Regional Planning for Sea Level Rise and Flooding

Hampton Roads Adaptation Forum
July 10, 2013

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Regional Planner

Project Information

- 1-Year Competitive PDC Grant from Virginia Coastal Zone Management Program
- Builds on (but is separate) from other grant-funded projects (3-Year Focal Area Grant; Adaptation Forum)
- Three deliverables:
  - Incorporating SLR into local plans
  - Adaptive Management + SLR
  - Public Outreach + Coordination

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Sea Level Rise Science Update

- Sea level rise is probably accelerating, and now we can detect it
  - Previous indications of acceleration, but could not be positive due to instruments used
- Three papers of significance to our region:
  - Sallenger et al.
  - Boon
  - Ezer and Corlett

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Sea Level Rise Science Update

- Sallenger et al. (2012)
  - Global sea level rise is not uniform
  - Significant variation noticed in sea level rise rates in the “Northeast Hotspot” - ~3 to 4 times higher than the global average
  - Increase probably occurred after 1990
  - Ranges from Cape Hatteras to Boston

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Sea Level Rise Science Update

- Boon (2012)
  - Continued statistical analysis of tide station records along Atlantic Coast from Virginia to Nova Scotia now shows statistically significant acceleration of relative sea level rise
  - In Hampton Roads, highest acceleration occurring at Gloucester Point/Yorktown; Sewells Point is second

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Sea Level Rise Science Update

- Ezer and Corlett (2012)
  - Statistical analysis of tide gauge data supports Sallenger's findings of SLR acceleration in the Northeast Hotspot

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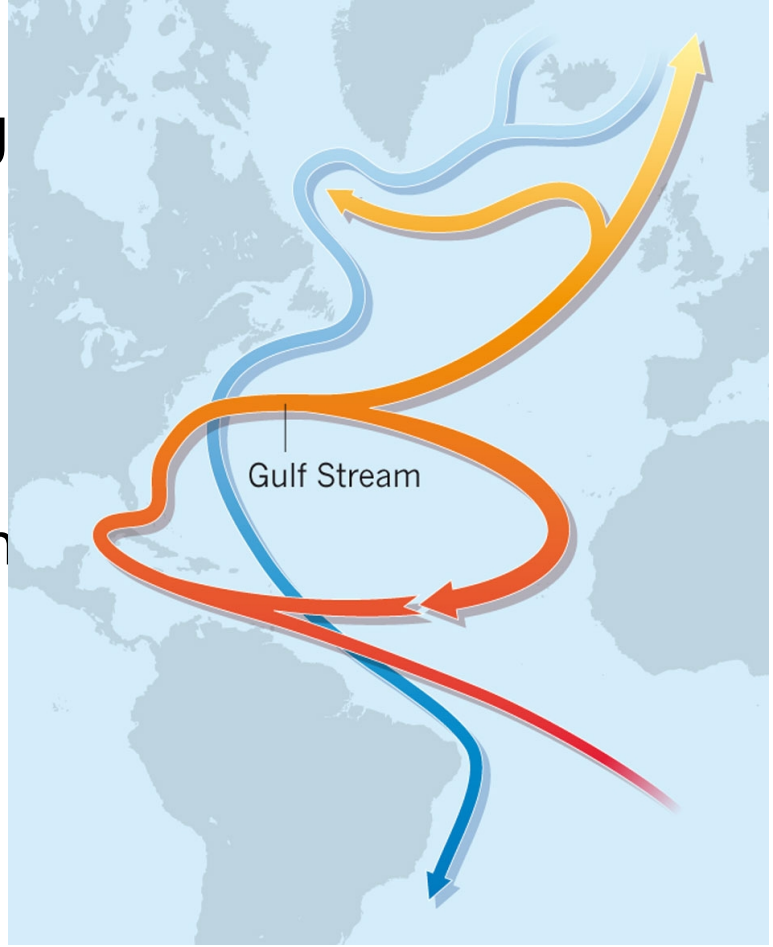
Sea Level Rise Science Update

