BASIN-WIDE MODEL DEVELOPMENT AND APPLICATION

Briefing to Diversion Panel

8/31/16

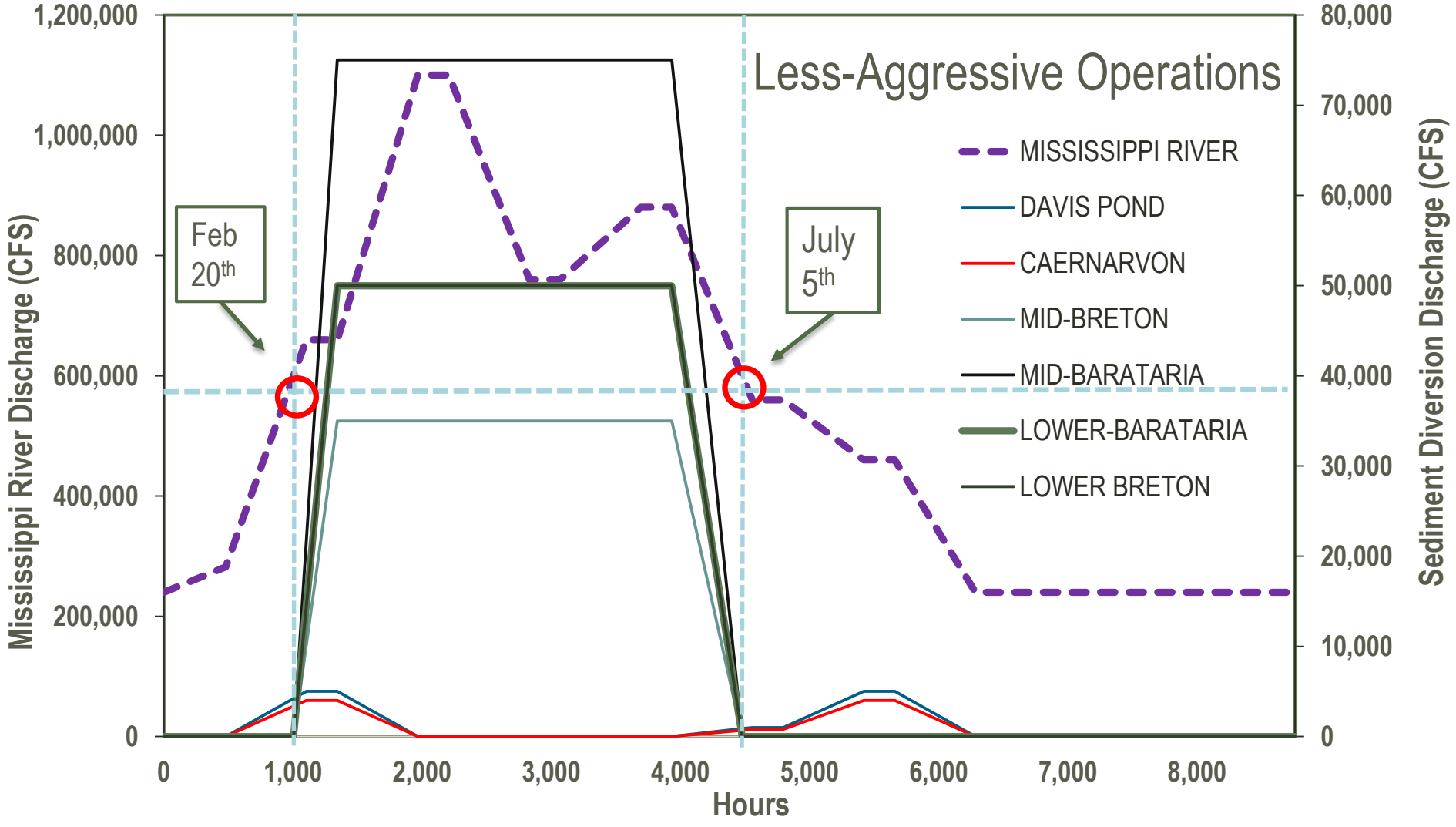
THE WATER INSTITUTE
OF THE GULF™

PRESENTATION OUTLINE

- Two mid-basin diversions: 50-year simulation
- Summary of model updates: Basinwide-V2
- Impact of vegetation on land change
- Synergy between diversions and marsh creation
- Optimization of operation plans (using historical hydrograph)

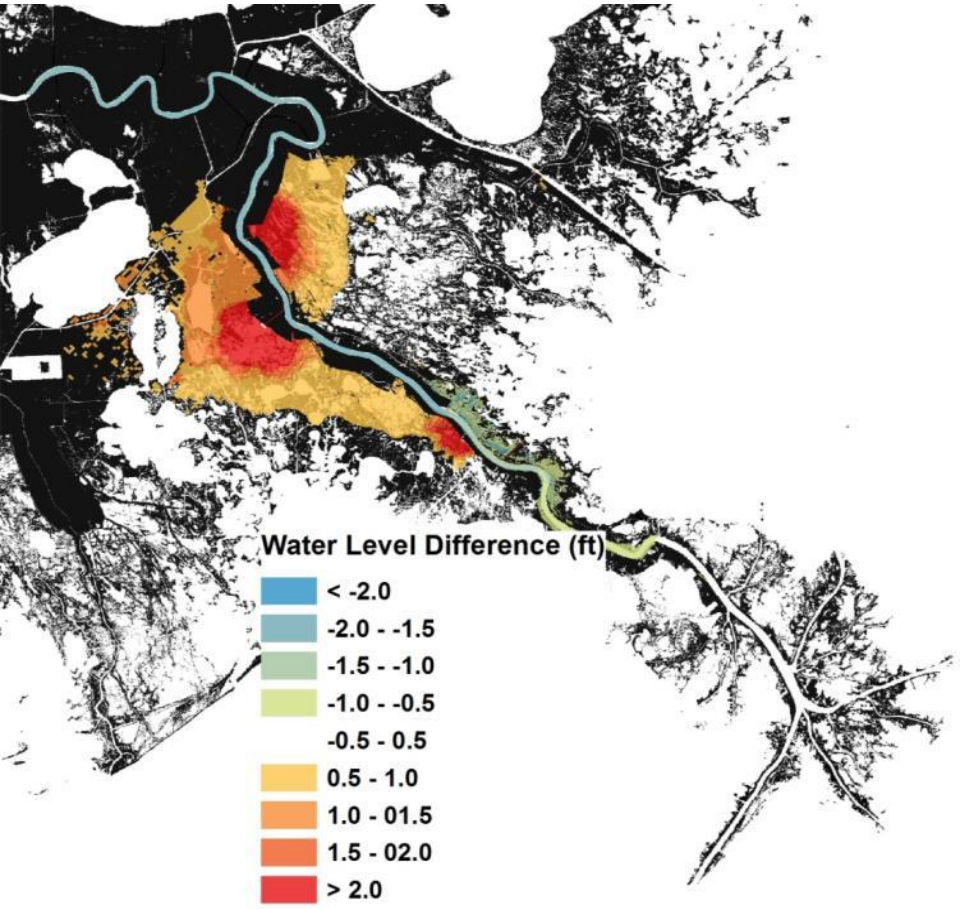
PROPOSED SEDIMENT DIVERSIONS

OPERATION PLAN

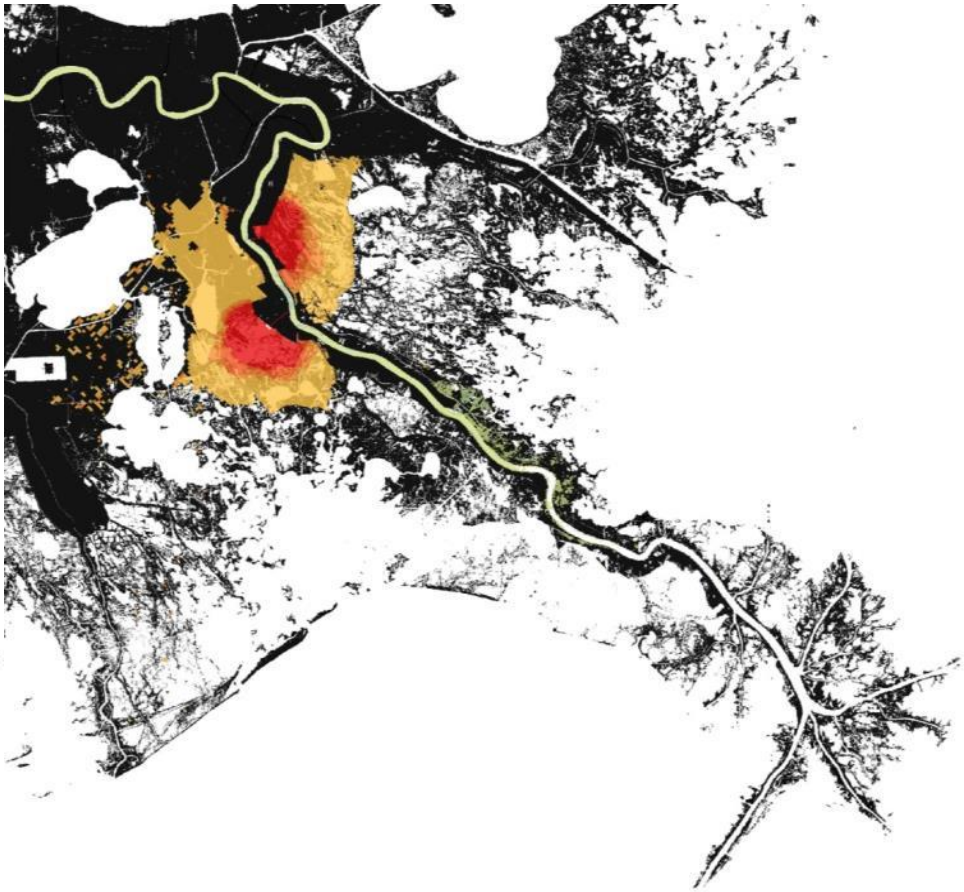


WATER LEVEL DIFFERENCE

Difference Between Future Without Project and 4 Diversions (Year 2070)



