ICCE 2018
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Borrow Site Excavation Impacts On Sediment Transport Along the Gulfstream Pipeline, Petit Bois Pass, Alabama

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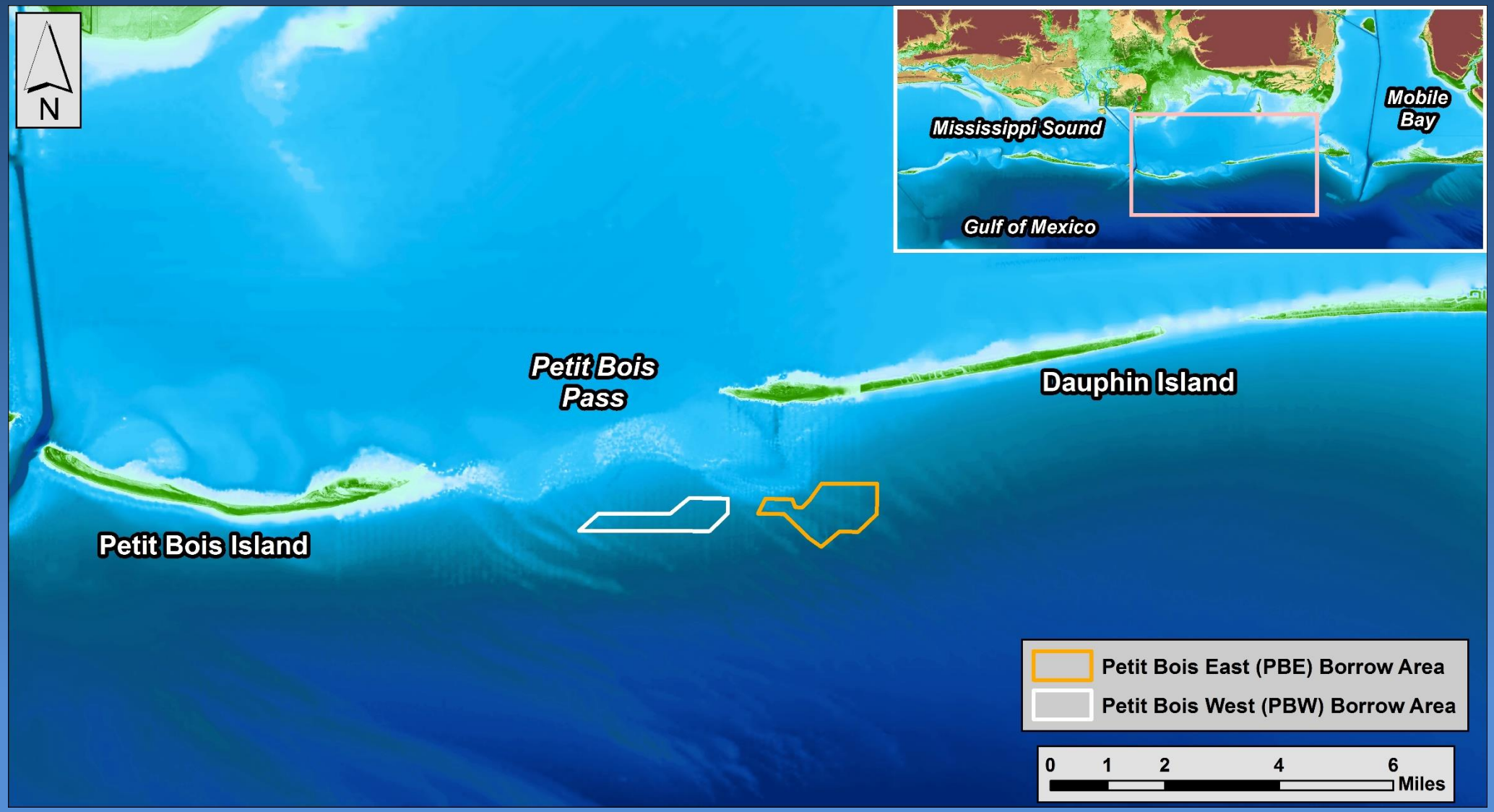
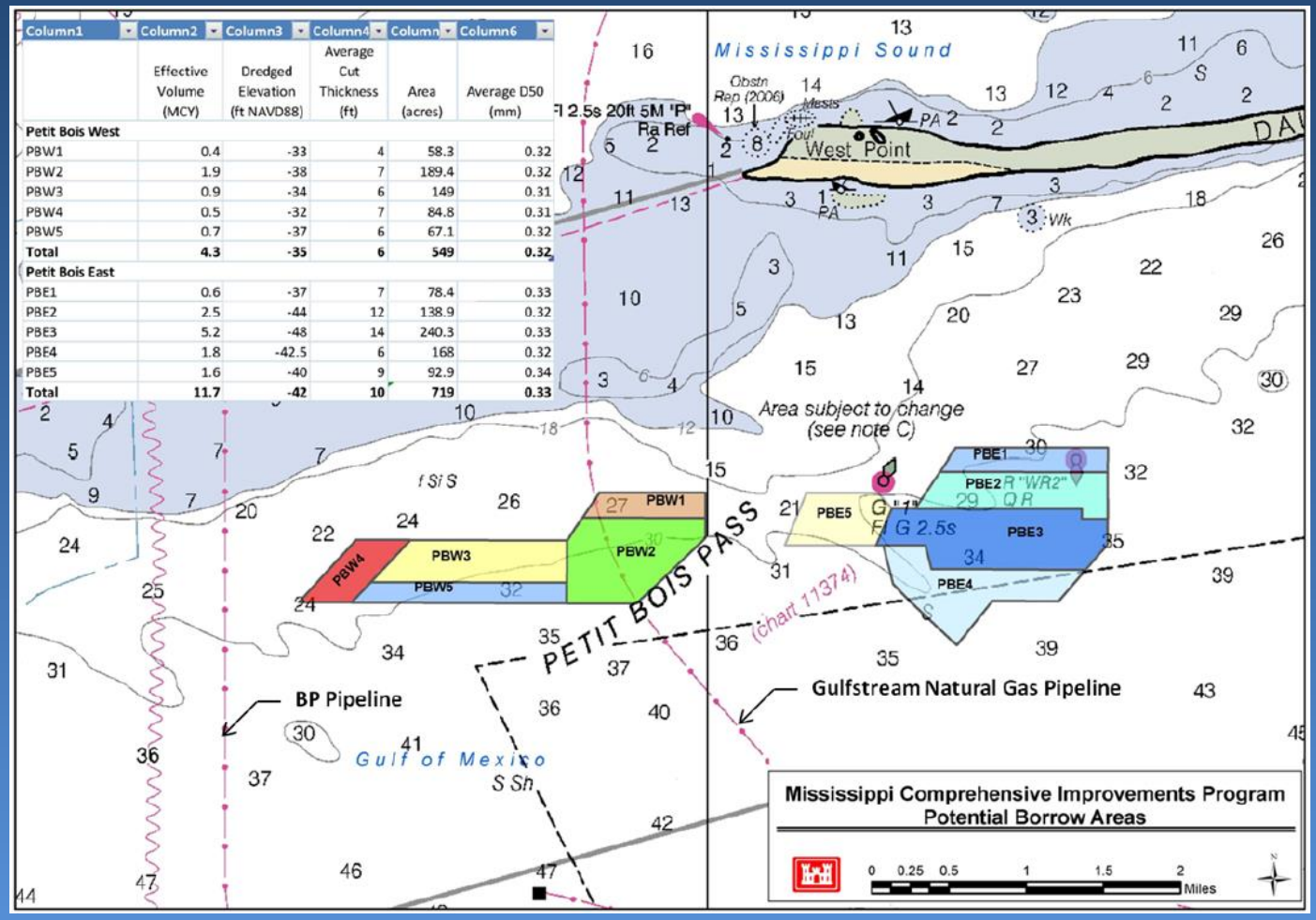
1. Introduction

