Surficial Sediment Distribution Maps

CPRA
Coastal Protection and Restoration Authority of Louisiana

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BOEM 's
GoM Offshore Sand Management Working Group

APTIM

New Orleans
November 29, 2018

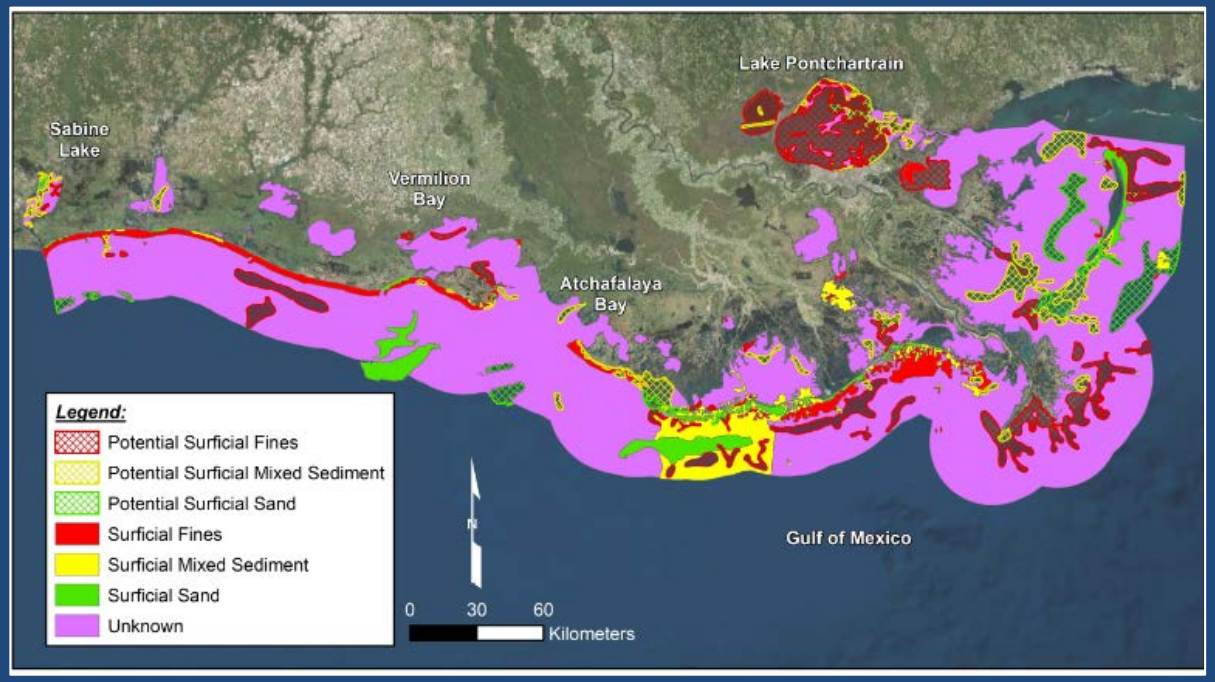
Khalil, S. M., Forrest, B., Haywood, E., and Raynie, R. (2018). ***Surficial Sediment Distribution Maps for Sustainability and Ecosystem Restoration of Coastal Louisiana:*** Shore & Beach, Vol. 86, No. 3 Summer 2018, 21-28 pp.

LASMP

{LA Sed. Mgmt. Plan}

LASARD

{LA Sand Resources Database}



SSD Map - Surficial Sediment Distribution Map

1. Important tools for resource planning
2. Critical role in the regional sediment management (LASMP)
3. Gap analyses - Indicators of presence or absence of geoscientific data
4. Base map for enforcement of regulations - decisions of decommissioned pipelines
5. Living document

Presentation Today …

- Land Loss
- Sediment Need
- Regional Sediment Management (LASMP & LASARD)
- Surficial Sediment Distribution Maps
- Sediment Volume /Sediment Accessibility/Pipelines
- Final Thoughts …

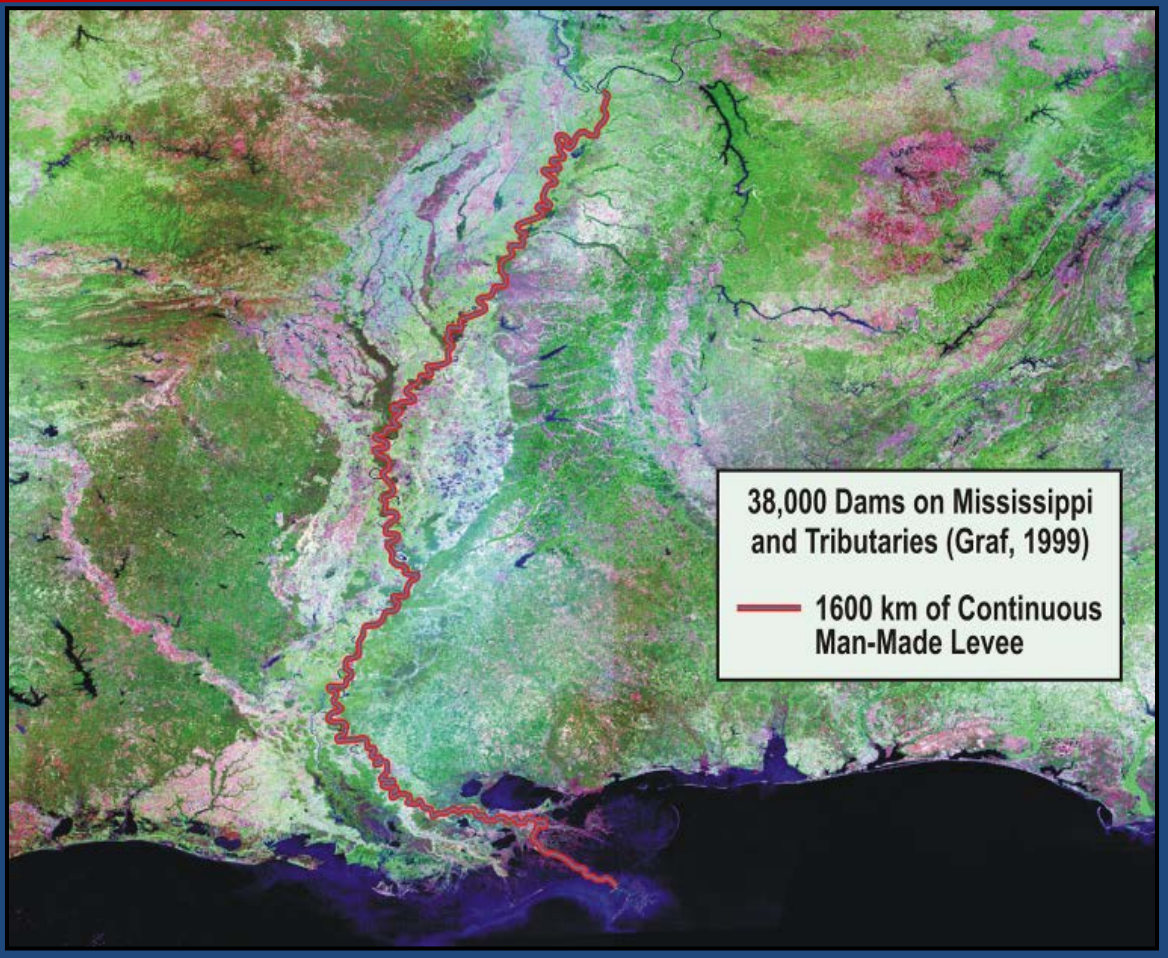
Mississippi River Delta Plain

Fragility & Vulnerability of the System

Sediment Starved System

Reasons for Sediment Starvation

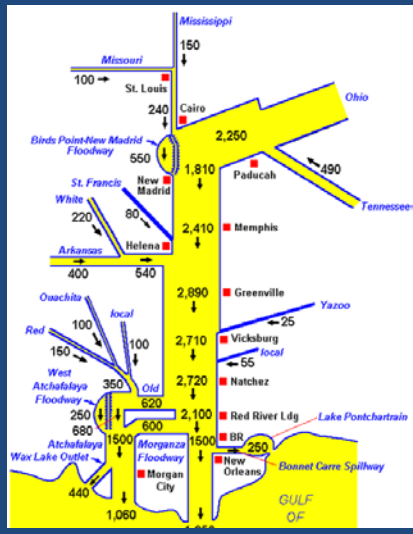
Dams and Levees



Mississippi River Alluvial Valley

Fisk (1947) Map of the river's historic course

River Flood Capacity Diagram (1958)