- Possible culprit: slowing of the Atlantic Meridional Overturning Circulation, resulting in water rising landward of the Gulf Stream
- Implications
  - Acceleration of SLR is being seen in the Mid-Atlantic
  - Long-term implications are unclear, since it is not know if this process will continue or for how long



http://www.nature.com/nature/journal/v485/n7397/fig_tab/485180a_F1.html

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Sea Level Rise – Updated Projections

- New global projections for 2013 National Climate Assessment
- Based on synthesis of research on global SLR (many methods)
  - Global Circulation Models
  - Tide Gauge Analysis
  - Semi-empirical models (relating atmospheric temperature, ocean temperature, ice melt)

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Sea Level Rise – Updated Projections

- Highest: maximum possible glacier and ice sheet loss by 2100
- Intermediate High: based on semi-empirical models which incorporate ice sheet loss
- Intermediate Low: based on IPCC 4th Assessment upper projections
- Low: Historic rate

- Note: Not designed to be used separately, but together as part of a risk management exercise

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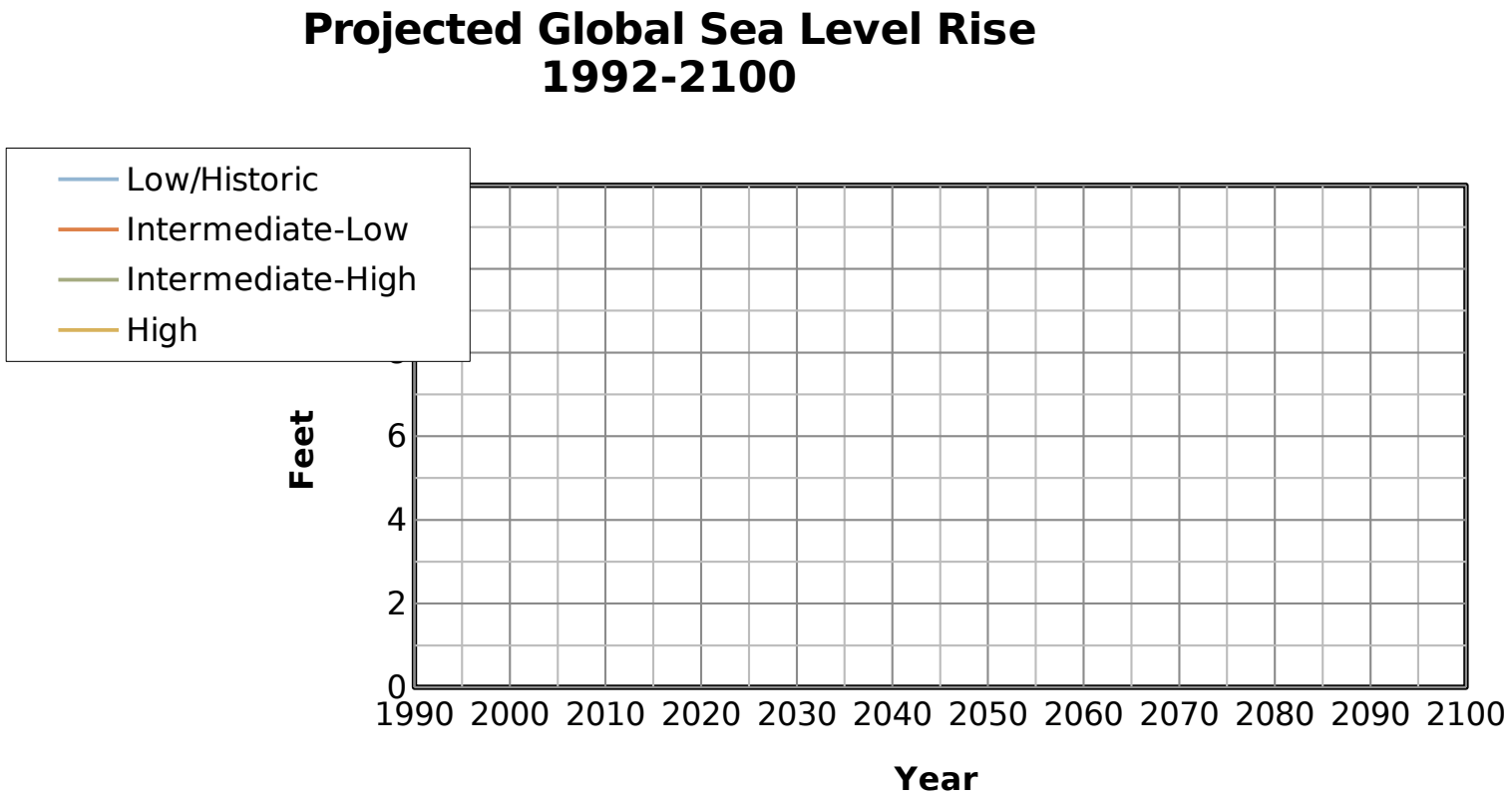
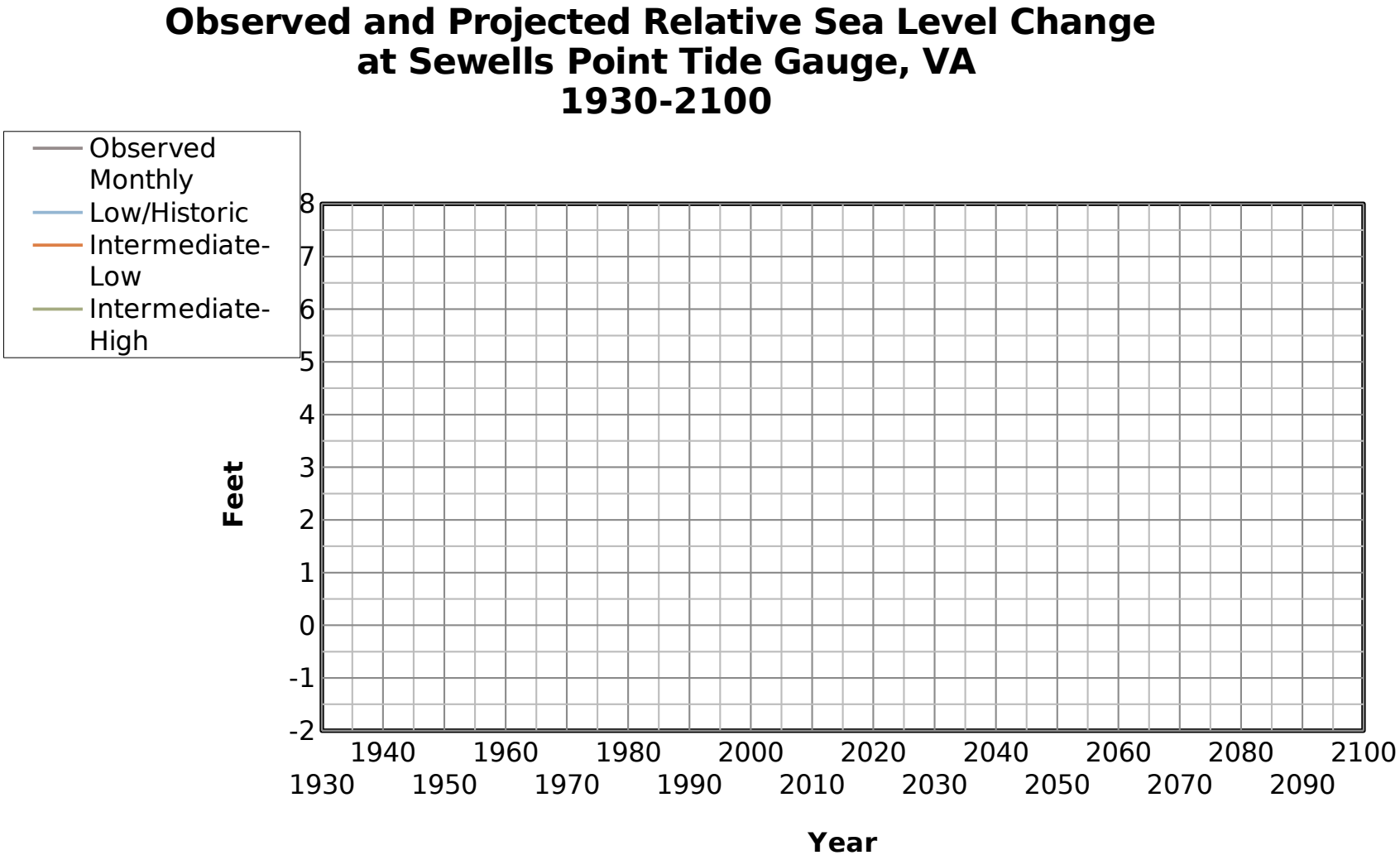
Sea Level Rise – Global Projections