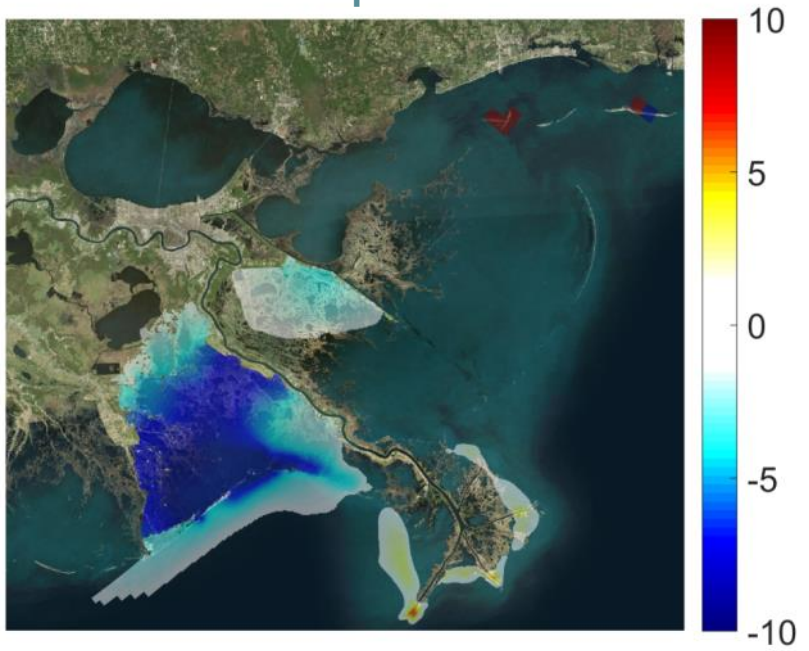
Difference Between Future Without Project and 2 Diversions (Year 2070)



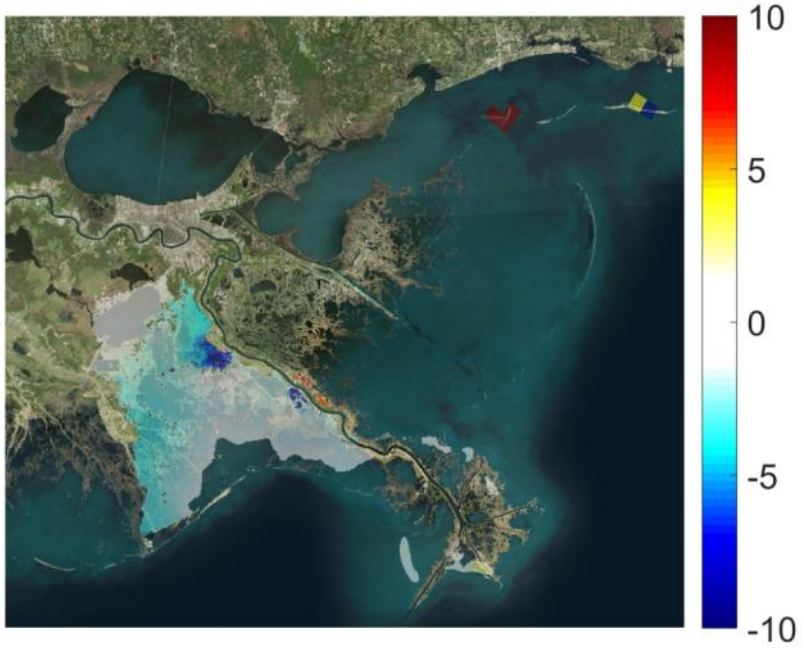
SALINITY - YEAR 2070

All Diversions – Future Without Project

April



October



SALINITY - YEAR 2070

Mid Diversions – Future Without Project

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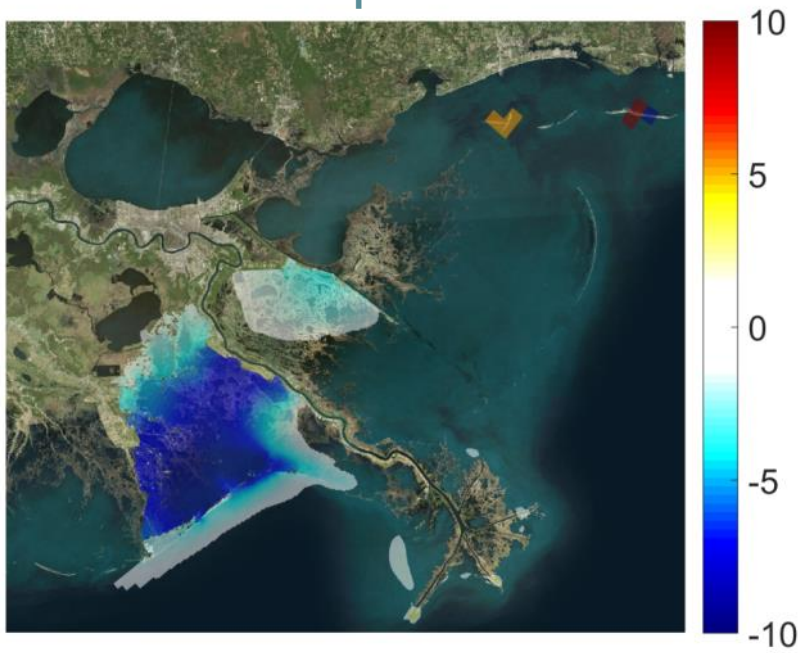

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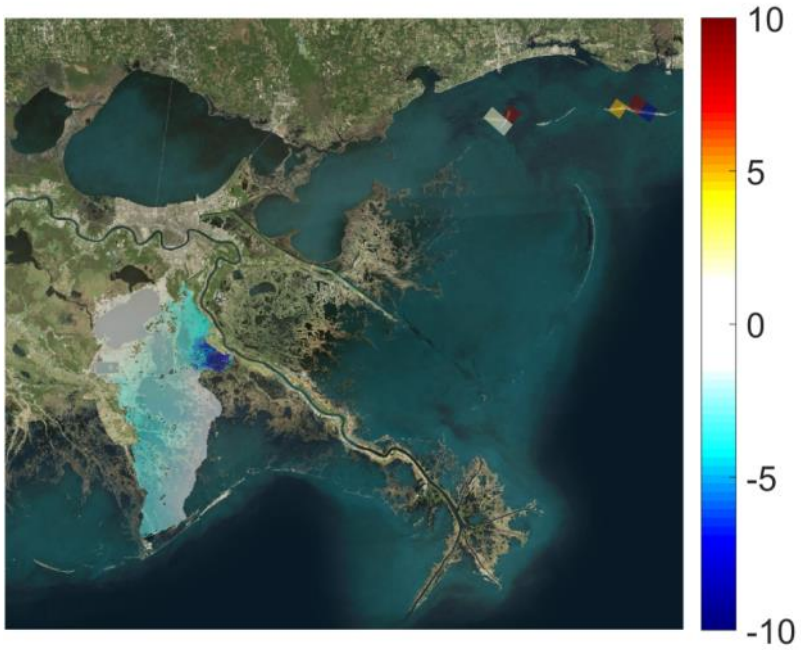
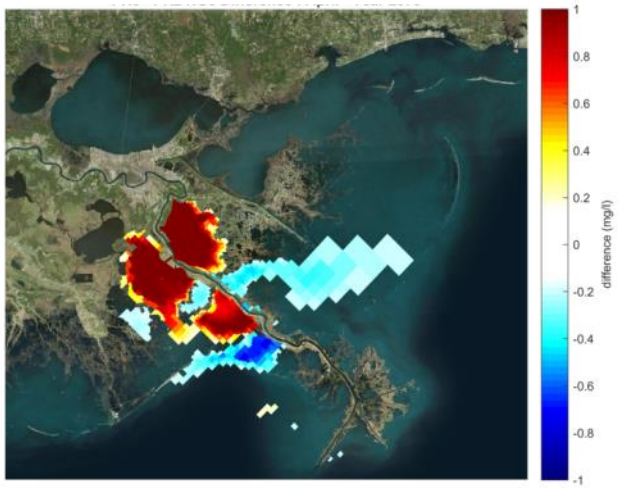