*Graf , 1999

Reduction in sediment supply from 400 MMT/yr before 1900 to 145 MMT/yr during 1987-2006

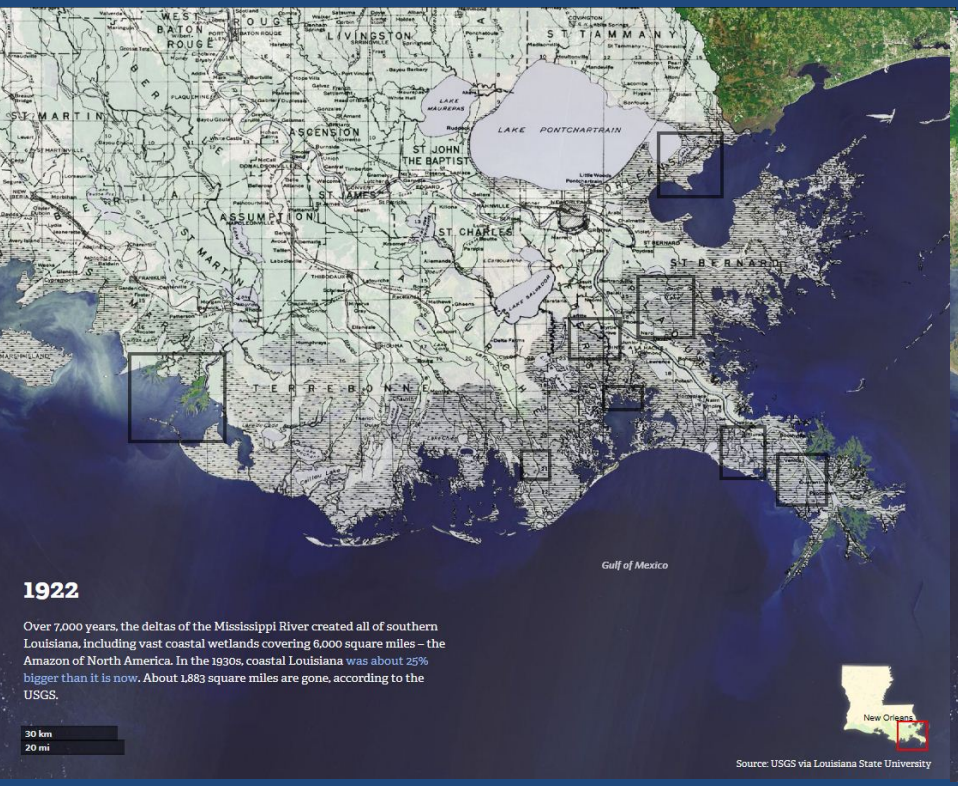
Sediment Loss

Sediment Starvation & Sediment Loss =

Land Loss

1922

2014



- ~16,000 km^2 of the Mississippi River Delta Plain (MRDP) was formed in ~7000 yrs
- In 1920's - 30's MRDP was about 25% bigger than now.
- In less than 100 years about 1900 mi^2 / ~5000 km^2 has been lost.
- Next 50 years about 2250 mi^2/ ~5800 km^2 additional land at risk

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Land Loss Predictions and Accommodation Space

	Land Loss (km^2)		Accommodation (km^3)		Sediment Needed (BT)**		Time Frame
Historical							
Morton et al. (2010)	1956-2004		1956-2004		1956-2004		1956-2004
	4,877		4.8		10		
Predicted							
2012 Master Plan (*Future without Action*)	Moderate	Less Optimistic	Moderate*	Less Optimistic*	Moderate	Less Optimistic	2012-2062
	1,994	4,532	2.0	4.4	5	12	
2017 Master Plan (*Future without Action*)	Medium	High	Medium*	High*	Medium	High	2017-2067
	5,838	10,679	5.7	10.5	16	28	
Blum and Roberts (2009)	Low	High	Low	High	Low	High	By 2100
	10,000	13,500	12	16	32	43	

***Assumed density of 1.5 g/cm^3 for mixed sand and mud with a 45% porosity (based on Blum & Roberts, 2009), and a cut to fill ratio of 1.8*

**After on Morton et al., 2010*

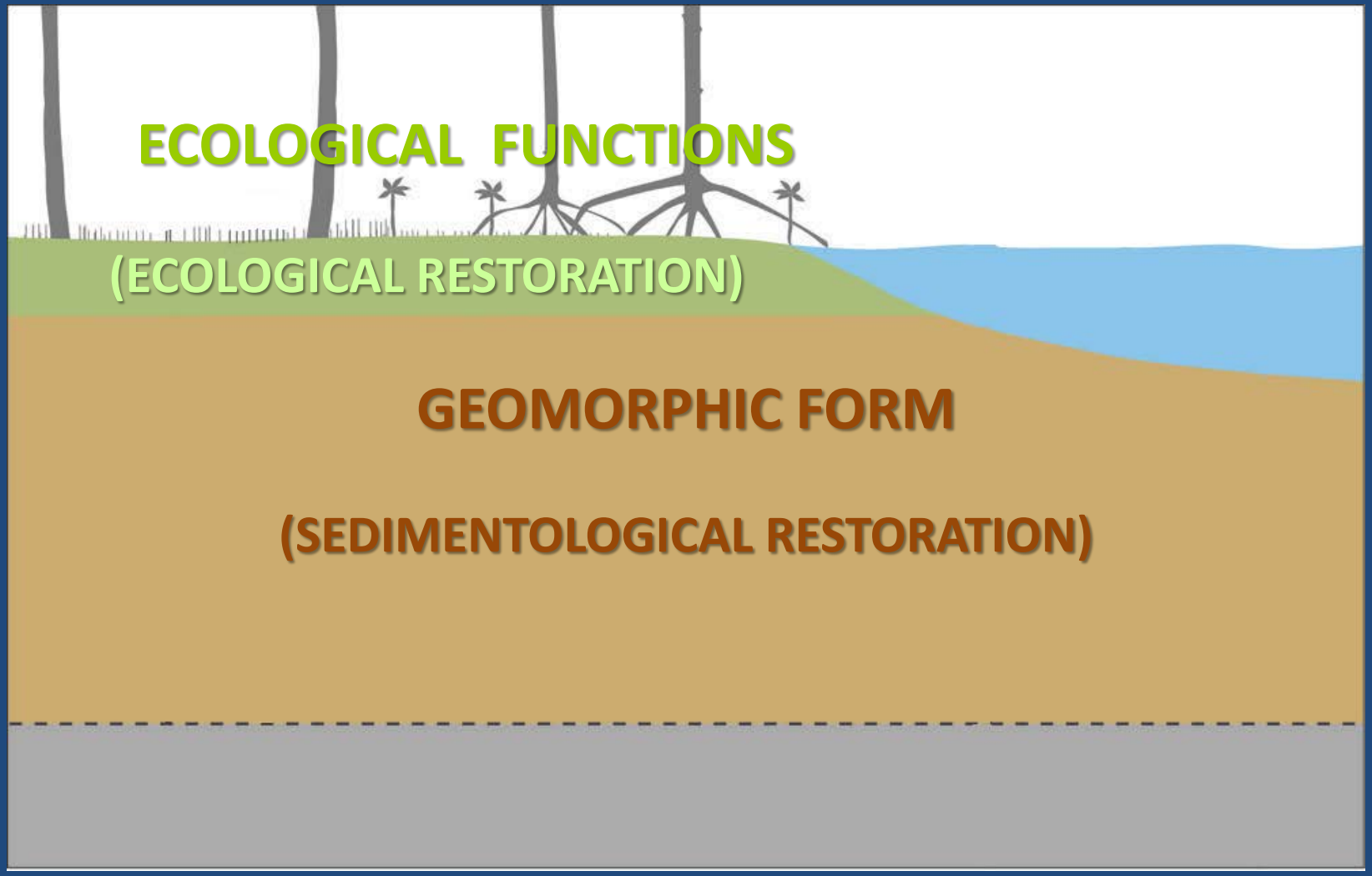
**Khalil et al 2018a; Khalil & Freeman 2014*

Mitigative Actions

Soft Option - Sedimentological Restoration
Sediment & Sediment Management plays a vital role

