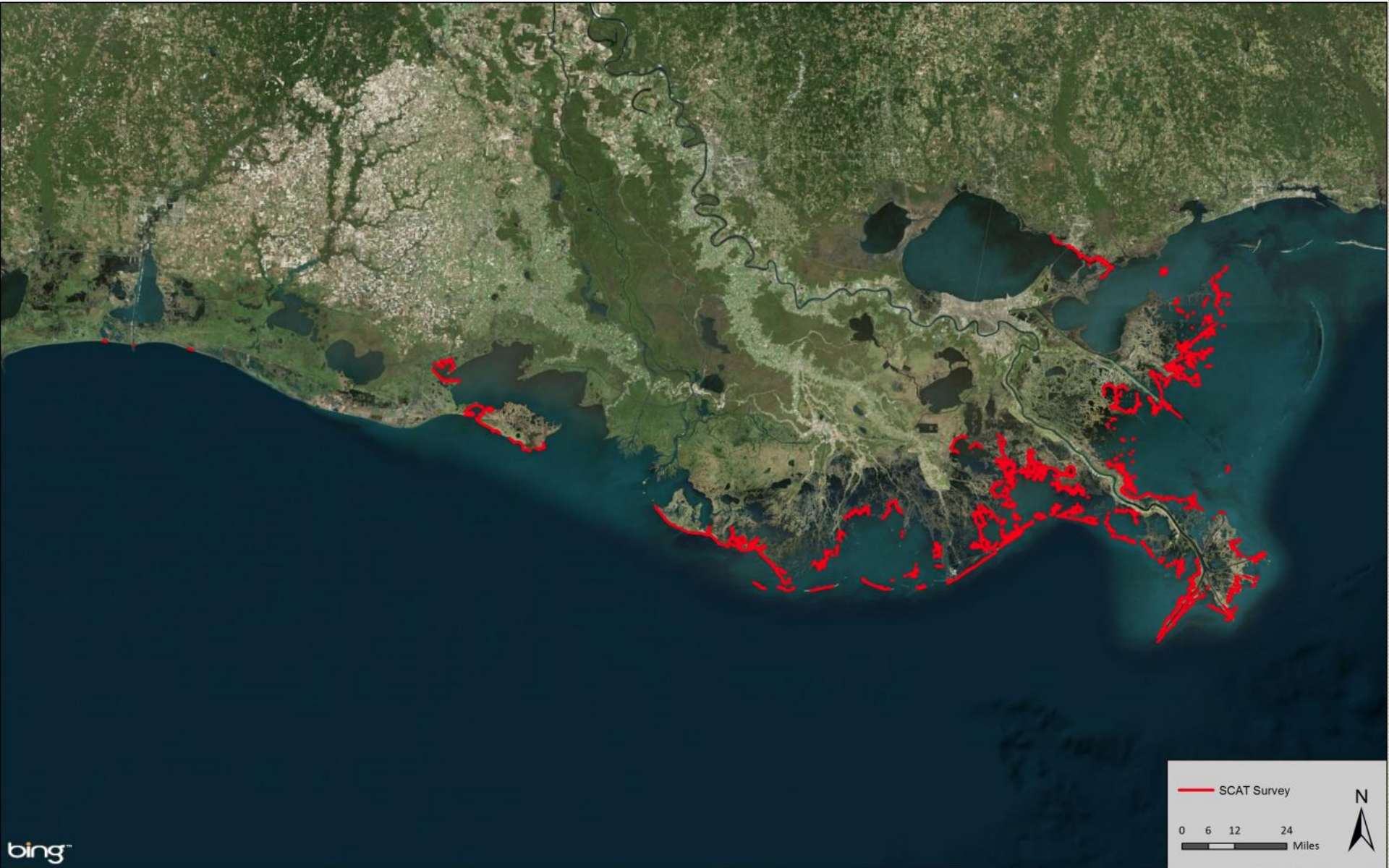


ASSESSMENT OF THE EFFECTS OF AN OIL SPILL ON COASTAL ARCHAEOLOGICAL SITES IN LOUISIANA

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A Cooperative Agreement between the
Bureau of Ocean Energy Management, Environmental Studies Program and
University of Louisiana at Lafayette
Gulf Coast Cooperative Ecosystem Studies Unit
Award Number M14AC00022



Areas surveyed by SCAT teams and HDR, Inc. during the MC252 oil spill response (from Cloy and Ostahowski 2015:Figure 5-2).