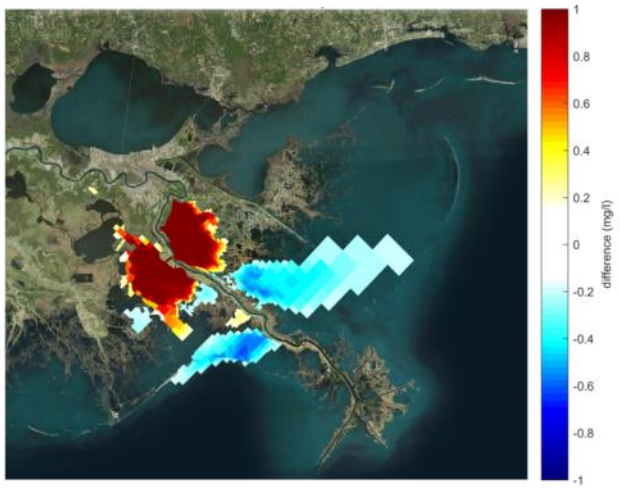
NITRATE: YEAR 2070

All Diversions – FWOP

Mid Diversions – FWOP

April





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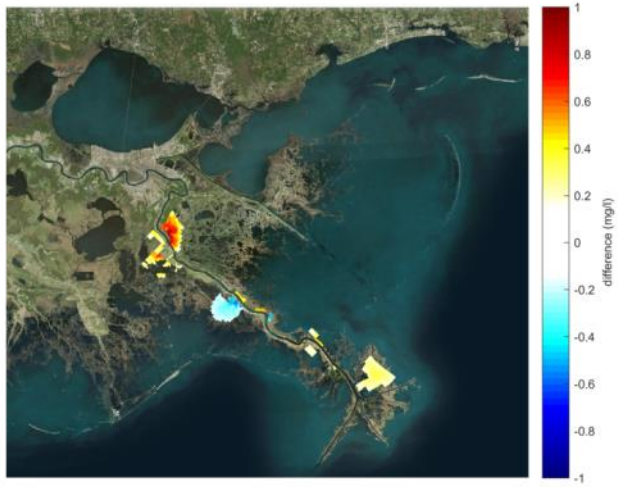
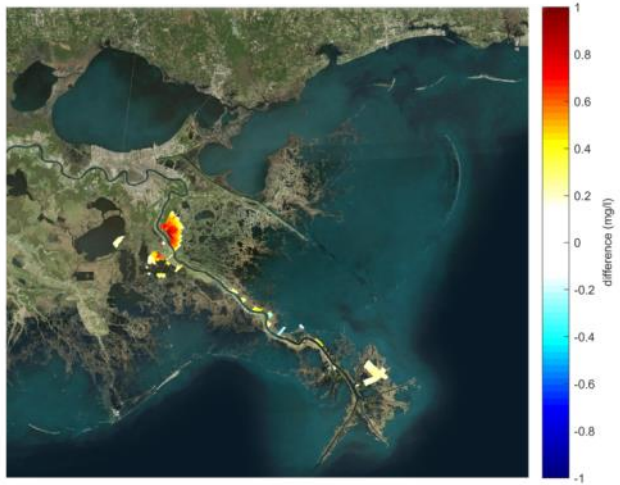
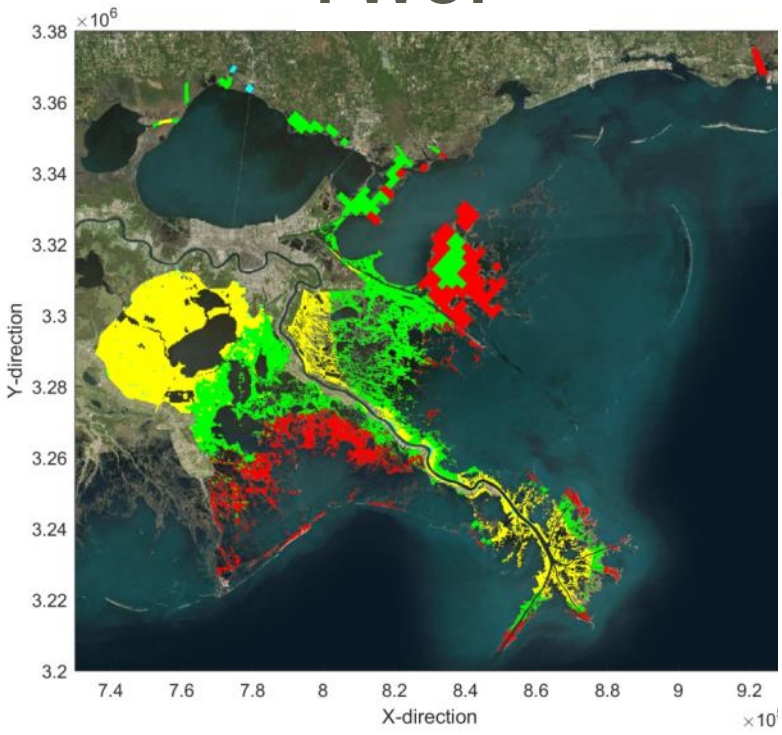


