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Swift Slough Restoration Feasibility and Design Alternative Analysis

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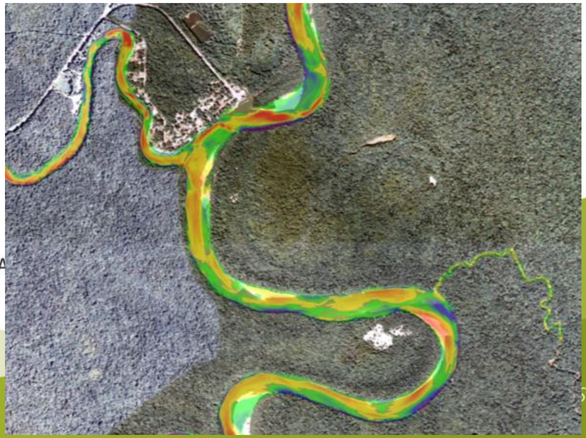
February 25, 2014

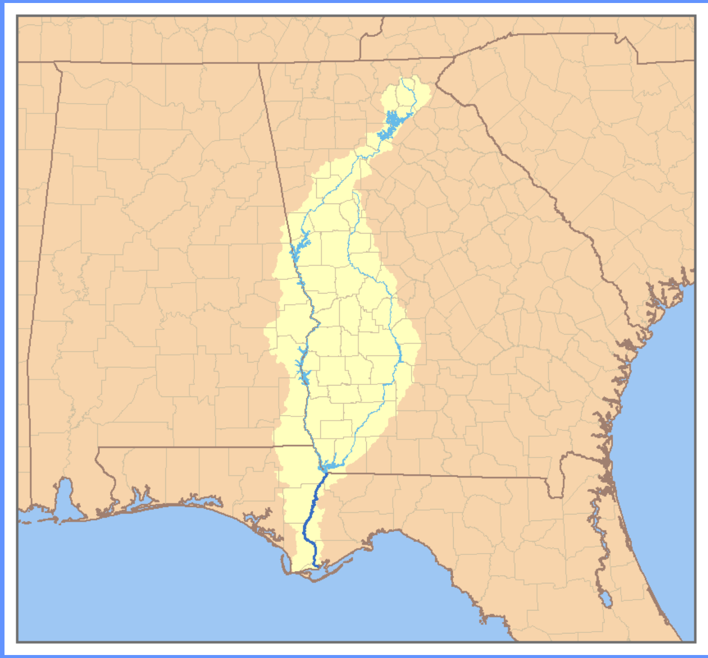


Presentation Overview

- Site Characteristics
  - Apalachicola River Basin, floodplain habitats, Swift Slough, Chipola Cutoff
- Goals and Design Objectives
- Methods
  - Field data collection effort
  - Geomorphic evaluation
  - 2D Hydrodynamic /sediment transport modeling
  - Development of design alternatives
- Results / Findings
  - Long term performance
  - Long term geomorphic trends

Apalachicola River Basin

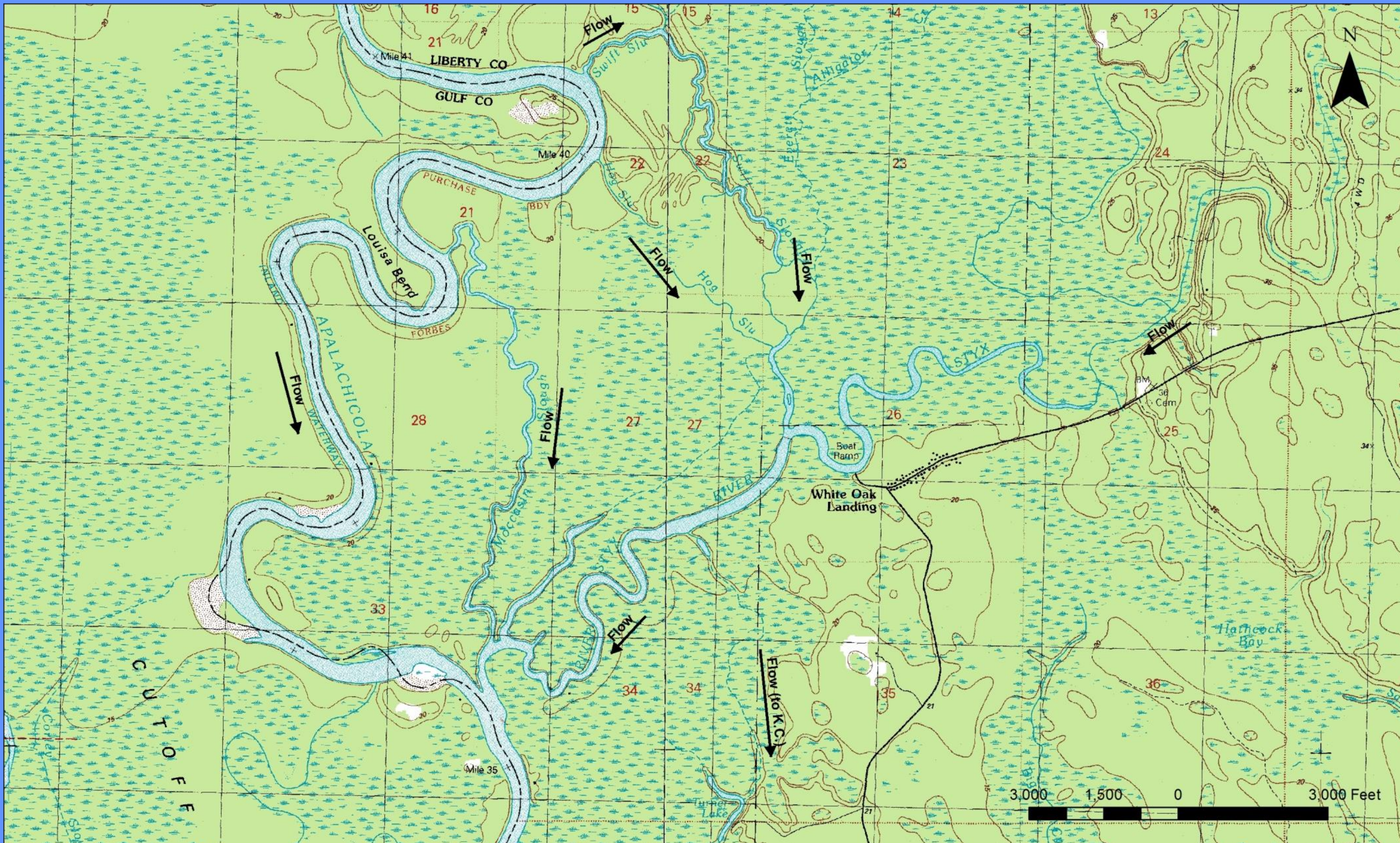
- Basin Characteristics
  - ACF River Basin: Apalachicola, Chattahoochee, Flint Rivers
  - Drainage area: 19,500 mi^2
  - Apalachicola River flows 107 miles Florida panhandle
  - 4 major reservoirs on the Chattahoochee River.
    - Provide for water supply and power generation / not much flood control
  - Water use between Georgia, Alabama and Florida is contentious



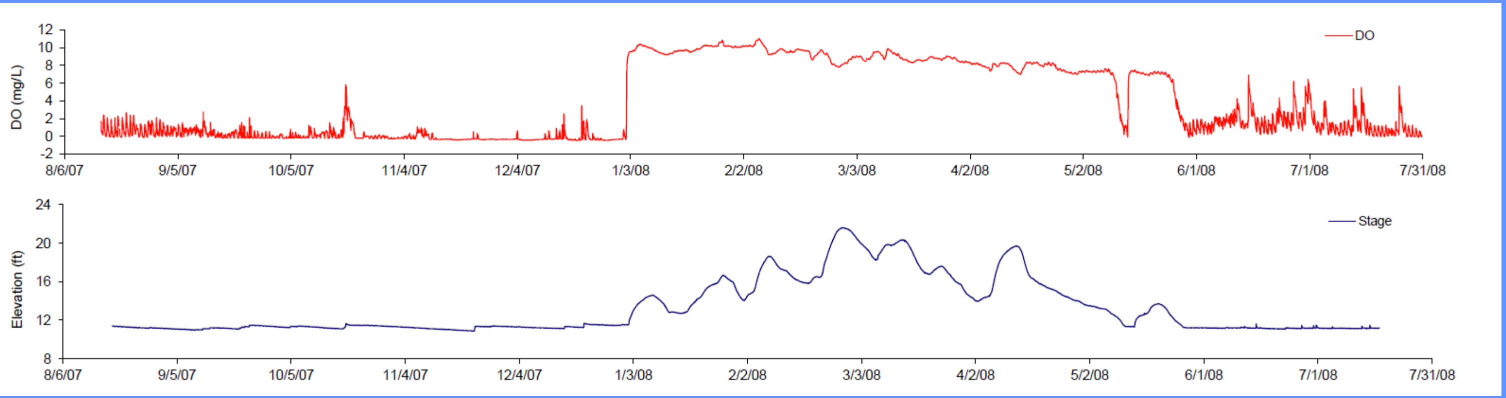
Apalachicola River Ecology

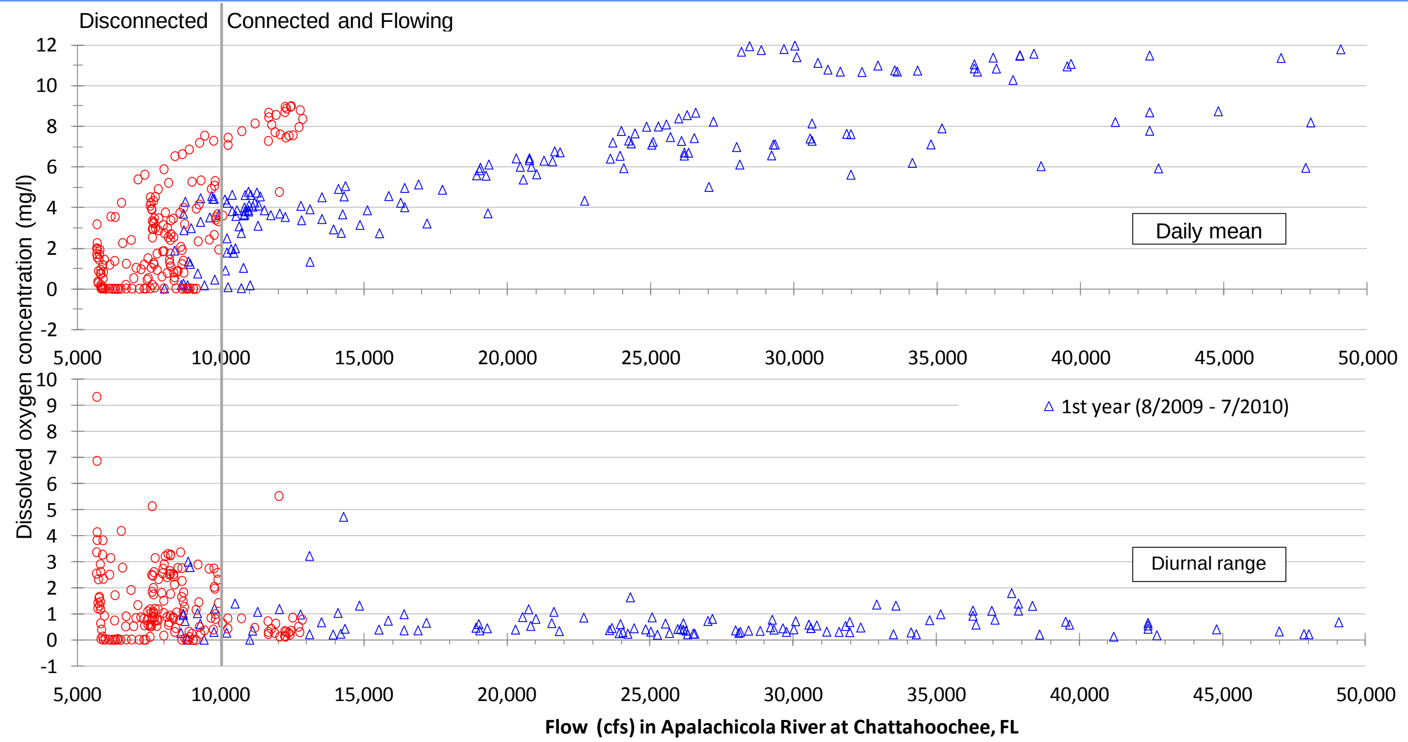
- River Characteristics
  - Forested floodplain up to 9 miles wide
  - Complex network of distributary and backwater slough systems within the Apalachicola River floodplain
    - critical spawning and nursery habitat for various aquatic species
  - Wet floodplain – bankfull capacity 35k cfs (~1.25 -year RI)
- Ecological Qualities
  - Home to 15 threatened and endanger species
    - Various plants species, Gulf Sturgeon, mussels
  - Apalachicola floodplain has the highest density of reptiles and amphibians in the continental US
  - Apalachicola Bay is one the most productive estuarine systems in the world – home to multi-million dollar oyster industry

