



NCER – New Orleans

August, 29, 2018

CALCULATING NET ECOSYSTEM SERVICE BENEFITS FOR THE LIGHTNING POINT LIVING SHORELINE, BAYOU LA BATRE, ALABAMA

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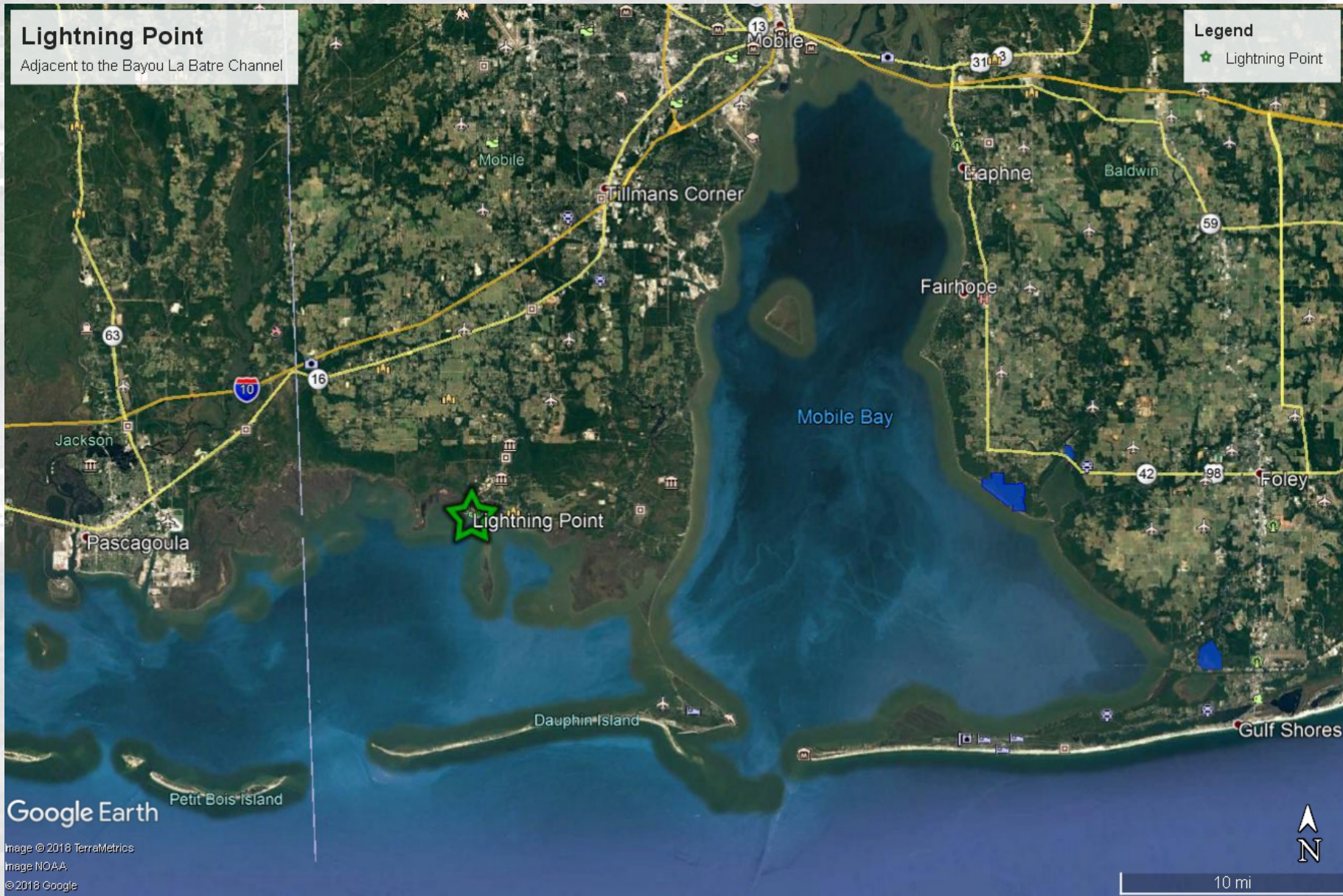


TENETS

- ⚡ **A Community Front Porch** – provide an enhanced experience for locals and visitor for boating, fishing, and site-seeing.
- ⚡ **Resilient and Productive Shoreline** – restore a diverse system of coastal habitats that enhances recreational opportunities and provides shoreline protection for the long-term.
- ⚡ **Enhance Accessibility** – provide a safe, enjoyable area for the community to arrive, park, walk, and connect with the waterfront while limiting impacts to restored habitats.

“Revitalize the locally important waterfront area at Lightning Point by restoring, enhancing, and protecting the shoreline habitats, and by providing improved community access.”

– Mission Statement

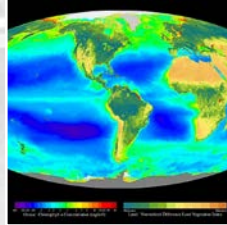


Living Shorelines – Major Components

- ⚡ Rock sill or structure to dampen wave energy and protect shoreline
- ⚡ Protected habitat or other Natural Nature Based Feature (NNBF) which can provide the following resource and habitat types:
 - ⚡ Marsh, low, intermediate and high
 - ⚡ Marsh Edge
 - ⚡ Subtidal Habitats (mud flats and SAV)
 - ⚡ Intertidal Oysters/Oyster Reefs



Ecosystem Services -



Supporting

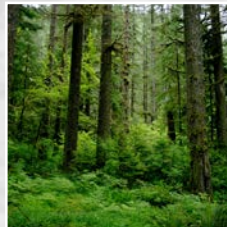
- Primary & Secondary Production
- Nutrient Cycling



Eco-centric

Provisioning

- Food
- Water



Regulating

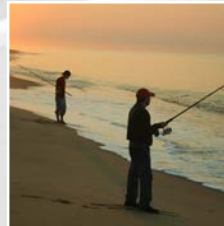
- Climate Regulation
- Disease Prevention



Not Considered Today

Cultural

- Aesthetic
- Recreational



Key Project Components

1. Shoreline Protection

- 1.5 miles of breakwaters

2. Habitat Creation

- >28 acres of marsh, tidal creeks

3. Public Access

- Complement City Docks project
- Walking paths, look-out
- Parking lot improvements