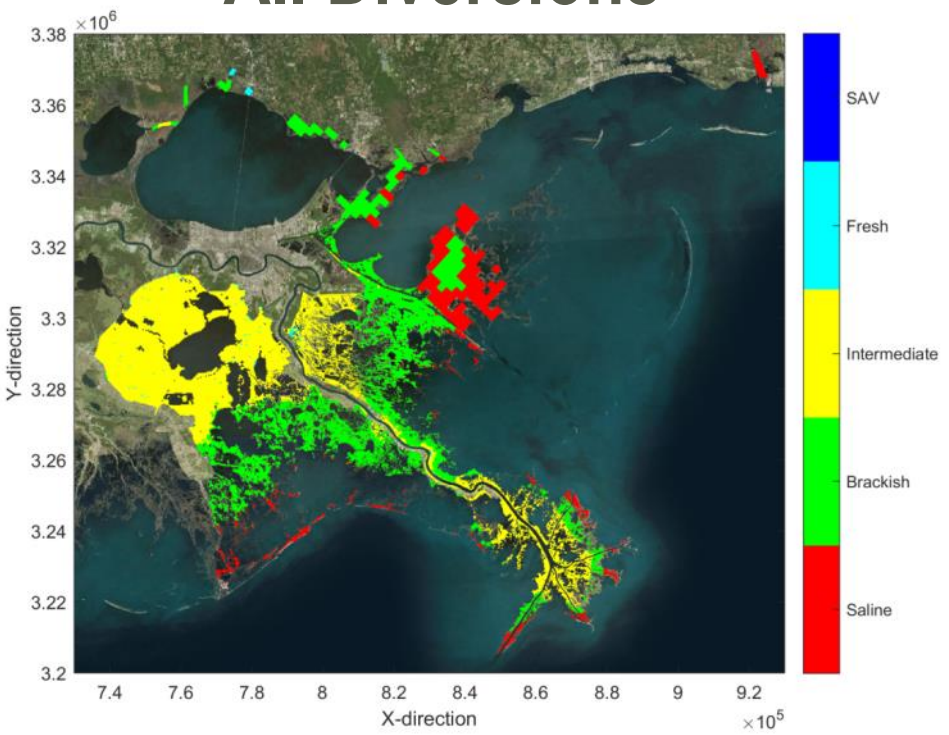


VEGETATION: YEAR 2070

FWOP

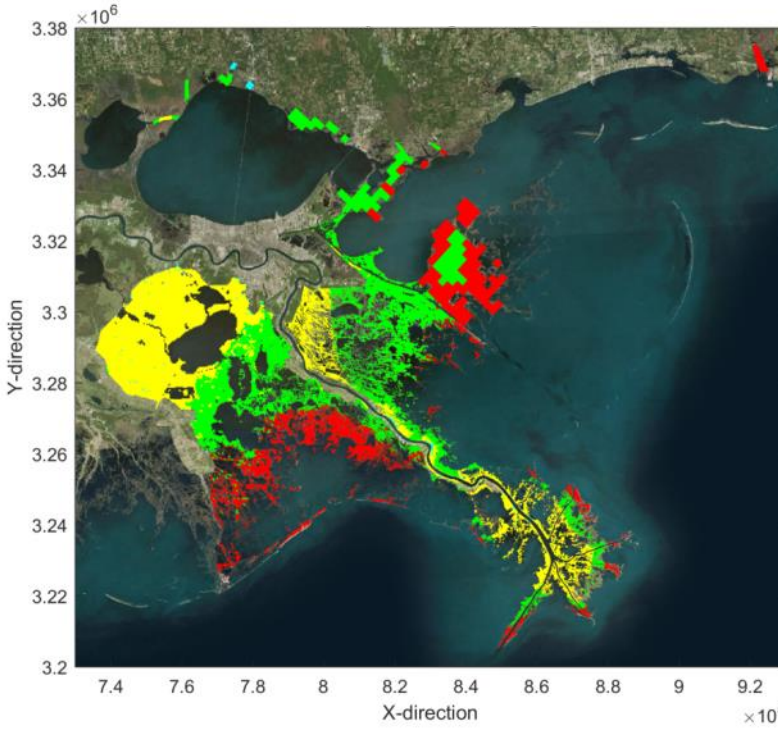


All Diversions

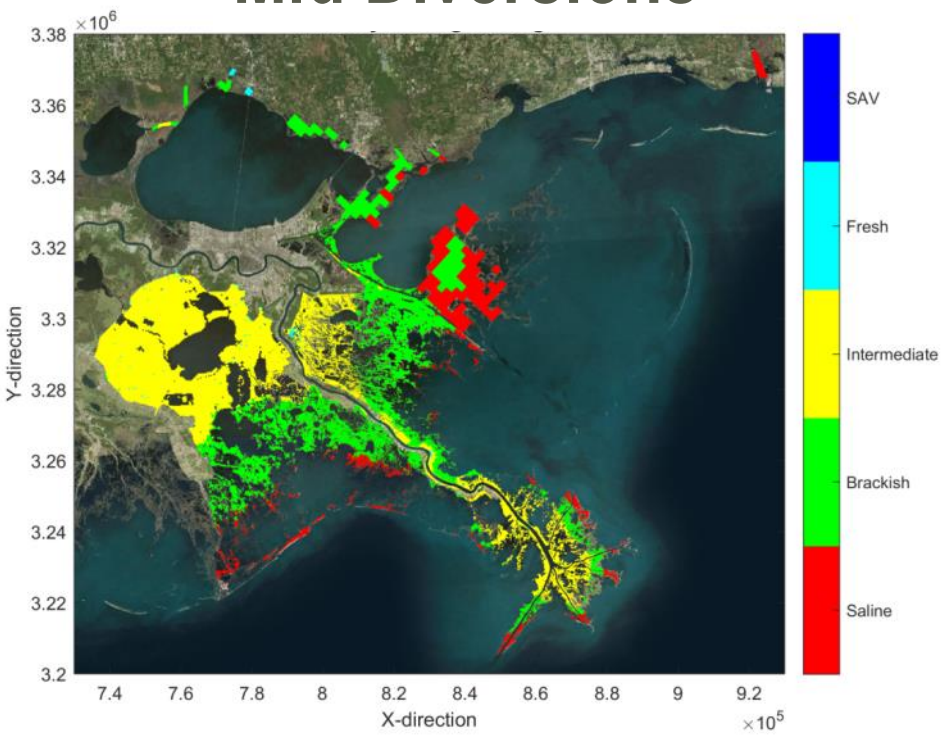


VEGETATION: YEAR 2070

FWOP

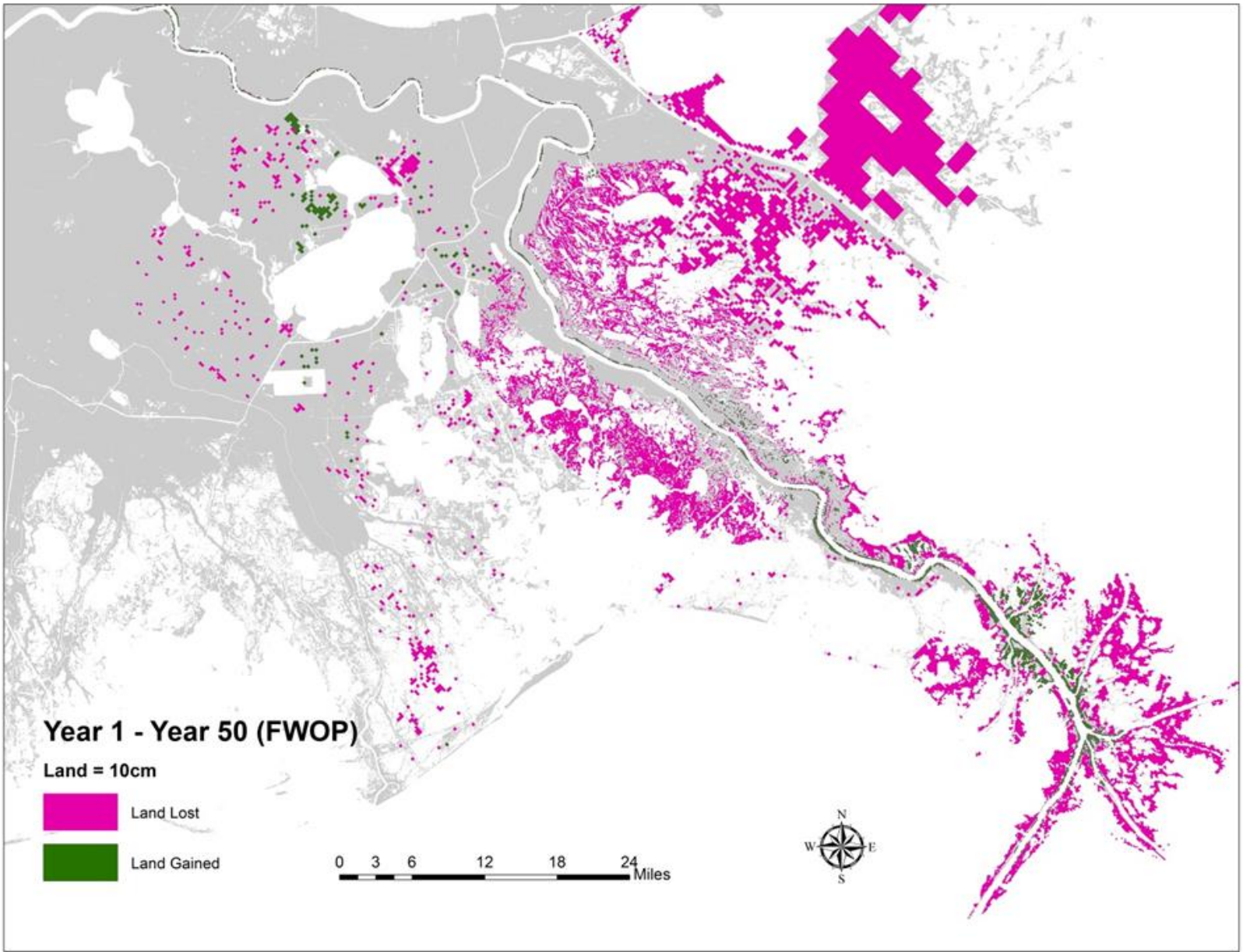


Mid Diversions



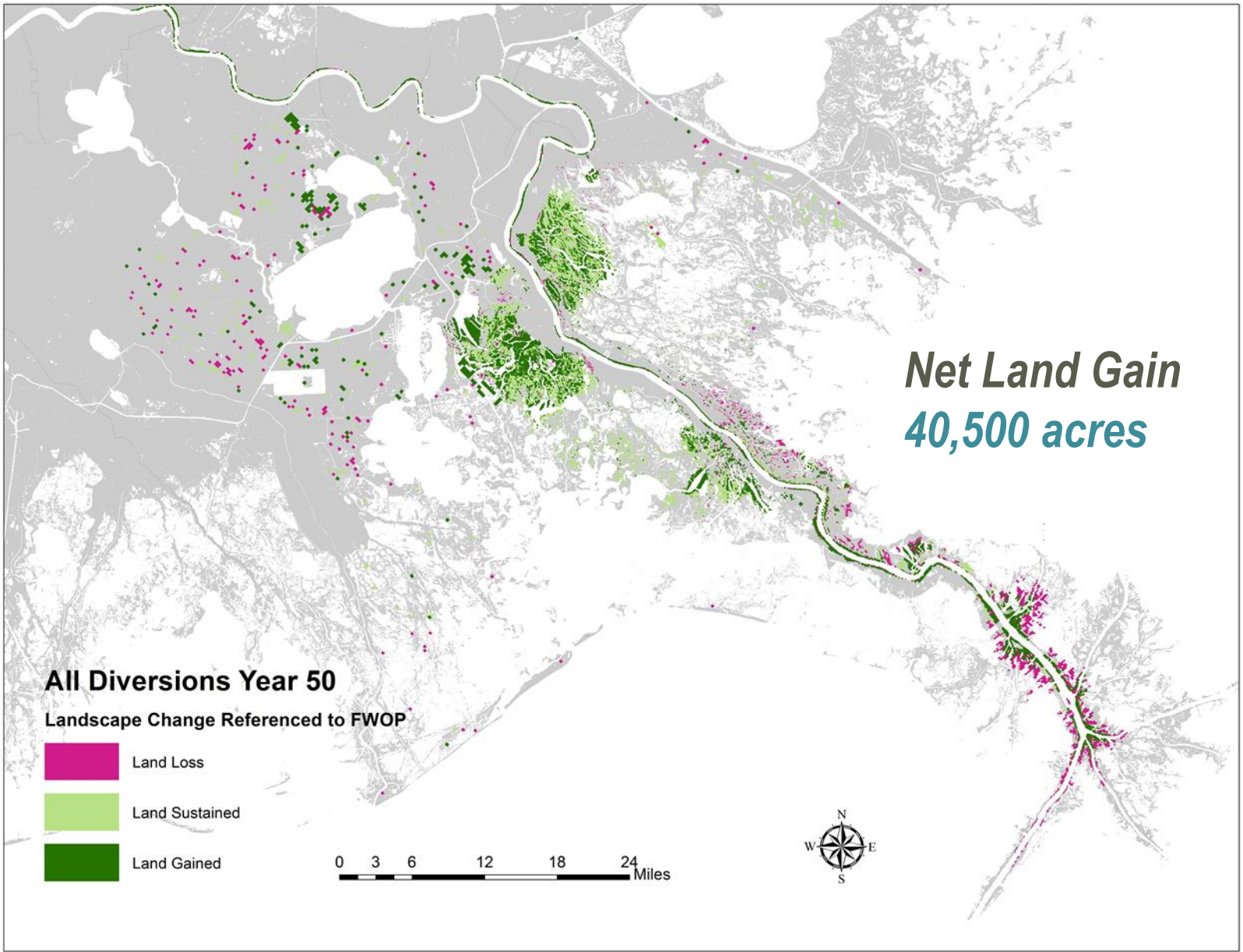
LAND CHANGE BY YEAR 2070

FUTURE WITHOUT PROJECT

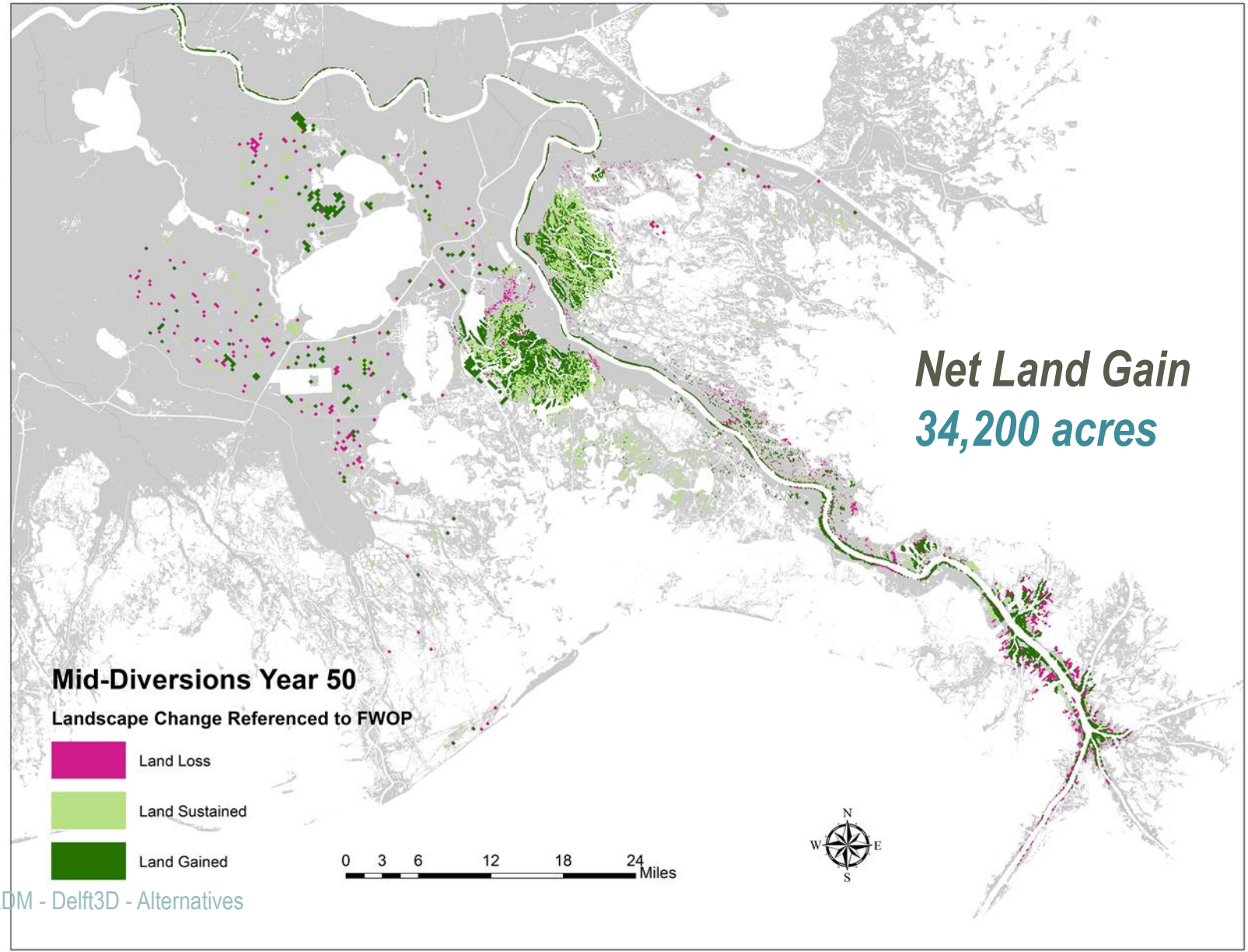


LAND CHANGE BY YEAR 2070

ALL DIVERSIONS

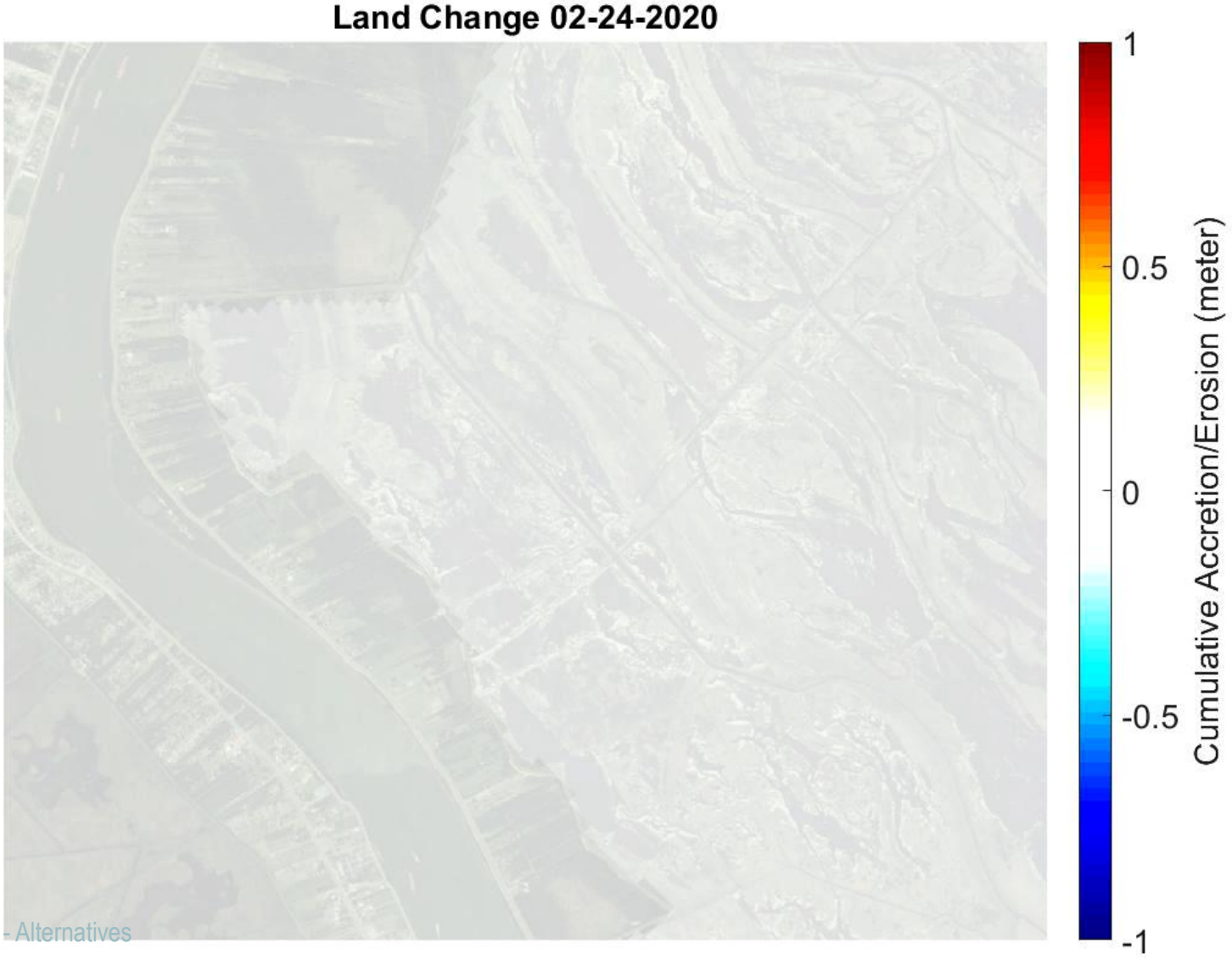


LAND CHANGE BY YEAR 2070
MID DIVERSIONS



BED LEVEL CHANGE: MID-BARATARIA

BED LEVEL CHANGE: MID-BRETON