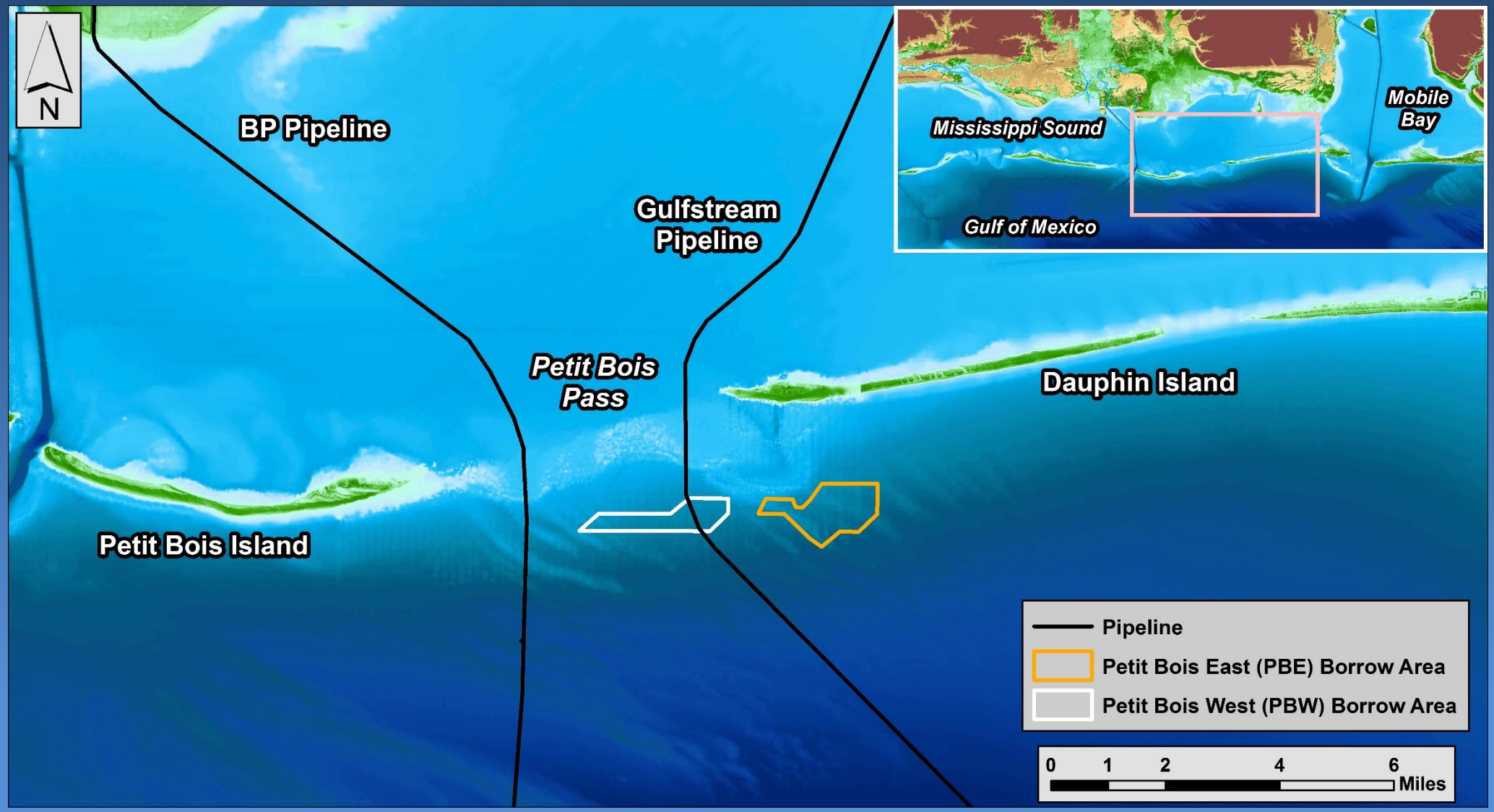


- Petit Bois sites designed for a total volume of 16 MCY
- For use with Ship Island restoration project (22 MCY total)
- Petit Bois West
  - 4.3 MCY volume
  - 31 ft NAVD depth
  - 6 foot average cut depth
- Petit Bois East
  - 11.7 MCY Volume
  - 35 ft NAVD depth
  - 10 foot average cut depth

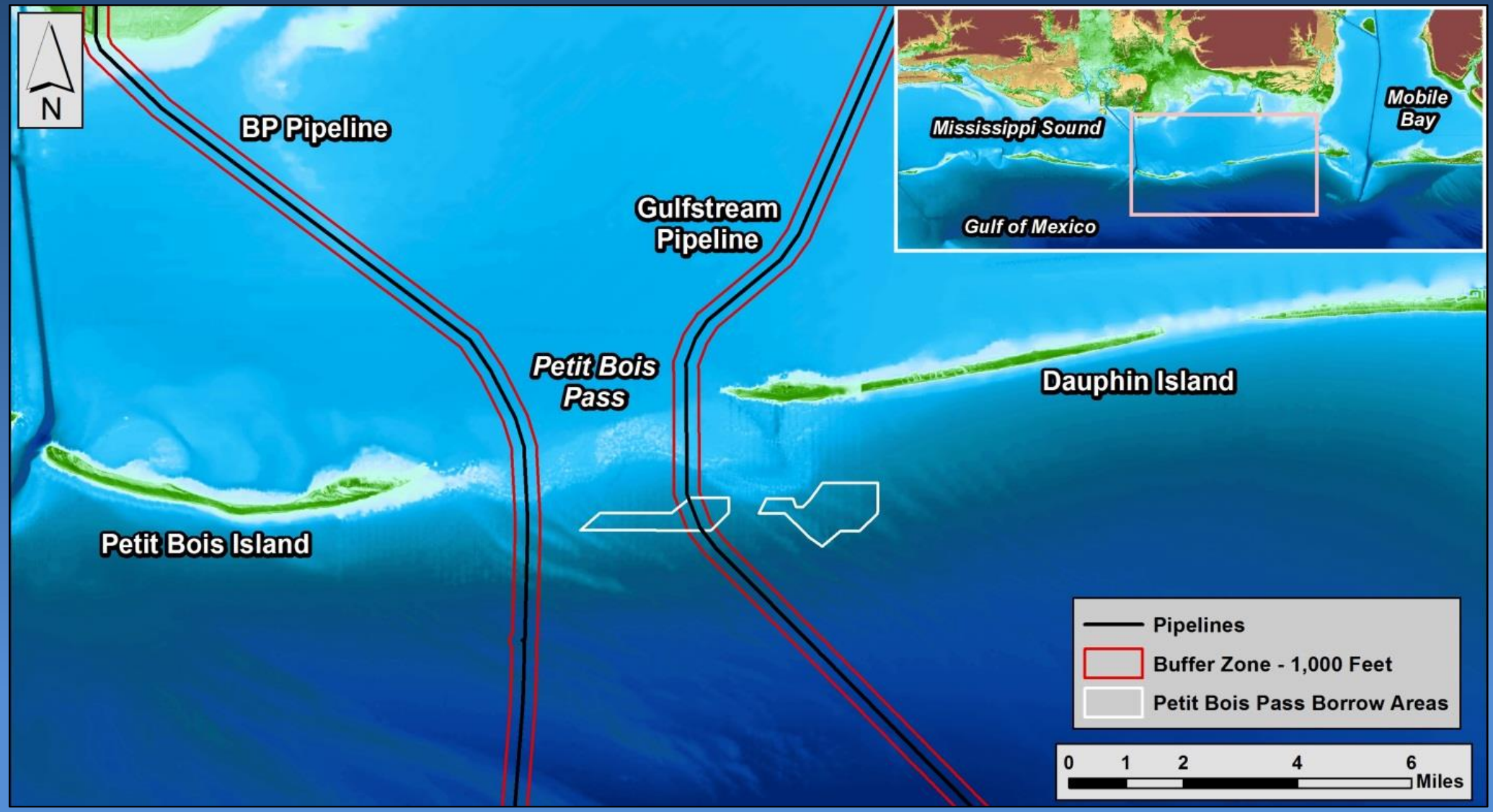
	Effective Volume (MCY)	Dredged Elevation (ft NAVD88)	Average Cut Thickness (ft)	Area (acres)	Average D50 (mm)
Petit Bois West					
PBW1	0.4	-33	4	58.3	0.32
PBW2	1.9	-38	7	189.4	0.32
PBW3	0.9	-34	6	149	0.31
PBW4	0.5	-32	7	84.8	0.31
PBW5	0.7	-37	6	67.1	0.32
Total	**4.3**	**-35**	**6**	**549**	**0.32**
Petit Bois East					
PBE1	0.6	-37	7	78.4	0.33
PBE2	2.5	-44	12	138.9	0.32
PBE3	5.2	-48	14	240.3	0.33
PBE4	1.8	-42.5	6	168	0.32
PBE5	1.6	-40	9	92.9	0.34
Total	**11.7**	**-42**	**10**	**719**	**0.33**