4. Beneficial Use of Dredge Material



1916

Shell Bell Rd

Google earth

1056 ft

1954

Shell Bell Rd

Google earth

1056 ft

Tour Guide 1997

Imagery Date: 11/18/2017 lat 30.383552° lon -88.266392° elev 0 ft eye alt 4566 ft

2011

Shell Belt Rd



Image USDA Farm Service Agency

Google earth 10

1056 ft

2017

Shell Belt Rd



1056 ft

Google earth

Tour Guide 1997

lat 30.387713° lon -88.271579° elev 0 ft eye alt 4566 ft



Shell Belt Rd

Google earth

1056 ft



- 1. Shoreline Protection
- 2. Habitat Creation
- 3. Public Access
- 4. Beneficial Use of Dredge Material

Artist Rendering

Natural Resource Damage Assessment Oil Pollution Act – 1990 - 33 U.S.C. §§2701-2761

⚡ Injury quantification under OPA involves quantifying the injury relative to baseline conditions—i.e., the condition of the natural resource or services that would have existed had the incident not occurred (15 CFR § 990.30).

Injury is estimated by loss of natural resources (biomass) or services (relative system function expressed as services/area/time relative to a baseline.



Baseline Productivity Established Using Modeling Approach for Multiple Trophic Levels and Habitats