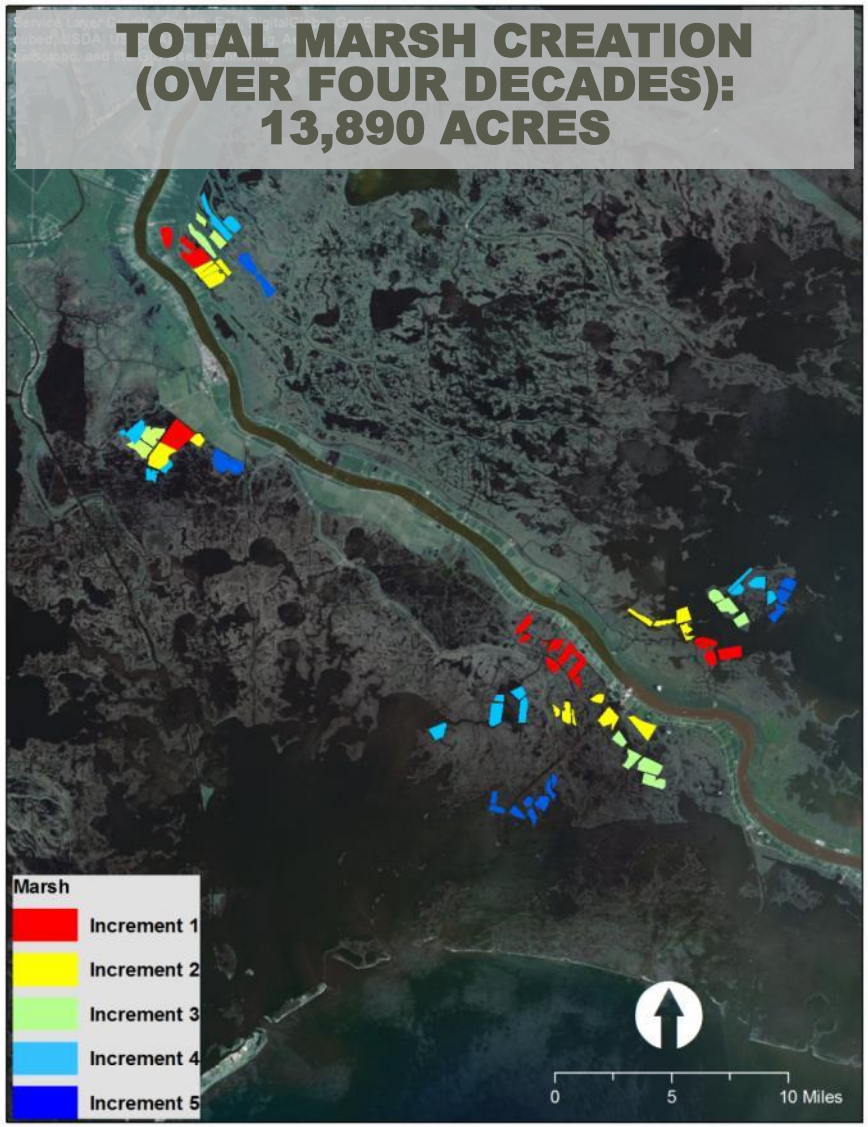


LAND CHANGE SUMMARY TABLE

MR Delta Management Land Loss in FWOP: 2020 - 2070		
Acreage: Land Loss		
Barataria	Breton Sound	MR Delta and NWR
-152,810	-96,687	-59,287

MR Delta Management Land Change Summary - 2070				
Referenced to FWOP				
	Acreage: Net Land Gain/Loss			
Name	Barataria	Breton Sound	MR Delta and NWR	Net
All Diversions - Less Aggressive	31,987	16,421	-7,888	40,520
Mid Diversions-Less Aggressive	23,704	14,855	-4,321	34,237

DREDGE ONLY: MARSH AREA



MODEL UPDATES: BASINWIDE – V2

- Revisions to the grid design & initial land area