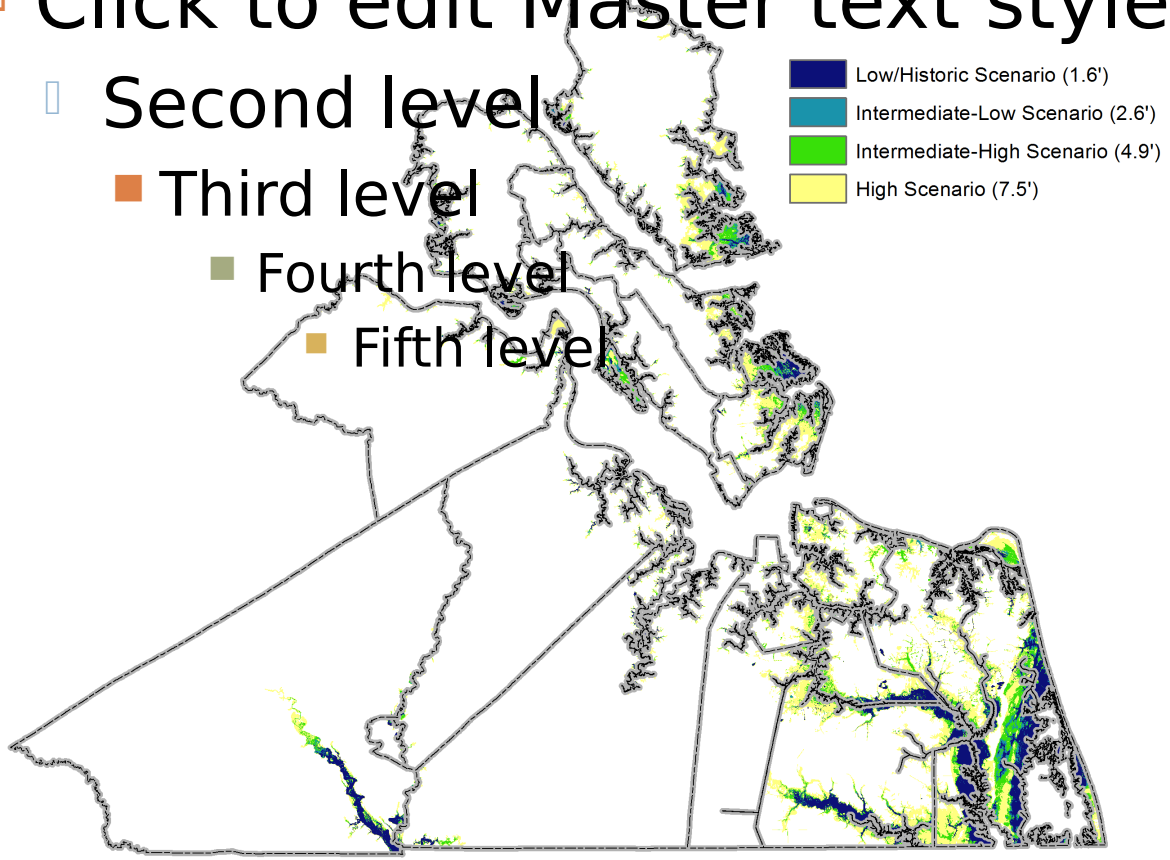


Sea Level Rise – Local Projections



Sea Level Rise Inundation Maps

- Click to edit Master text styles
  - Second level
    - Third level
      - Fourth level
        - Fifth level