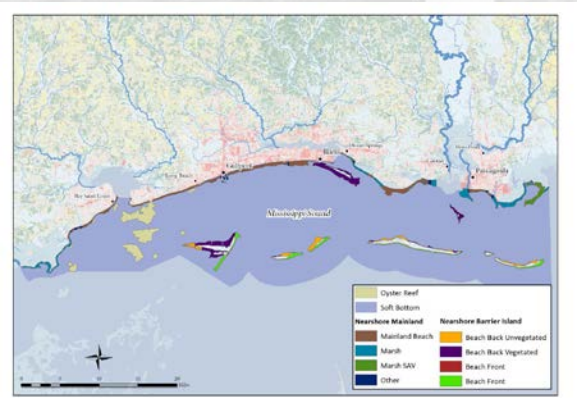


Figure 2. AQUATOX Habitat Map

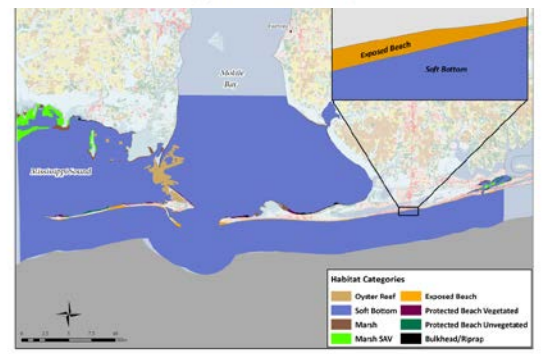
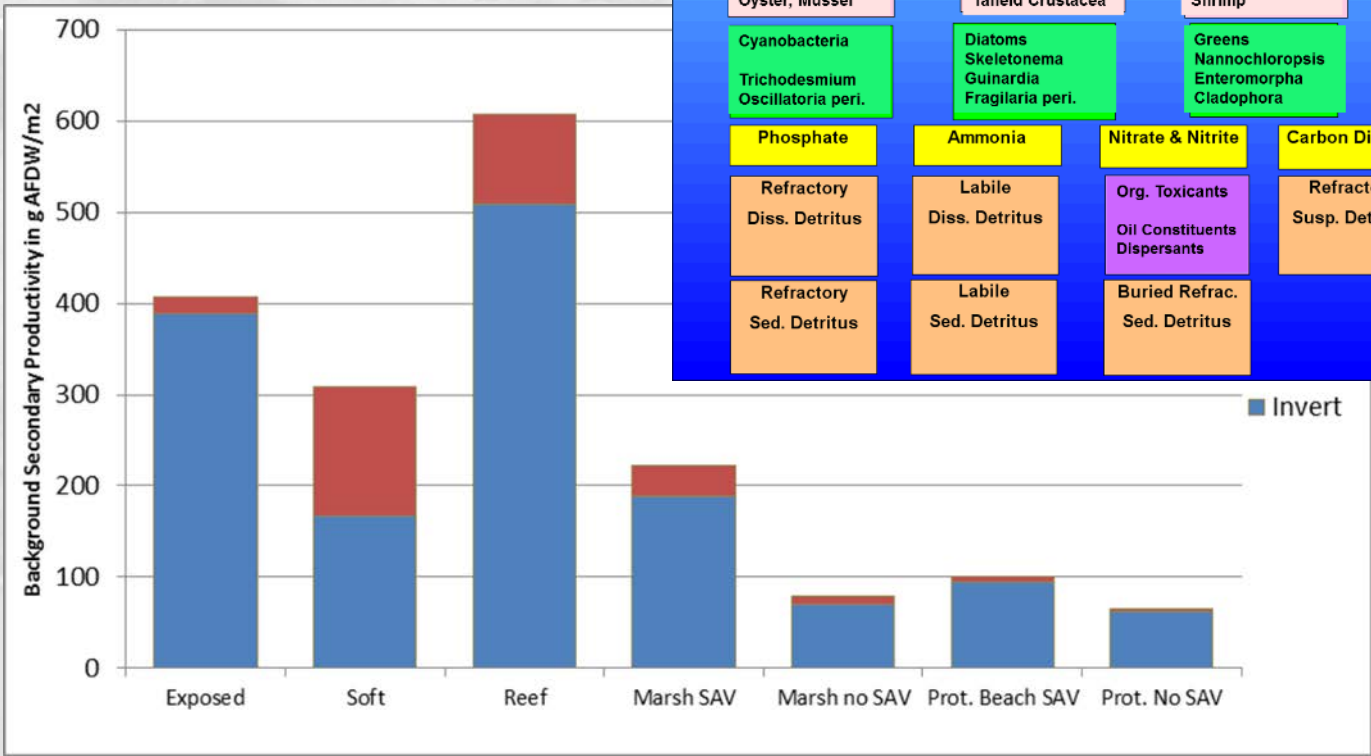
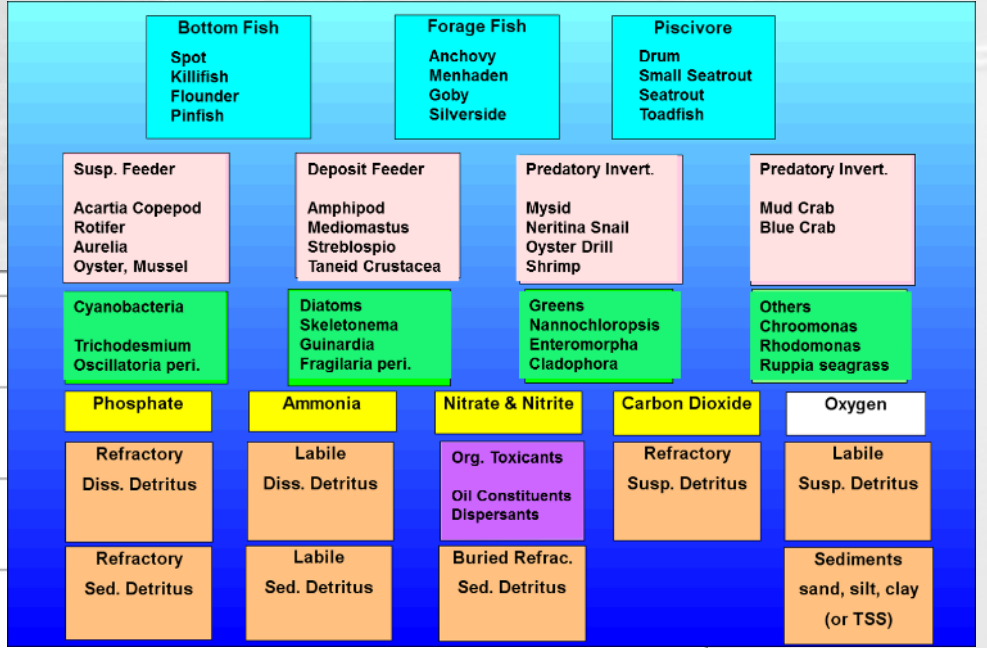
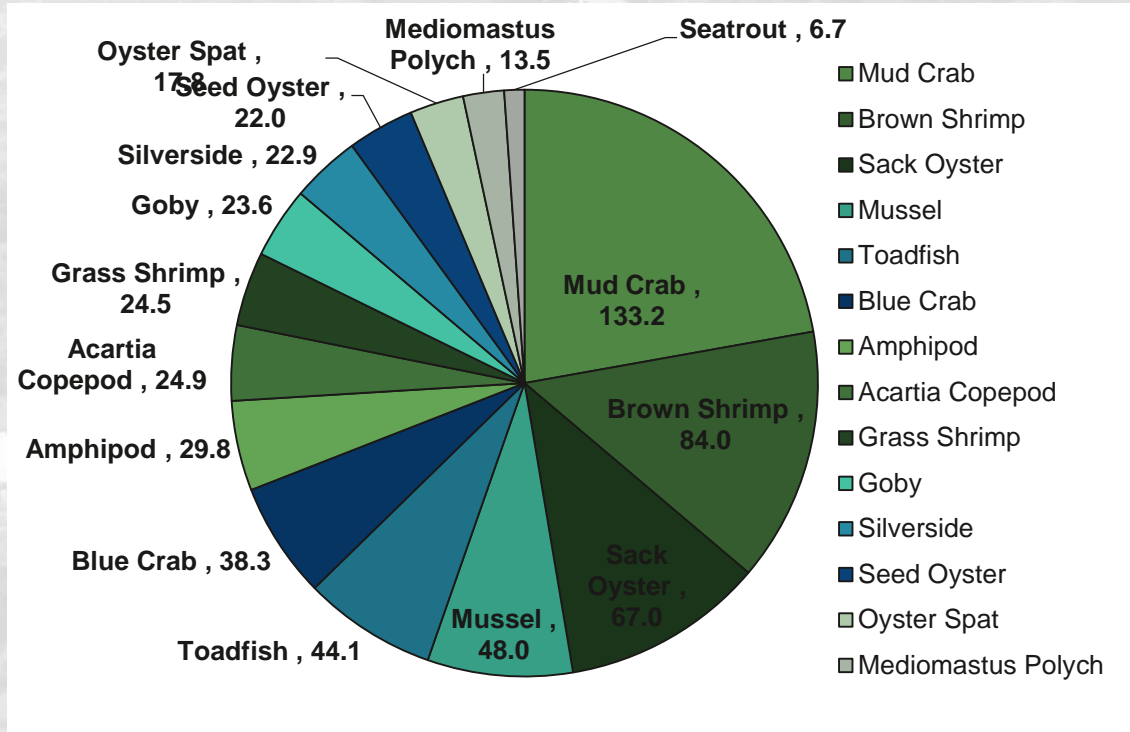