- Update of projects in the landscape
- Improved model calibration
- Improved coupling between veg & morph
- Update soil properties
- Real Time Control for Caernarvon and Davis Pond

INITIAL ACREAGE

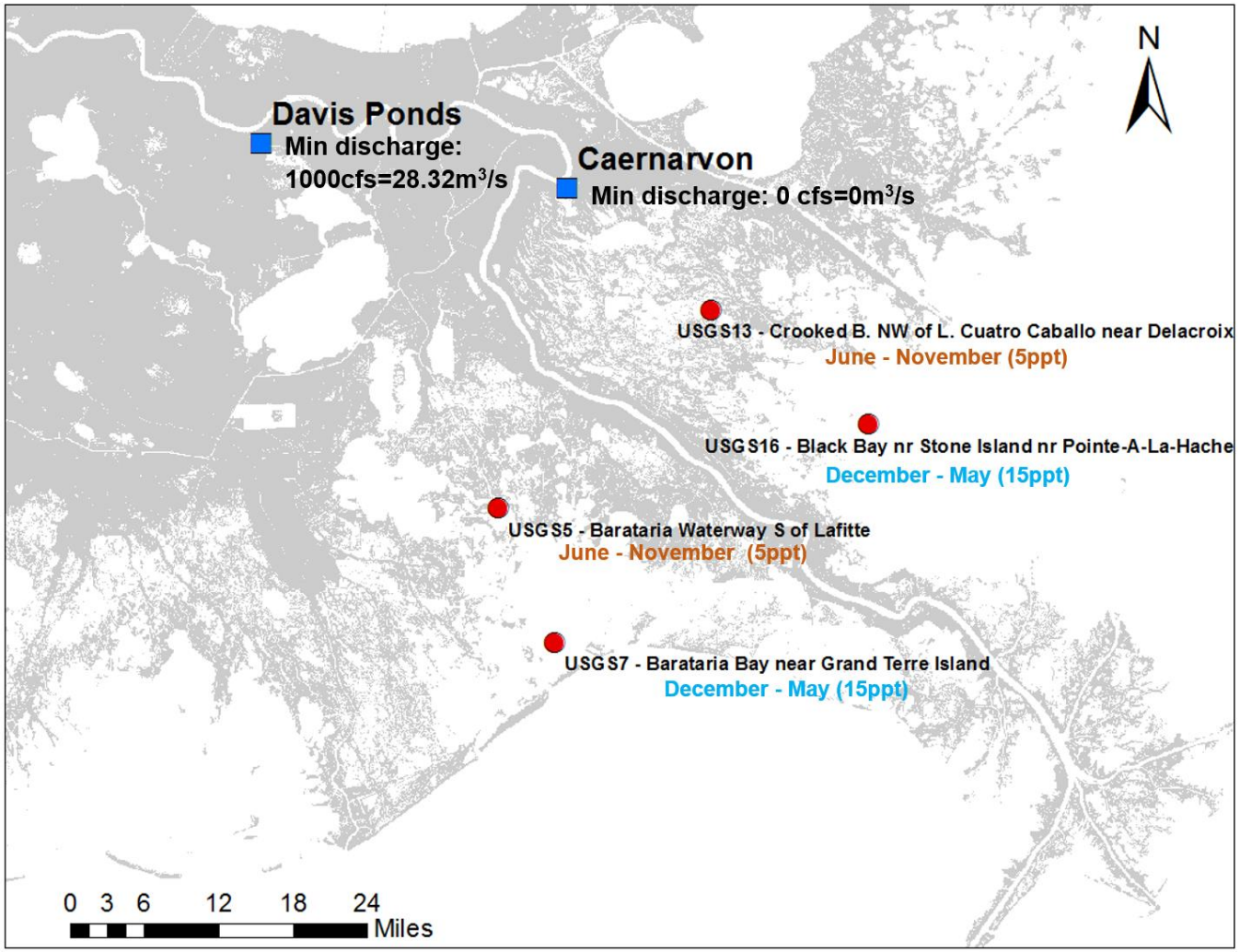
Model and Version	Land Acreage (bed elevation >= 0ft, NAVD 88)			
	Barataria	Breton	MRD	Sum
Delft3d V1	259,974	149,090	74,404	483,468
Delft3d V2 – EC*	341,571	162,447	68,719	572,737
Delft3d V2 – FWOP**	344,821	163,141	71,339	579,302
Master Plan	364,165	157,720	72,920	594,805
ADH	383,000	178,525	~59,000	597,758

* EC: existing conditions.