- Gulfstream pipeline: 36-inch pipe between Alabama and Florida
- Delivers 1.3 billion cubic feet per day of natural gas to central and south FL
- In operation since 2002, it was the first interstate pipeline in the Gulf of Mexico



- Initial recommendation was to add a 1000-foot-wide buffer around the pipeline
- Buffer based on available general guidance for pipeline buffers
- Buffer reduced the total extraction volume my 1.4 MCY (30%)



- Guidance on dredging buffer in the literature

  - 1000-foot buffer taken from Nairn, Langendyk and Michel (2004) for sites offshore of Louisiana
  - Based on Research Planning, Inc. and Baird & Associates, (2004) work developing dredge buffers around archeological sites
  - 1000 feet “the upper end suggested by dredging contractors”, so is conservative based on practice
  - Recommended maximum slope between bottom of borrow excavation and seabed at pipeline is 1:100 for a 10 foot cut
  - Planned PBW excavations were well within the recommended slope and cut limits

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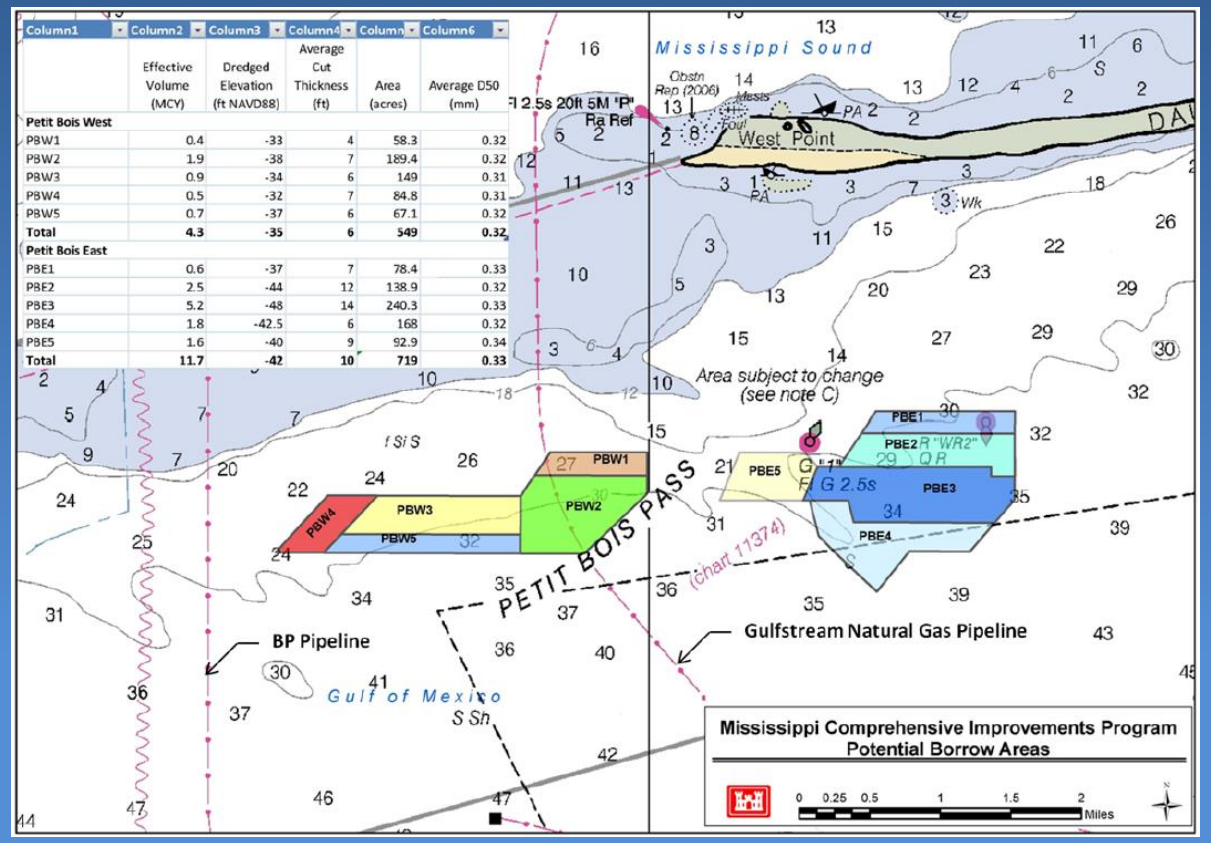
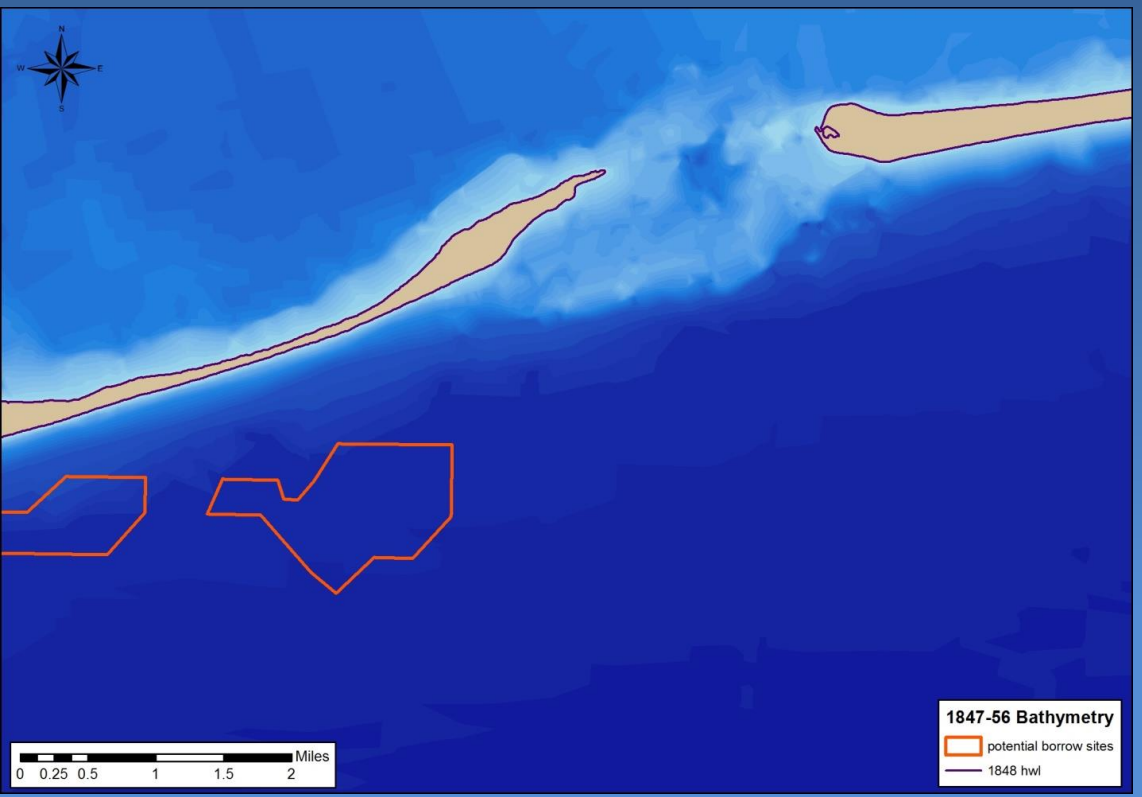
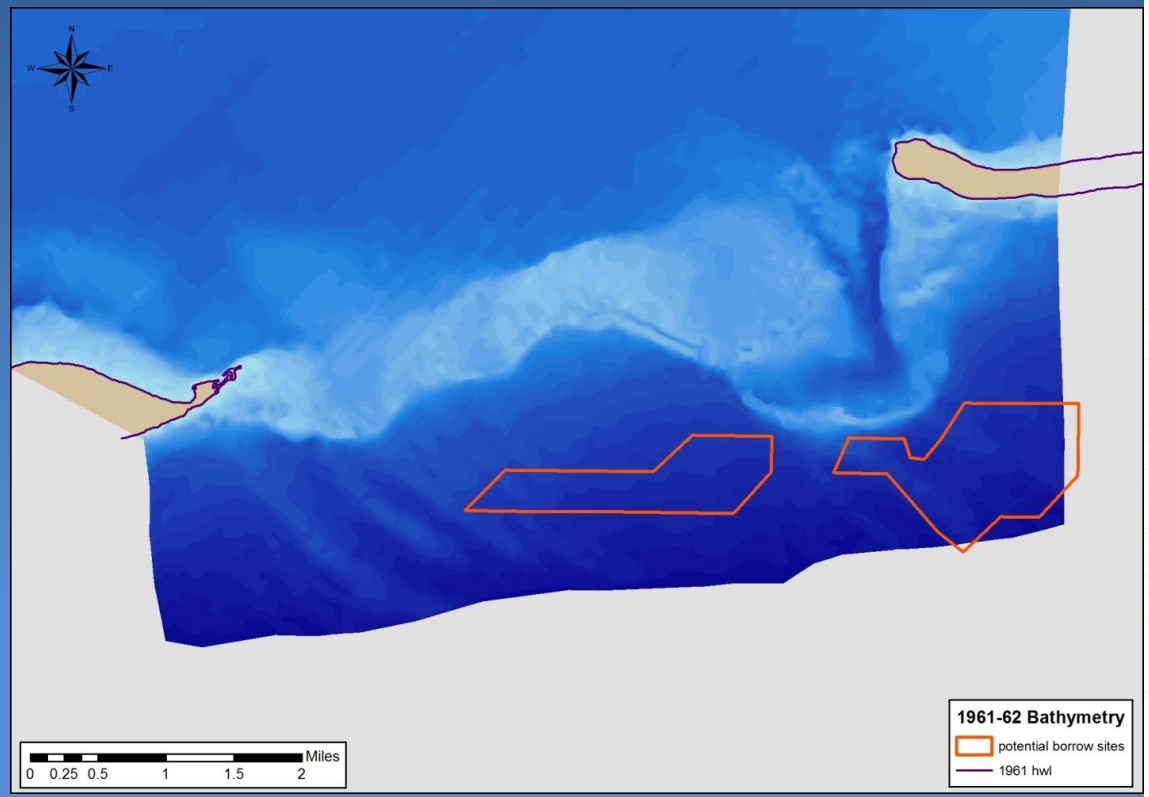


