6	27.7	32.8	34.0	32.8	34.0
S6	Dam Neck Rd between General Booth Blvd and 410	5.8	5.8	6.3	6.3	11.4	11.4	12.3	12.3	12.3	12.3
S7	Northampton Blvd at I-64	5.5	5.6	5.6	5.8	6.0	6.2	6.9	7.1	6.9	7.1
W1	Holland Rd/US 58 between Portsmouth Blvd and Godwin Blvd	6.7	7.3	13.4	14.3	30.0	30.8	41.8	43.9	41.8	43.9
W2	460 between US 58/ Holland Rd and US 258/Courthouse Hwy	6.9	7.4	12.5	13.2	24.2	24.8	35.6	37.3	35.6	37.3
W3	US 13/Portsmouth Blvd between US 58 and Nansemond Pkwy	4.7	5.2	10.0	10.8	30.0	30.8	37.6	38.4	37.6	38.4
W4	Constance Road/US 13 between Wilroy Rd and US 460/Main St	5.0	5.5	12.8	13.6	33.4	34.3	41.2	42.1	41.2	42.1

CLEARANCE TIMES BASED ON REVERSE LANE OPERATION ON I-64 NB into Richmond

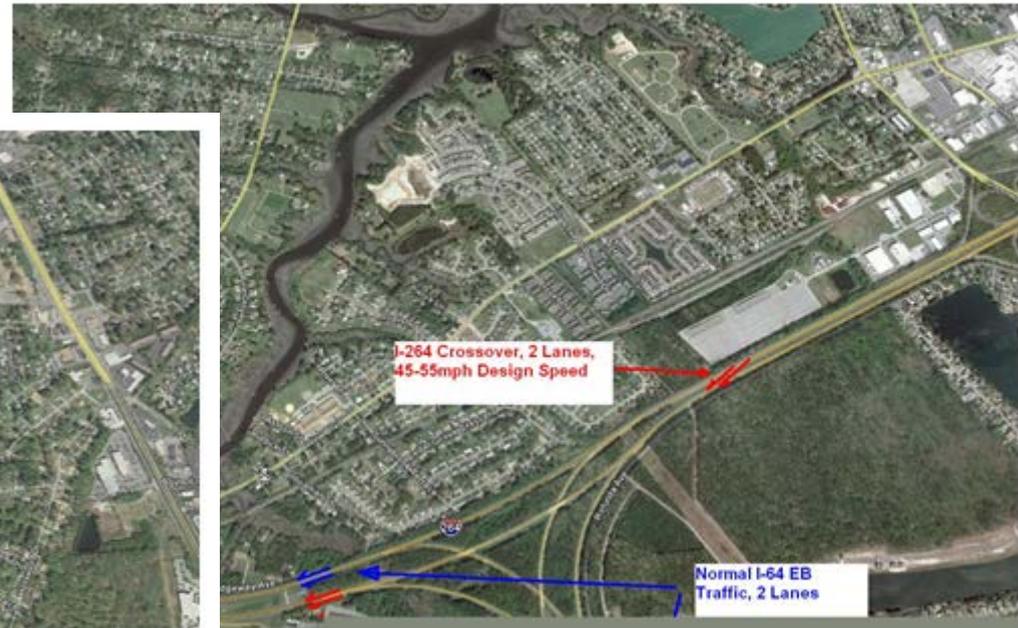
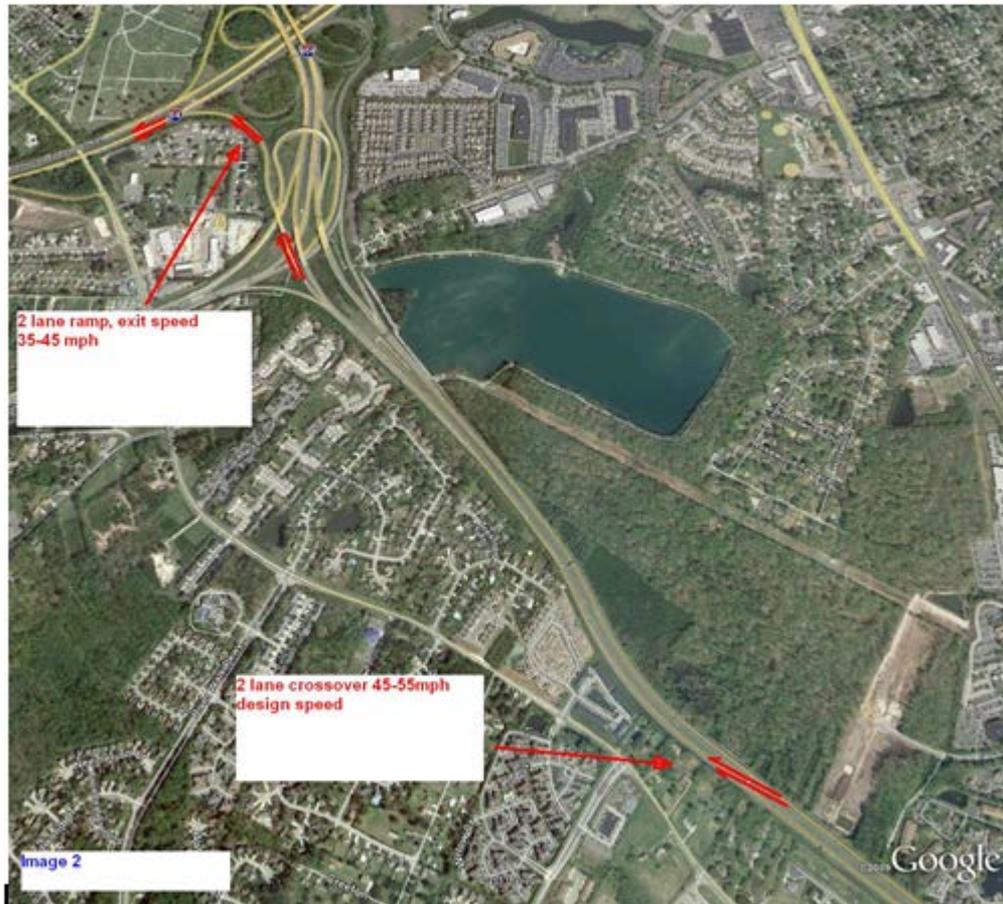
Modeled/Critical Roadway Segment	Times with Heavy Background Traffic									
	Cat 1		Cat 2		Cat 3		Cat 4		Cat X	Cat X
	low occ	high occ	low occ	high occ	low occ	high occ	low occ	high occ	low occ	high occ
I-64 Normal Lanes from Hampton Roads Bridge Tunnel to Richmond	11.5	13.0	21.1	23.3	33.1	35.5	58.0	60.5	58.0	60.5
I-64 Contra Flow from Hampton Roads Bridge Tunnel to Richmond	7.2	8.1	13.1	14.5	20.7	22.1	36.2	37.7	36.2	37.7
Time Savings from Normal Traffic Operations	4.3	4.9	7.9	8.8	12.5	13.4	21.8	22.8	21.8	22.8

B. Identification of Projects

- Identified a project for each segment with **clearance time > 18 hours**
 - Exceptions:
 - segments covered by a committed highway project
 - segments covered by a hurricane improvement project already identified in this study
- Projects identified:
 1. 168/64/58 Southside Reversal
 2. Evacuation Timing Plans for US 17 Signals
 3. HRBT Build-8 Alternative
 4. I-64 Peninsula Widening
 5. US 58 Widening (6 lanes from Holland Rd to I-95)

Note: Some projects had already been **proposed by others**, but some projects **we had to conceive**.