Apalachicola Floodplain Sloughs



Slough Habitat Quality and Mainstem Flow





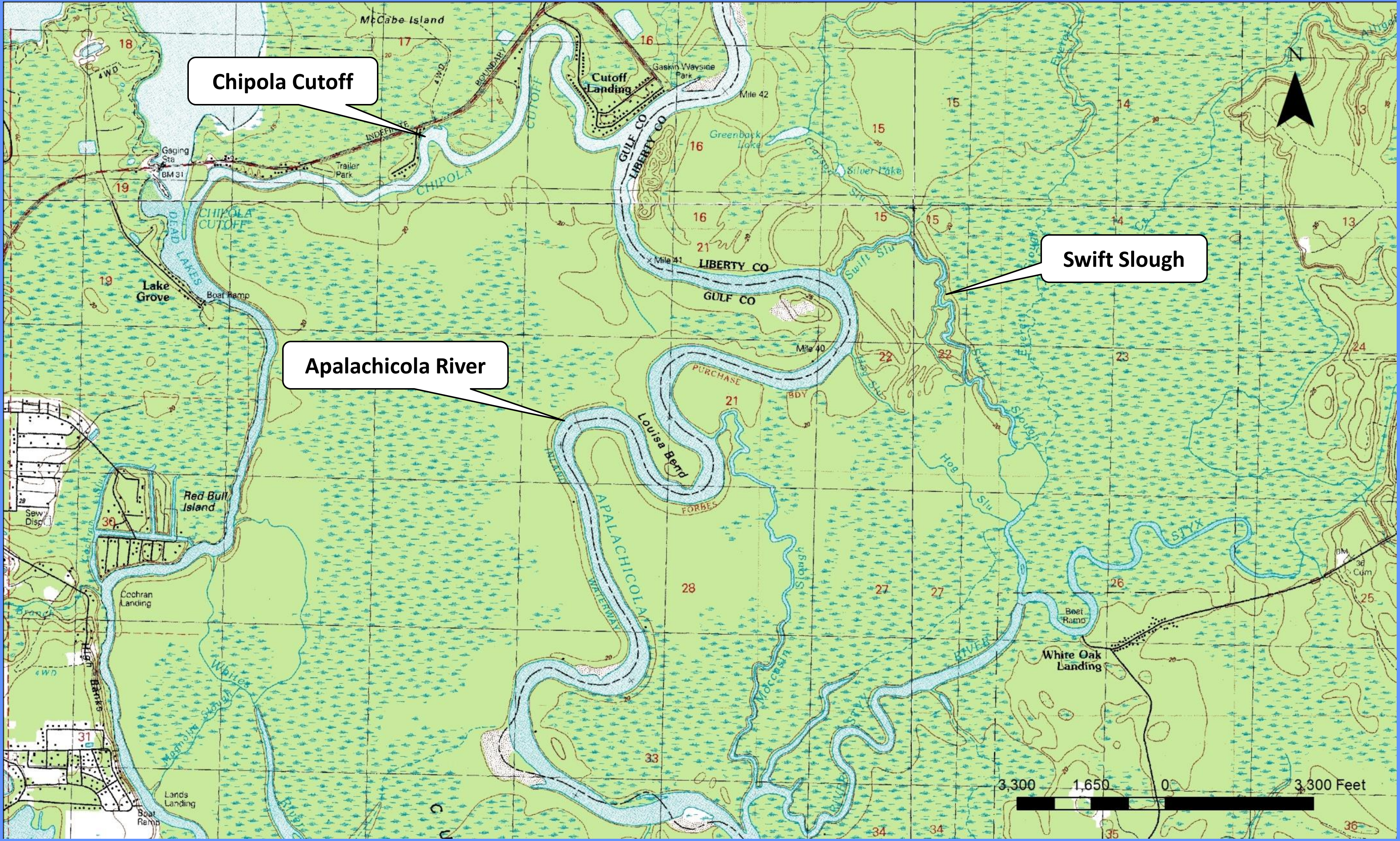
Apalachicola T&E Species

Fat-three Ridge

Gulf Sturgeon

Apalachicola *Threatening* Species

Study Reach – Chipola Cutoff & Swift Slough



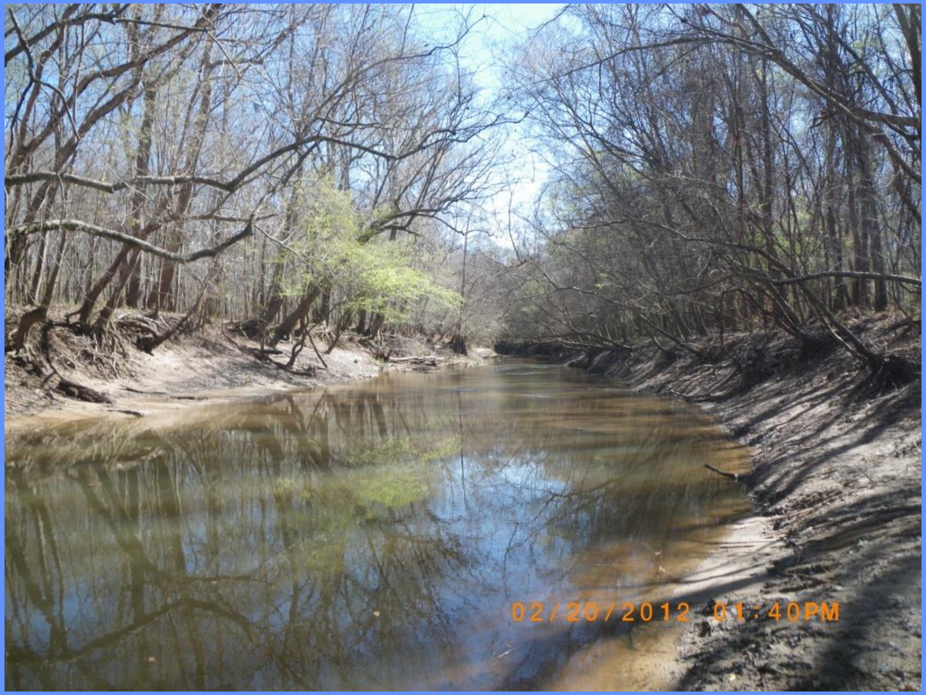
Goals and Objectives

- Goal:
  - Improve hydrologic connectivity during *low flow periods* between Apalachicola River and Swift Slough
  - Reduce mortality of T&E mussel species that inhabit Swift Slough
  - Minimize impact to existing mussel populations
  - Determine how long the improve connectivity can be maintained
- Approach:
  - Develop a better understanding of the hydrologic / sediment regime within the study reach
    - Geomorphic evaluation and data collection and development a 2D sediment transport model
  - Develop three alternatives and test performance / feasibility

Swift Slough Connectivity

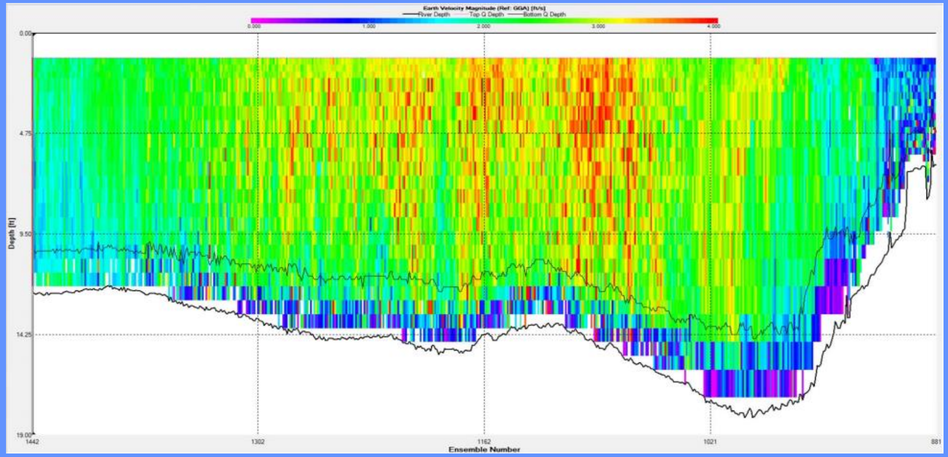
Disconnected – 5k cfs

Connected – 10k cfs



Methods – Field Data Collection

- Development of 2D sediment transport model
  - *Water level* monitoring (Sept 11 – Dec 13)
  - *Flow* (Q) measurements
    - ADCP at ~5k, 16k, 33k cfs
  - *Sediment discharge* (Qs) measurements
    - Bed and suspended load – (~5k, 16k, 33k cfs)
  - *Bathymetric surveys* of Apalachicola, Swift Slough, Chipola Cutoff (2012 & 2013)



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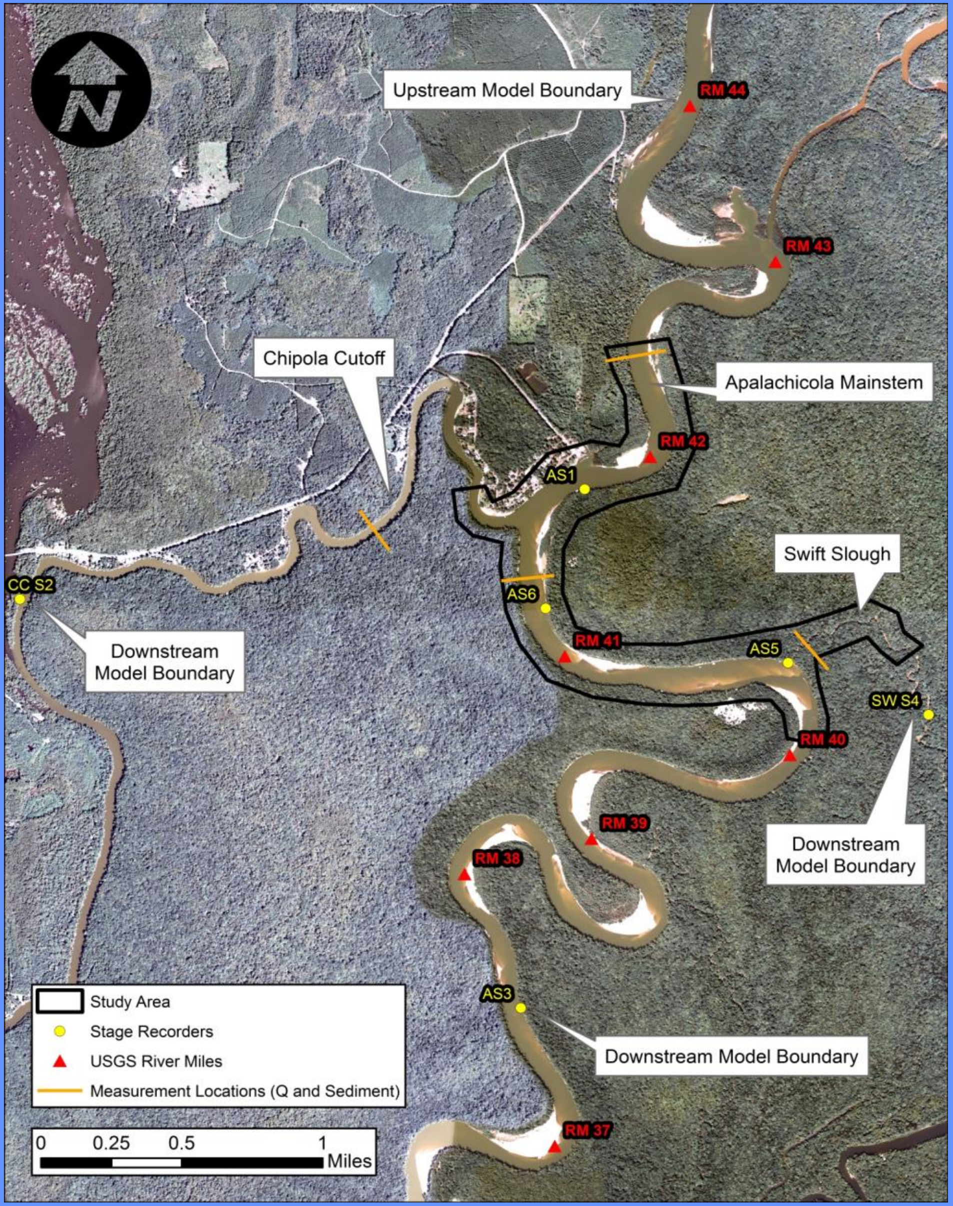

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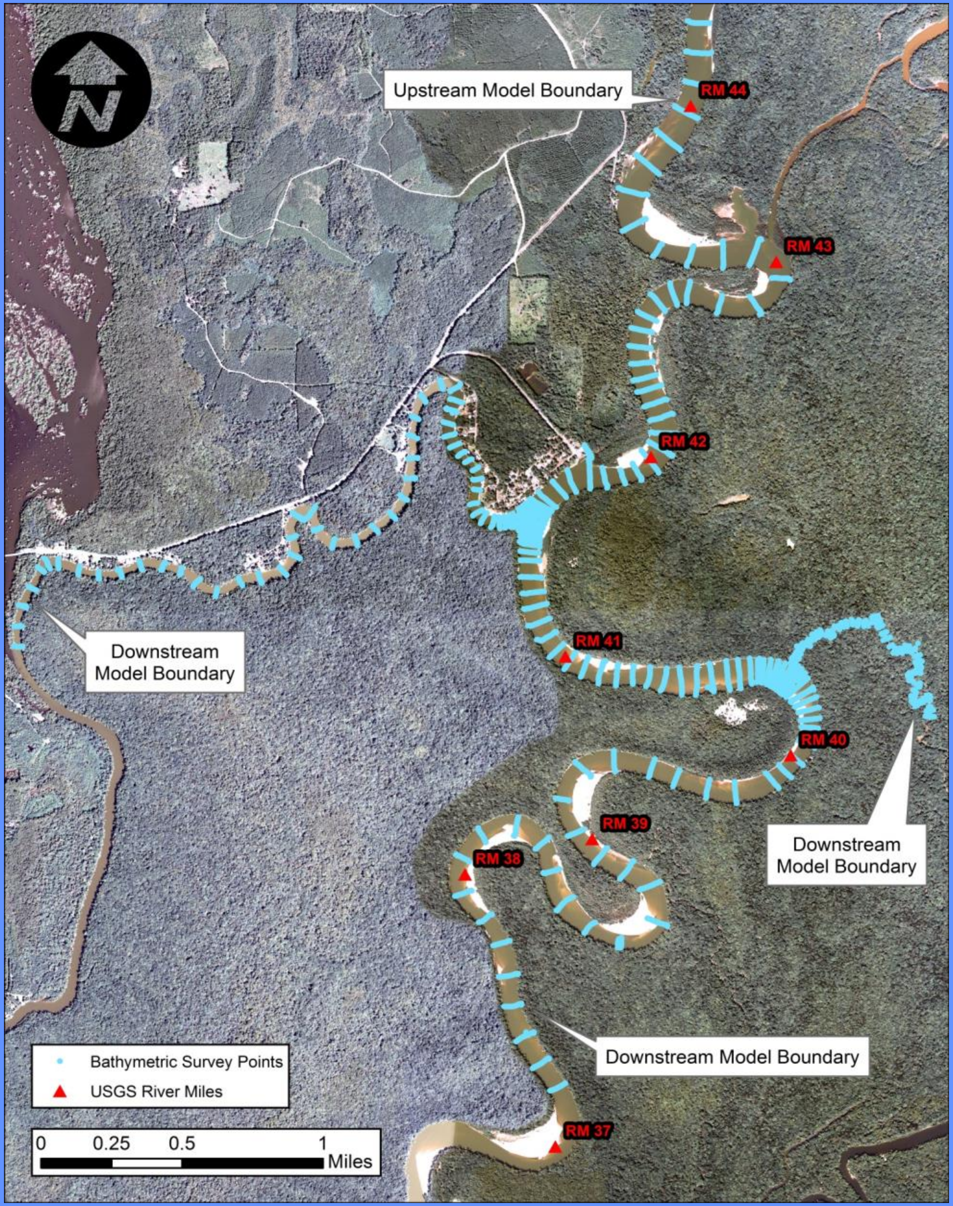
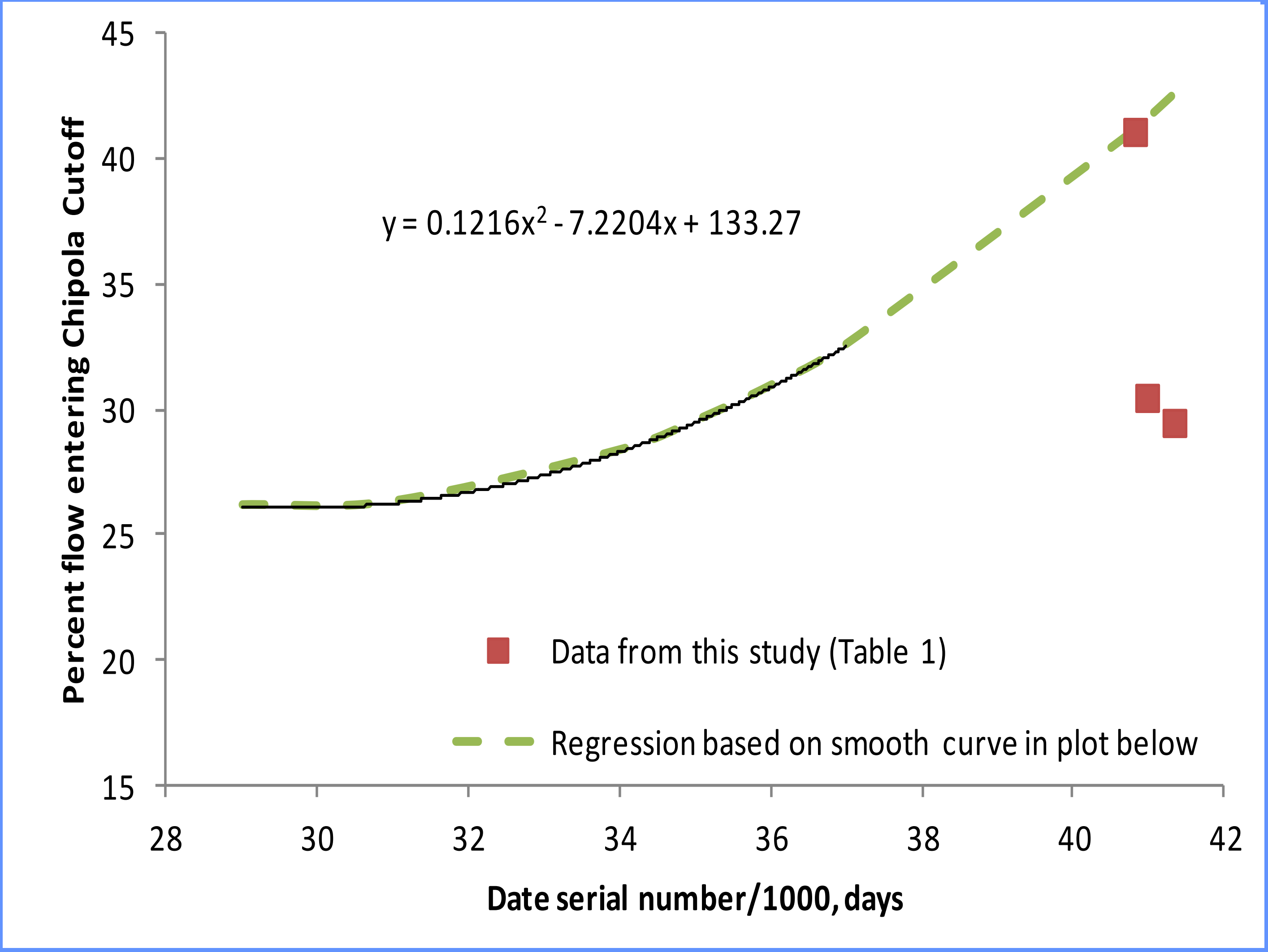