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Adaptive Management

- Uncertainty inherent in sea level rise and other climate change projections requires using non-traditional planning techniques
- Scenario planning
  - Multiple possible futures
  - No one selected as preference
  - Goal is to find solutions that work well across multiple scenarios – *robust solutions*

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Adaptive Management

- Adaptive Management
  - “Learning while doing”
  - More commonly used in natural resources planning (ex. U.S. Forest Service, Chesapeake Bay Program)
  - Four steps:
    - Select goals to drive initial policies
    - Monitor performance/results
    - Assess progress
    - Reassess decisions and continue

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Adaptive Management

- Plans and policies need to be regularly reconsidered to determine what the state of the science
- When adopting specific policies, metrics should be adopted to measure if and how they are used

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Sea Level Rise and Local Plans

- Planning techniques that can help local governments plan for sea level rise
  - Buildout analysis
  - Mapping
  - Vulnerability analysis
  - Safe growth audits

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Sea Level Rise and Local Plans

- Existing plans and policies can be modified to address future risks from sea level rise
  - Comprehensive Plans
  - Codes of Ordinances
  - Capital Improvement Programs

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Roadways Serving the Military

- HRTPO Project
- Third phase of multi-year study
- Phase I: Highway Network Analysis
- Phase II: Military Commuter Survey
- Phase III: Roadways Serving the Military and Sea Level Rise/Storm Surge

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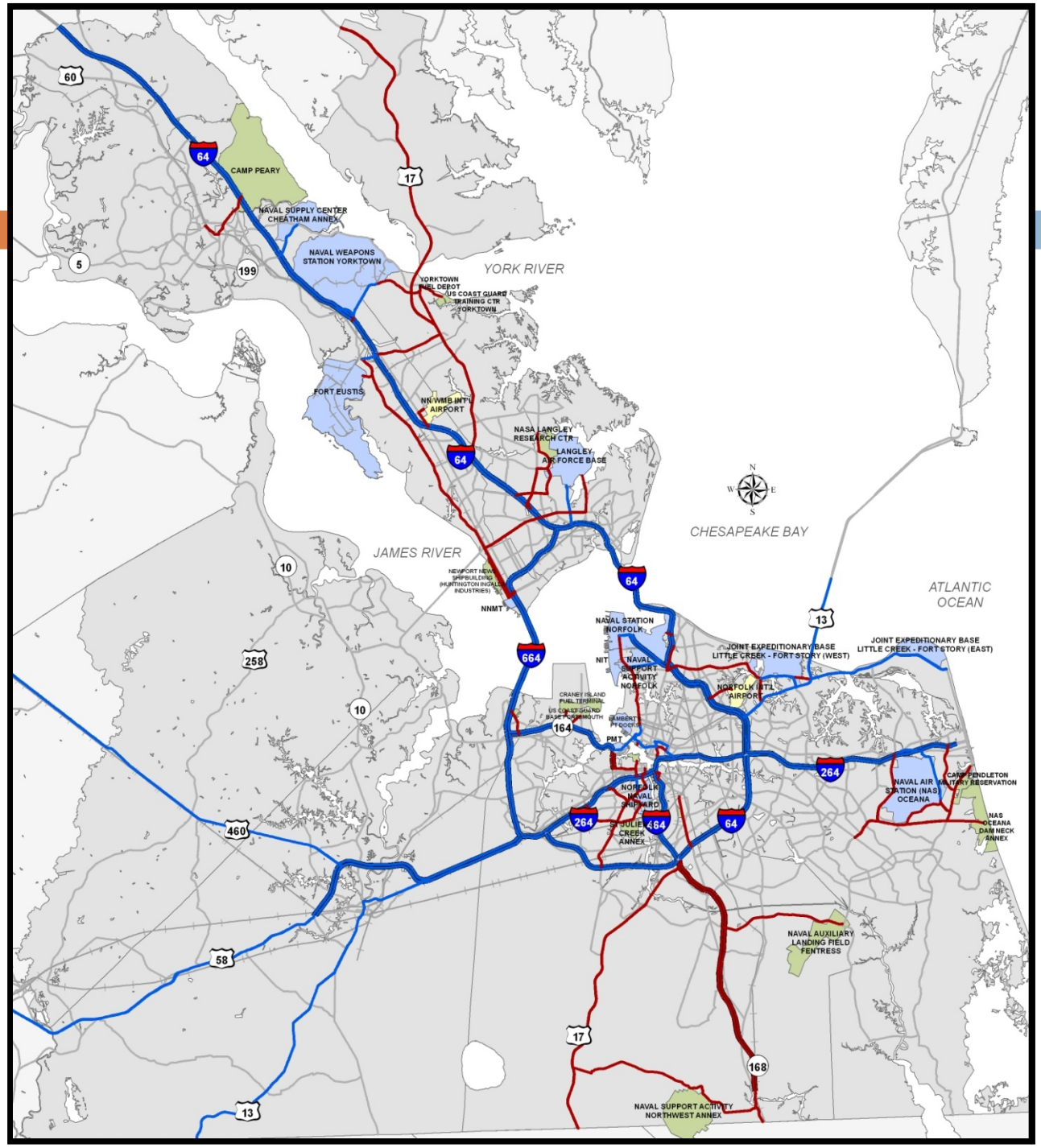
the heartbeat of HAMPTON ROADS TPO TRANSPORTATION PLANNING ORGANIZATION