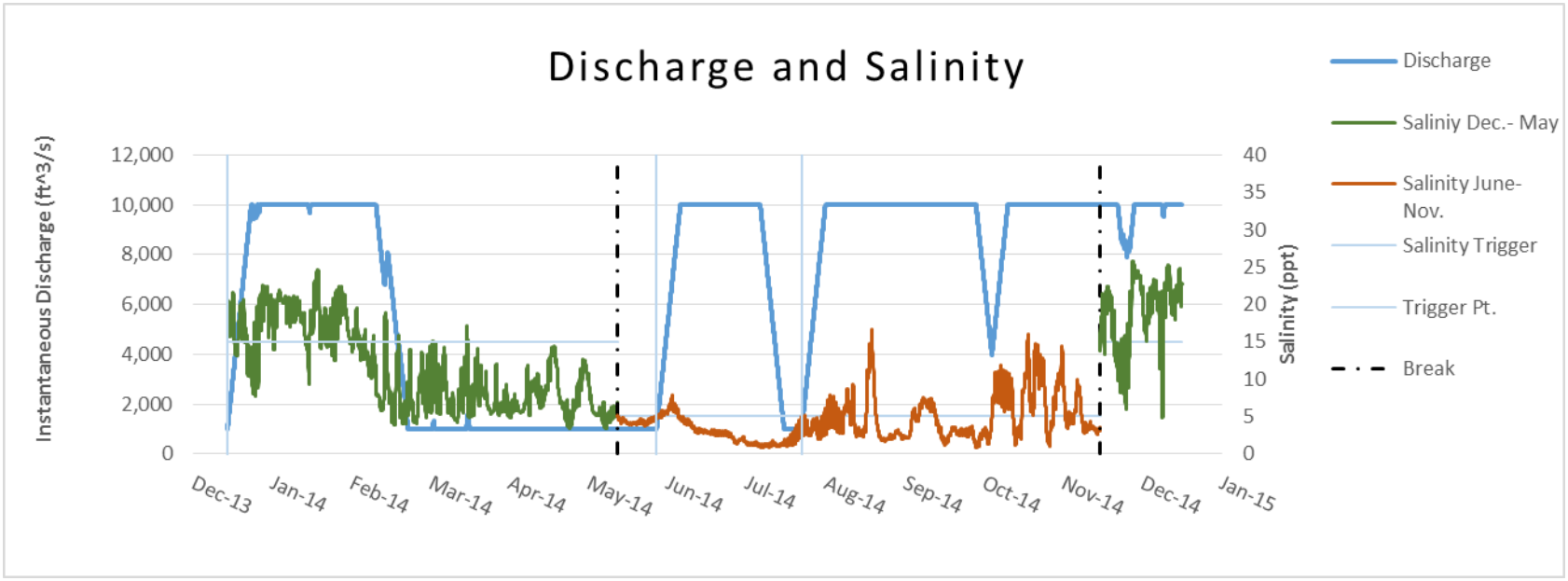
** FWOP: includes projects under (or imminent) construction