Results – Field Data Collection

Date	Location	Discharge - Q (cfs)	Bed load Discharge (tons/day)	Suspended Load Discharge (tons/day)	Total Sediment Load (tons/day)
9/19/2011 to 9/21/2011	Apalachicola RM 42.3	5,413	173	175	348
9/19/2011 to 9/21/2011	Chipola Cutoff	2,329	17	69	86
9/19/2011 to 9/21/2011	Apalachicola RM 41.3	3,108	80	109	189
2/24/2012 to 2/26/2012	Apalachicola RM 42.3	15,973	460	818	1,278
2/24/2012 to 2/26/2012	Chipola Cutoff	4,875	132	184	316
2/24/2012 to 2/26/2012	Apalachicola RM 41.3	11,058	253	656	910
2/20/2013 to 2/21/2013	Apalachicola RM 42.3	32,691	1,523	3,350	4,873
2/20/2013 to 2/21/2013	Chipola Cutoff	9,644	190	754	945
2/20/2013 to 2/21/2013	Apalachicola RM 41.3	22,393	726	1,932	2,658

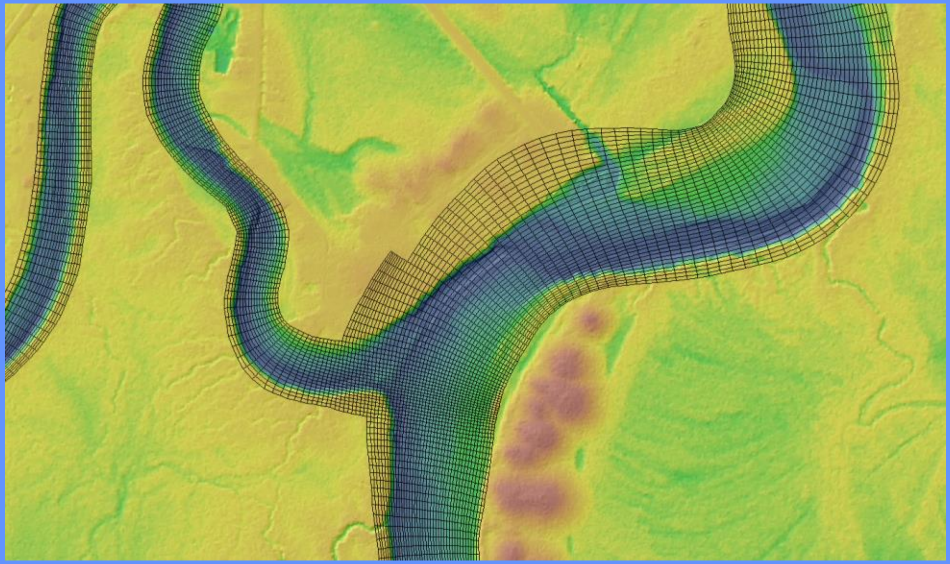
- 5,400 cfs – Apalachicola receives 57% of flow, but 75% of total sediment load
- 16,000 cfs – Apalachicola receives 69% of flow, but 75% of total sediment load
- 33,000 cfs – Apalachicola receive 70% of flow, but 80% of total sediment load

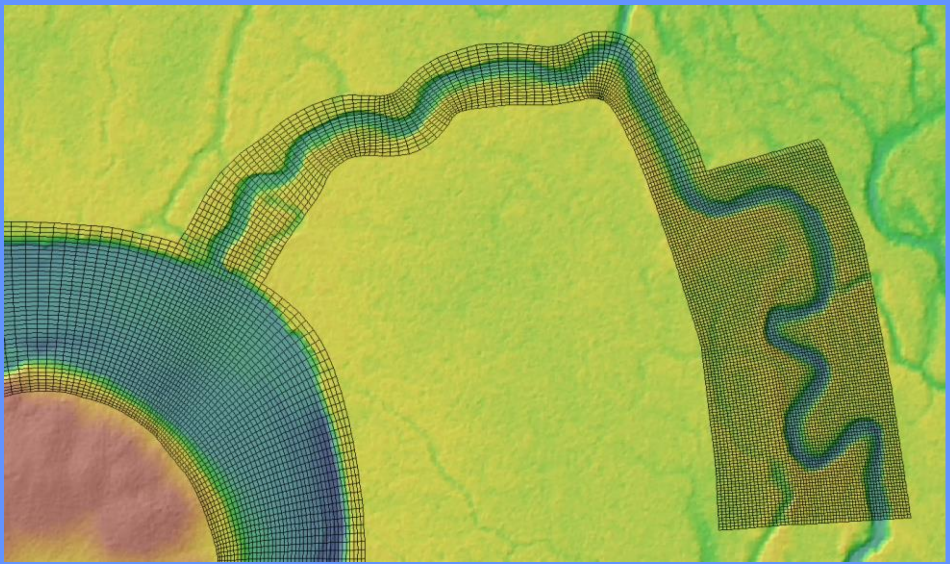
Results – Flow Split Ratio Comarpison



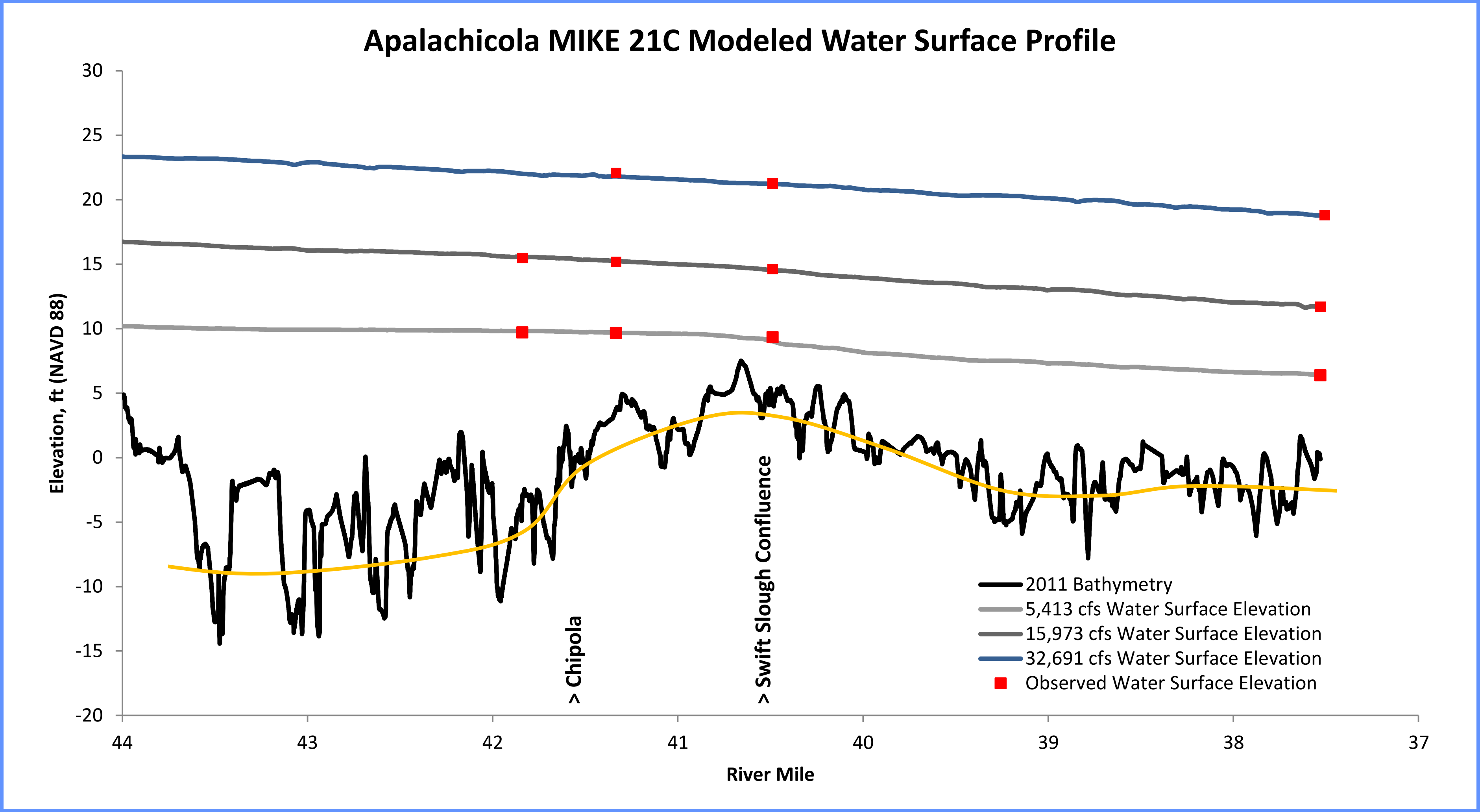
Methods – Model Development

- MIKE 21C – hydraulic / sediment transport model
  - Dynamically linked 2D curvilinear grid model developed by DHI
  - Solves vertically-integrated equations of continuity and conservation of momentum (the Saint Venant equations)
  - Simulates erosion and deposition of non-cohesive sands – Yang equation
  - Include algorithms for helical flow and vertical sediment concentration profiles – quasi 3D.
- Simulate measured flows (5k, 16k, 33k cfs) for 6 month duration



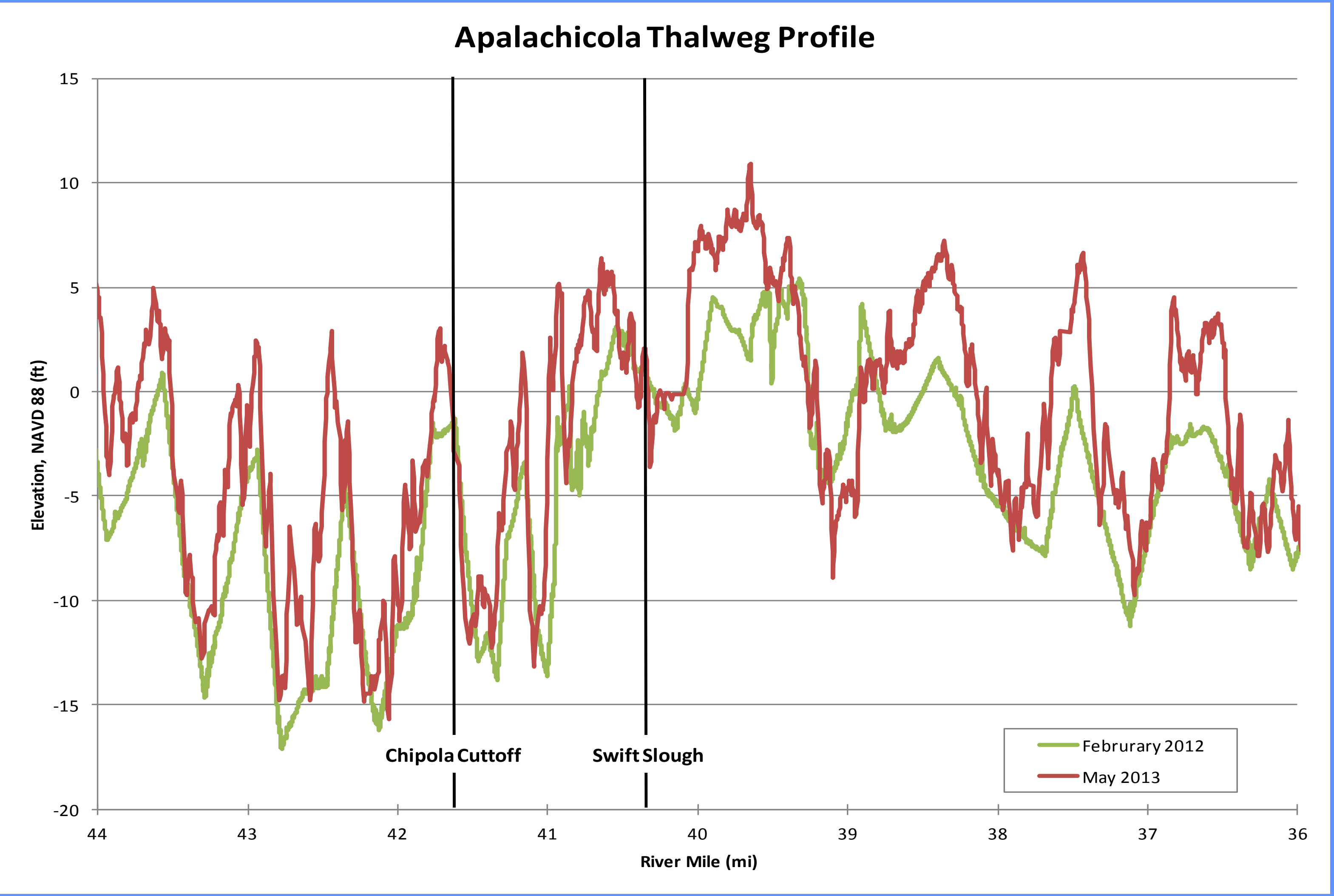


Model Calibration - Hydrodynamics



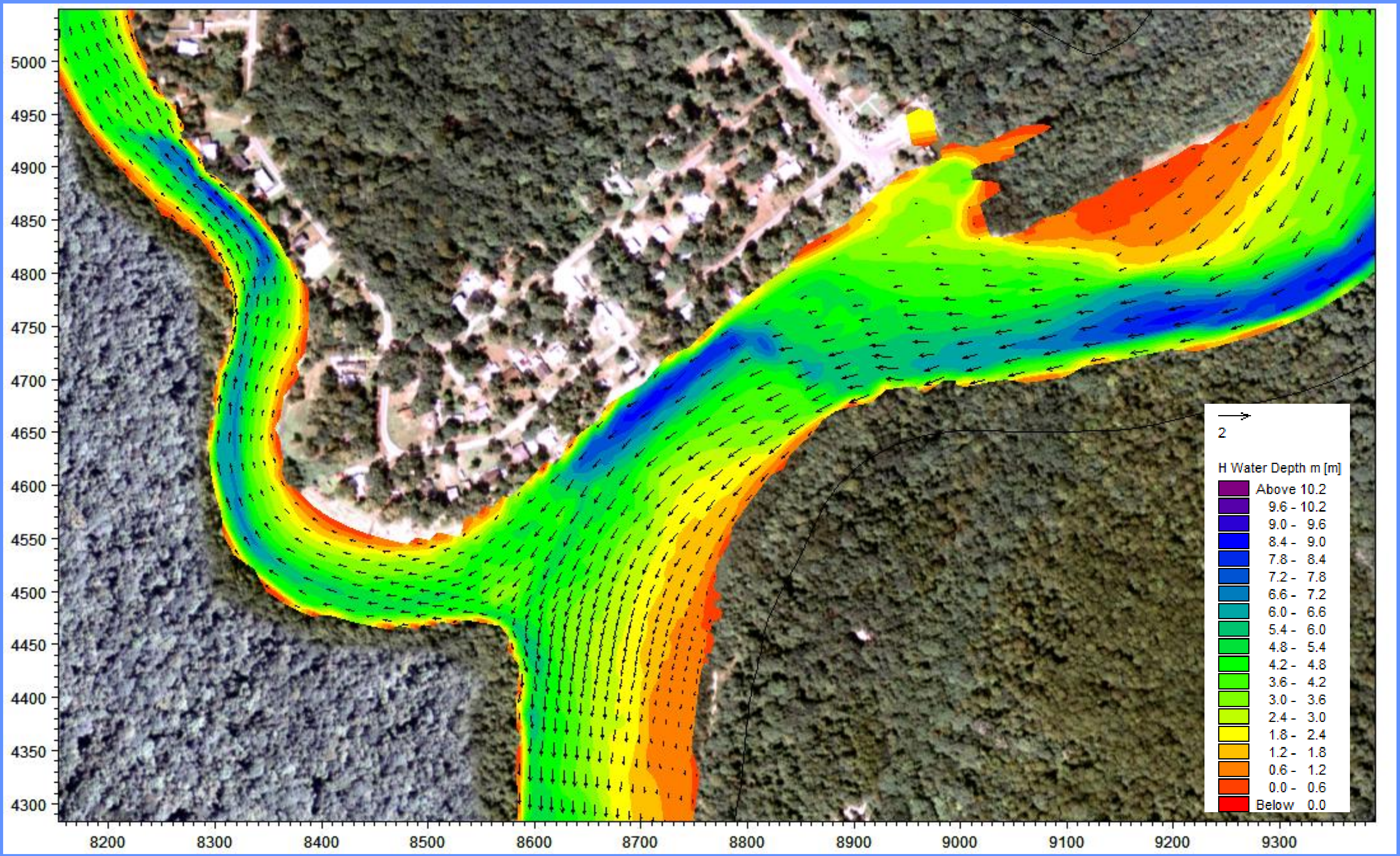
- Hydraulic model calibrated using measured stage and flow