Figure 2. Habitat categories for Alabama AQUATOX

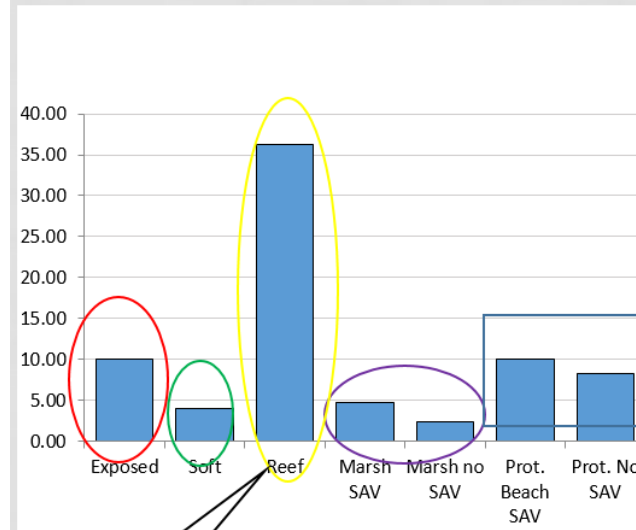


Baseline productivity used to estimate Injury to all Impacted Resources



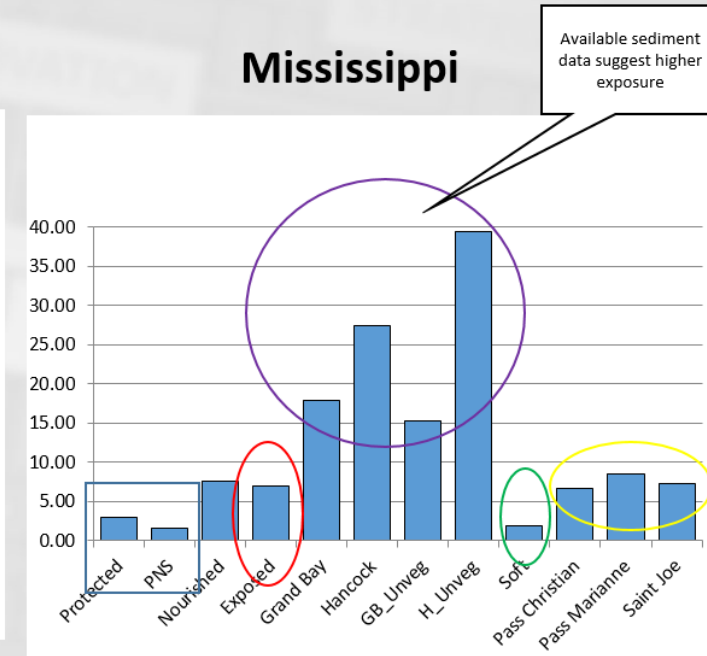
Cedar Pt. Reef AL: Baseline Productivity ~ 600 g/m2

Alabama



Higher grass shrimp and mud crab injury

Mississippi

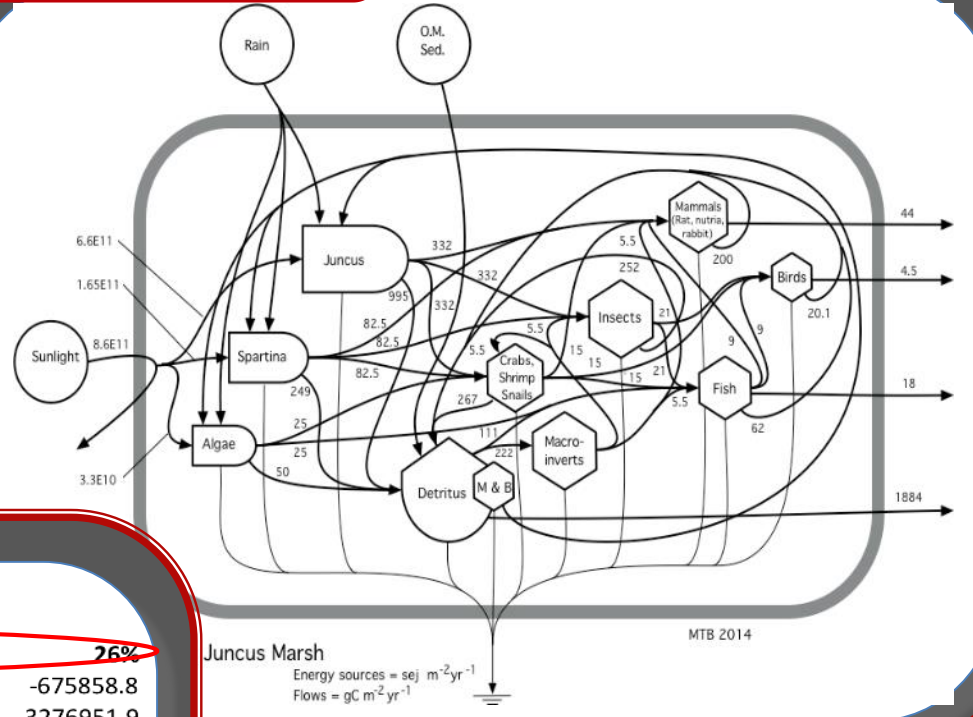


Available sediment data suggest higher exposure

Developed Baseline and Injury Modeling Results for Coastal Marsh Habitats



Juncus Marsh Food Web



Compute net change

Percent Dif.	-24%	-18%	-13%	-59%	-62%	-52%	-58%	-43%	-56%	26%
Difference	53597.0	135104.9	249287.0	194465.6	221593.8	315337.7	281844.4	172736.5	57867.7	-675858.8
Sum	165183.3	596966.3	1704024.4	132685.7	134806.5	287307.1	200434.0	228439.5	45230.0	3276951.9

	Algae	Spartina	Juncus	Crabs, shrimp, snails	Macro Inverts	Insects	Mammals	Fish	Birds	Detritus
	301.8	1001.1	2669.6	445.1	443.5	840.3	663.2	531.5	134.1	3546.7
	301.8	1001.1	2669.7	445.1	443.5	840.3	663.1	531.5	134.1	3547.6
	301.8	1001.1	2669.7	445.1	443.5	840.3	662.9	531.5	134.1	3548.5
	301.8	1001.1	2669.8	445.1	443.5	840.3	662.7	531.5	134.1	3549.3
	301.8	1001.1	2669.9	445.1	443.5	840.3	662.6	531.5	134.1	3550.1
	301.8	1001.1	2669.9	445.1	443.5	840.3	662.4	531.5	134.1	3550.9
	301.8	1001.1	2670.0	445.1	443.6	840.3	662.2	531.5	134.1	3551.7
	301.8	1001.1	2670.0	445.1	443.6	840.3	662.1	531.5	134.1	3552.5
	301.8	1001.1	2670.1	445.2	443.6	840.3	661.9	531.6	134.1	3553.2
	301.8	1001.1	2670.2	445.2	443.7	840.3	661.8	531.6	134.1	3553.9
	301.8	1001.2	2670.2	445.2	443.7	840.3	661.6	531.6	134.1	3554.6

Brown and Zarba, 2015. DWH Admin Record



Natural Resource Damage Assessment (NRDA)

- ⚡ OPA Baseline Requirements
- ⚡ AQUATOX (an EPA Food Chain Model) - Modifications for NRDA application
- ⚡ NRDA Calibration of Baseline for Northern Gulf Coast
- ⚡ NRDA Baseline Productivity Estimates representing the Natural Capital for the Various Habitats