**Khalil et al 2018a ; Killebrew & Khalil 2018*

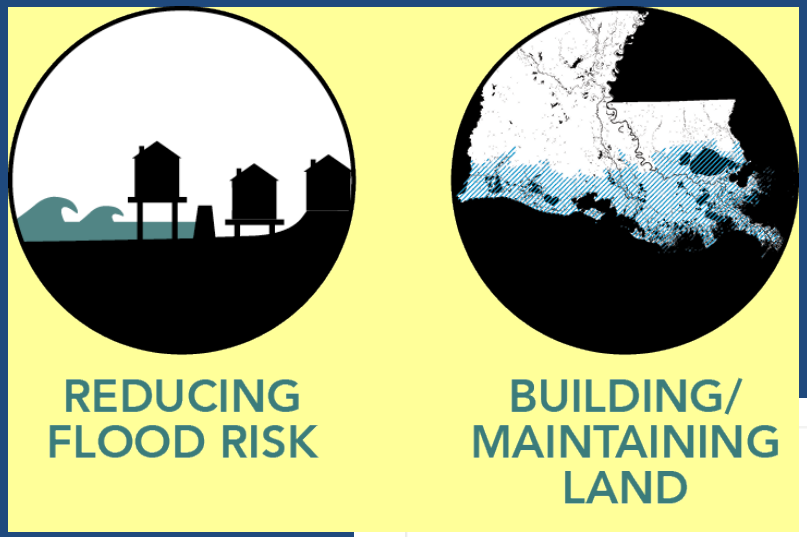
Sustainable Ecosystem Restoration



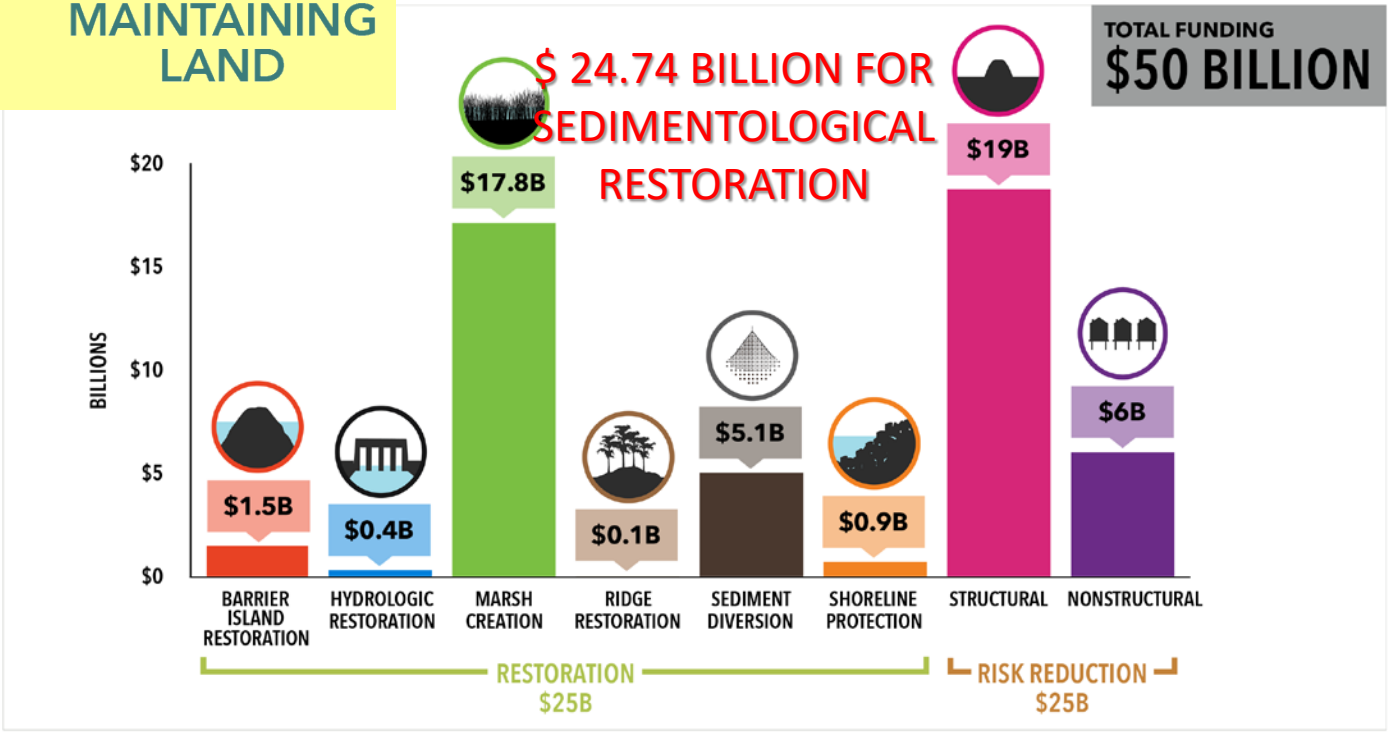
**Khalil et al 2018a ; Killebrew & Khalil 2018*

Coastal Master Plan 2017

Decision Drivers For Project Selection



Funding by Project Type



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Available Sediment Sources

- Fluvial/Riverine sand/sediment sources
  - *Sediment diversions (bed load & suspended sediment)*
  - *Dedicated dredging and transportation by P/L*
  - *Maintenance Dredging & CDFs*
- Offshore & Nearshore sand/sediment sources
  - *Buried Paleo-channels*
  - *Ebb/Flood Deltas*
  - *Sand Shoals*

SEDIMENT MANAGEMENT

Offshore Sediment Sources
<2.5 BCY/~28.5 BCY

SEDIMENT

OCS Waters, State Waters, Coastal Zone Lower Mississippi & Atchafalaya River

Sediment Borrow Area

Borrow Area Management
- Optimal Utilization
- Location vs. project
- Location vs. pipeline
- Delineation of potential sand sources in OCS

Borrow Area Monitoring
- Infilling rate
- Slope Stability Issues
- Hypoxia

Programmatic Monitoring/ Adaptive Management
- SWAMP
  - Barrier Island Comprehensive Monitoring Program (BICM)
  - Met-Oceanic Data - WAVCIS
  - Eustatic Sea Level Rise
  - Subsidence

*Khalil et al 2018 a, b

Regional Sediment Management
- Fluvial Sediment Sources/Diversions
- Offshore & Nearshore Sediment Resources
  - *Sediment Deposits*
  - *Sediment - Maintenance Dredging*
  - *Contained Disposal Facilities (CDFs)*

Sediment Evaluation
- Evaluation of potential areas
  - Delineation of sediment source/Borrow Area
  - Offshore/Nearshore (State/Federal Waters)
  - Rivers: Lower Miss River/Atchafalaya River

Sediment Management Tools
- Protocol for exploration
  - *Guidelines for sediment searches (DSSM)*
- LA Sand Resources Database (LASARD)
  - *SOP for data acquisition*
- Surficial Sediment Distribution Maps
- LA Sed Allocation Allotment Plan (LASAAP)
- Operational Sediment Budget (OSB)

Policy/ Regulation

- Federal Standard
- Pipeline/O&G
- Cultural Resources
- Environment Issues
- Sea Level Rise Policy