- Is the general guidance of a 1000-foot buffer adequate in this case?
  - Historical shoreline and bathymetry data show that the borrow sites are near dynamic features
  - The pipeline operator was already having to work to maintain the regulated cover in some areas
  - Erosion at some locations was great enough to lead to spanning of the pipeline
  - Permitting of the borrow sites even with the buffer would require some sort of demonstration that dredging the borrow site would not lead to further problems





- Is the general guidance of a 1000-foot buffer adequate in this case?
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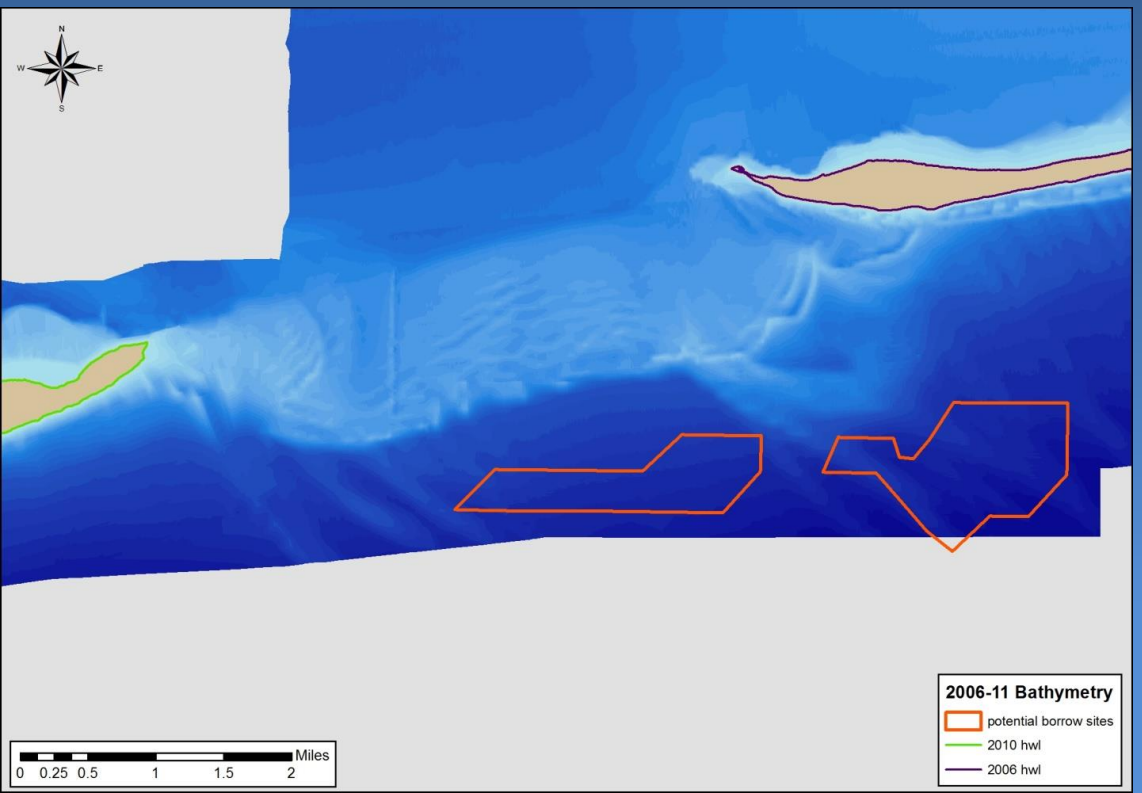
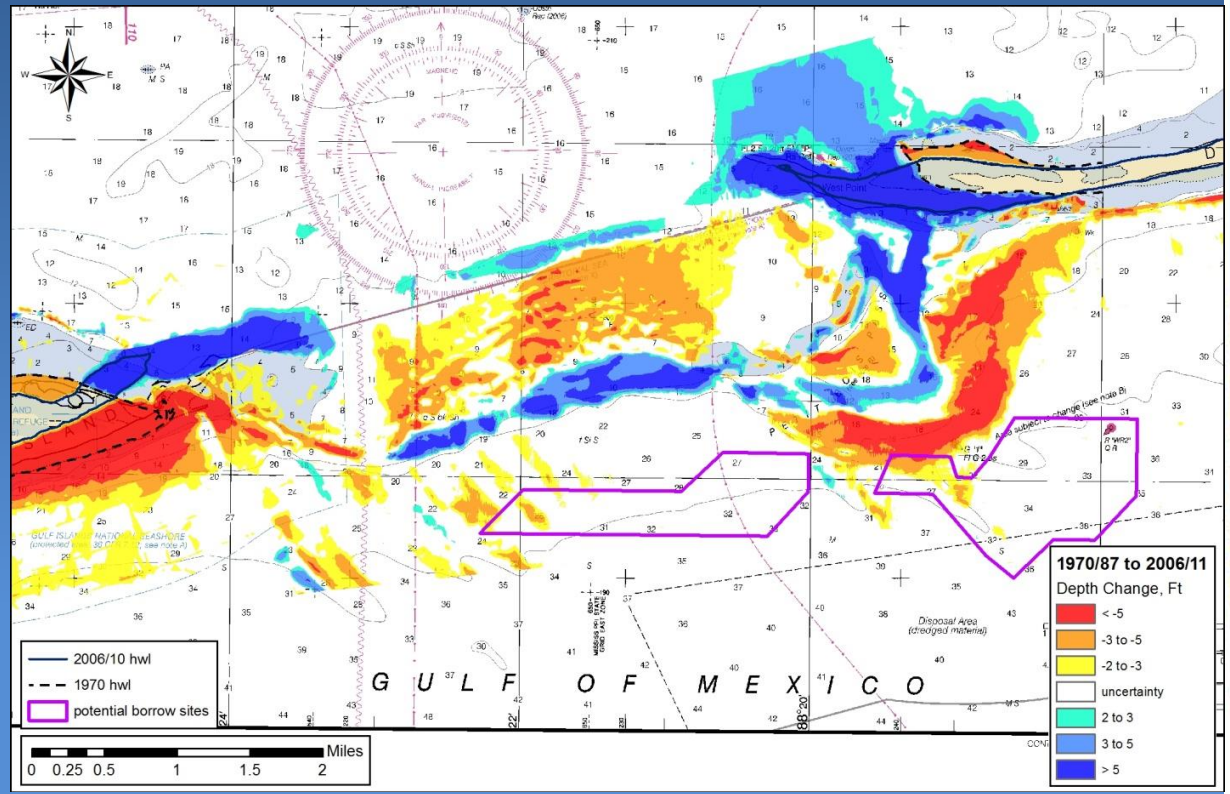
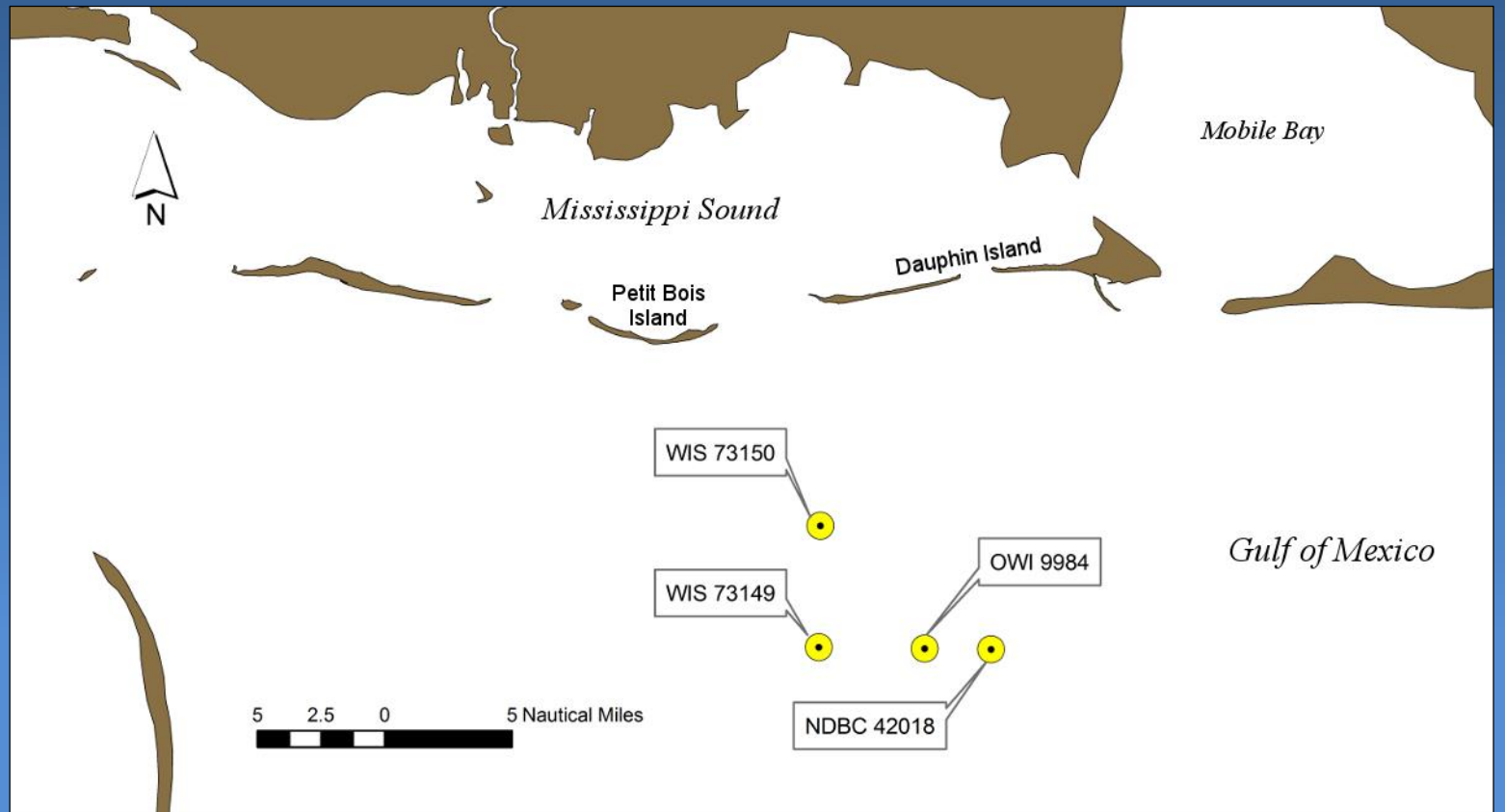