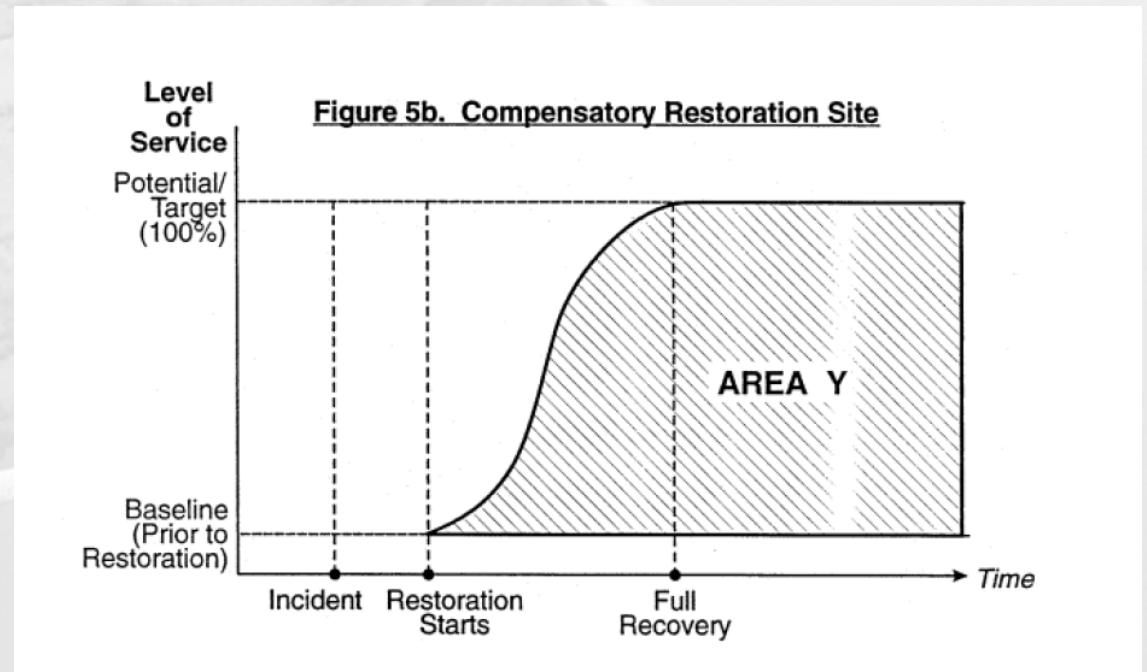
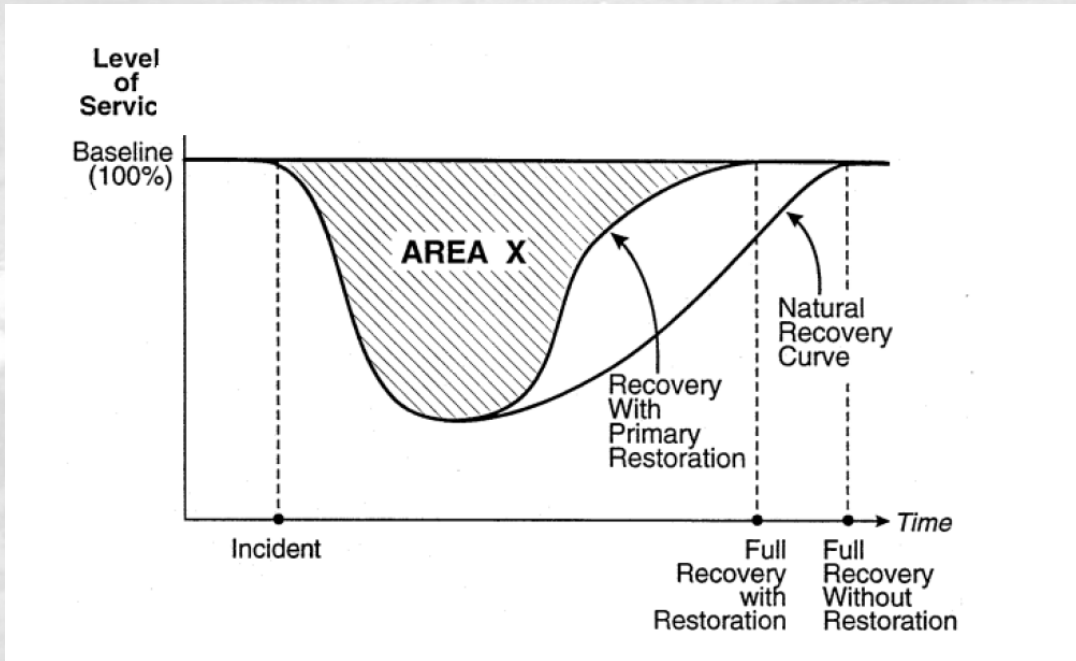


RESULT:

Have Developed Verifiable Baseline Productivity Habitats for all Habitats Impacted by DWH Incident that can be used for Establishing Baseline Levels for Restoration **AND** for estimating **increase in Natural Capital for various Restoration Actions**

Measuring Restoration Benefits: Habitat Equivalency Analysis (HEA) and Resource Equivalency Analysis (REA)

⚡ Agencies Use HEA and REA to estimate injury and recovery of resources



Primary and Compensatory Restoration

REA Example, kg Oyster Productivity (Biomass)