Roadways Serving the Military



LEGEND

STRAHNET Roadway

Non-STRAHNET Roadway Serving Military Site or Intermodal Facility

Strategic Highway Network (STRAHNET) Site

Other Intermodal Facility

Other Military Site

Prepared by: HRTPO Staff, April 2011

Strategic Highway Network (STRAHNET) - minimum defense highway network (Dept. Of Defense) to support defense emergency and are used for daily military cargo movement.

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Potential Submergence of Roadways Serving the Military

Two Scenarios

1) **1.5 foot relative sea level rise**
2) **4.5 foot total relative water level rise (1.5 foot relative sea level rise + 3 foot storm surge)**

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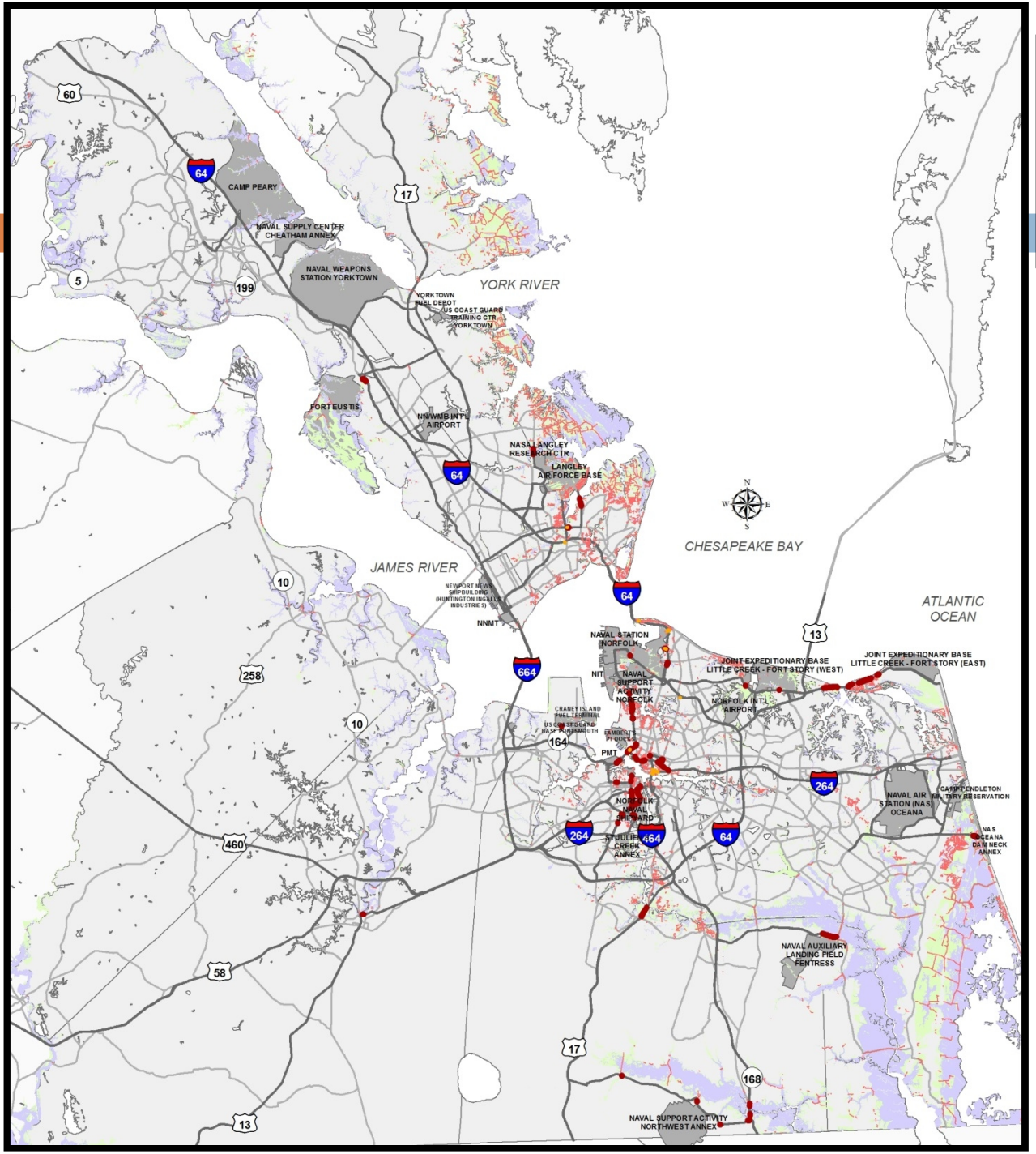