Coordination with Stakeholders

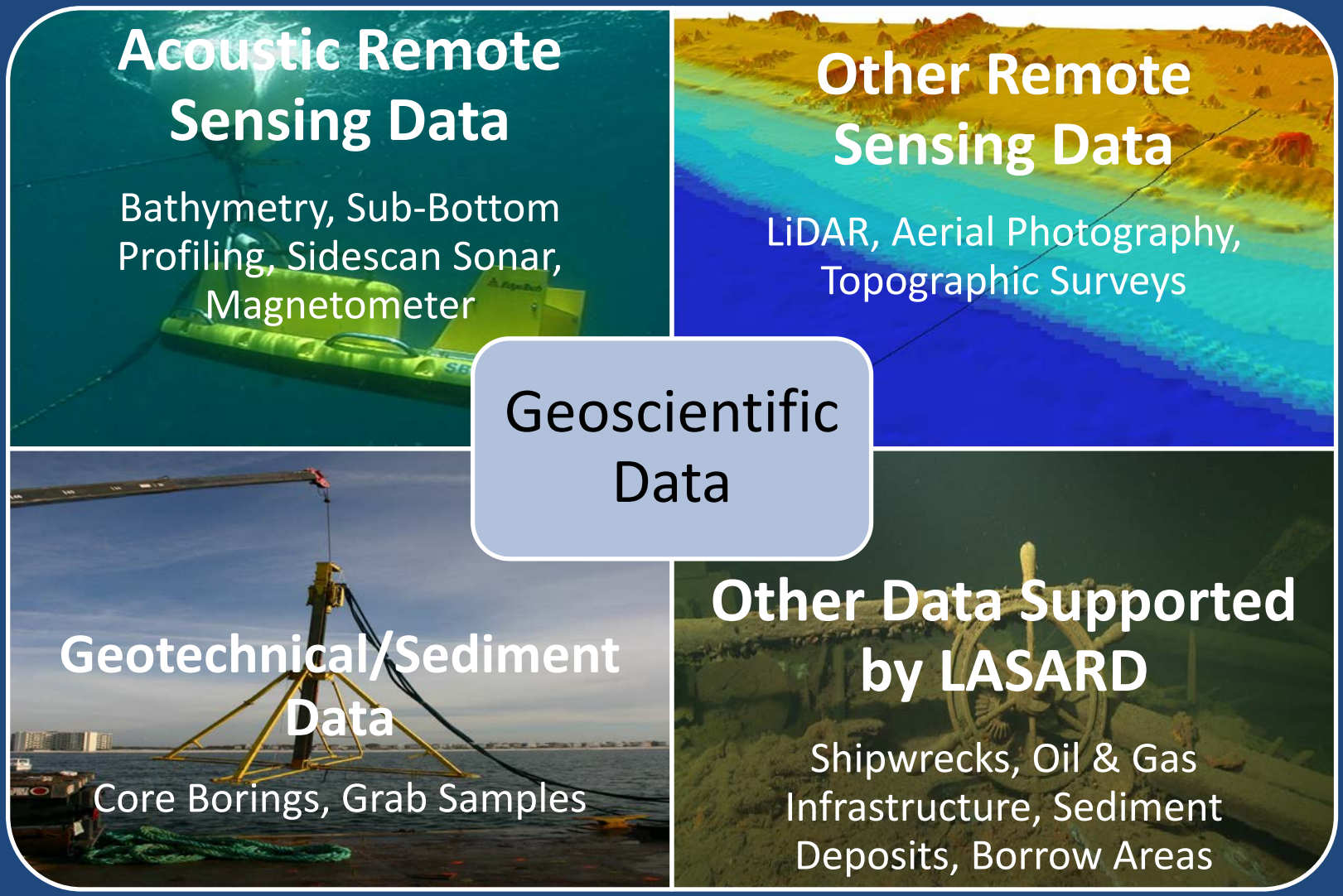
State, Federal, NGO

- LCA Miss River Delta Mgmt Study
- Atchafalaya Basin Sed Mgmt Plan
- Others

*Khalil et al 2010, Khalil & Freeman 2014

LOUISIANA SEDIMENT MANAGEMENT PLAN (LASMP)

Louisiana Sand Resource Database (LASARD)



*Khalil et al 2016 & 2010

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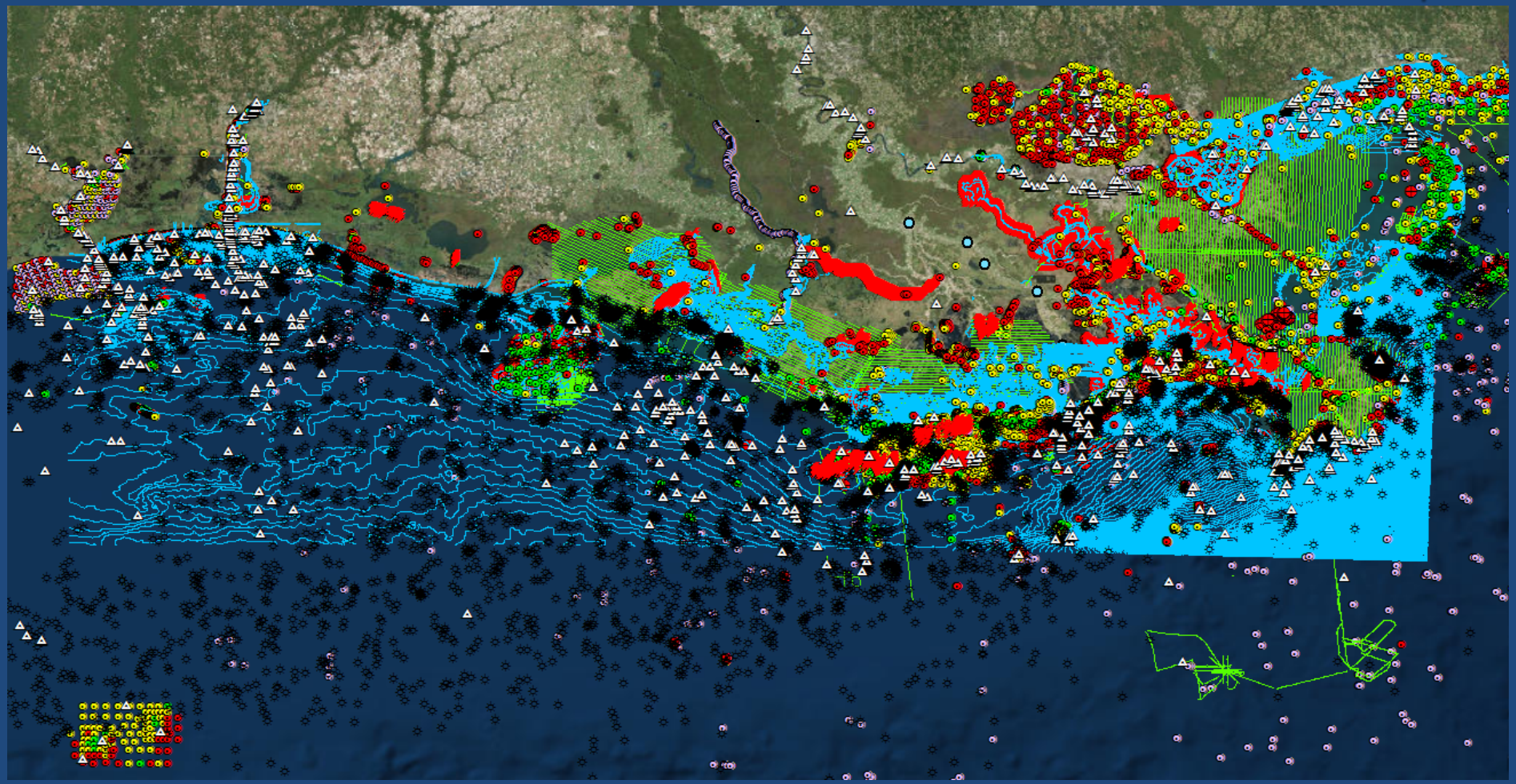
Louisiana Sand Resource Database (LASARD)

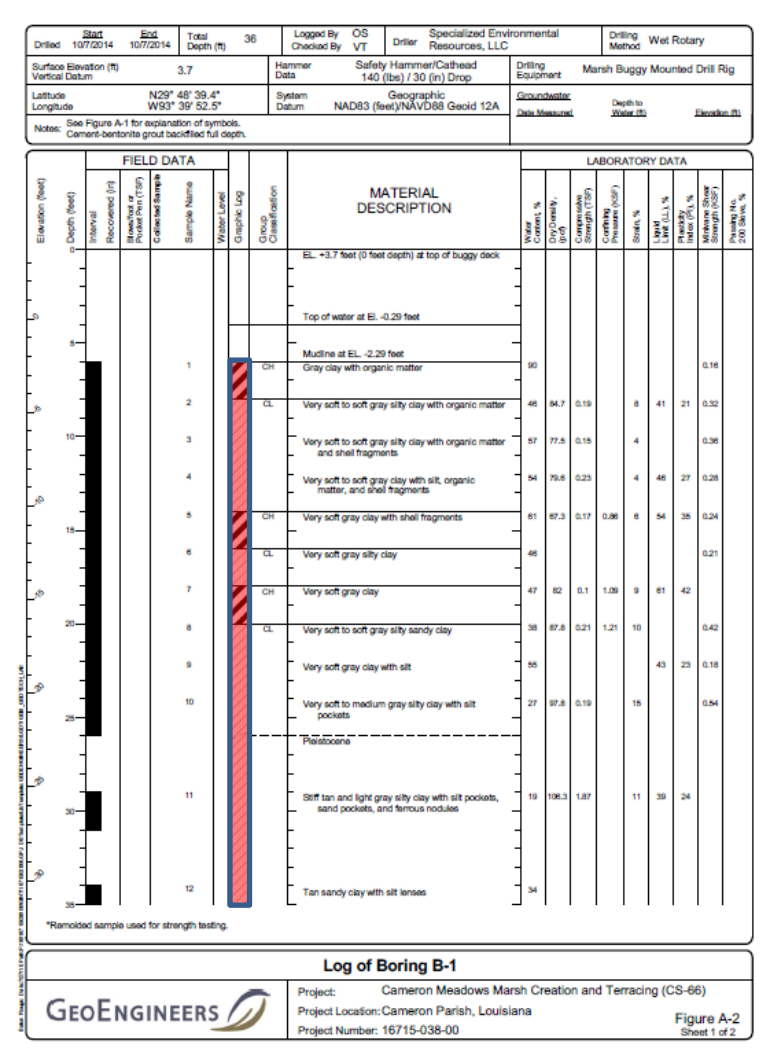
~2,000 datasets have been formatted to meet LASARD standards