Model Validation – Sediment Transport



Erosion and depositional trends validated through repeat bathymetric surveys

Existing Condition Water Depth – 16,000 cfs



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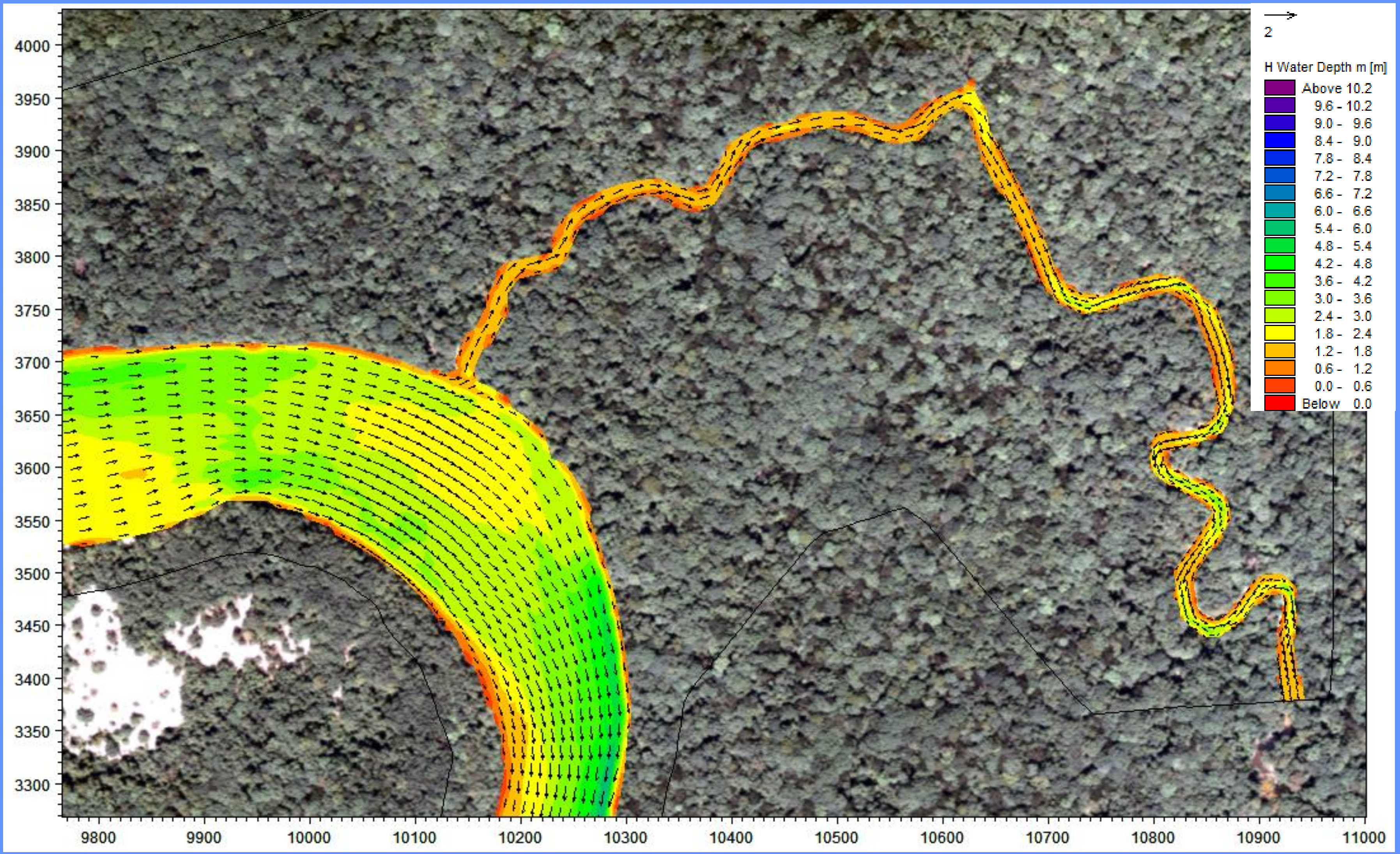
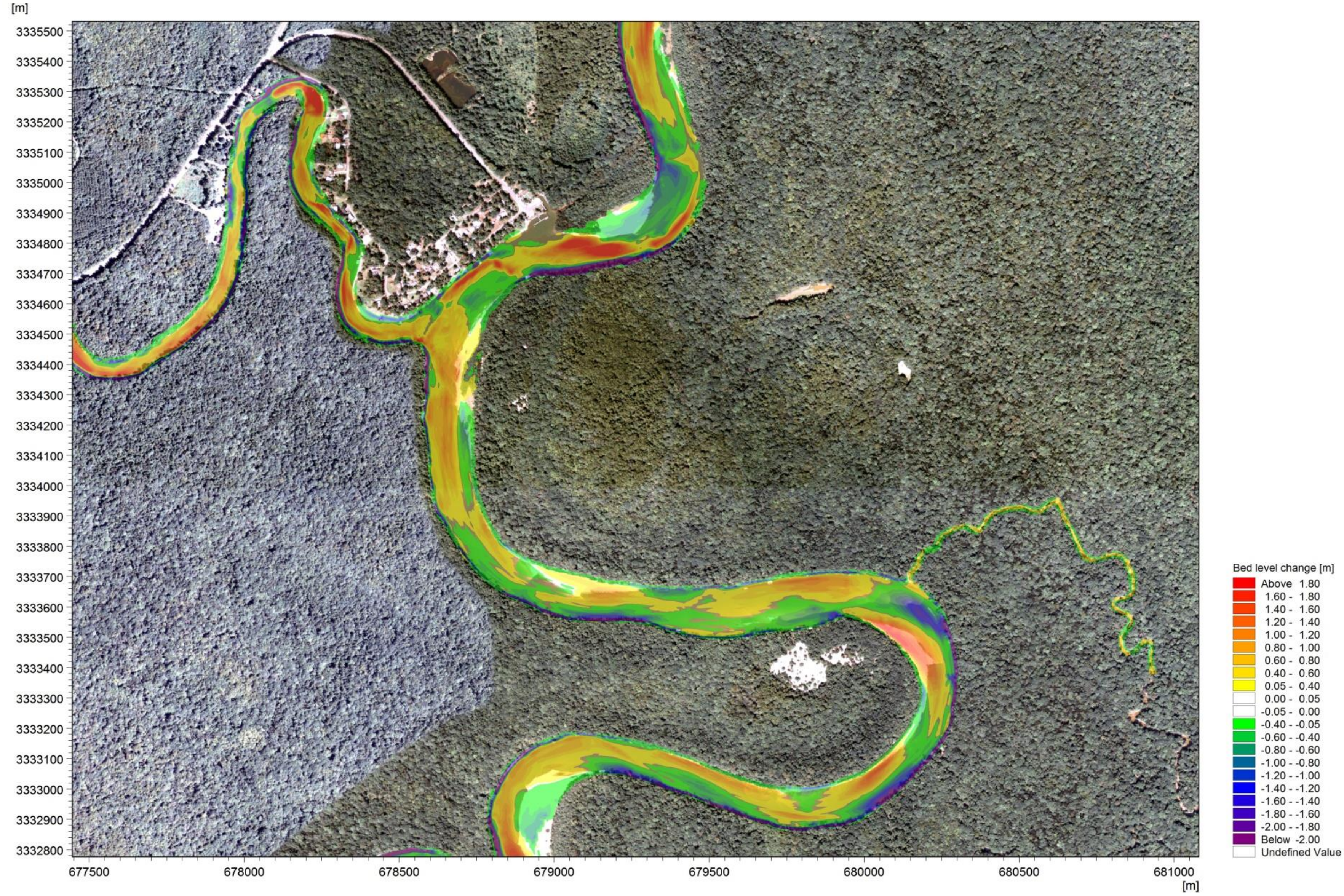
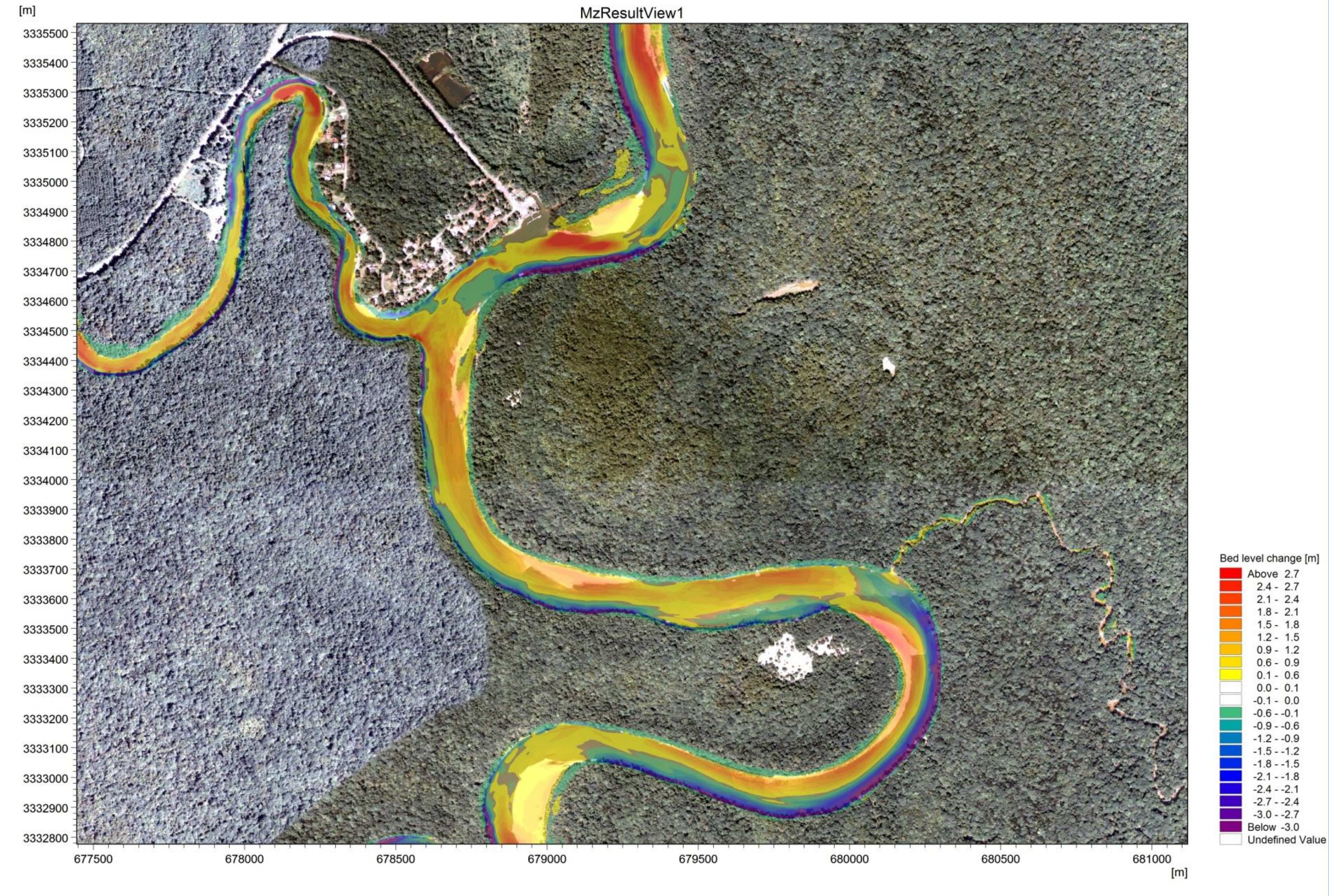


Existing Condition Bed Level Change – 5,400 cfs

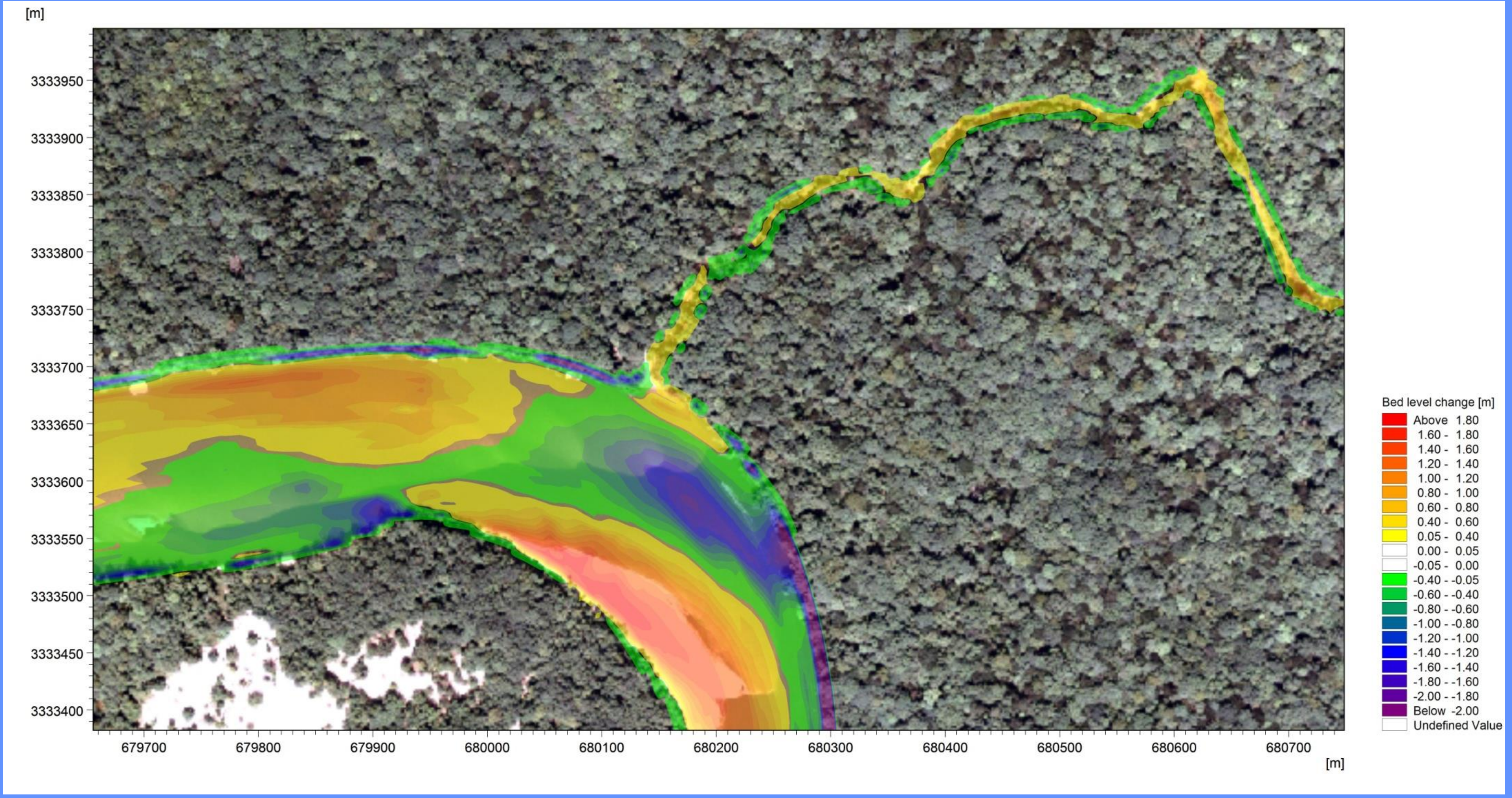
Existing Condition Bed Level Change – 16,000 cfs



