MISSISSIPPI RIVER HYDRODYNAMICS AND DELTA MANAGEMENT STUDY: BASIN-WIDE MODEL DEVELOPMENT

Delft3D Production Runs: 2020 – 2070

Fate of Nutrients

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PROJECT GOAL

- Produce a calibrated and validated model capable of simulating:
 - Morphological evolution processes that occur during the creation of a new delta and wetland areas
 - Nutrient effects to the wetland vegetation, soil, and the pelagic primary producers of Breton Sound and Barataria Bay estuaries





POTENTIAL SEDIMENT DIVERSION LOCATIONS



Likely flow conditions of four sediment diversions:

• ~35-75,000 CFS (~ 1,000-2,100 CMS)



D-WAQ: WATER QUALITY





D-WAQ MODEL SETUP SUBSTANCES

8 Phytoplankton Groups:

- Freshwater Diatoms, Freshwater Flagellates, Green Algae, *Microcystis*, *Anabaena*
- Marine Diatoms, Marine Flagellates, Dinoflagellates

Water Quality Variables:

- TOC, POC, DOC,
- TN, PON, DON, NH4, NO3
- TP, POP, DOP, **PO4**
- Si, Silt, Clay, **TSS**
- DO, ChI a

SEDIMENT DIVERSION PRODUCTION RUNS (PR)



PR ID	Description	Operating Plan	Design Discharge (cfs)	Sea Level Rise	Subsidence Rate
PR1	Mid-Barataria	Less Aggressive	75K	Intermediate	20% into range
FWOP/PR2	Future Without Project	N/A (No Diversions)	N/A (No Diversions)	Intermediate	20% into range
PR6	All Four Diversions	Less Aggressive	35K,50K,50K,75K	Intermediate	20% into range
PR7	All Four Diversions	Aggressive	35K,50K,50K,75K	Intermediate	20% into range

Less Aggressive = operation for 5 months (Feb – July) Aggressive = operation all year



WATER QUALITY - TSS: 2070









WATER QUALITY – TSS: 2070

34

3.38

PR6 – **PR2**

PR6 - PR2 TSS Difference : April - Year 2070

PR1 – PR2

April

3.22

3.2

7.4 7.6 7.8



8.2 8.4

X-direction

8.6 8.8 9

8

9.2

×10⁵



PR7 – PR2



8.4

8.6

8.2

X-direction

8

8.8

9

9.2

×10⁵

7.4 7.6 7.8



WATER QUALITY - NO3: 2070



WATER QUALITY – NO3: 2070

PR6 – **PR2**

PR6 - PR2 NO3 Difference : April - Year 2070

PR1 – PR2

April

3.2

7.4 7.6 7.8



8.2 8.4

X-direction

8

8.8

9

8.6

9.2

×10⁵



PR7 – PR2







WATER QUALITY - PO4: 2070







BS6 0.4 PR1 PO4 (gP/m3) 0.0 1.0 1.0 PR2 PR6 PR7 0 01/31 03/02 04/01 08/29 01/01 05/01 05/31 06/30 07/30 09/28 10/28 11/27 12/27 Time (in 2070)

WATER QUALITY - PO4: 2070

7.8

8

8.2 8.4 8.6 8.8 9 9.2

X-direction

PR6 - PR2 PO4 Difference : October - Year 2070

 $\times 10^{5}$

9.2

×10⁵

PR1 –PR2

April

October

3.2

7.4 7.6 7.8

8 8.2 8.4 8.6 8.8 9 9.2

X-direction



PR6 –PR2

PR6 - PR2 PO4 Difference : April - Year 2070

PR7 –PR2





X-direction

×10⁵

8

8.2 8.4 8.6 8.8

X-direction

3.2

×10⁵

7.4 7.6 7.8

WATER QUALITY - Chi a: 2070











WATER QUALITY – Chl a: 2070

PR6 – **PR2**

9.2

9.2

×10⁵

×10⁵

PR1 – PR2 PR1 - PR2 Chl Difference : April - Year 2070 PR6 - PR2 Chl Difference : April - Year 2070 3.4 3.4 3.38 3.38 3.36 3.36 3.34 3.34 3.32 3.32 April 3.3 3.3 3.28 3.28 3.26 3.26 3.24 3.24 3.22 3.22 3.2 3.2 7.4 7.6 7.4 7.6 7.8 8.2 8.4 8.6 8.8 9 9.2 7.8 8 8.2 8.4 8.6 8.8 9 8 X-direction $imes 10^5$ X-direction PR1 - PR2 Chl Difference : October - Year 2070 PR6 - PR2 Chl Difference : October - Year 2070 3.4 3.4 3.38 3.38 3.36 3.36 3.34 3.34 3.32 3.32 October 3.3 3.3 3.28 3.26 3.26 3.24 3.24 3.22 3.22 3.2 3.2 7.4 7.6 7.8 8 8.2 8.4 8.6 8.8 9.2 7.4 7.6 7.8 8 8.2 8.4 8.6 8.8

×10⁵

X-direction

PR7 – PR2







X-direction

PR6 ANIMATION: TSS





PR6 ANIMATION: Chl a





WATER QUALITY CONCLUSIONS

- Operating sediment diversions could result in high concentrations of TSS, NO3, PO4, and ChI a in the open water of estuaries
- TSS
 - Responds to diversion operation (declines when not operating)
 - High concentrations near outfall area
- NO3 and PO4
 - Elevated concentrations at some sites and periods of time
 - High concentrations near outfall area
- Chl a
 - Responds to diversion operation
 - Tends to be consistently higher than FWOP
 - Implications to food webs and fisheries







THANK YOU

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EXTRA SLIDES

SEDIMENT DIVERSION PRODUCTION RUNS (PR)

PR ID	Description	Operating Plan	Design Discharge (cfs)	Sea Level Rise	Subsidence Rate
PR1	Mid-Barataria	Less Aggressive	75K	Intermediate	20% into range
FWOP/PR2	Future Without Project	N/A (No Diversions)	N/A (No Diversions)	Intermediate	20% into range
PR3	Mid-Breton	Less Aggressive	35K	Intermediate	20% into range
PR4	Lower-Breton	Less Aggressive	50K	Intermediate	20% into range
PR5	Lower-Barataria	Less Aggressive	50K	Intermediate	20% into range
PR6	All Four Diversions	Less Aggressive	35K,50K,50K,75K	Intermediate	20% into range
PR7	All Four Diversions	Aggressive	35K,50K,50K,75K	Intermediate	20% into range
PR8	Marsh Creation/Dredge Only	N/A (No Diversions)	N/A (No Diversions)	Intermediate	20% into range
PR9	No Vegetation (20 yrs)	Less Aggressive	35K,50K,50K,75K	Intermediate	20% into range

Less Aggressive = operation for 5 months Aggressive = operation all year PR8 = PR6 diversion footprints with sediment from 11 river bars



D-WAQ: SEDIMENT/SOIL LAYERS





PHYTOPLANKTON- PR2: 2070

April



September



Diatoms

Anabaena

PHYTOPLANKTON- PR6: 2070

April

3.4 × 10

3.38

3.36

3.34

3.32

3.3

3.28

3.26

3.24

3.22

3.2

3.4 × 10

3.38

3.36

3.34

3.32

3.3

3.28

3.26

3.24

3.22

3.2

7.4 7.6

7.8

Y-direction

7.4 7.6 7.8

Y-direction



Diatoms