1. 168/64/58 Southside Reversal

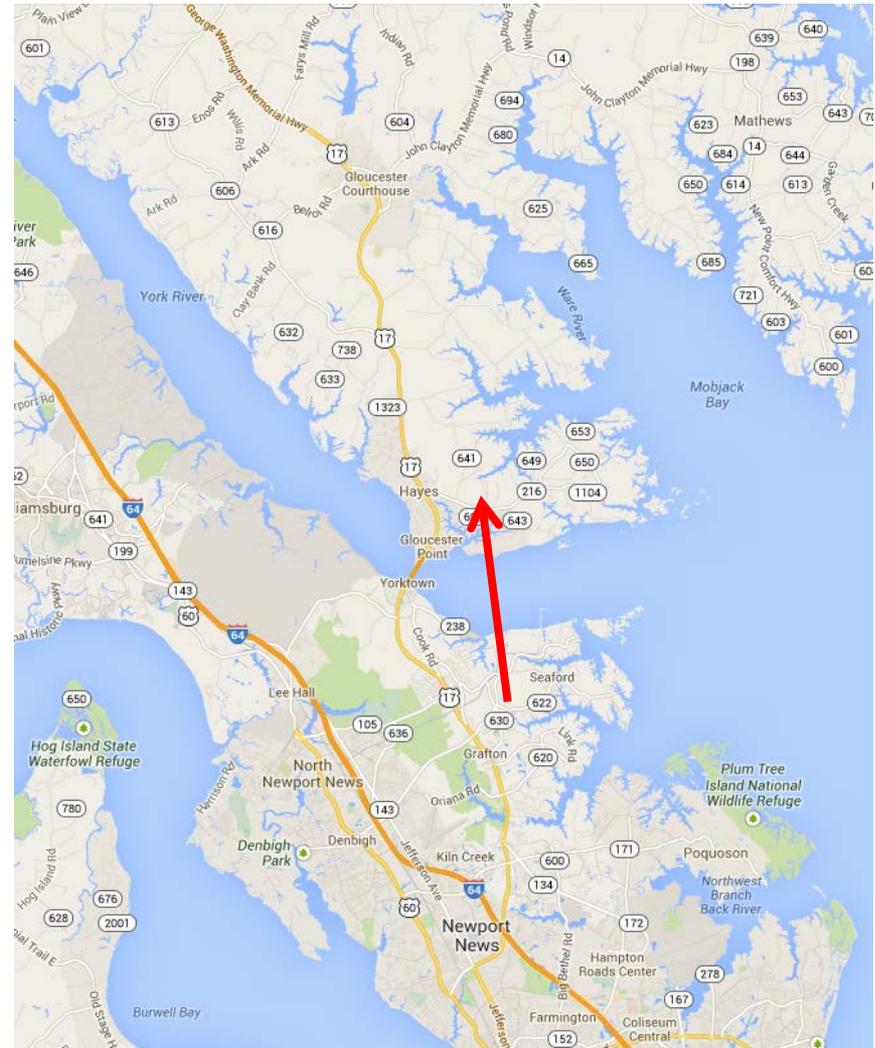


Reversal ends on Suffolk Bypass west of US 460 exit.

2. Evac. Timing Plans for US 17 Signals

- Newport News-
 - from I-64 to York CL:
3 signals
- York County-
 - [adaptive system]:
0 signals
- Gloucester-
 - from York CL to Fiddlers
Green Rd:
16 signals