Existing Condition Bed Level Change – 33,000 cfs



Existing Condition Bed Level Change – 16,000 cfs



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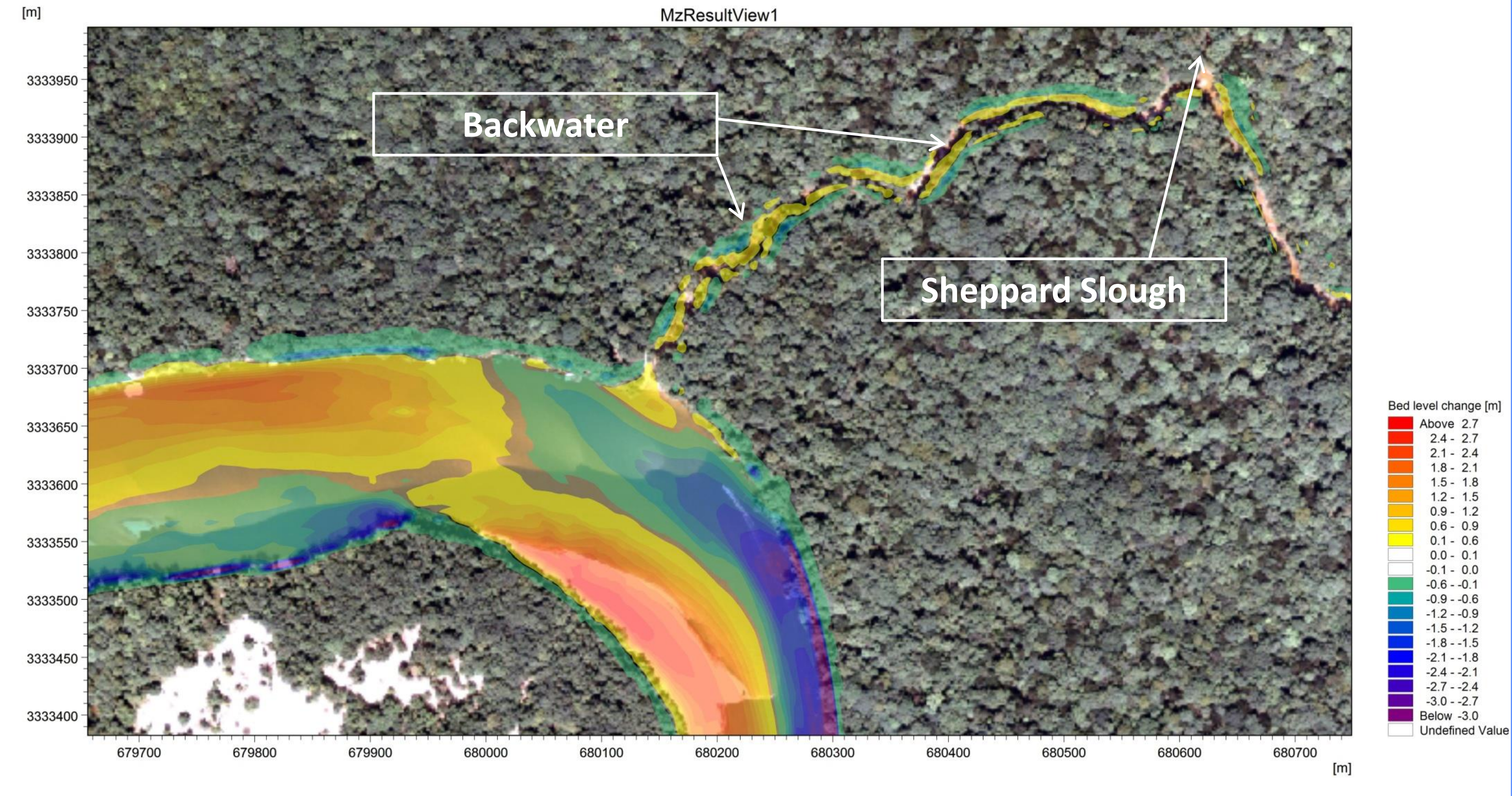
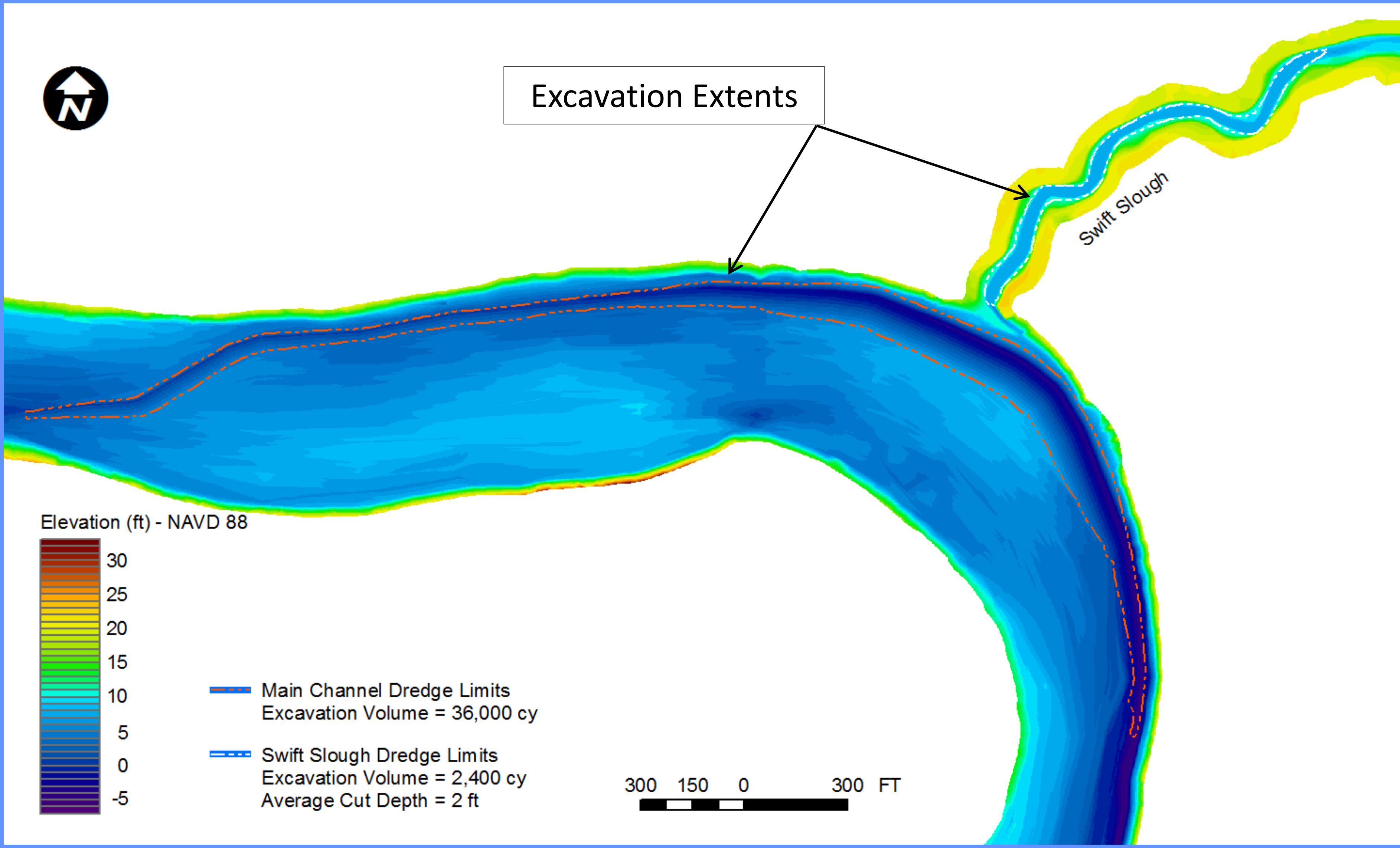
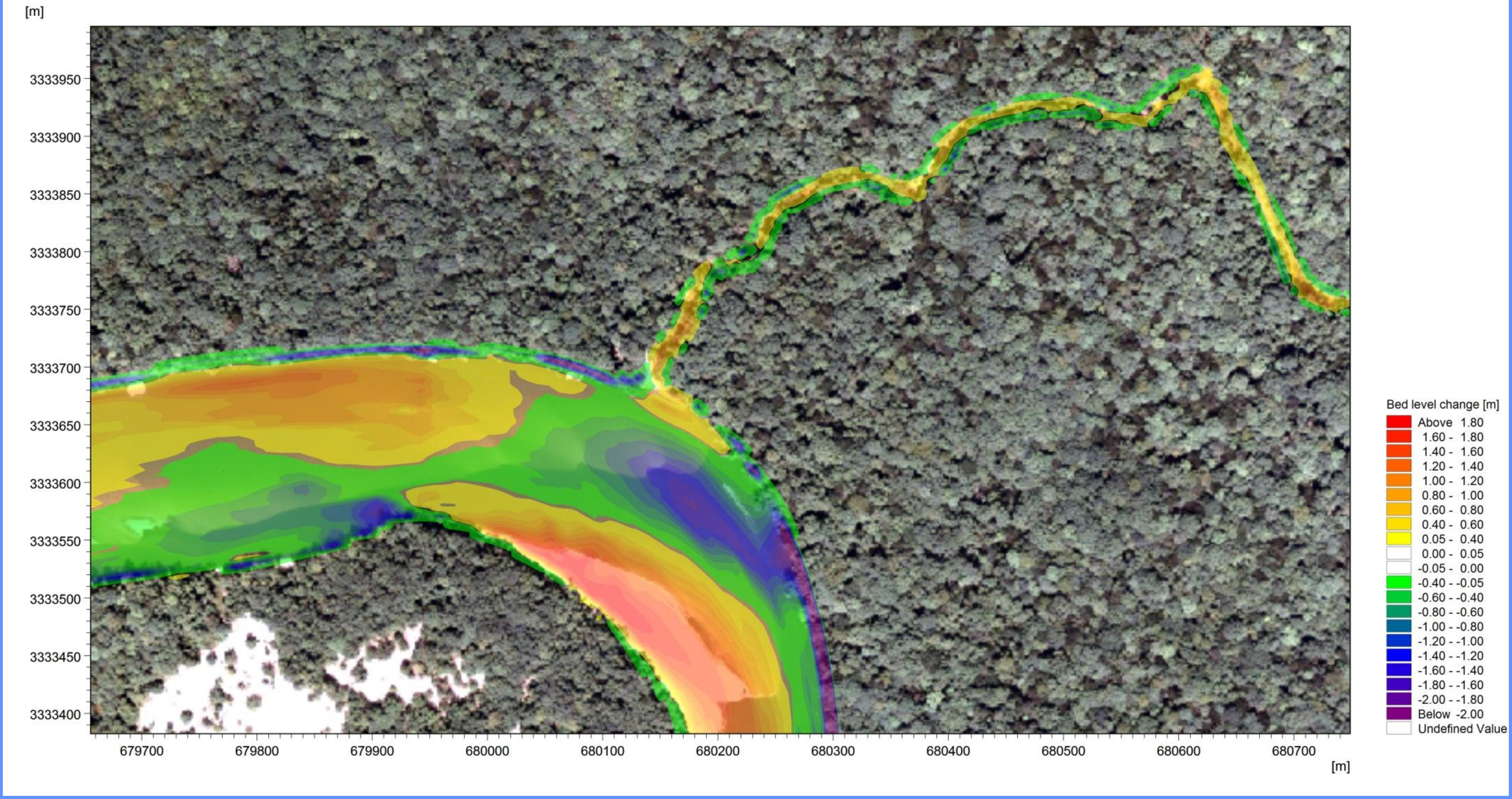