2. Development of Engineering Analysis

- Used Coastal Modeling System (CMS) to test borrow site performance under various conditions
- Waves and Meteorological data from Ocean Weather (OWI) hindcast
  - At that time, WIS did not cover Katrina (2005)
  - Used gridded OWI data during Hurricane Katrina for an analysis of extreme conditions at the borrow sites



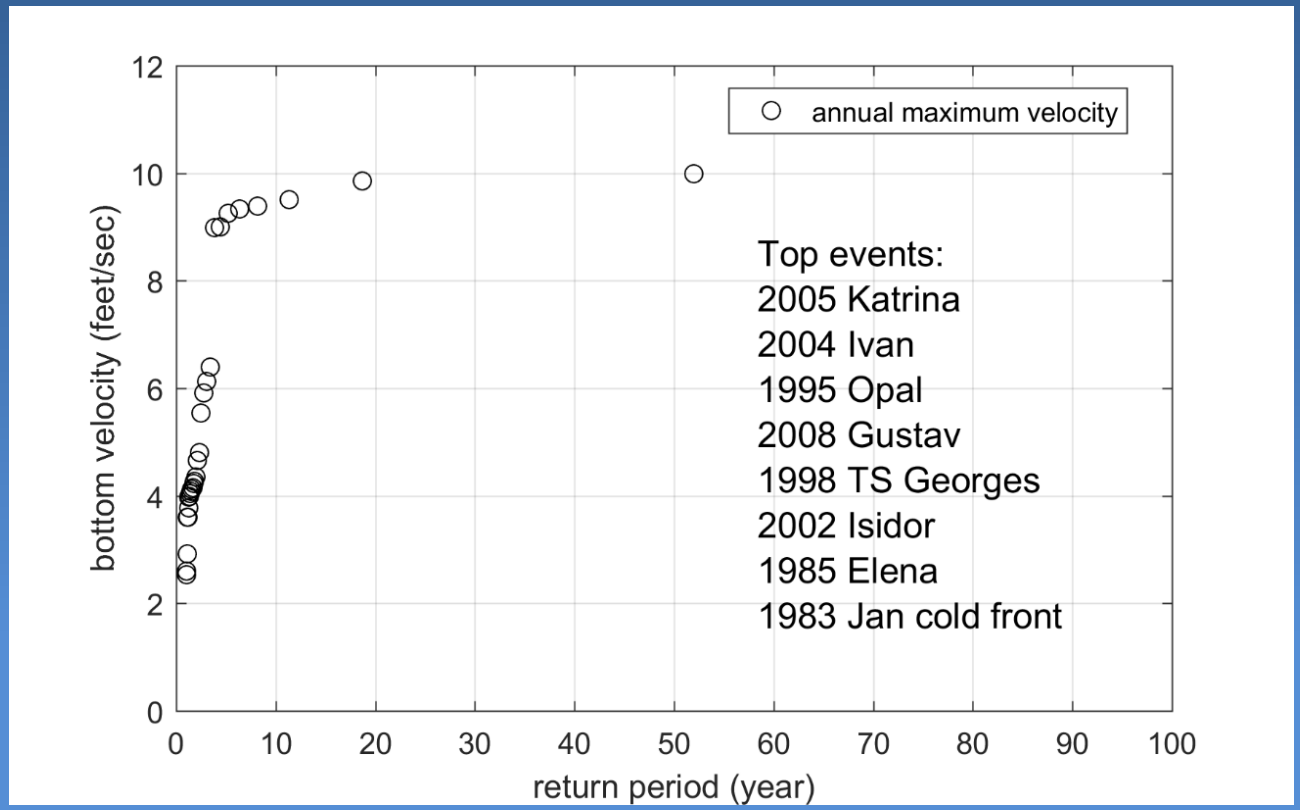
- Modeled conditions developed for average-annual and extreme event conditions

  - An analysis of annual conditions in the OWI record revealed that 1984 was the most comparable to the average of the entire hindcast record (1980 through 2008) based on wave energy at the borrow sites