>15,000 core borings/sediment samples incorporated into the maps



https://cims.coastal.louisiana.gov/default.aspx

Delineation of Potential Sediment Resources



Drilled: Start 10/7/2014 End 10/7/2014	Total Depth (ft) 36	Logged By OS / Checked By VT	Driller: Specialized Environmental Resources, LLC	Drilling Method: Wet Rotary
Surface Elevation (ft) Vertical Datum: 3.7		Hammer Data: Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment: Marsh Buggy Mounted Drill Rig
Latitude: N29° 48' 39.4" Longitude: W93° 39' 52.5"		System Datum: Geographic NAD83 (feet)/NAVD88 Geoid 12A		Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)
Notes: See Figure A-1 for explanation of symbols. Cement-bentonite grout backfilled full depth.				

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot or Pocket Pen. (TSF)	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA: Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF)	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Minifonte Shear Strength (KSF)	Passing No. 200 Sieve, %
	0								EL. +3.7 feet (0 feet depth) at top of buggy deck									
									Top of water at El. -0.29 feet									
	5								Mudline at EL. -2.29 feet									
					1			CH	Gray clay with organic matter	90							0.16	
					2			CL	Very soft to soft gray silty clay with organic matter	46	84.7	0.19		8	41	21	0.32	
	10				3				Very soft to soft gray silty clay with organic matter and shell fragments	57	77.5	0.15		4			0.36	
					4				Very soft to soft gray clay with silt, organic matter, and shell fragments	54	79.6	0.23		4	46	27	0.28	
					5			CH	Very soft gray clay with shell fragments	61	67.3	0.17	0.86	6	54	35	0.24	
	15				6			CL	Very soft gray silty clay	46							0.21	
					7			CH	Very soft gray clay	47	82	0.1	1.09	9	61	42		
	20				8			CL	Very soft to soft gray silty sandy clay	38	87.8	0.21	1.21	10			0.42	
					9				Very soft gray clay with silt	55					43	23	0.18	
	25				10				Very soft to medium gray silty clay with silt pockets	27	97.8	0.19		15			0.54	
									Pleistocene									
	30				11				Stiff tan and light gray silty clay with silt pockets, sand pockets, and ferrous nodules	19	106.3	1.87		11	39	24		
	35				12				Tan sandy clay with silt lenses	34								

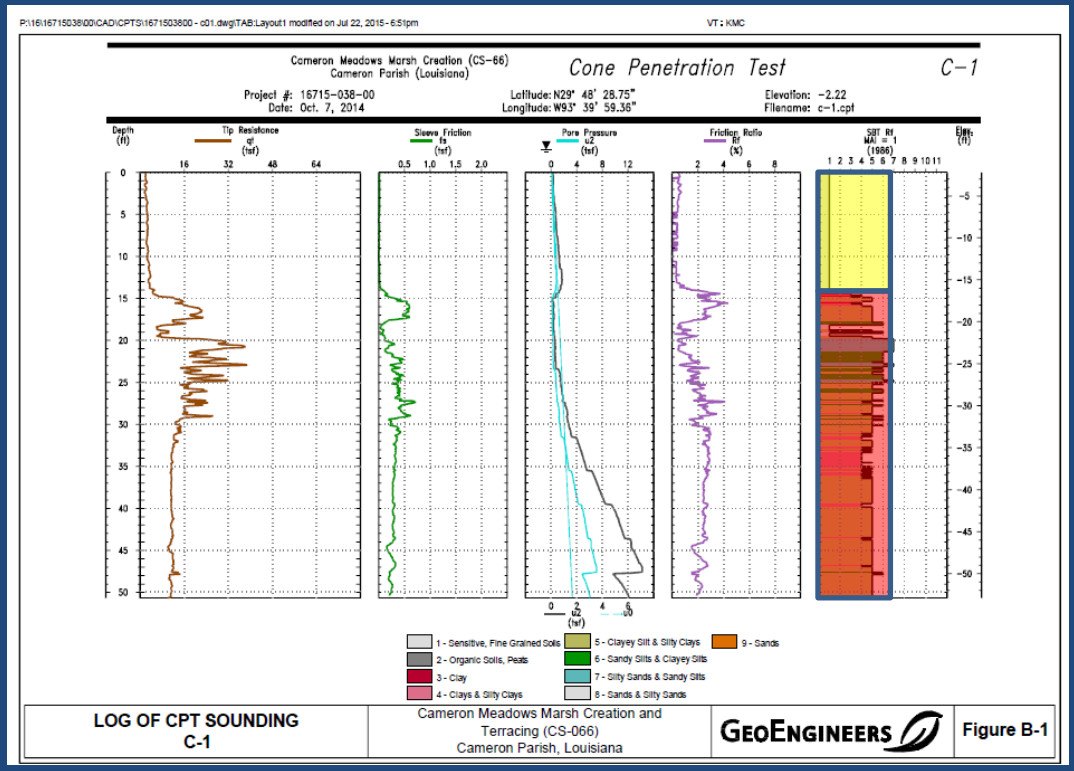
*Remolded sample used for strength testing.

Log of Boring B-1

GeoEngineers

Project: Cameron Meadows Marsh Creation and Terracing (CS-66)
Project Location: Cameron Parish, Louisiana
Project Number: 16715-038-00