Design Alternative 1 & 2



Alternative 1 Bed Level Change – 16,000 cfs



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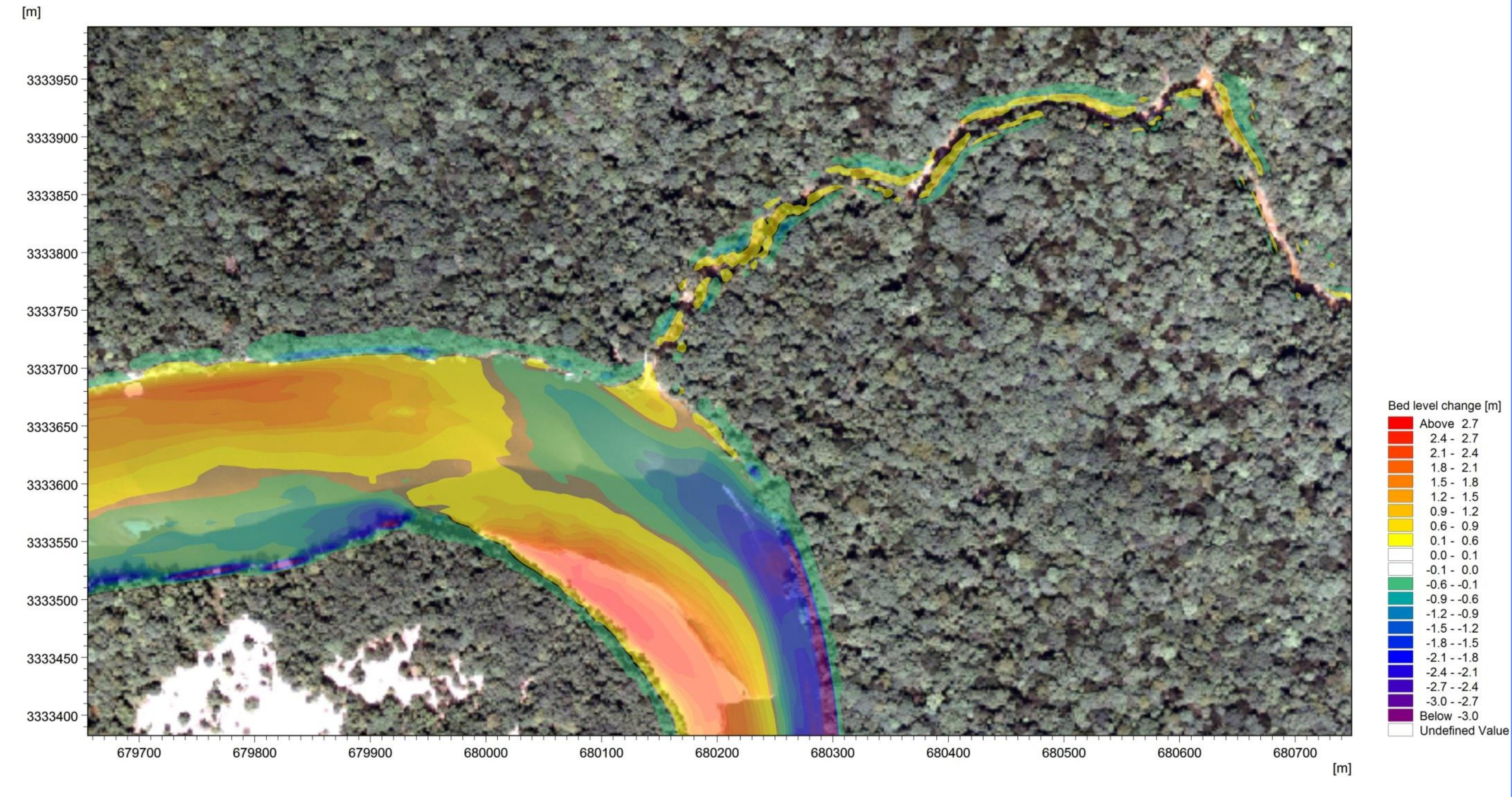
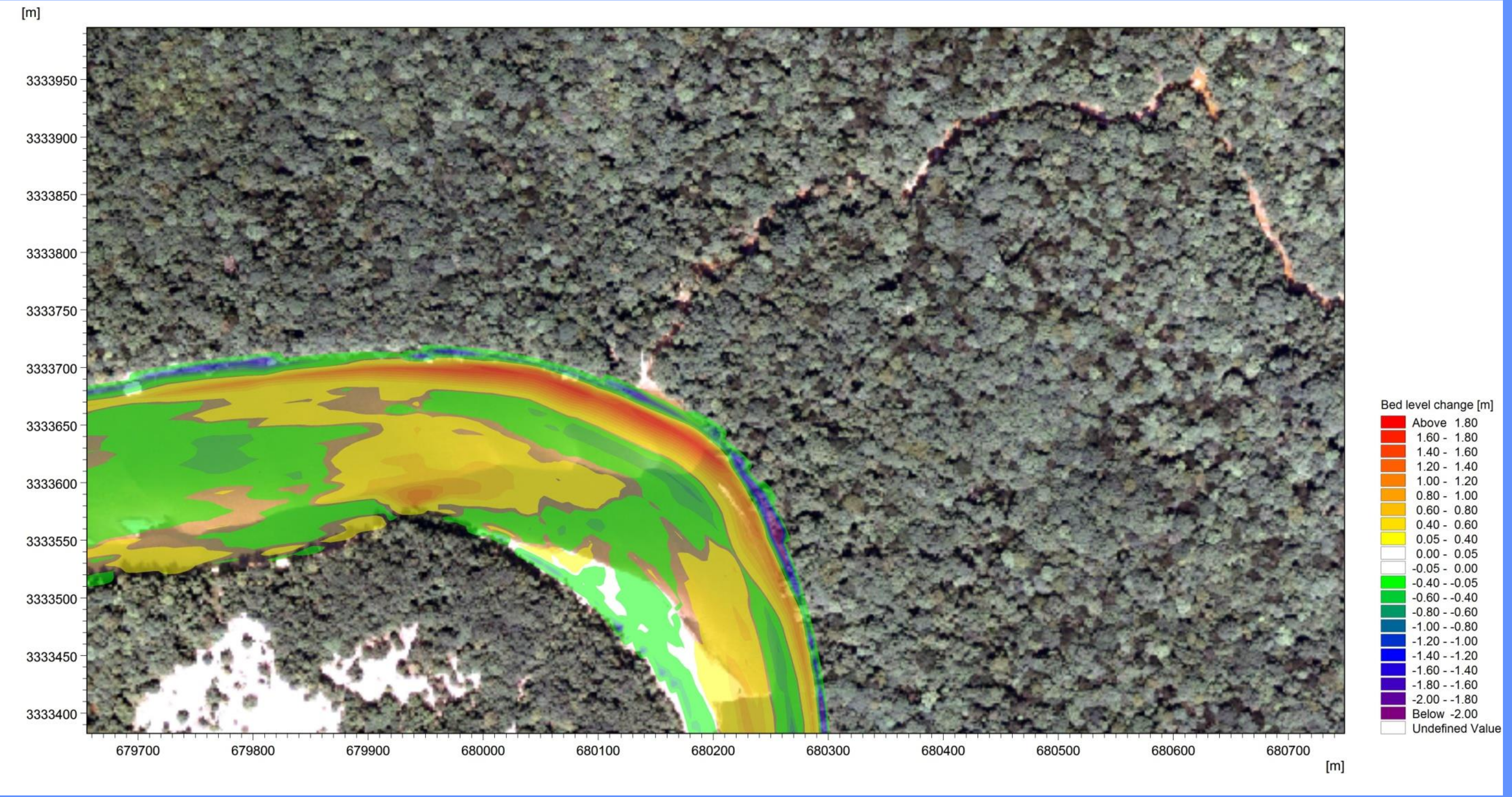
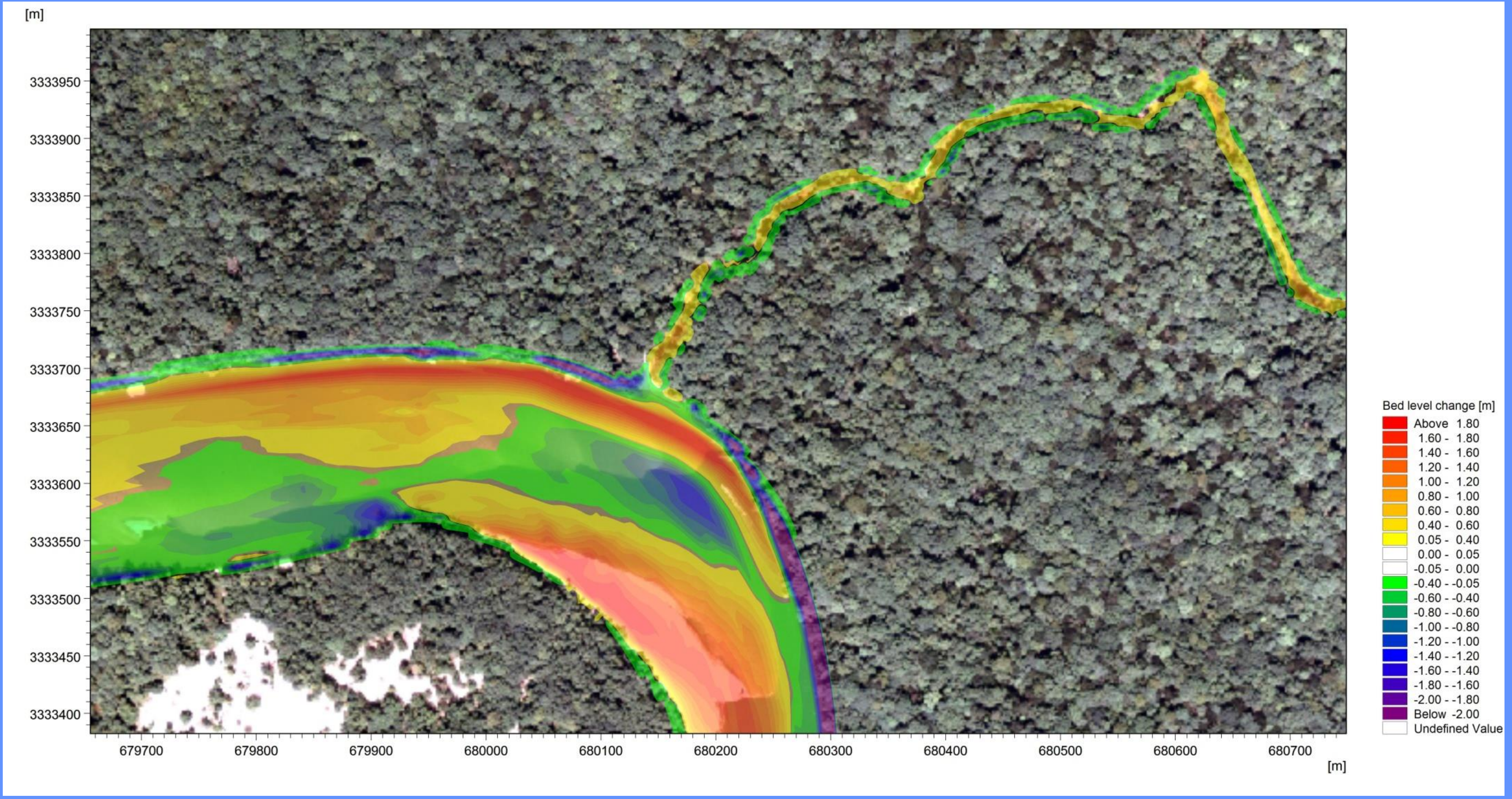


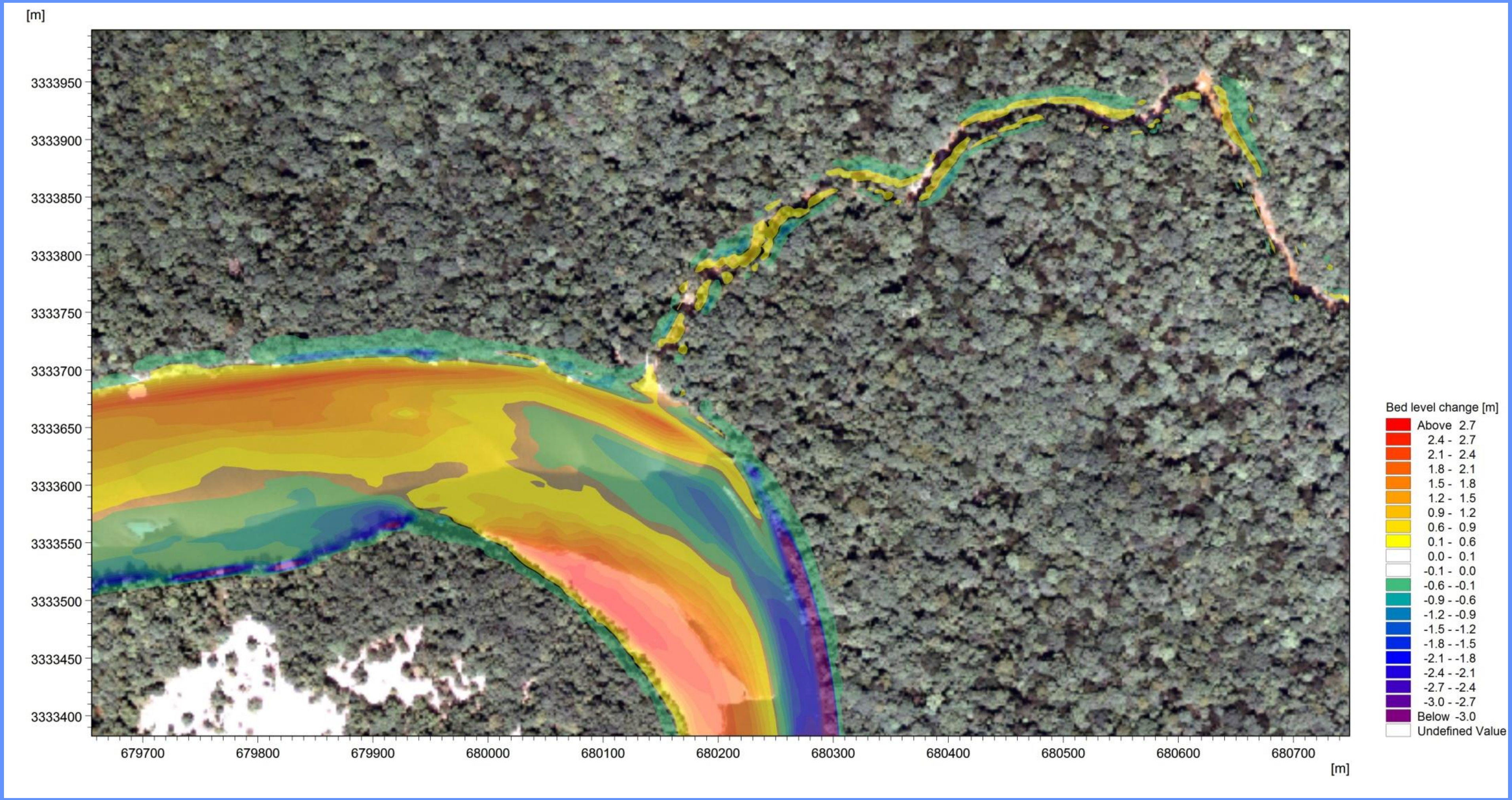
Alternative 2 Bed Level Change – 5,400 cfs