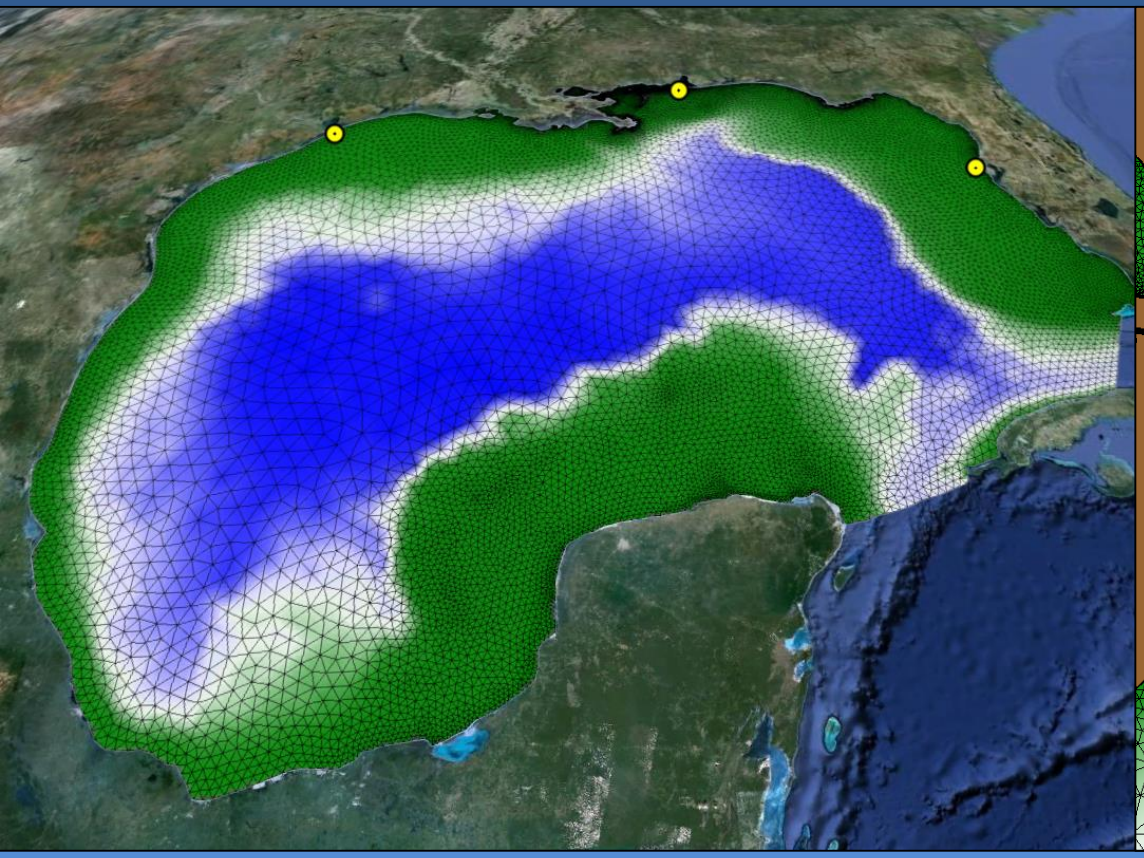
  - Waves during extreme events at the site are depth limited, so maximum bottom velocities at the borrow site occur within a narrow band between 9 and 10 ft/sec (2.7 and 3.2 m/sec)

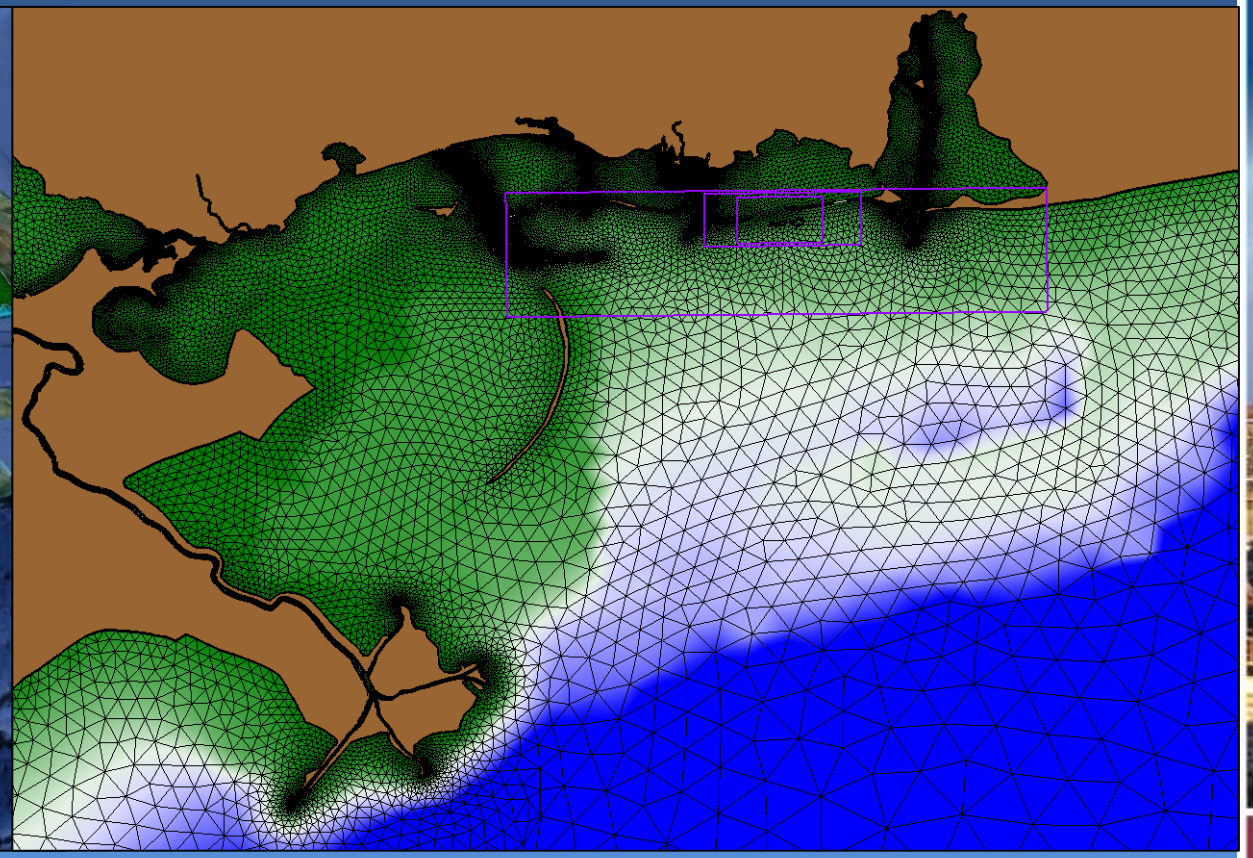
  - An extremal analysis of bottom currents at the borrow sites shows that orbital velocities in excess of 9 ft/sec (2.7 m/sec) have a return period of about 4 years

  - With respect to bottom currents at the borrow sites, Katrina can be used to represent storms with a return period of 4 years or more



- CMS model developed using ADCIRC to provide hydrodynamic boundary condition for nearshore model grids
- Nested CMS-Wave grids used to propagate waves from OWI station to CMS-Flow grid of the Petit Bois Pass region