Goals and Objectives

1. Assess the effects of the MC252 oil spill at prehistoric sites on the Louisiana Gulf Coast:
 - a) Direct impacts, including cultural features and analytical techniques.
 - b) Long-term impacts on formation processes, data collection, conservation, and curation.
 - c) Potential impacts on future studies and costs.
2. Provide the SHPO and BOEM with information relevant to CRM planning and compliance.

List of Sites for Assessment

Site No.	Name
16JE2	Cheniere St. Denis
16JE3	Bayou Cutler #1
16LF293	Redfish Slough
16PL8	Adams Bay
16SB153*	Unnamed site on Lake Borgne
16SB174	Comfort Island
16SB178	Southern Comfort
16SB180	Bayou Pierre 1
16SB182	Scow Island Scatter
16SB185	Acorn Mounds
16SB186	Live Oak Bayou Mounds
16SMY17*	Bayou Sale

*Control site not previously characterized as having oil present from the 2010 MC 252 spill. Assessment conducted at sites highlighted and in bold.



16SMY17

16JE2

16SB153

16SB185
16SB182
16SB174
16SB178

16LF293



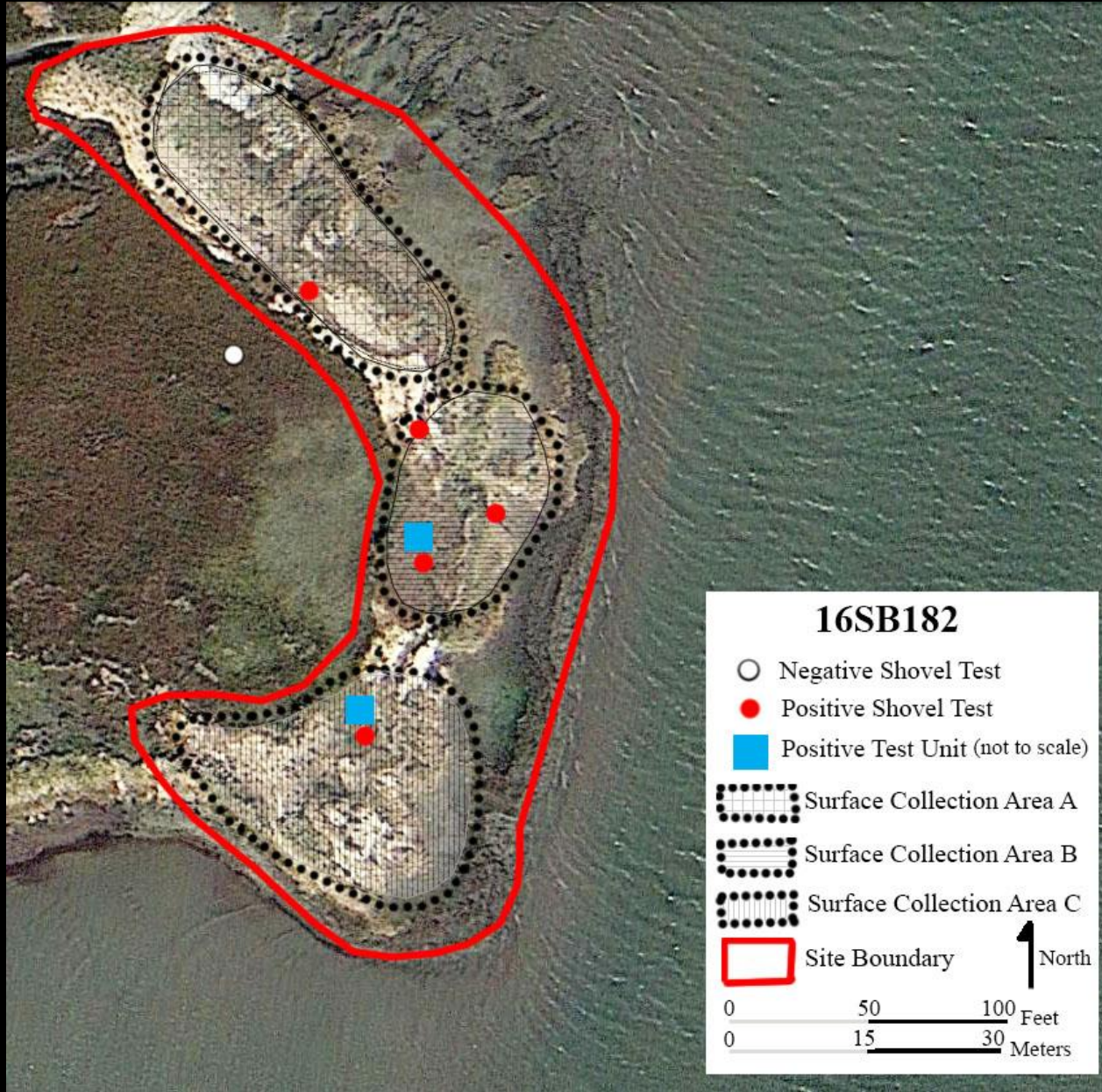
Sites Assessed for the Effects of Oil



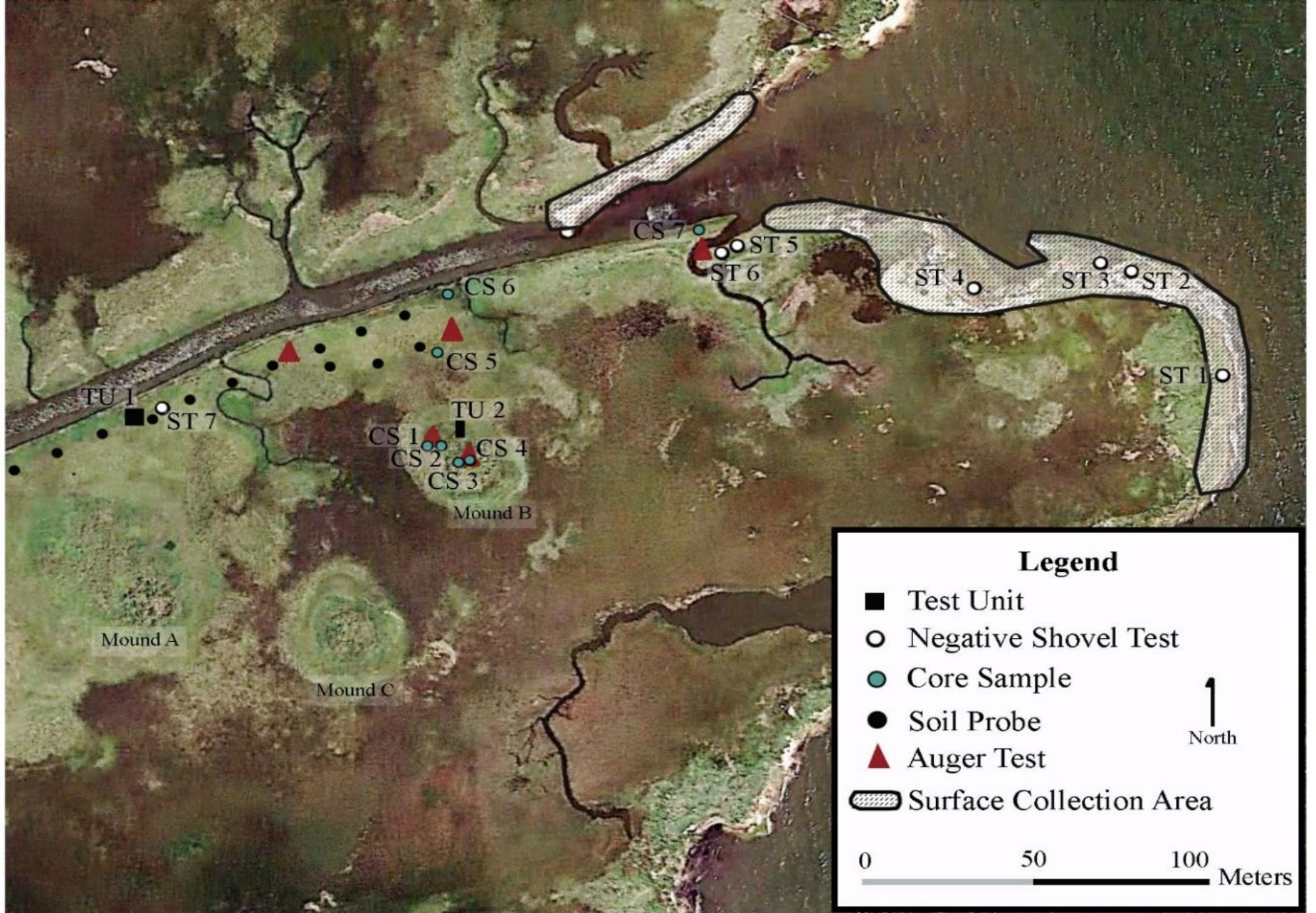
Comfort Island (16SB174)