Alternative 2 Bed Level Change – 16,000 cfs



Alternative 2 Bed Level Change – 33,000 cfs



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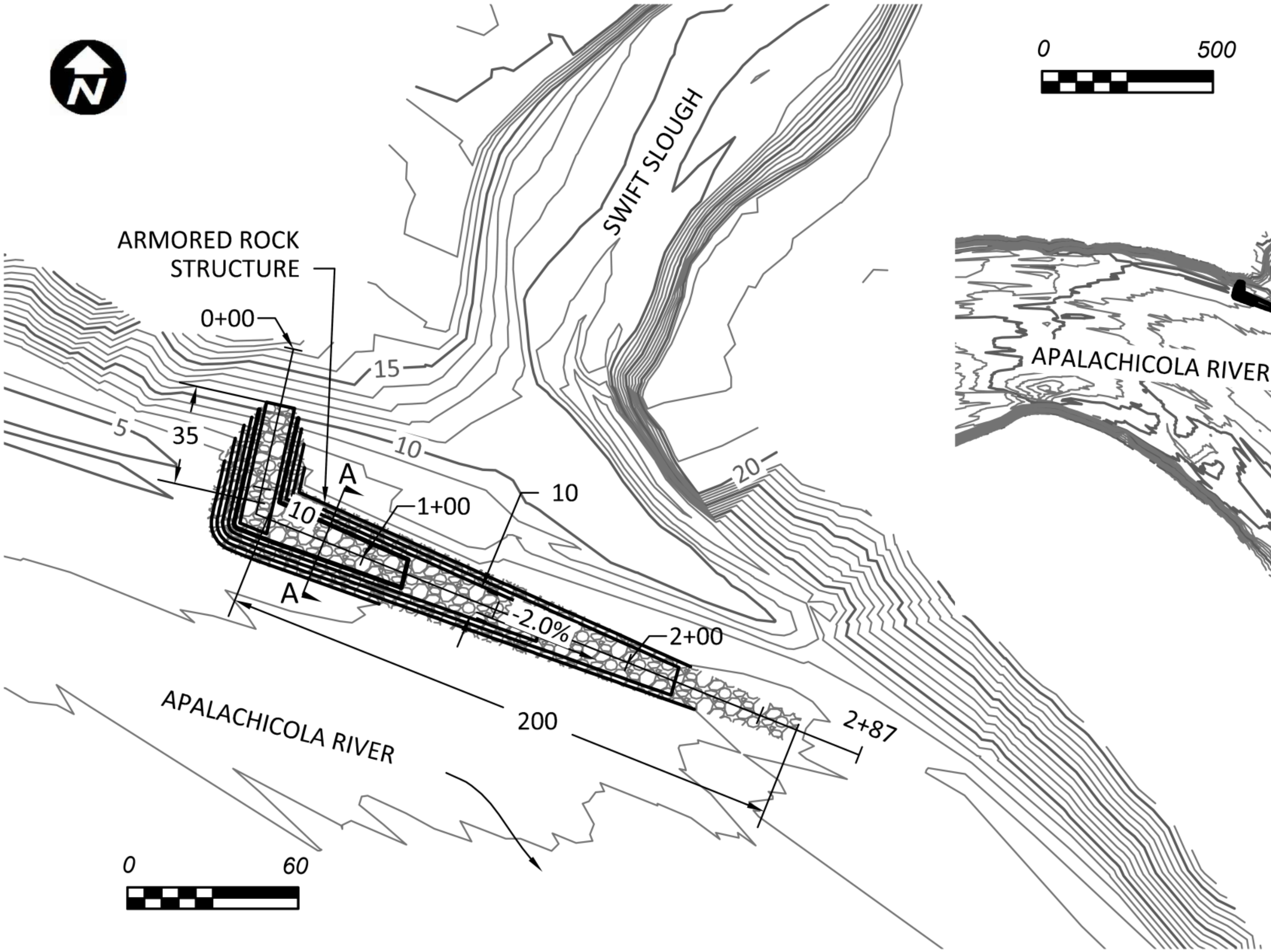
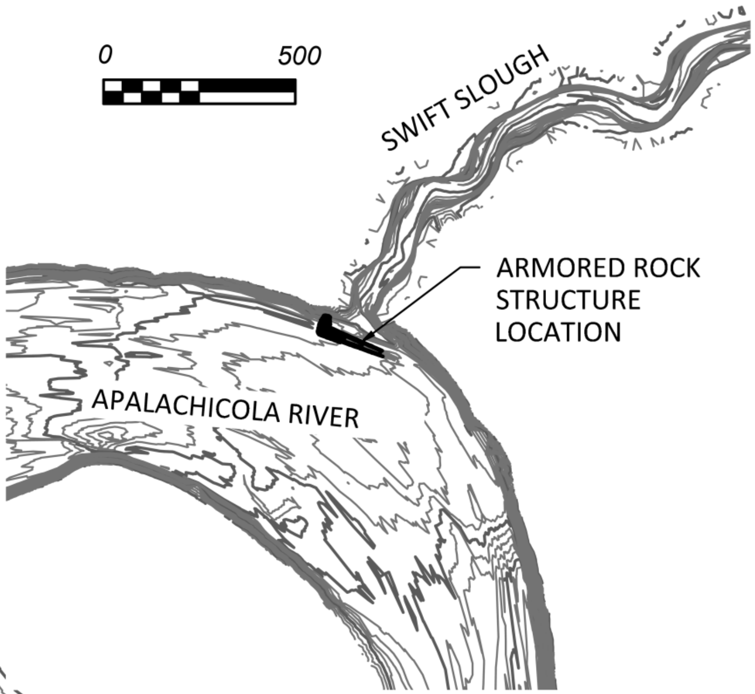
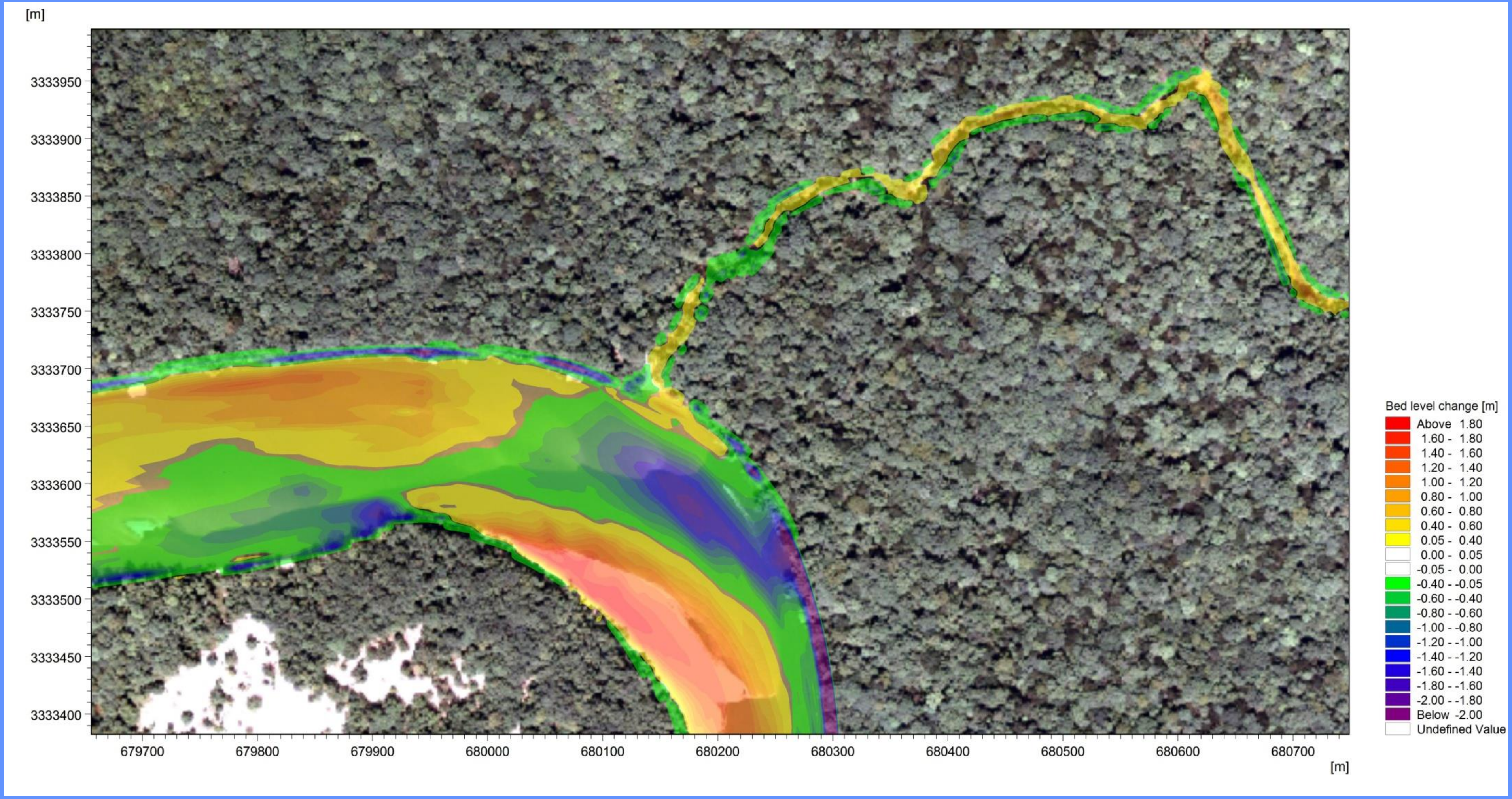
Design Alternative 3





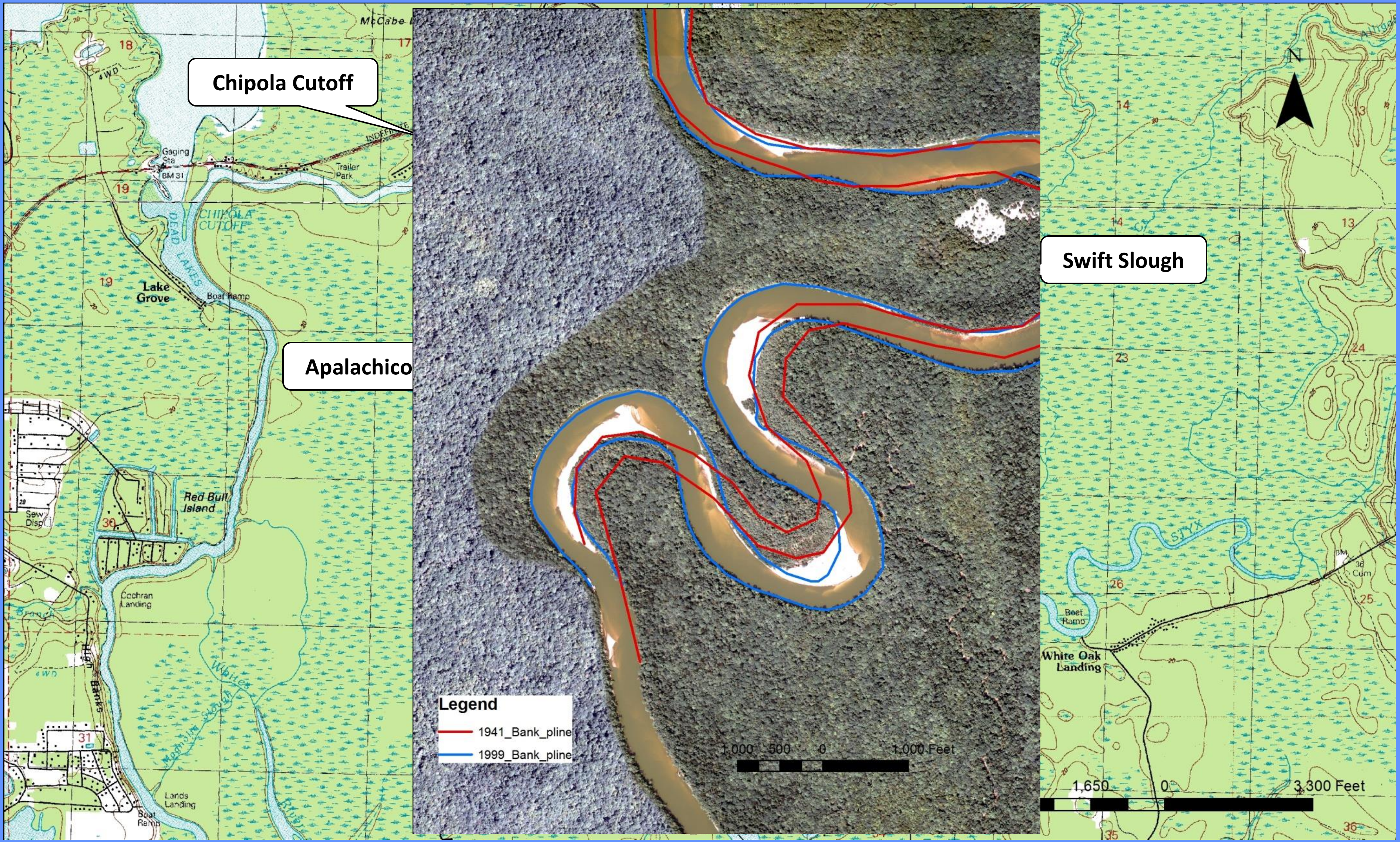
Alternative 3 Bed Level Change – 16,000 cfs



Summary of Predicted Aggradational Trends

Alternative	Maximum Dredge Depth (m)	Predicted Depth of Aggradation (m)		
		5,413 cfs	15,693 cfs	32,691 cfs
1 – Swift Dredge	0.6	0	1.0	0.6
2 – Ap. & Sw. Dredge	3 (mainstem) 0.6 (Swift)	2.0 (mainstem) 0 (Swift)	2.5 (mainstem) 0.8 (Swift)	2.7 (mainstem) 0.4 (Swift)
3 – L-Structure	na	0	0.25	0.20

Geomorphic Considerations



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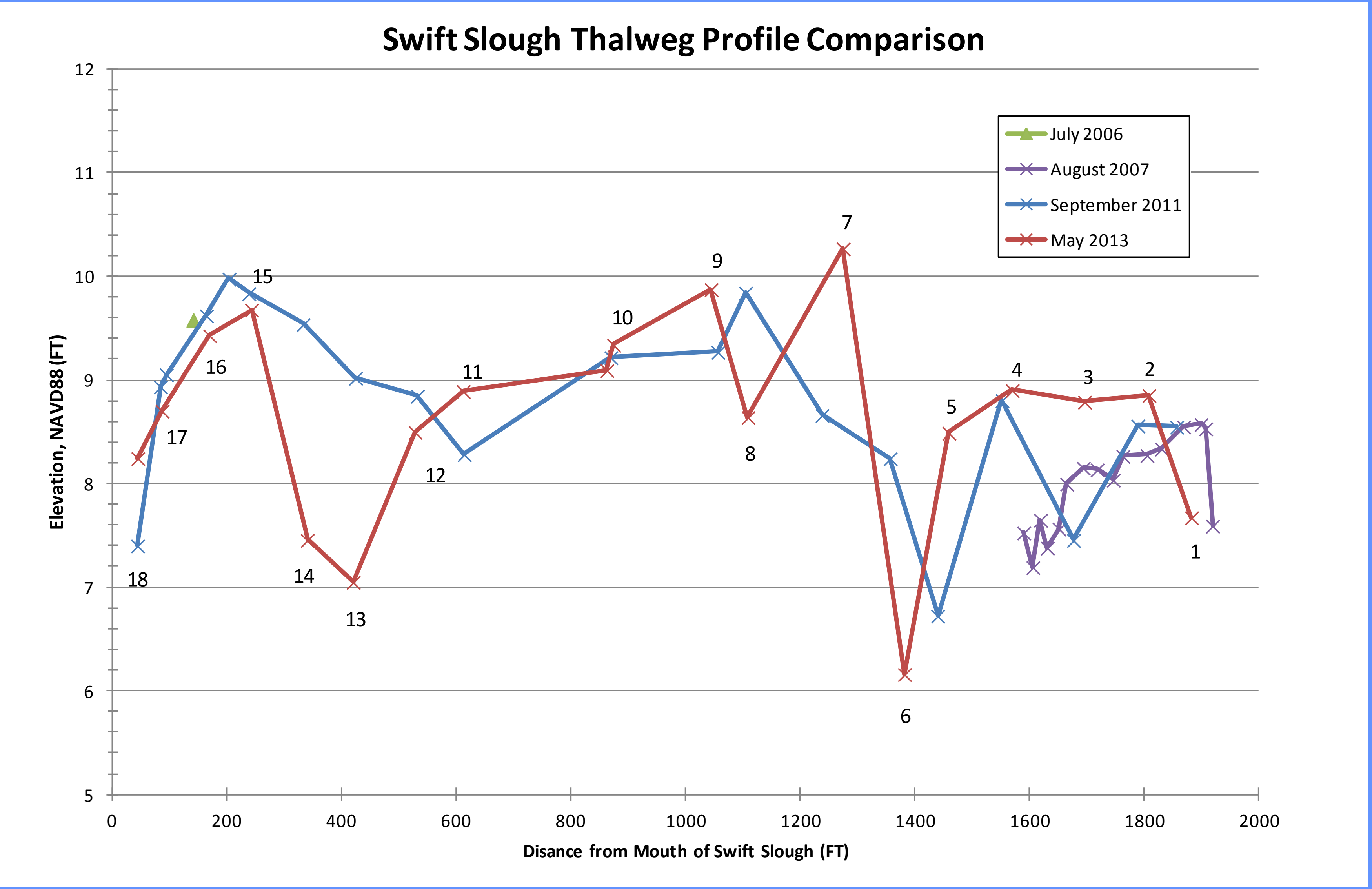