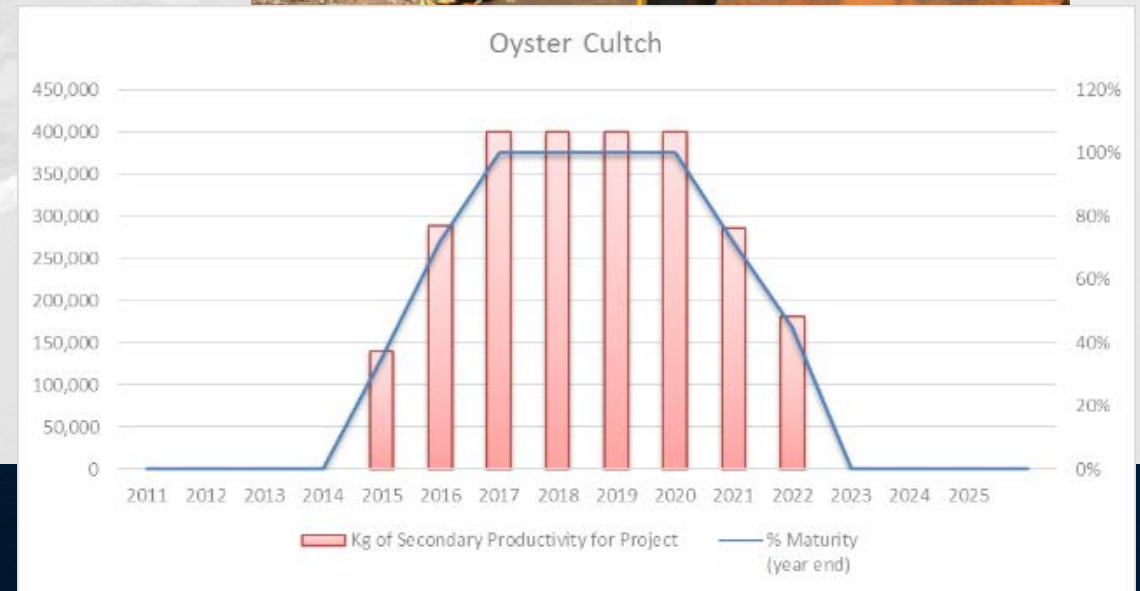
Early Restoration used Compensatory Restoration to provide offsets to be used against the total habitat and resource injuries to be calculated in the future



Year	% Maturity (year end)	Kg of Secondary Productivity for Project	Discount Rate	Discount Factor	Discounted kg/yr
2011	0%	0	3.0%	1.00	0
2012	0%	0	3.0%	0.97	0
2013	0%	0	3.0%	0.94	0
2014	0%	0	3.0%	0.92	0
2015	35%	140,276	3.0%	0.89	124,633
2016	72%	287,888	3.0%	0.86	248,334
2017	100%	400,400	3.0%	0.84	335,329
2018	100%	400,400	3.0%	0.81	325,562
2019	100%	400,400	3.0%	0.79	316,079
2020	100%	400,400	3.0%	0.77	306,873
2021	72%	286,286	3.0%	0.74	213,024
2022	45%	180,180	3.0%	0.72	130,166
2023	0%	0	3.0%	0.70	0
2024	0%	0	3.0%	0.68	0
2025	0%	0	3.0%	0.66	0

Project Area = 1430 Acres

Offset = **2,000,000 D-kg's** secondary production at a cost of **\$11,000,000**



Natural Capital: Resource Values (Biomass- DKg-AFDW) Negotiated During Early Restoration

*



DWH Early Restoration	LOCATION	Negotiated Secondary Productivity Value/DKg	Negotiated Forage Fish Value/DKg
Phase 1	Oysters-LA	\$ 3.54	
Phase 1	Oysters-MS	\$ 5.57	
Phase 1	Benthos-MS	\$ 3.40	
Phase 3	LS-MS	\$ 7.53	
Phase 4	LS-AL	\$ 6.87	\$ 137.40
Phase 4	LS-MS	\$ 14.48	\$ 289.60
Phase 4	LS-AL	\$ 45.90	\$ 918.00
AVERAGE		\$ 12.47	\$ 249.40



Natural Capital: Salt Marsh Habitat Monetary Values negotiated for DWH Early Restoration

Project	Project				Metric	Approx. Cost	DWH
	State	Acreage	Offset	Offset			Negotiated Cost
							\$/Offset
Lake Hermitage Marsh Creation	LA	104.00	518.00	Marsh DSAYs	\$ 13,200,000	\$	25,483
Marsh Island (Portersville Bay) Marsh Creation	AL	74.00	540.00	Marsh DSAYs	\$ 9,400,000	\$	17,407
Hancock County Marsh Living Shoreline Project	MS	96.00	347.45	Salt Marsh habitat DSAYs	\$ 20,000,000	\$	57,562
Caillou Headlands Back Barrier	LA	207.36	584.74	Back Barrier	\$ 22,809,183	\$	39,007
Chenier Ronquille Back Barrier	LA	298.31	841.23	Back Barrier	\$ 20,852,359	\$	24,788
Shell Island Marsh-Back Barrier	LA	271.95	766.91	Marsh - Back Barrier	\$ 19,010,042	\$	24,788
North Breton Islands	LA	137.30	387.19	Back Barrier	\$ 28,209,653	\$	72,858
Restore Living Shorelines and Reefs in Mississippi Estuaries	MS	272.00	34.00	Salt Marsh habitat DSAYs	\$ 2,000,000	\$	58,824
Point aux Pins Living Shoreline	AL	859.00	29.00	DSAYs of Salt marsh habitat	\$ 1,015,000	\$	35,000
Shell Belt and Coden Belt Roads Living Shoreline	AL	**	50.00	DSAYs of Salt marsh habitat	\$ 2,100,000	\$	42,000
						AVERAGE	\$ 39,772



Measured in Discount Service Acre Years (DSAY's)

Source: Blancher & Blancher 2016

Estimated Economic Value of Natural Resources Alabama-Mississippi (DWH\$)

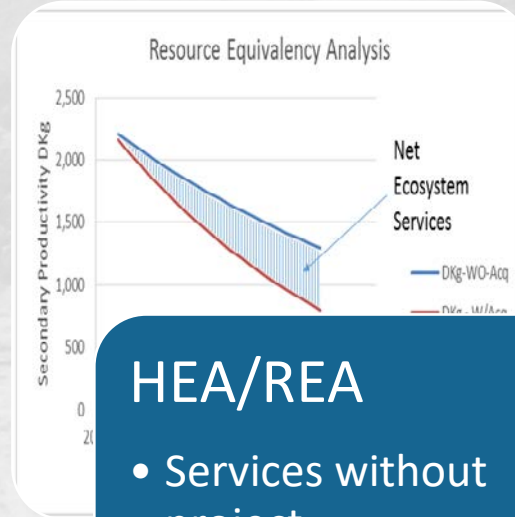
HABITAT	PRIMARY	SECONDARY	TERTIARY	Estimated Economic Value	References
	Unit Production g/m ²	Unit Production g/m ²	Unit Production g/m ²	\$/Acre	
Beach	1182	186.9	8.9	\$ 19,134.34	Clough, et al. 2015; Blancher & Blancher, 2016
Beach w/ seagrass	3702.22	285.7	14.49	\$ 38,881.51	Clough, et al. 2015; Blancher & Blancher, 2016
Forested Upland				\$ 1,800.00	Brown and Campbell, 2015
Forested Wetland	4127.1	412.7	41.3	\$ 60,114.23	Bardi & Brown, 2000
Marsh	1956	318	244	\$ 39,000.00	Productivity: Zarba & Brown, 2015; \$ estimate, Blancher & Blancher 2016
Marsh Edge	809.88	211.71	27.27	\$ 27,451.20	Clough, et al. 2015; Blancher & Blancher, 2016
Marsh Edge w/ Seagrass	8181.84	567.1	98.03	\$ 114,853.83	Clough, et al. 2015; Blancher & Blancher, 2016
Soft Estuarine Bottom	3416.4	501.34	42.4	\$ 61,514.41	Clough, et al. 2015; Blancher & Blancher, 2016
Upland				\$ 1,200.00	Prof. Judgement