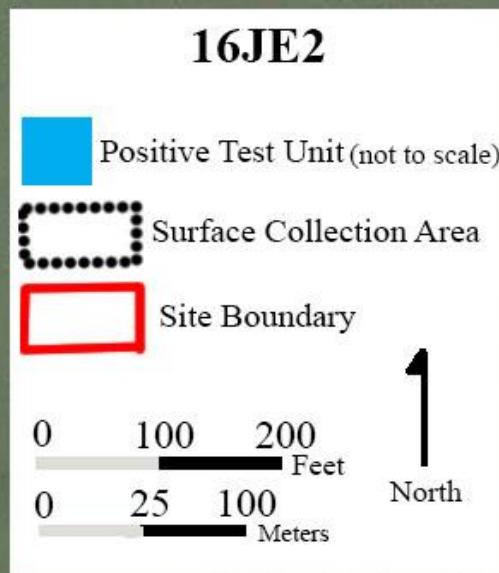
Southern Comfort (16SB178)



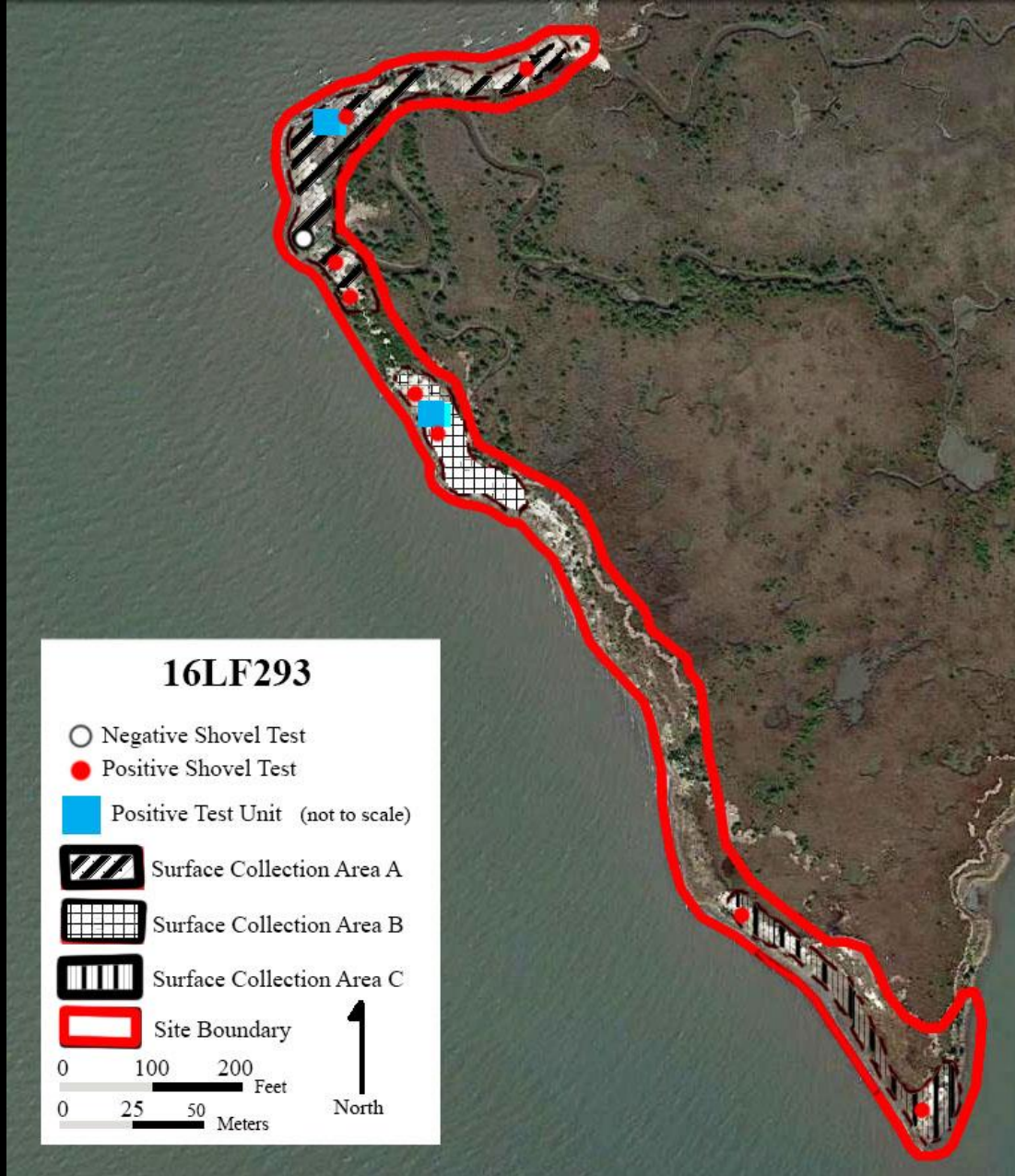
Scow Island Scatter (16SB182)