Potential Submergence of Roadways Serving the Military

LEGEND

Roadway Serving the Military – Submerged by 4.5 feet of water rise

Ramp on Roadway Serving the Military – Submerged by 4.5 feet of water rise

Roadway Serving the Military – Not impacted

Other Roadway – Submerged by 4.5 feet of water rise*

Area Submerged by 1.5 feet of water rise (1.5' Relative Sea Level Rise)

Area Submerged by 4.5 feet of water rise (1.5' Relative Sea Level Rise + 3' Storm Surge)

Military and Supporting Site

Prepared by: HRTPO Staff, April 2013
Data source for projected flooded areas: HRPDC Staff, April 2013

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Roadways Serving the Military Submerged by 4.5 feet of Relative Water Rise

Locations by Locality
Chesapeake
Ballahack Road (just east of Lake Drummond Cswy)
Ballahack Road (just east of Pine Grove Lndg)
Ballahack Road (just west of Old Battlefield Blvd)
Battlefield Blvd (Gallbush Rd to Old Battlefield Blvd)
Dominion Blvd (Cedar Rd to Steel Bridge)
Old Battlefield Blvd (Ballahack Rd to Chesapeake Expressway)
Mount Pleasant Rd (Doolittle Ave to Fentress Airfield Rd)
Hampton
King St (Walkers Landing Ln to Clover St)
King St (Waters Edge Cir to Percy Ln)
Mercury Blvd (LaSalle Ave to Seldendale Dr)
Mercury Blvd ramps at LaSalle Ave
Wythe Creek Rd (Carys Chapel Rd to Wythe Landing Loop)
Newport News
Warwick Blvd (Lees Mill Dr to Industrial Park Dr)
Norfolk
Bay Ave (Potomac Pl to I-64)
Brambleton Ave (Colley Ave to 2nd St)
Brambleton Ave (Dunmore St to Duke St)
Brambleton Ave (Pulaski St to Tidewater Dr)
Brambleton Ave (May Ave to Maltby Ave)
Brambleton Ave (just north of I-264)
Granby St (Patrol St to E Bayview Blvd)
Hampton Blvd (just south of Claud Ln)
Hampton Blvd (N Fairwater Dr to Westmoreland Ave)
Hampton Blvd (just north of 49th St)
Hampton Blvd (Baldwin Ave to Graydon Ave)
Hampton Blvd ramps at Brambleton Ave/Midtown Tunnel
Hampton Blvd ramp at Gresham Dr
Midtown Tunnel/Hampton Blvd (Brambleton Ave to east side entrance/exit)
Shore Dr (0.15 miles east of Heutte Dr)
Tidewater Dr (Tabb St to Virginia Beach Blvd)
Virginia Beach Blvd (at Monticello Ave)
Virginia Beach Blvd (at Tidewater Dr)