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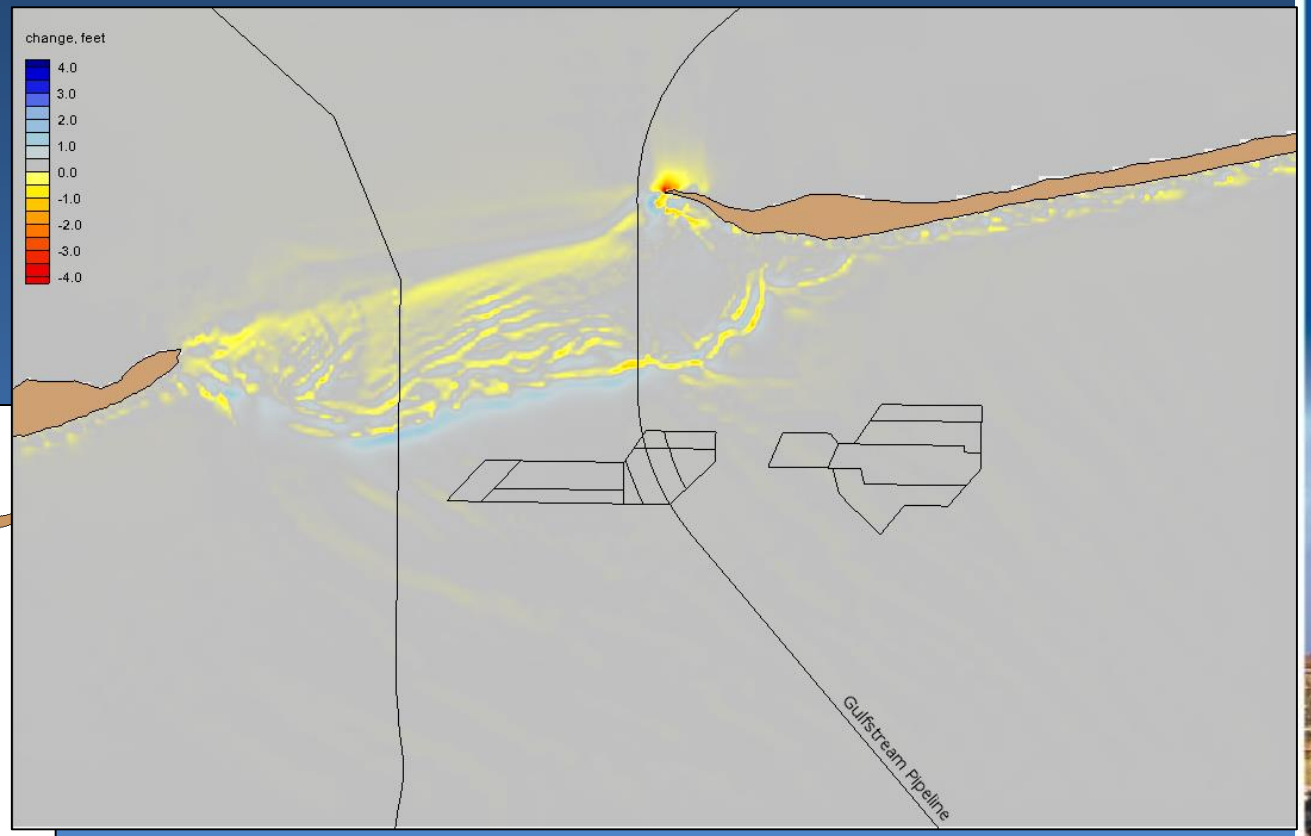
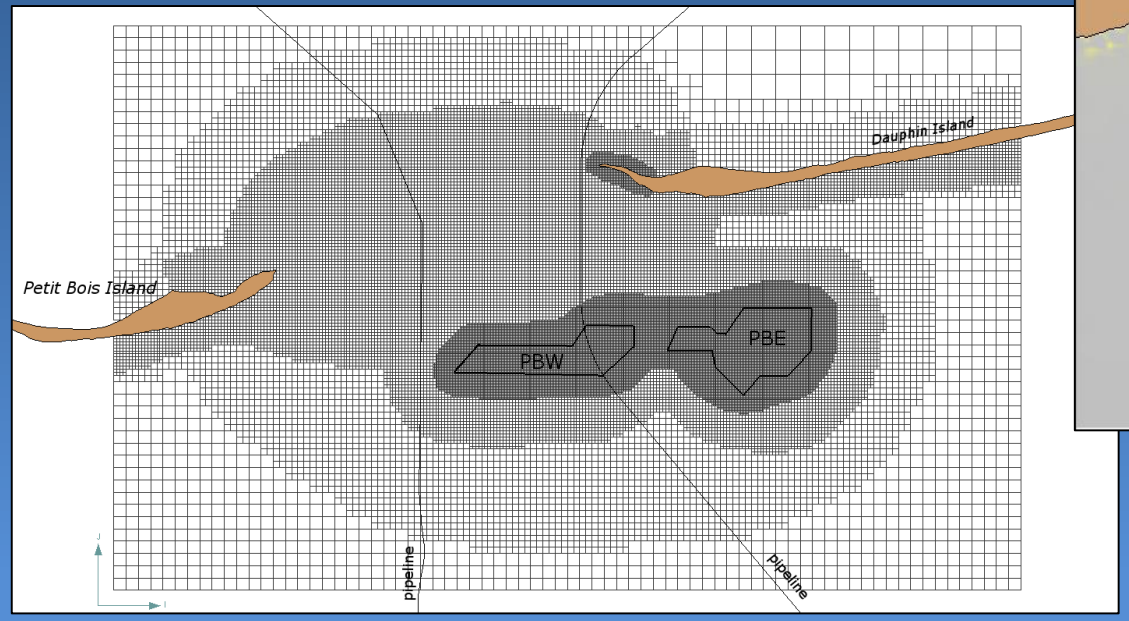
- CMS-Flow run with pre- and post-dredge conditions with 1000-foot buffer
  - one typical year
  - Katrina