Acorn Mounds (16SB185)



Cheniere St. Denis (16JE2)



Redfish Slough (16LF293)



16SMY17

16JE2

16SB153



16LF293

16SB185
16SB182
16SB174
16SB178



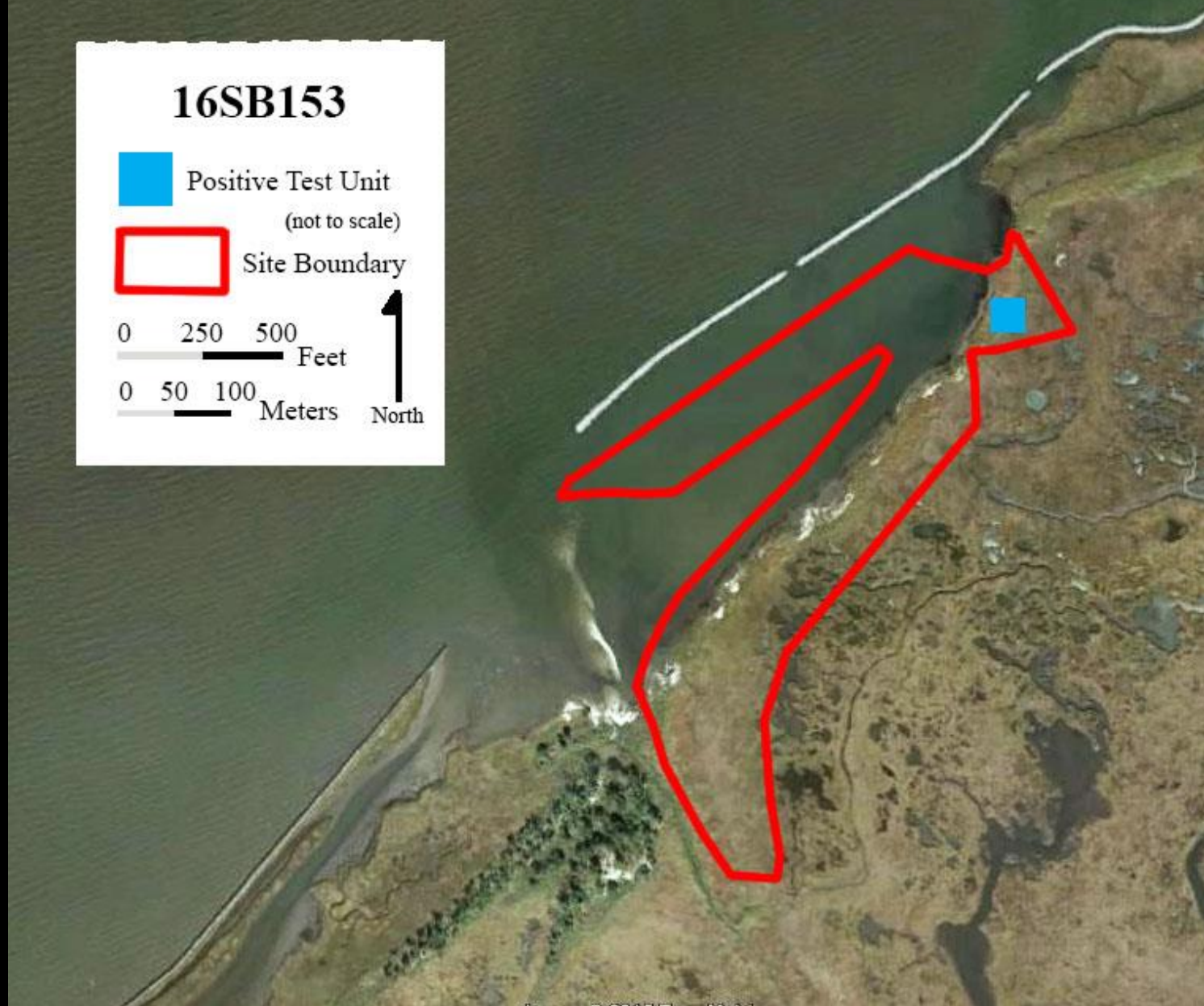
Sites Assessed for the Effects of Oil

16SB153

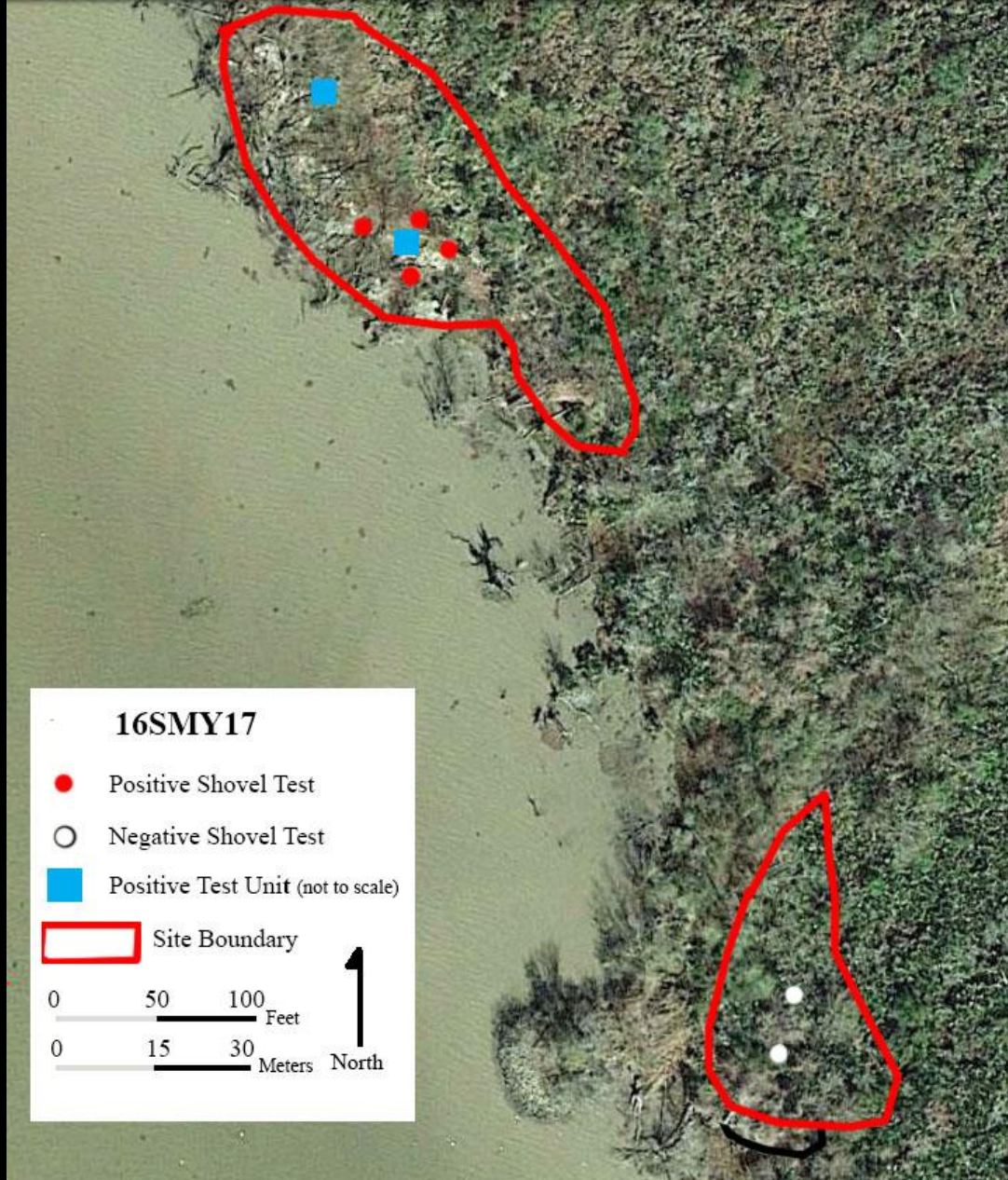
-  Positive Test Unit
(not to scale)
-  Site Boundary

0 250 500 Feet

0 50 100 Meters



Unnamed Site (16SB153) on Lake Borgne



Bayou Sale (16SMY17)

Methodology



Excavation of a
1-by-1meter Test Unit
at Scow Island Scatter



50cm-by-50cm Test Unit



1m-by-50cm Test Unit

Special Sampling Methods



Core extraction.