Figure A-2
Sheet 1 of 2



Delineation of Potential / Sediment Resources

> 1 mile spacing

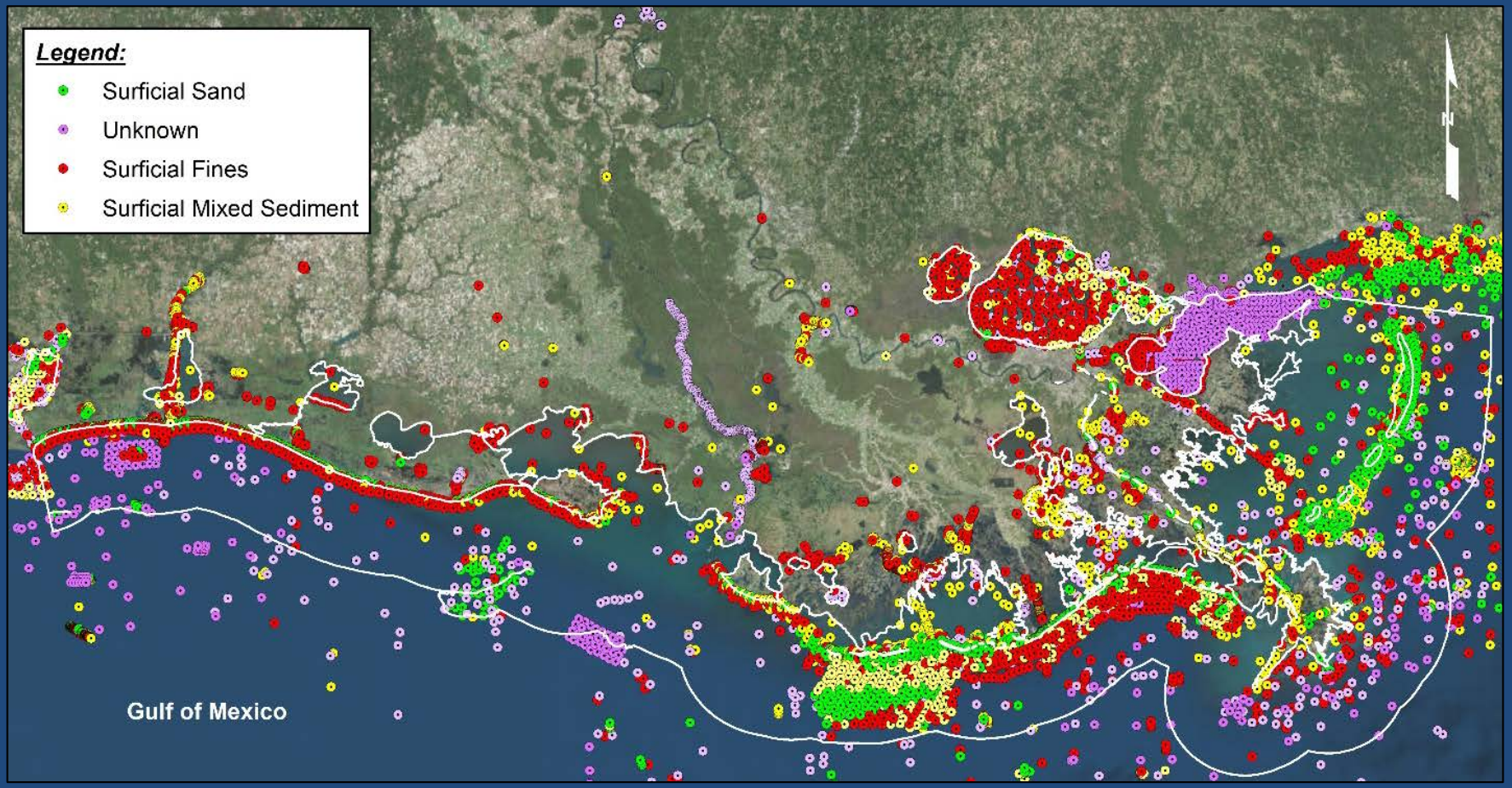
<1 mile spacing

<u>POTENTIAL</u> Surficial Fines

Surficial Sand

*Khalil et al 2018b

Delineation of Sediment Resources



Offshore Sediment Volume Estimates

1st order sediment volume estimates calculations:

- Thickness of mixed sediment and surficial fines assumed to be 10 ft
- Areas of surficial sand reviewed separately
  - Core borings reviewed to determine average thickness of each deposit

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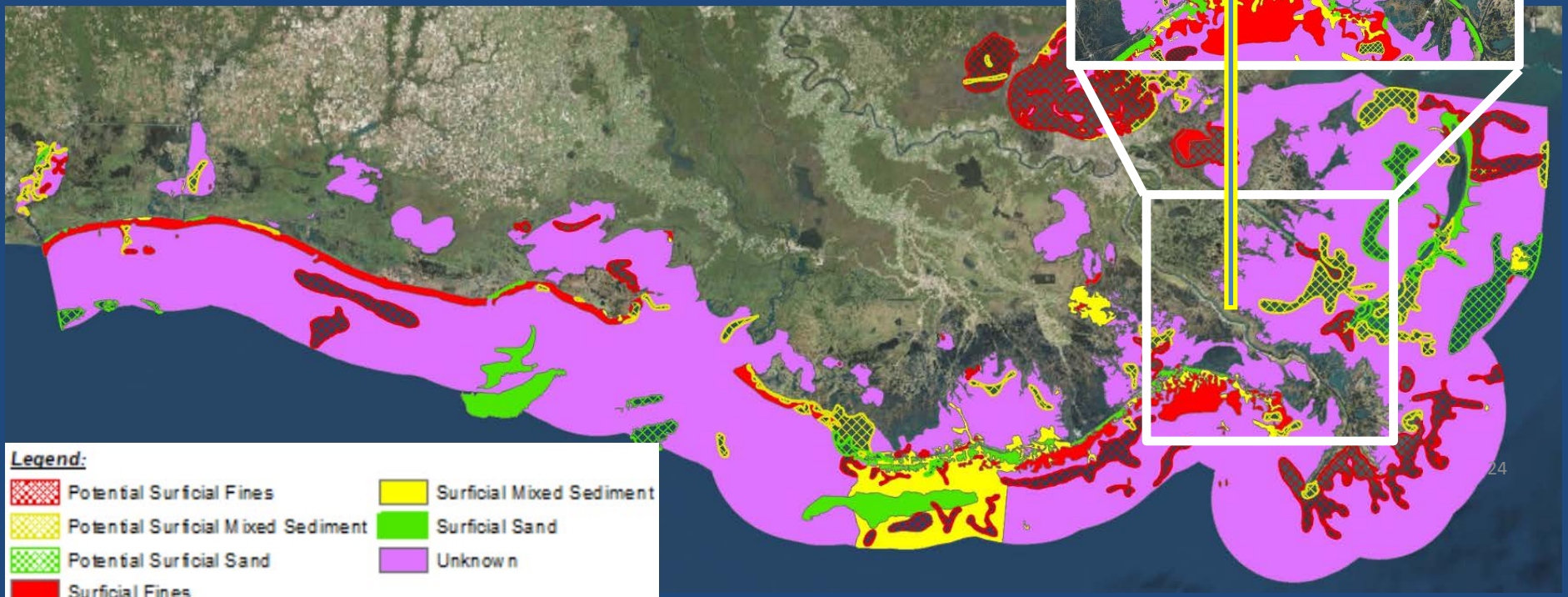
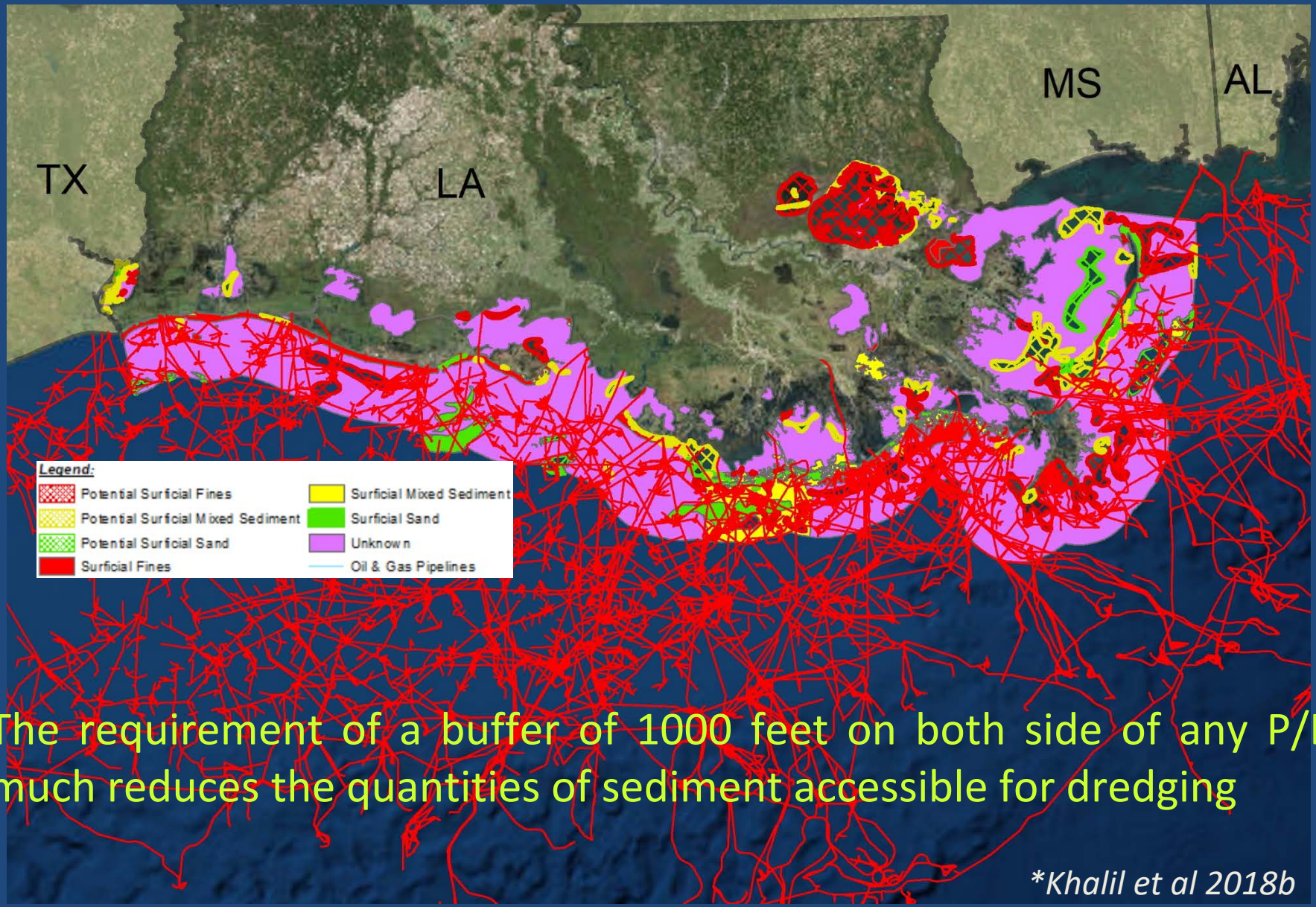
1st Order Surficial Sediment Distribution Maps