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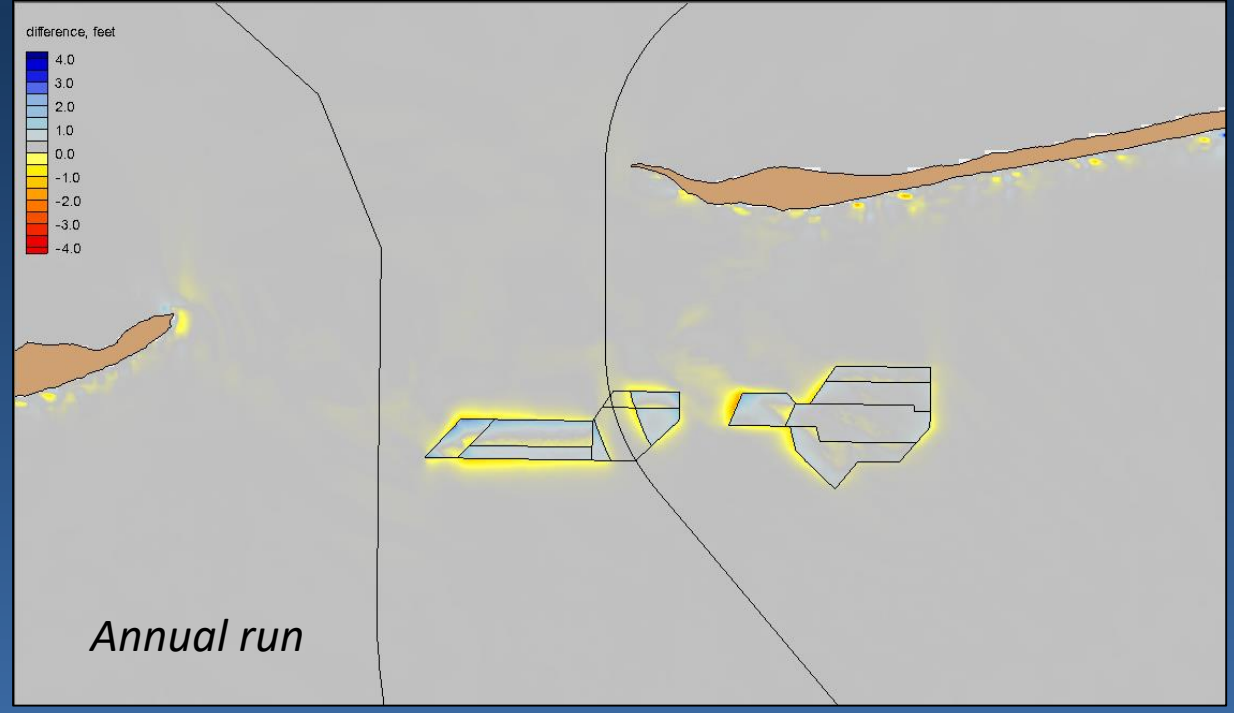
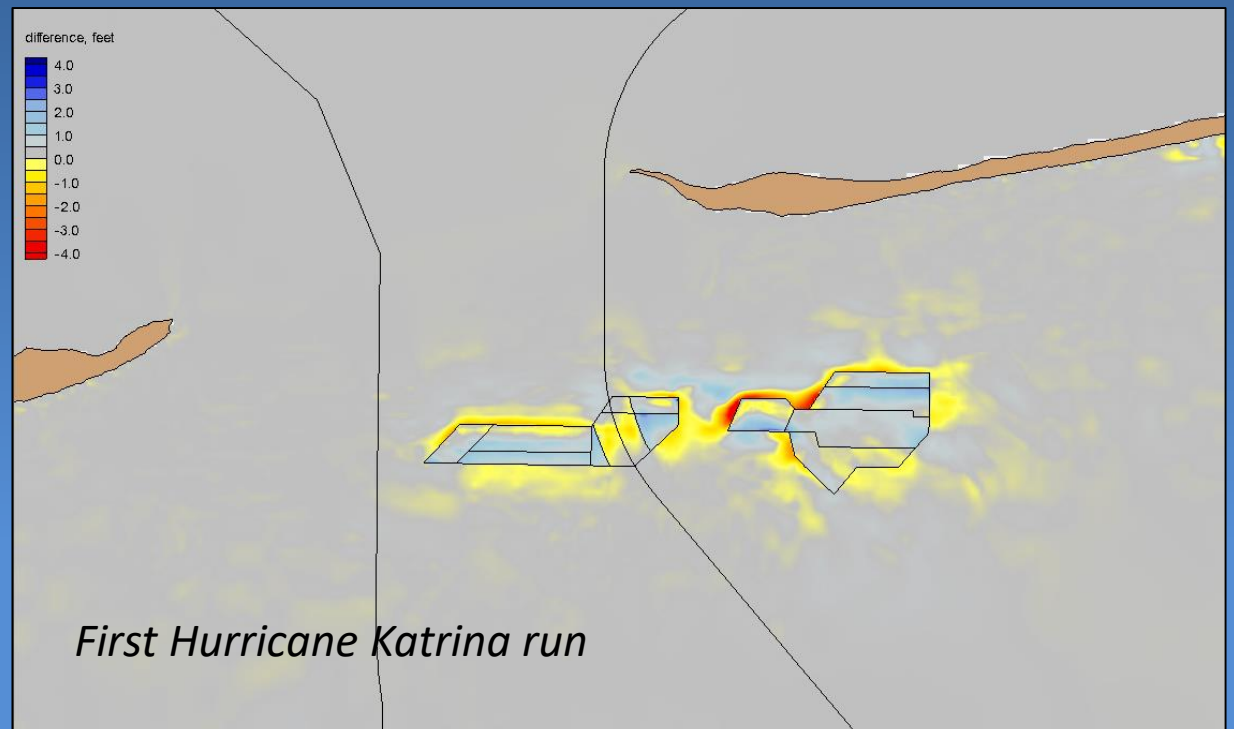
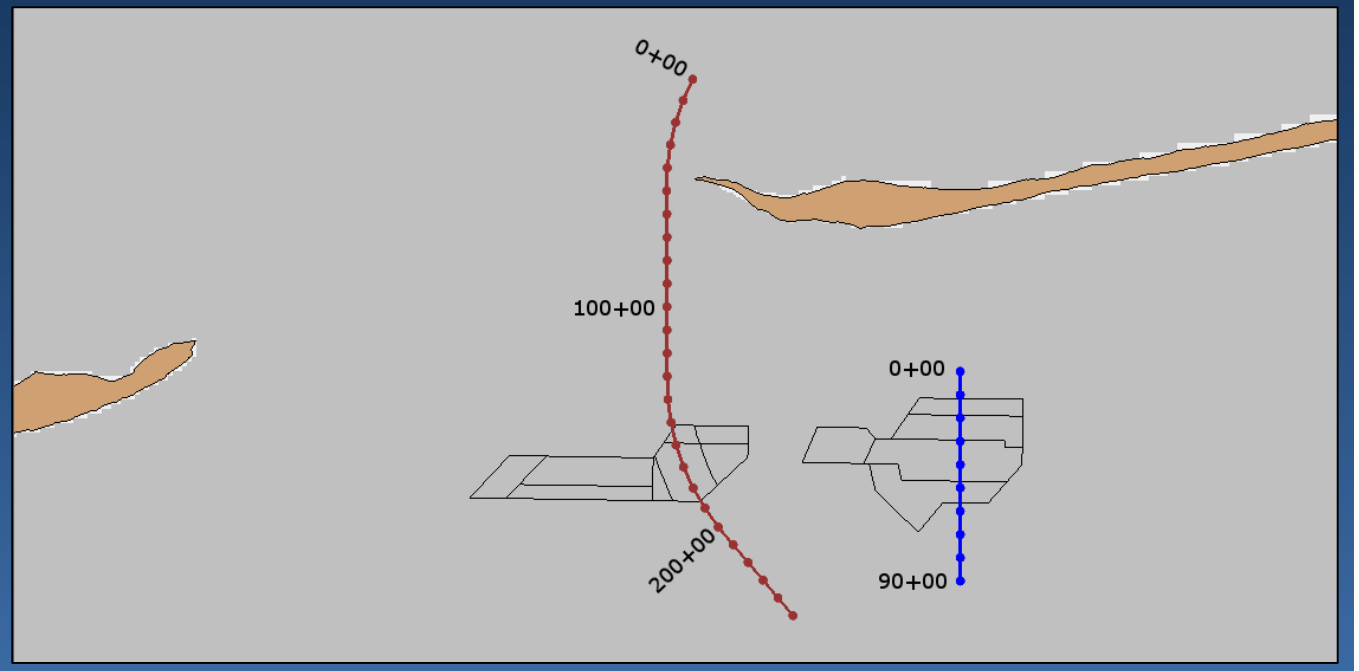
- Results of annual run show very little change along the pipeline
- Results of Katrina show much larger changes, with maximum erosion of about 1 foot along the pipeline corridor
- Cumulative runs of Katrina show that each additional extreme event (four year return period or greater) causes similar magnitude impacts
- Extreme event impacts with the 1000-foot dredge buffer are large enough to be concerning and require modifying the dredge plan

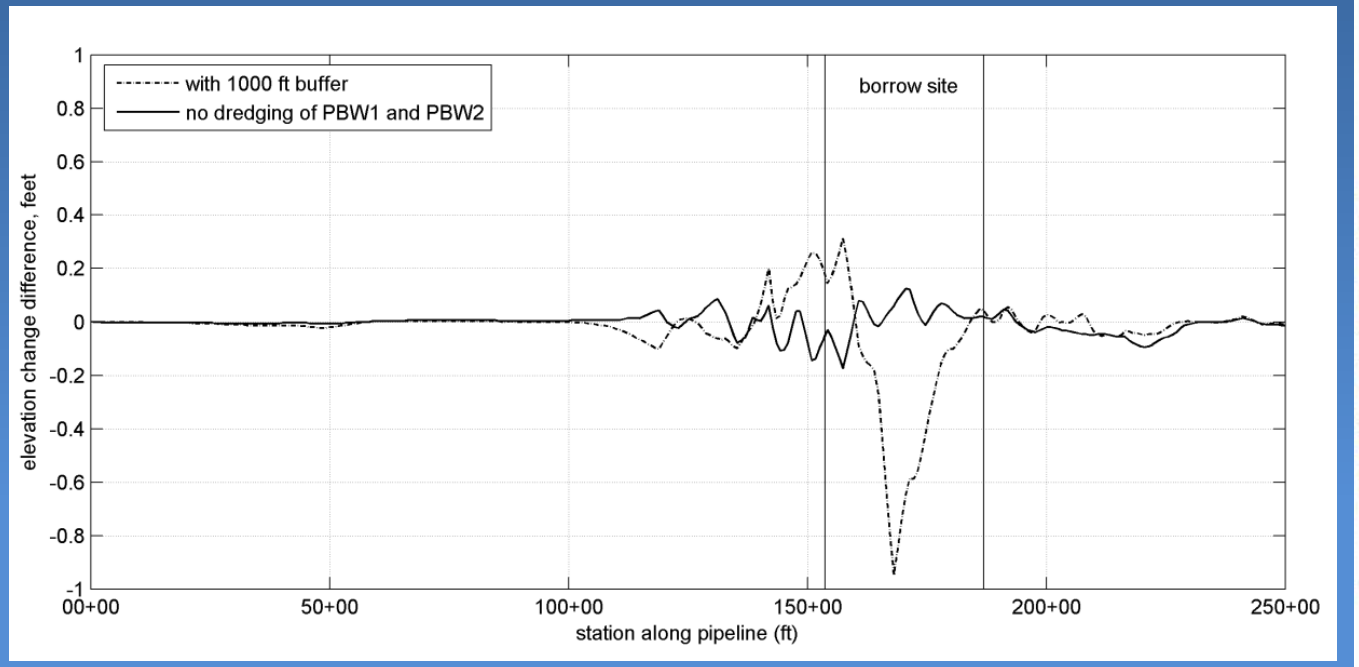




3. Modified Plan

- The dredging plan was modified to completely exclude dredging of two subsections of Petit Bois West (PBW1 and PBW2)
- New plan removed 2.3 MCY from the total 4.3 MCY originally planned for PBW
  - more than 50% reduction from original plan
  - but only 20% reduction from PBW with 1000-ft buffer
- Katrina run of new plan showed much less change along the pipeline





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4. Conclusion

- The final modified recommended dredge plan for the Petit Bois sites was permitted and is planned to be used for the Ship Island restoration
- To date 3.7 MCY of sand has been placed in Camille Cut of a total of 7 MCY planned for this year (Phase 1)
- The portion of Petit Bois West in Mississippi will be used in Phase 1
- The remainder in Petit Bois West and East is scheduled to be used in Phase 3

Thanks to:

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