Detecting Oil and Its Source



Example of sediment sample prepared for DES, LSU



Sample storage

Detecting Oil and Its Source

- Oil detected in samples from subsurface and surface at six sites.
- Twelve of 28 samples (42.9%) tested positive.
- Five of 12 (41.7%) that tested positive were a match or possible match with MC252.
- Oil from an indeterminate source detected in three samples from intact or minimally disturbed contexts at the Acorn Mounds site and Cheniere St. Denis.

Trace Element Analysis

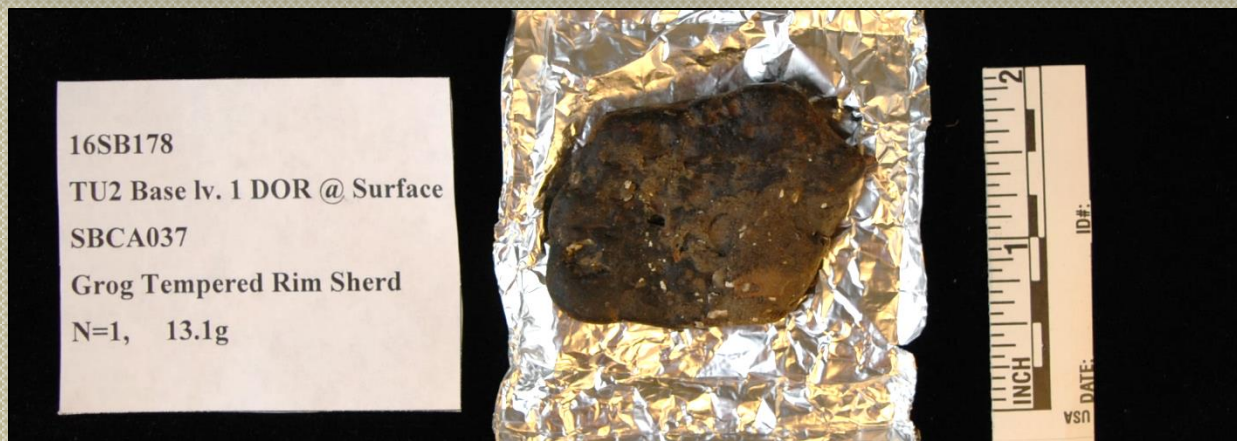
- Neutron Activation Analysis (NAA)
- Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS)



Trace Element Analysis

- Elevated levels of Arsenic in one sherd from Southern Comfort (16SB178), possibly caused by crude oil.
- No increased concentrations of other elements present in crude oil.
- Oil not present in sufficient quantities to infiltrate pottery sherds, or
- Hydrocarbon contamination may not hinder elemental analyses.

Absorbed Residue Analysis



Absorbed Residue Analysis

- Nine of 17 pot sherds (53%) from 5 of 7 sites had some level of contamination by oil, dispersant, or both.
- Lower levels of contamination can be mitigated and do not prevent analysis.
- Higher levels of hydrocarbon contamination impede analysis of absorbed lipids.
- Interpretation most problematic in residues contaminated by both oil and dispersant.