- On the basis of sediment data in LASARD
- Sediment are delineated into 7 categories
- 252 surficial sediment deposits offshore
- 30 sand bars in the Mississippi River
- These are tools to implement LASMP



*Khalil et al 2018 a & b,

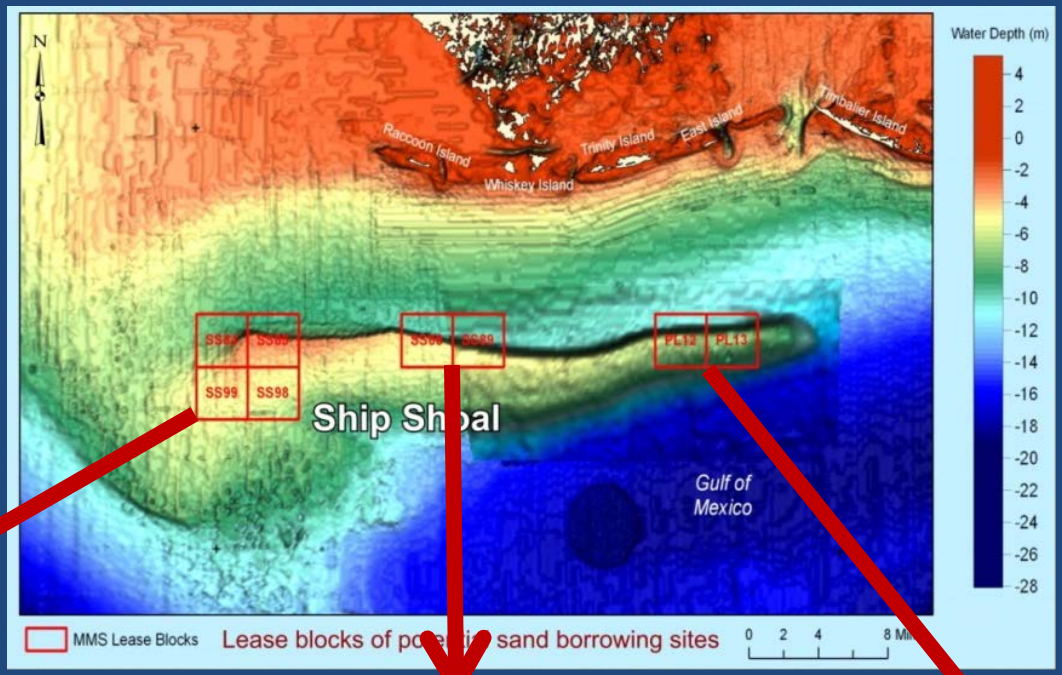
Accessible Offshore Sediment Resources

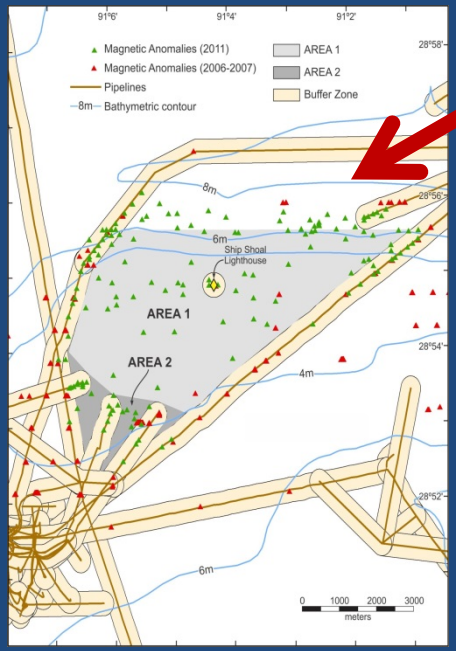


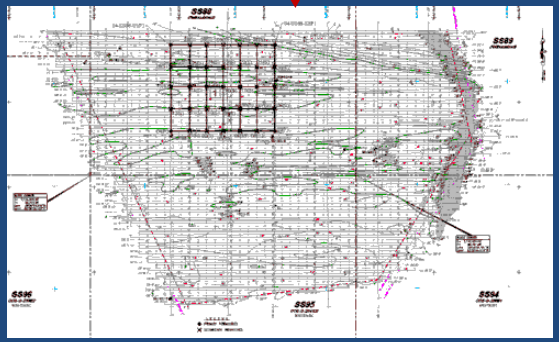
The requirement of a buffer of 1000 feet on both side of any P/L much reduces the quantities of sediment accessible for dredging