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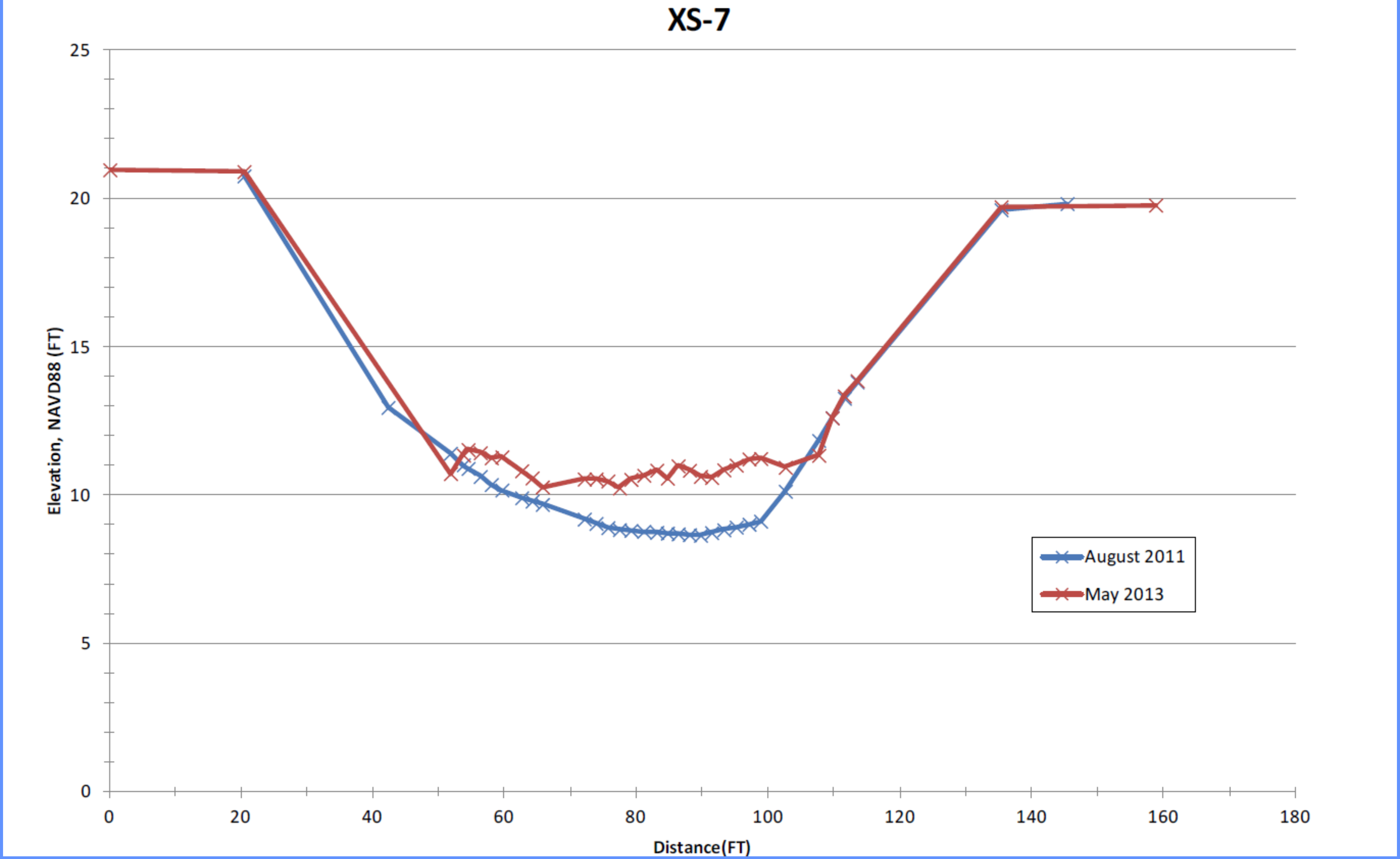

Conclusions

- Sediment Regime
  - Mainstem of the Apalachicola downstream of the Chipola Cutoff is receiving a proportionally more sediment than water which is driving long-term a aggradational trend in the downstream reach
- Flow Split Ratio
  - Apparent increase in capture by Chipola Cutoff during low flow periods
- Alternatives 1 & 2 (dredge Swift & mainstem)
  - Dredge cuts will fill within 1-2 years, especially in the 10,000 to 20,000 cfs flow range
- Alternative 3 (rock structure)
  - Model results do not indicate a benefit from the structure, but more analysis is warranted – physical / 3D modeling or implement and monitor performance
- Bathymetric surveys
  - comparison on the mainstem shows a 5-7 ft increase in the bed elevation following 5 month high flow period, which is consistent with model results
  - comparison of Swift Slough reveals a dynamic bed morphology, but is interpreted to generally be in an equilibrium condition

Recommendations

- *<u>NO</u>* on Alternatives 1 & 2
  - Relative short term benefits and potential impact to existing mussel populations
  - Alternative 3 deserves some consideration, but needs additional study or implement with monitoring and adaptive management
- It’s all about scale
  - Restoration strategies need to be conceived at the same spatial and temporal scale as processes responsible for resource degradation
- Species centric focus
  - How do we manage for T&E species, but provide consideration the entire ecosystem
- We’ve developed a powerful tool
  - Let’s see how else we can use it

Acknowledgements

- Charles Mesing, FFWCC
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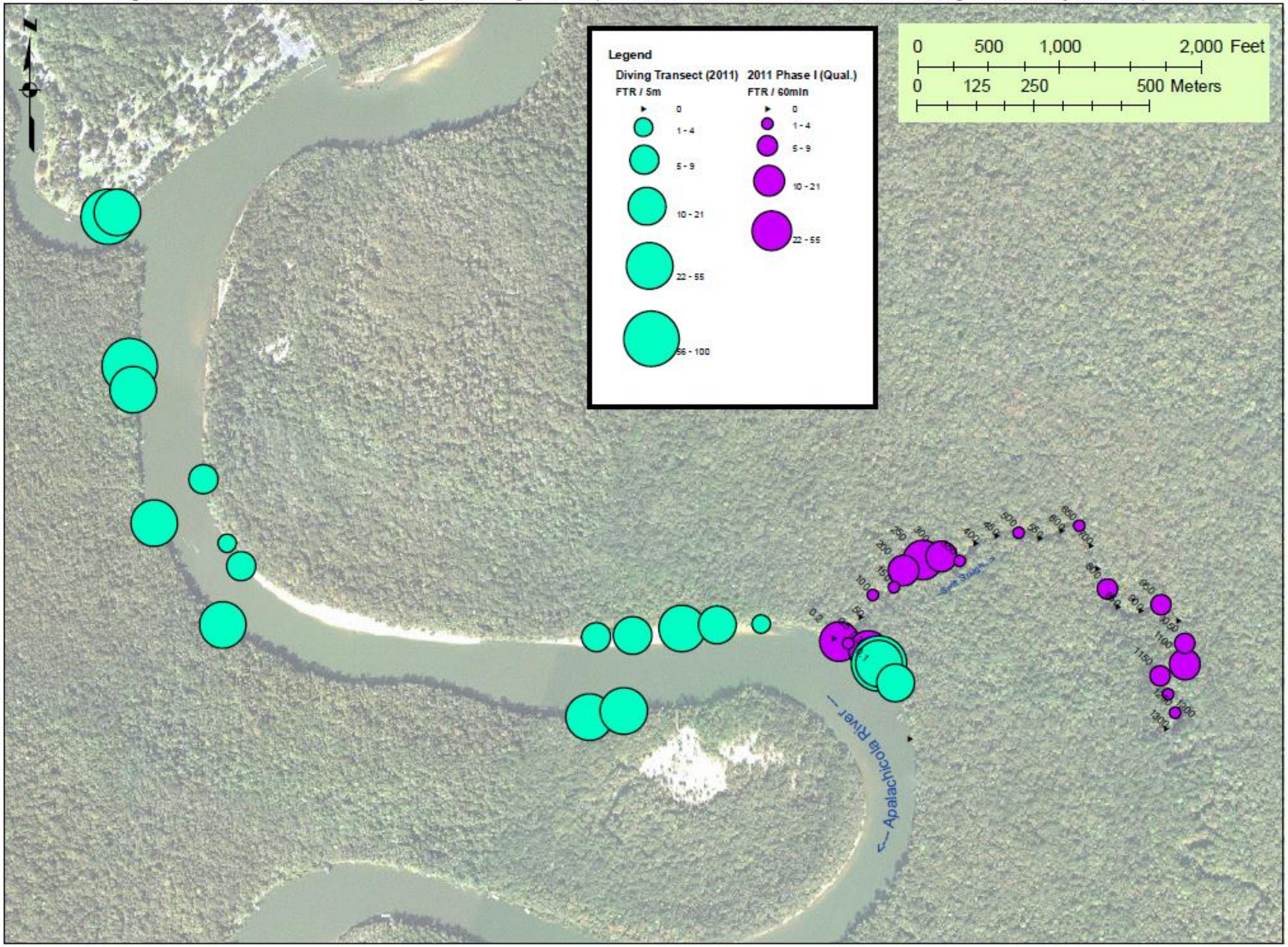
- Jesse (Rusty) Barker, M.S., cbec
- Ben Taber, B.S., cbec

Extra Slides

Extra Slides

Figure 4. CPUE and Distribution of Fat Threeridge in Swift Slough and the Apalachicola River from Phase I Timed Searches and Diving Transect Surveysin October, 2011.



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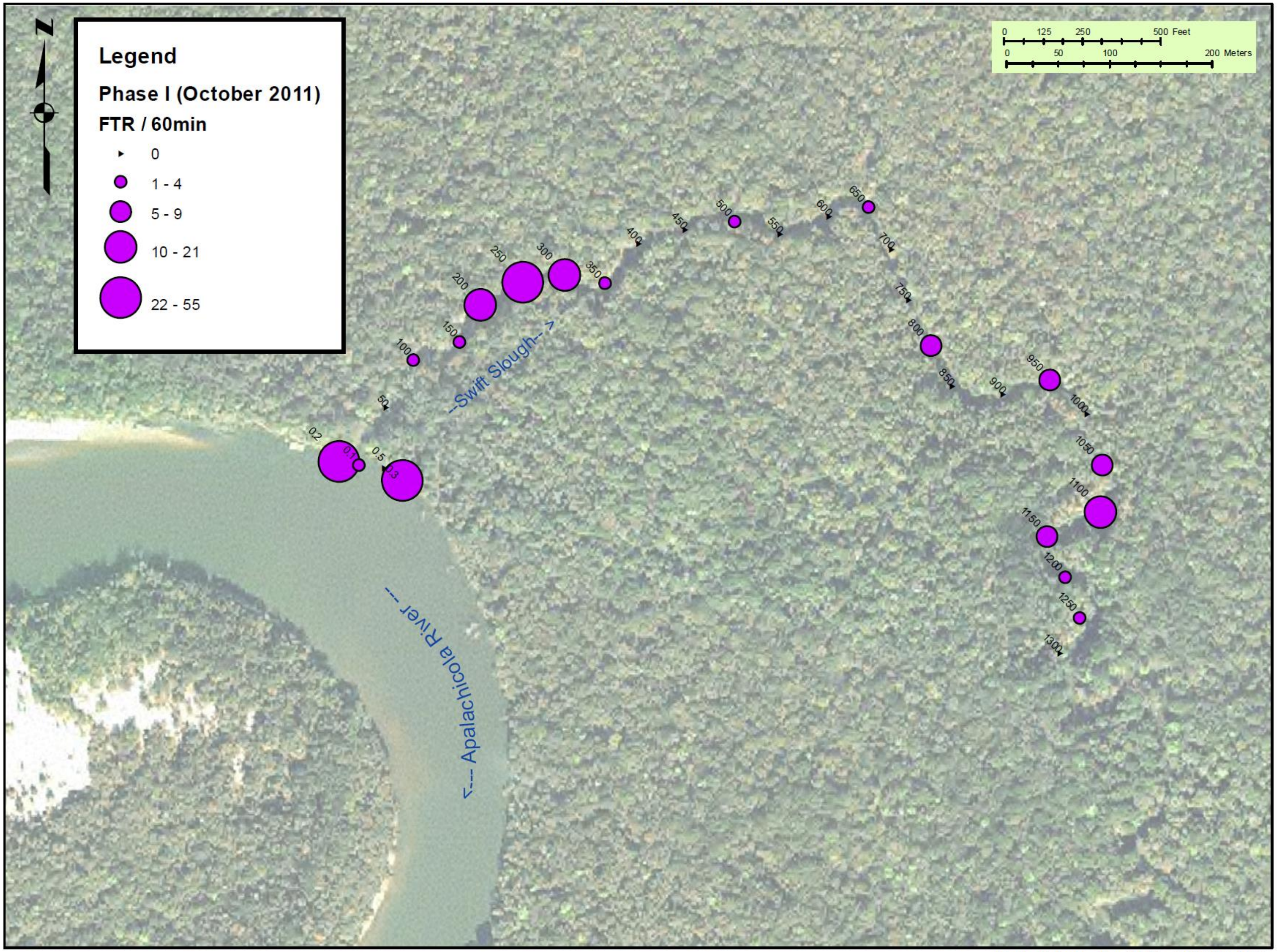
Swift Slough Restoration Feasibility

Extra Slides

Figure 2a. CPUE of live Fat Threeridge in Swift Slough from Phase I, October 2011.



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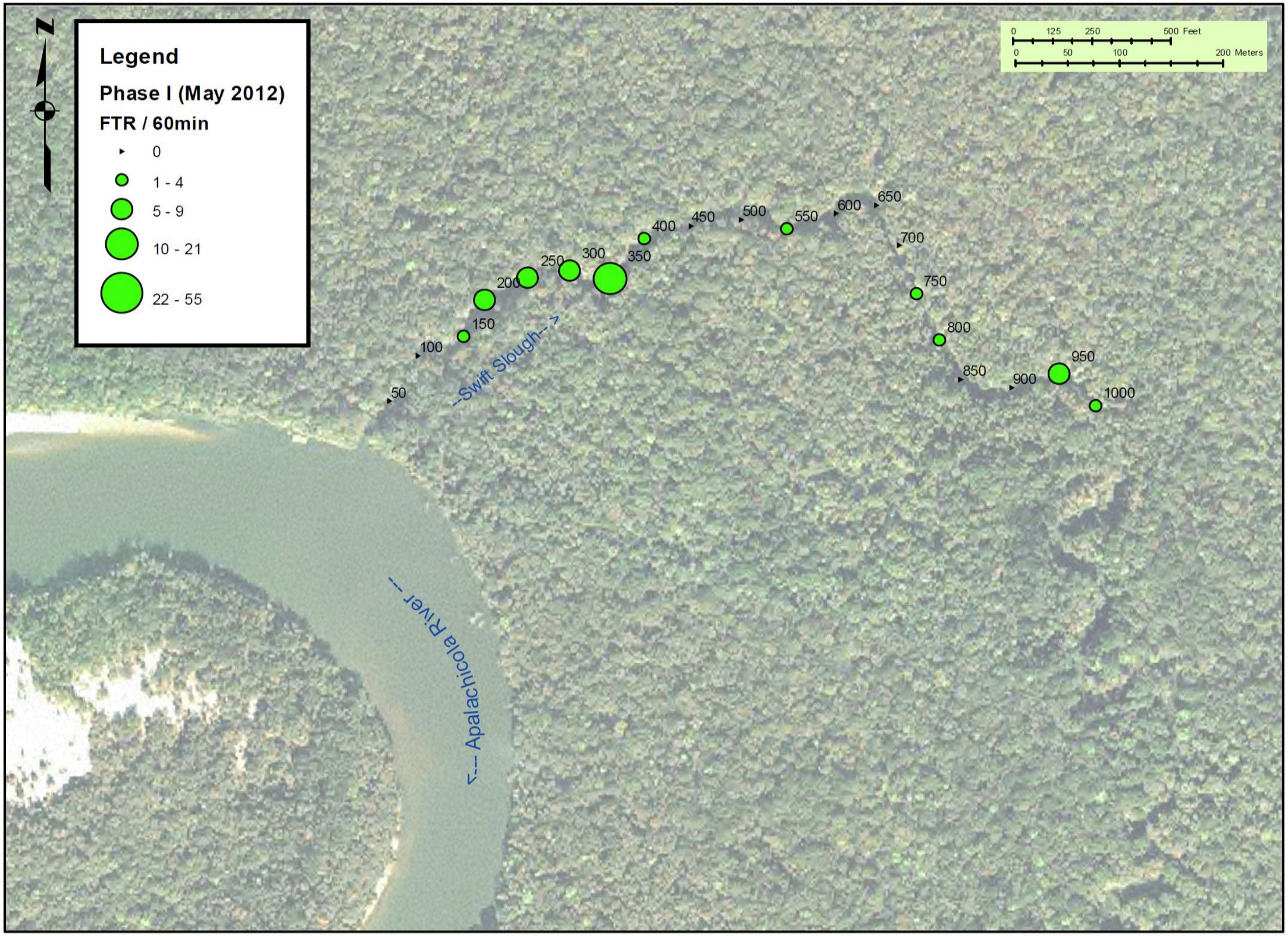
Extra Slides

Figure 2b. CPUE of live Fat Threeridge in Swift Slough from Phase I, October 2012.



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