Total Project: Evacuation
timing plans for 19 signals



Remaining Projects: Lane Additions

3. HRBT Build-8 Alternative: **\$5B**

- 12 miles including doubling existing bridge-tunnel

4. I-64 Peninsula Widening: **\$3B**

- 54 miles adding 1 or 2 lanes in each direction

5. US 58 Widening: **\$1B**

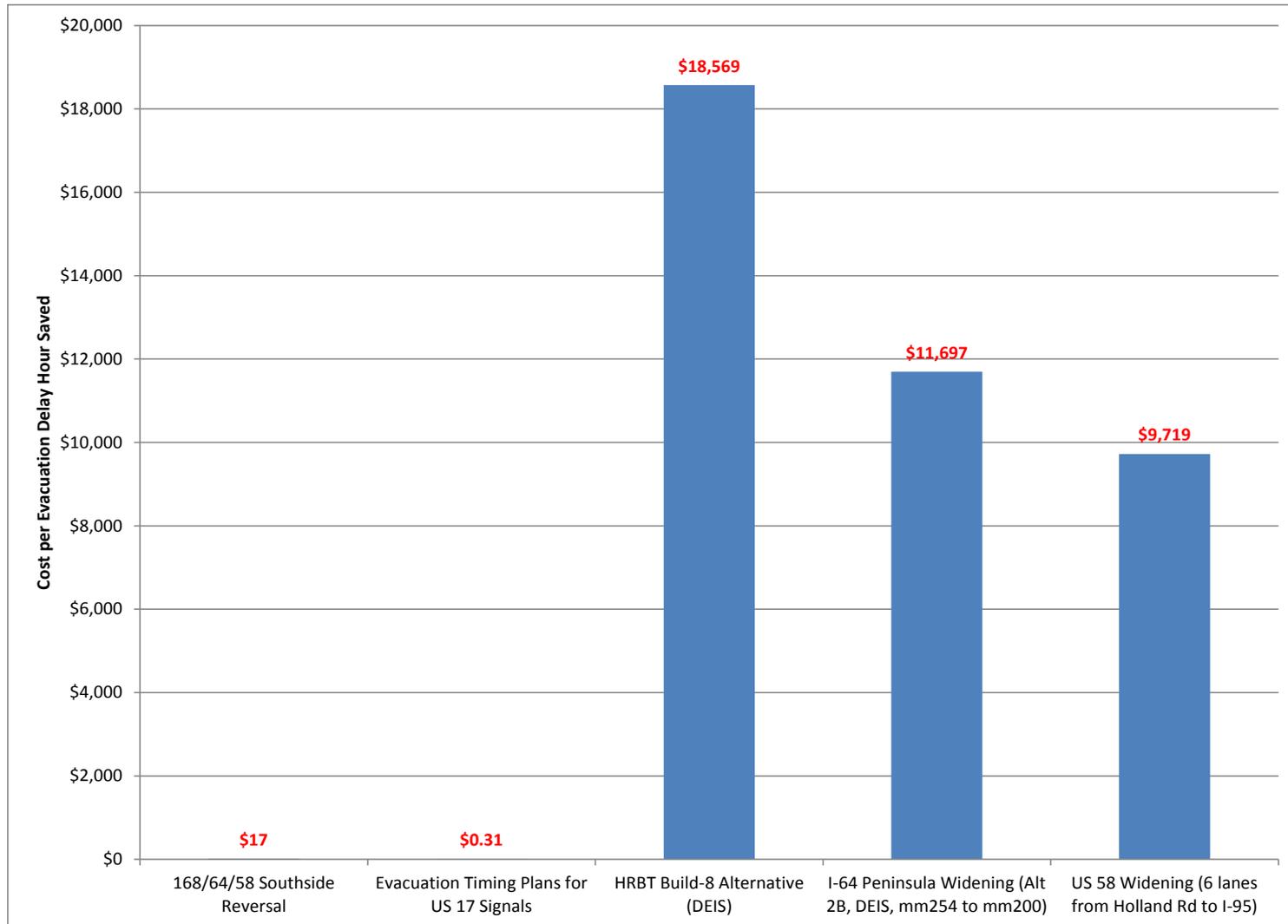
- 55 miles adding 1 lane in each direction

C. Calculation of Cost Effectiveness

$$\text{Cost Effectiveness} = \text{Cost} / \text{Effect}$$

- Cost: construction cost estimates
 - prepared by VDOT
- Effect: **delay savings** (vehicle hours)
 - calculated by HRTPO staff

Results



Recommendation

- Given the **high cost effectiveness** of:
 1. 168/64/58 Southside Reversal and
 2. Evacuation Timing Plans for US 17 Signals,
 - staff recommends that the HRTPO Board and VDOT consider **funding these two projects**.

Electronic Copy of Study

- The study can be found on www.hrtpo.org
 - Click “Reports & Data”
 - Click “Technical Reports”
 - Click *Prioritizing Highway Projects for Improvement of Evacuation* (T-14-01, HRTPO, March 2014)