Radiocarbon AMS Dating

Beta	Site	Provenience/Context	Pretreatment	Material	CONVENTIONAL AGE	2 SIGMA CALIBRATION	Intercept*
421684	Cheniere St. Denis (16JE2)	TU3 L2, 25-35 cm	solvent extraction	Bone Collagen	870 +/- 30 BP	Cal AD 1050 to 1085 (Cal BP 900 to 865) and Cal AD 1125 to 1140 (Cal BP 825 to 810) and Cal AD 1150 to 1225 (Cal BP 800 to 725)	Cal AD 1165
421683			standard	Bone Collagen	780 +/- 30 BP	Cal AD 1215 to 1280 (Cal BP 735 to 670)	Cal AD 1260
421682	Comfort Island (16SB174)	TU2 L2, 15-20 cm	solvent extraction	Charred Material	1230 +/- 30 BP	Cal AD 685 to 885 (Cal BP 1265 to 1065)	Cal AD 770
421681			standard	Charred Material	1170 +/- 30 BP	Cal AD 770 to 905 (Cal BP 1180 to 1045) and Cal AD 920 to 965 (Cal BP 1030 to 985)	Cal AD 885
421678	Scow Island Scatter (16SB182)	TU2 L2, 19 cm, east half	solvent extraction	Charred Material	1020 +/- 30 BP	Cal AD 980 to 1035 (Cal BP 970 to 915)	Cal AD 1020
421677			standard	Charred Material	970 +/- 30 BP	Cal AD 1015 to 1155 (Cal BP 935 to 795)	Cal AD 1030
421674	Acorn Mounds (16SB185)	Mound B, Core 4, 210-216 cm	solvent extraction	Charred Material	1120 +/- 30 BP	Cal AD 780 to 785 (Cal BP 1170 to 1165) and Cal AD 880 to 990 (Cal BP 1070 to 960)	Cal AD 900 Cal AD 925 Cal AD 945
421673			standard	Charred Material	1030 +/- 30 BP	Cal AD 975 to 1030 (Cal BP 975 to 920)	Cal AD 1015
421664	on Lake Borgne (16SB153)	TU1, 134-139 cm, west wall core sample	solvent extraction	Bone Collagen	590 +/- 30 BP	Cal AD 1295 to 1370 (Cal BP 655 to 580) and Cal AD 1380 to 1415 (Cal BP 570 to 535)	Cal AD 1325 Cal AD 1345 Cal AD 1395
421663			standard	Bone Collagen	500 +/- 30 BP	Cal AD 1405 to 1445 (Cal BP 545 to 505)	Cal AD 1425
421662	on Lake Borgne (16SB153)	TU1, 134-139 cm, west wall core sample	solvent extraction	Bone Collagen	450 +/- 30 BP	Cal AD 1420 to 1465 (Cal BP 530 to 485)	Cal AD 1440
421661			standard	Bone Collagen	500 +/- 30 BP	Cal AD 1405 to 1445 (Cal BP 545 to 505)	Cal AD 1425

Radiocarbon Dating



Samples contaminated with oil
from MC252.

Uncontaminated Samples

Results of Experimental Pretreatment and Radiocarbon/AMS for Subsamples from Bayou Sale (16SMY17)

BETA	ANID	Provenience/Context	Pretreatment	Material	CONVENTIONAL AGE	2 SIGMA CALIBRATION	Intercept*
421668	SYAA021 & SYAC021	TU2 L4, 30-35 cm	solvent extraction	Bone Collagen	1340 +/- 30 BP	Cal AD 650 to 690 (Cal BP 1300 to 1260) and Cal AD 750 to 760 (Cal BP 1200 to 1190)	Cal AD 665
421667	SYAA021 & SYAC021		standard	Bone Collagen	2130 +/- 30 BP	Cal BC 345 to 320 (Cal BP 2295 to 2270) and Cal BC 205 to 85 (Cal BP 2155 to 2035) and Cal BC 75 to 55 (Cal BP 2025 to 2005)	Cal BC 170
421666	SYA021 & SYAB021	TU2 L4, 30-35 cm	solvent extraction	Bone Collagen	1290 +/- 30 BP	Cal AD 660 to 770 (Cal BP 1290 to 1180)	Cal AD 685
421665	SYA021 & SYAB021		standard	Bone Collagen	1380 +/- 30 BP	Cal AD 620 to 670 (Cal BP 1330 to 1280)	Cal AD 655

* Intercept of radiocarbon age with calibration curve. Samples shown in gray intentionally contaminated with oil.

Conclusions

- Oil in samples at 6 sites, with a match or possible match for MC252 in 5 of 12 (42%) of samples that tested positive.
- Absorbed residue analysis adversely affected by high levels of contamination, especially when both oil and dispersant are present.
- Crude oil and dispersant can infiltrate deeply-buried cultural deposits.
- Hydrocarbon contamination must be taken into account in pretreatment for radiocarbon dating.
- Pre-testing for oil and dispersants at coastal sites.



Acorn Mounds Site (16SB185), view to the south.

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