Net Ecosystem Service Benefit - Process



NRDA

- Baseline
- Early Restoration Values



HEA/REA

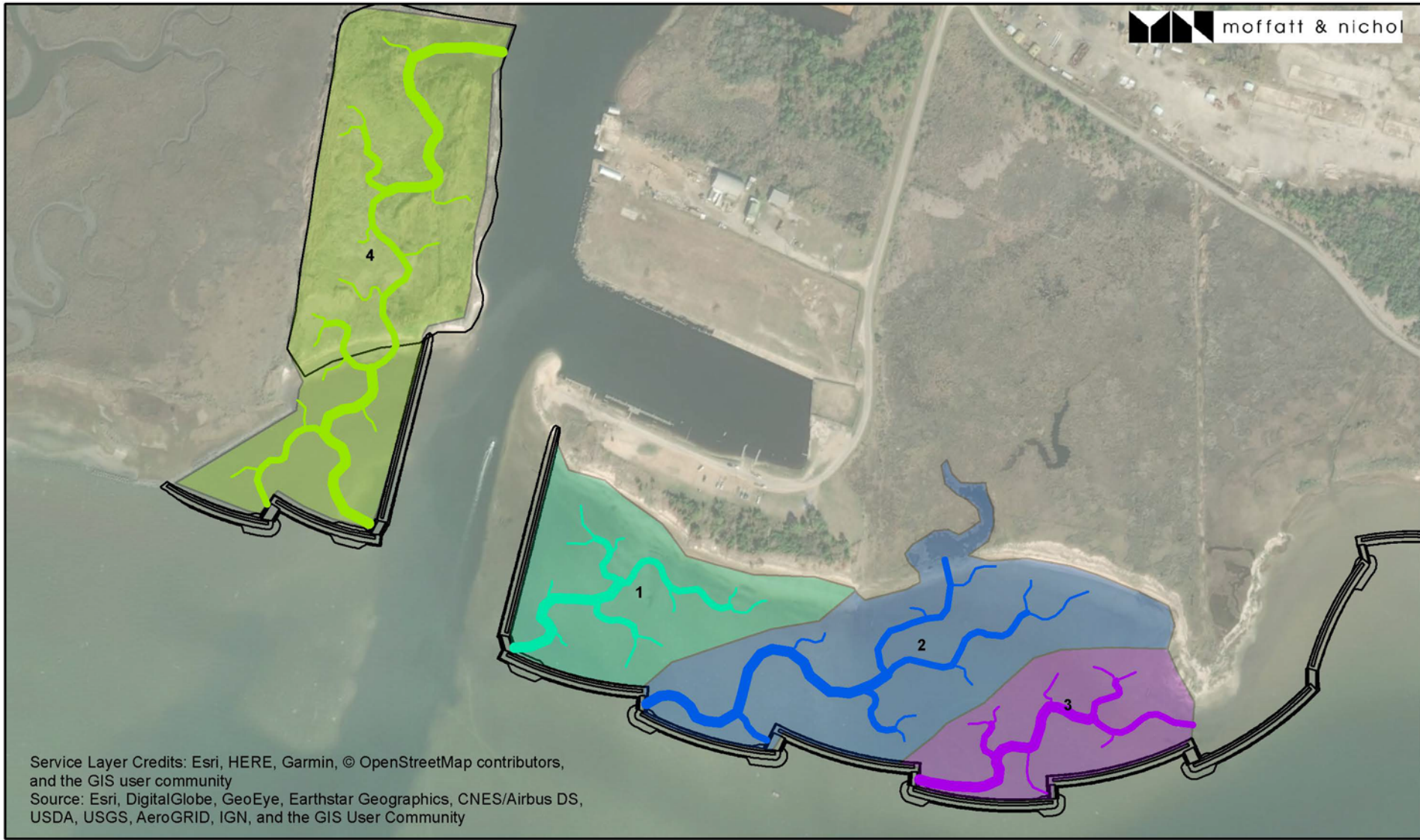
- Services without project
- Services with project
- Net Services or Services Gained with the project



NET Ecosystem Service Values

- DSAY's
- D-Kg productivity (1°, 2°, 3°)
- Monetary Value \$\$

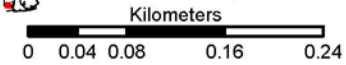
Tidal Creeks



Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
 Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Breakwaters
- Marsh Creation Drainage Areas**
- 1
- 2
- 3
- 4
- Tidal Creek Network**
- 3rd Order Channel, Width: 30-50 ft, Depth: -2 - -2.5 ft
- 2nd Order Channel, Width: 15-30 ft, Depth: -1.5 - -2 ft
- 1st Order Channel, Width 10-15 ft, Depth: -1 - -1.5 ft