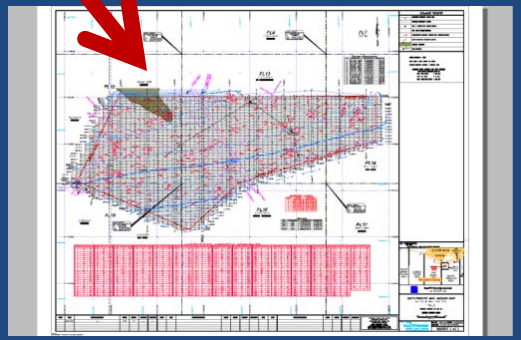
**Khalil et al 2018b*

SHIP SHOAL COMPLEX









Western SS Blocks 84, 85, 98 & 99

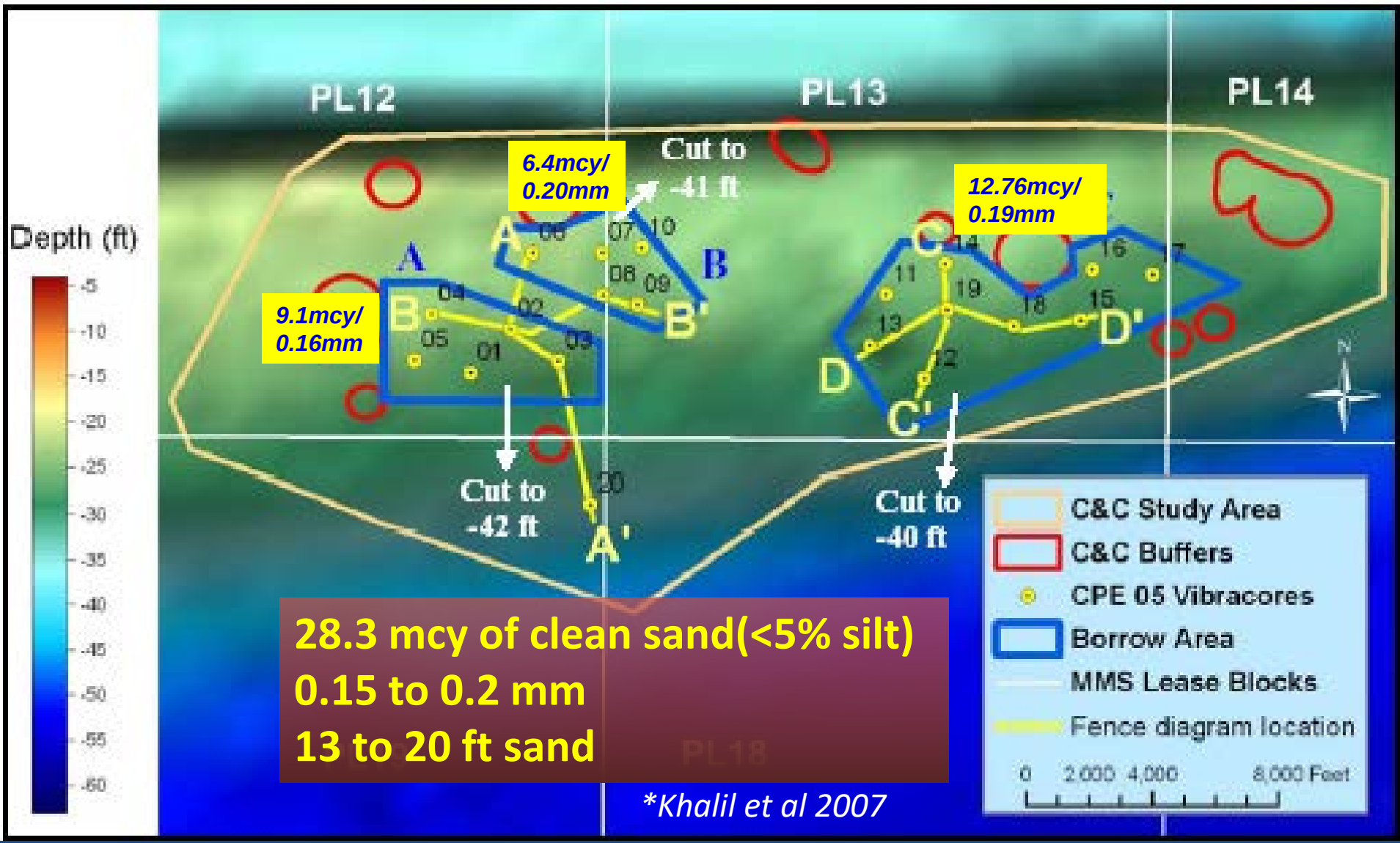
Central Ship Shoal Blocks 88 & 89

Whiskey Island Restoration

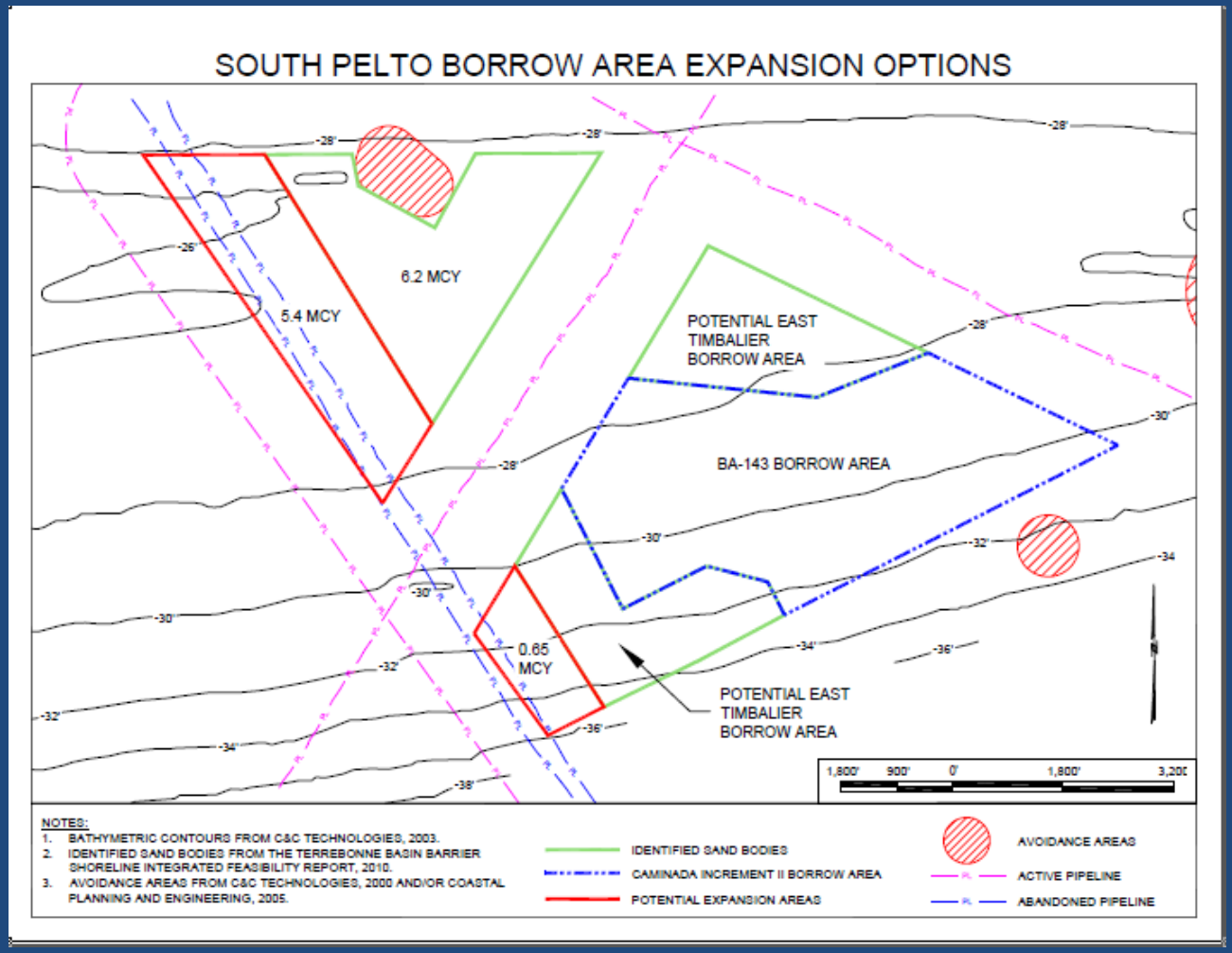
Eastern Ship Shoal SP Blocks 12 & 13

Caminada Headland Restoration

Carving out Borrow Area (South Pelto Blocks 12 &13)



Expansion of Borrow area



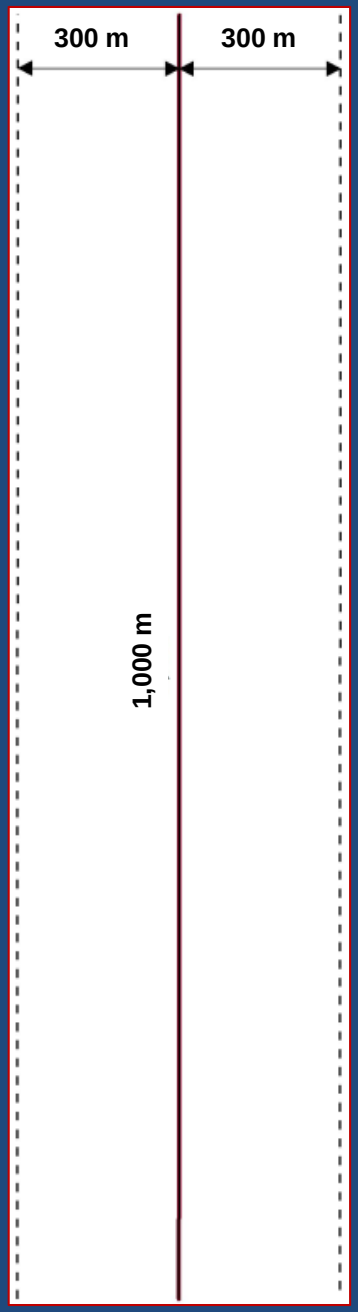
~6 MCY of “Restoration Quality Sand” would be dredgeable by removal of decommissioned P/L

Sediment Volume Estimates*

Location	Sediment Type	Total Available Volume of Sediment	Total Dredgeable Volume of Sediment	Reduction in Volume (%)
Offshore	Surficial Sand	3,146	1,848	41
	Potential Surficial Sand	3,643	2,500	31
	Surficial Mixed Sediment	4,431	2,353	47
	Potential Surficial Mixed Sediment	5,031	3,607	28
	Surficial Fines	4,074	2,636	35
	Potential Surficial Fines	10,727	8,020	25

*(*Million Cubic Meters)*

**Khalil et al 2018b*



1 Km Long Decommissioned Pipeline *vs*. Sediment Volume

Volume & Value of sediment resources rendered unavailable by a 1 km abandoned pipeline

- It will occupy 1,000 X 600 m = 600,000 m^2 of significant sediment resources area
- It will prevent access to about 600,000 m^2 x 3 m (thick) = 1,800,000 m^3 = 1.8 MCM/2.4 MCY
- Average Emplacement Cost of 1 m^3 of sand = ~$21
- Economic value of 1.8 MCM = ~$37.8 million

**Khalil et al 2018 a & b, 2010*

Final Thoughts…

- SSD maps support restoration – sediment management, planning, design, sediment volume estimates, and state & federal regulatory efforts
- Sedimentological restoration on system scale is **the** solution to restore the degrading ecosystem – ~5-28 BT of sediment is needed
- ~41% of Louisiana's offshore sand resources are inaccessible due to oil and gas infrastructure
- In 2007-2008, MMS (BOEM/BSEE), in coordination with the State, identified several offshore blocks for protection of sediment resources for restoration
- Decommissioned pipelines form a fraction of active pipelines and represent our only option to help remove obstructions to sediment resources
- Notion that the pipelines could be removed as and when sediment resources are needed is untenable
- Oil and gas industry are our partners in this effort and it is critical that we work together towards a solution to this challenge

References

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THANKS


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