Locations by Locality
Portsmouth
Court St (Bart St to Premier Pl)
Crawford St (County St to Columbia St)
Effingham St (Firehouse Ln to North St)
Effingham St (Crawford Pkwy to Williamson Dr/Naval Medical Center Portsmouth gate)
Effingham St (George Washington Hwy to Fayette St)
Effingham St (Nelson St to Henry St)
Effingham St (Randolph St to Bart St/I-264)
Elm Ave (just west of Williams Ave/Victory Blvd)
Frederick Blvd (at George Washington Hwy)
George Washington Hwy (Bainbridge Ave to Hanbury Ave)
George Washington Hwy (Alabama Ave to Andrews St)
George Washington Hwy (Peach St to Effingham St)
London Blvd (Ruth Brown Way to Chesapeake Ave)
Midtown Tunnel (west side entrance/exit)
Port Centre Pkwy (Nelson St to Jefferson St)
Portsmouth Blvd (Effingham St/George Washington Hwy to 6th St)
Suffolk
Constance Road (just east of N Main St)
Virginia Beach
Dam Neck Rd (at NAS Oceana Dam Neck Annex main gate)
Shore Dr (Jack Frost Rd to Staples Mill Ln)
Shore Dr (Bayville Rd to E Stratford Rd)
Shore Dr (Vista Point to Kleen St)
Shore Dr (Sea Shell Rd to Bayberry St)
Shore Dr (just east of Kendall St)

Interstate and Ramp Locations
Hampton Roads
I-264 ramps at Brambleton Ave
I-264 ramps at E City Hall Ave
I-264/Berkley Bridge ramps at Waterside Dr
I-564 (near Tower St)
I-64 ramps at W Bay Ave
I-64 ramps at 15th View St/W Ocean View Ave
I-64 ramps at 4th View St
I-64 ramp at LaSalle Ave

Note: Locations specified within these tables are based on the nearest roadway segment.

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RO/DS HRTPO TRANSPORTATION PLANNING ORGANIZATION

Hampton Roads Military Installation Gates Potentially Blocked

Due to submergence of surrounding roadways by 4.5' relative water rise

- Naval Auxiliary Landing Field Fentress (Chesapeake) – Main Gate (Fentress Airfield Rd)
- Naval Support Activity Northwest Annex (Chesapeake) – Main Gate (Relay Rd)
- Langley Air Force Base (Hampton) – King St Gate
- Naval Station Norfolk (Norfolk) – Gate 4 (Bay Ave)
- Naval Station Norfolk (Norfolk) – Gate 10 (Ridgewell Ave/Bellinger Blvd)
- Craney Island Fuel Terminal (Portsmouth) – Main Gate (Cedar Ln)
- Naval Medical Center Portsmouth (Portsmouth) – Main Gate (Effingham St)
- Norfolk Naval Shipyard (Portsmouth) – Gate 3 (Lincoln St/Gosport Row)
- Norfolk Naval Shipyard (Portsmouth) – Gate 10 (Port Centre Pkwy/Portsmouth Blvd)
- Norfolk Naval Shipyard (Portsmouth) – Gate 15 (Effingham St)
- Norfolk Naval Shipyard (Portsmouth) – Gate 36 (Elm Ave)
- Joint Expeditionary Base Fort Story (Virginia Beach) – Gate 6 (Atlantic Ave – west end from Shore Dr)
- Joint Expeditionary Base Fort Story (Virginia Beach) – Gate 8 (Atlantic Ave – east end from 89th St)
- NAS Oceana Dam Neck Annex (Virginia Beach) – Main Gate (Dam Neck Rd/Va[illegible]d St)

Recommendations

Questions?

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Virginia Coastal Zone
MANAGEMENT PROGRAM