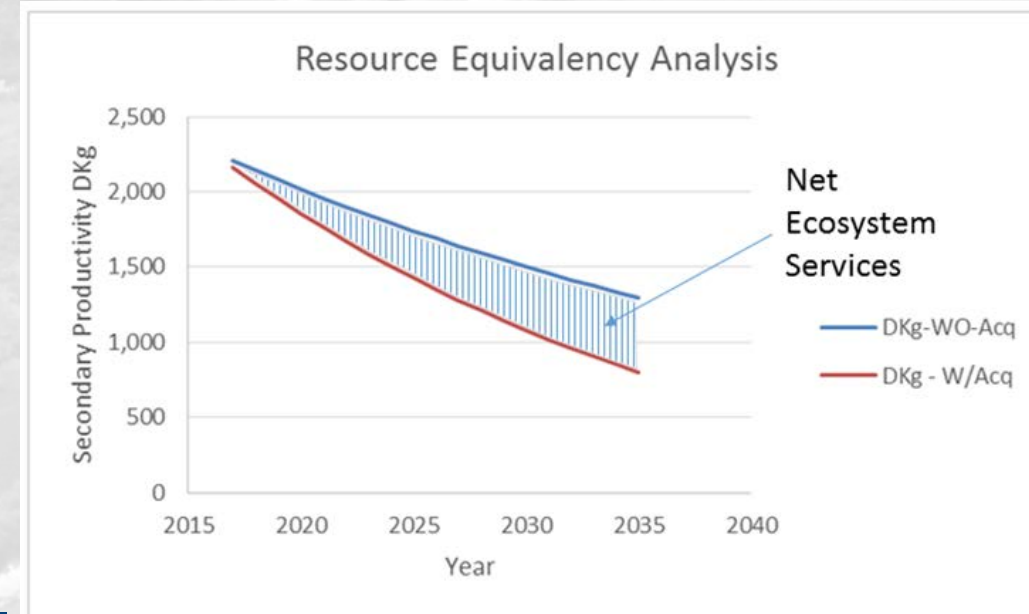
Habitats



Habitat Type	Restored/Enhanced/ Created (Acres)
Beach Edge with SAV	8
Marsh Edge (tidal creeks)	15
Marsh	60
Oyster Reef (breakwater)	5
Scrub-scrub	6
Pine flatwood	3

RESOURCE AND PRODUCTION SERVICES (Supporting)

- ⚡ The net ecosystem service benefit was analyzed based on three scenarios:
- ⚡ **Without project** – Baseline Condition assume continued erosion and sea level rise and calculate services over 25 years.
- ⚡ **With project**– Active Project Restoration. This represents the nominal Ecosystem Service .
- ⚡ **With project plus Additional Ecosystem Services** – From storm protection, nutrient uptake and recreational services are not accounted for



ESTIMATED NET ECOSYSTEM SERVICES BENEFIT FOR THE LIGHTNING POINT PROJECT AS WELL AS INDIVIDUAL HABITAT BENEFITS FOR EACH OF THE RESOURCE CATEGORIES.

NATURAL RESOURCE CATEGORY	BASELINE OUTPUT	RESTORED	BASELINE	RESTORED	NET BENEFIT
			Natural Resource Value - BASELINE (25 years of production)	Natural Resource Value - RESTORED (25 years of production)	NET VALUE- UPLIFT+RESTORE minus BASELINE
Salt Marsh (DSAYS) ENHANCED	270	320	\$ 10,517,771	\$ 12,464,144	\$ 1,946,372
Salt Marsh (DSAYS) CREATED	0	795	\$ -	\$ 30,987,446	\$ 30,987,446
Salt Marsh (DSAYS) RESTORED	0	320	\$ -	\$ 12,464,144	\$ 12,464,144
Forested Upland (DSAYS)	48	49	\$ 86,822	\$ 89,012	\$ 2,190
Scrub_Shrub Upland (DSAYS)	320	101	\$ 319,593	\$ 100,648	\$ (218,945)
Marsh Edge w/ SAV - PP Dkg	0	8,723,086	\$ -	\$ 10,467,703	\$ 10,467,703
Marsh Edge w/ SAV - SP Dkg	0	607,128	\$ -	\$ 7,285,530	\$ 7,285,530
Marsh Edge w/ SAV - TP Dkg	0	104,481	\$ -	\$ 12,537,703	\$ 12,537,703
Marsh Edge w/o SAV - PP Dkg	556,294	0	\$ 667,552	\$ -	\$ (667,552)
Marsh Edge w/o SAV - SP Dkg	38,718	0	\$ 464,617	\$ -	\$ (464,617)
Marsh Edge w/o SAV - TP Dkg	6,663	0	\$ 799,561	\$ -	\$ (799,561)
Beach Edge w/ SAV - PP Dkg	2,093,246	2,156,325	\$ 2,511,895	\$ 2,587,590	\$ 75,695
Beach Edge w/ SAV - SP Dkg	161,338	166,006	\$ 1,936,056	\$ 1,992,067	\$ 56,011
Beach Edge w/ SAV - TP Dkg	8,142	8,388	\$ 977,074	\$ 1,006,518	\$ 29,444
Beach Edge w/o SAV - PP Dkg	4,331,300	0	\$ 5,197,560	\$ -	\$ (5,197,560)
Beach Edge w/o SAV - SP Dkg	333,447	0	\$ 4,001,363	\$ -	\$ (4,001,363)
Beach Edge w/o SAV - TP Dkg	16,848	0	\$ 2,021,741	\$ -	\$ (2,021,741)
Oyster Reef PP Dkg	0	80,617	\$ -	\$ 96,740	\$ 96,740
Oyster Reef PP Dkg	0	191,868	\$ -	\$ 2,302,418	\$ 2,302,418
Oyster Reef PP Dkg	0	22,841	\$ -	\$ 2,740,973	\$ 2,740,973
TOTALS			\$ 29,501,607	\$ 97,122,636	\$ 67,621,029

MONETARY VALUE ARE BASED ON NEGOTIATED PRICES FOR OTHER SIMILAR NRDA EARLY RESTORATION PROJECTS.

Benefits Achieved with Project

- ⚡ Ecosystem Benefits (Habitats in terms of DSAY's or DKg) of Restored/Created Habitats are increased 4:1
- ⚡ On a per dollar basis, using the DWH economic comparison, the Benefit:Cost ratio approaches a 4.2 BCR on a dollar basis - \$67.6MM NESB:\$16MM Total Cost (Planning/Engineering/Construction) just for the Supporting Ecosystem Services
- ⚡ Additional benefits such as increased protection for harbor by reducing storm surge, and recreational benefits for enhanced access and activities would increase the BCR

Roundme

⚡ <https://roundme.com/tour/269923/view/836853/>

Acknowledgements

⚡ Engineering and Design funded by National Fish and Wildlife Foundation Gulf Environmental Benefit Fund



Thank You

www.moffattnichol.com