*** approximate estimate from ERDC

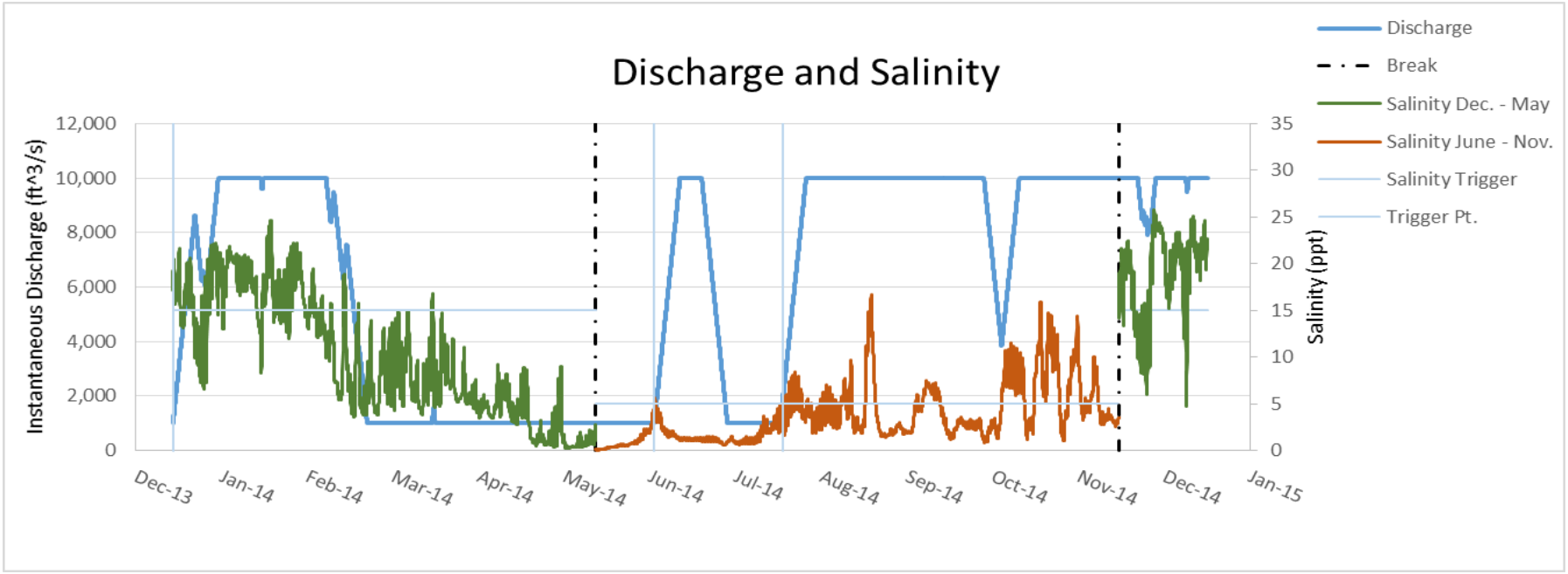
REAL TIME CONTROL
RULES AND TRIGGER STATIONS



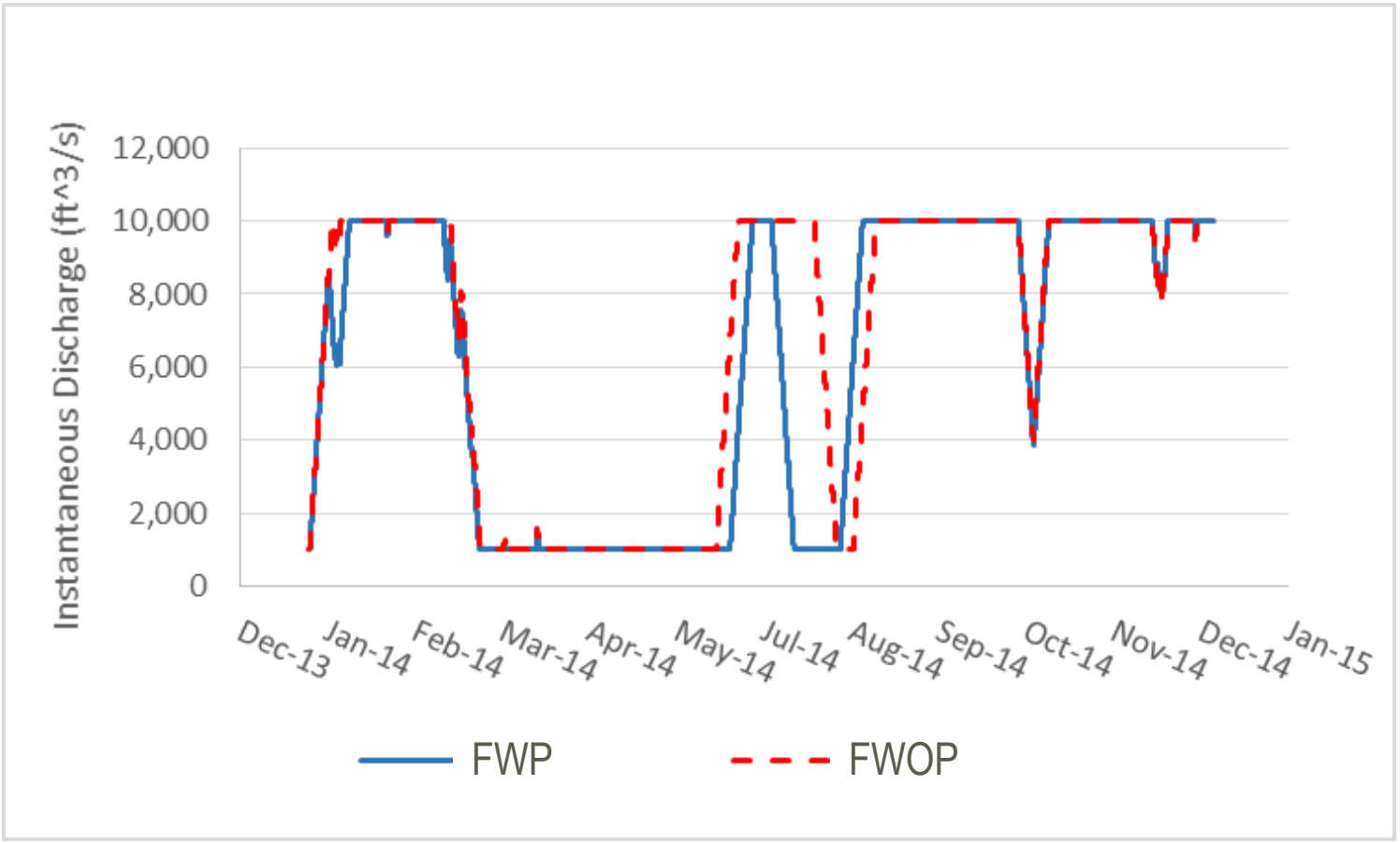
FWOP: DAVIS POND DISCHARGE



FWP: DAVIS POND DISCHARGE

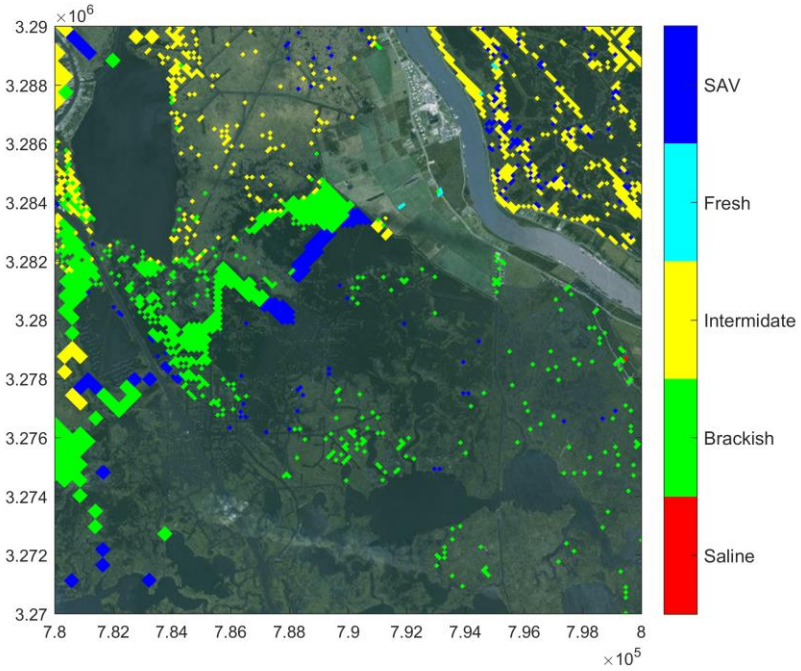


DAVIS POND DISCHARGES: FWOP & FWP

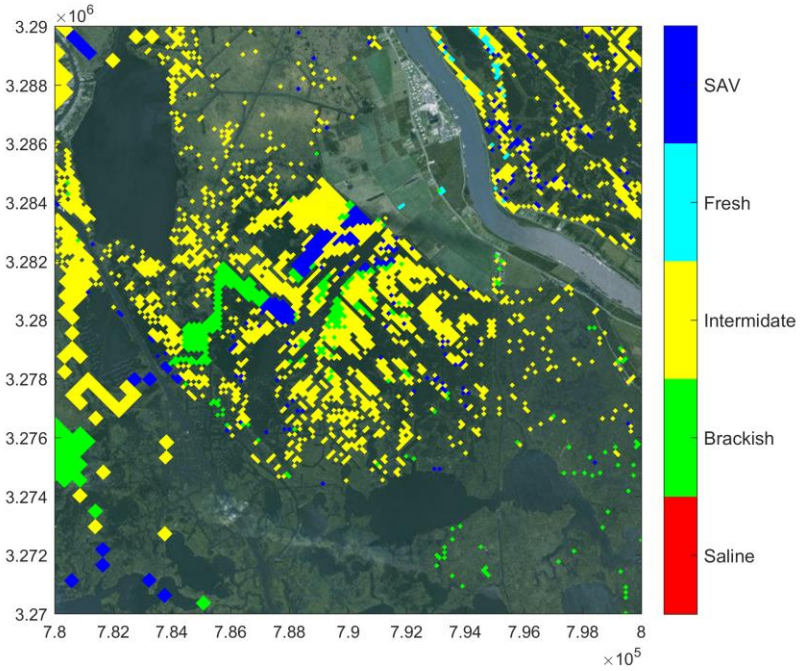


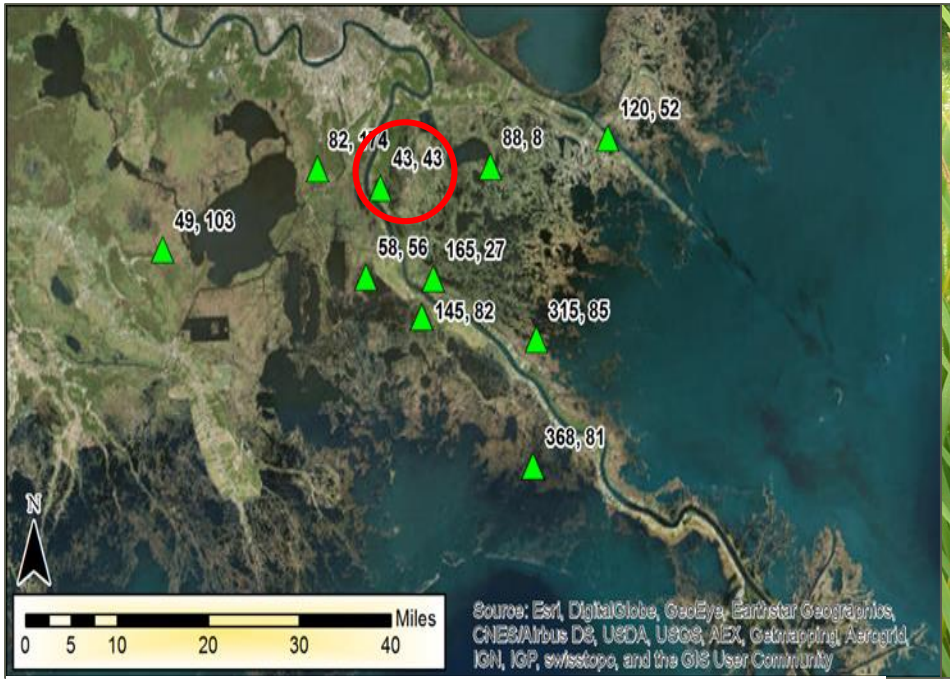
VEGETATION COVERAGE: OUTFALL MID BARATARIA

FWOP



FWP

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82, 114
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49, 103
58, 56
165, 27
145, 82
315, 85
368, 81
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Miles
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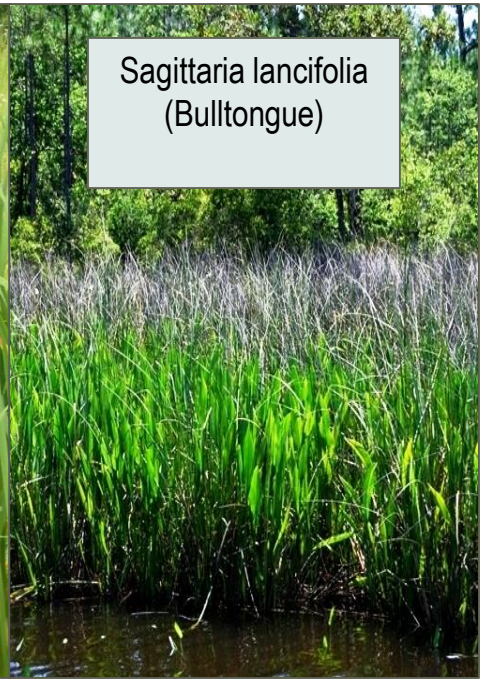
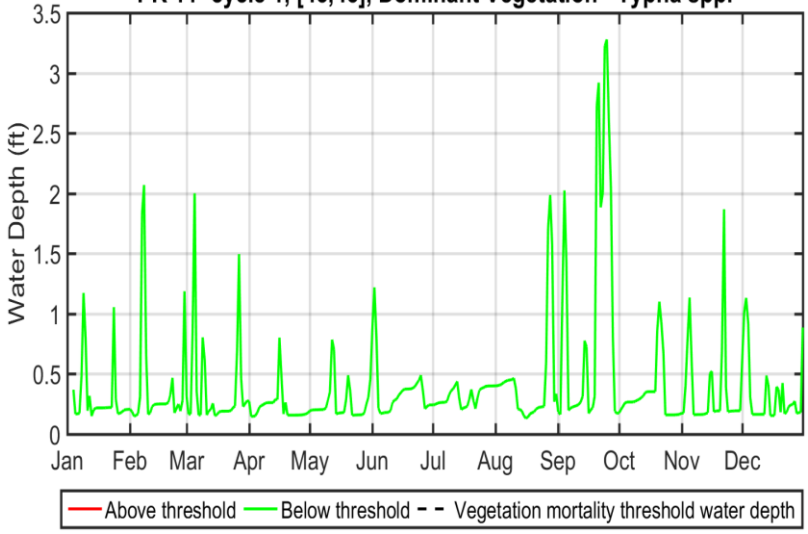
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Typha spp. (Cattail)


Sagittaria lancifolia (Bulltongue)


PR 11- cycle 1, [43,43], Dominant Vegetation - Typha spp.
Water Depth (ft)
3.5
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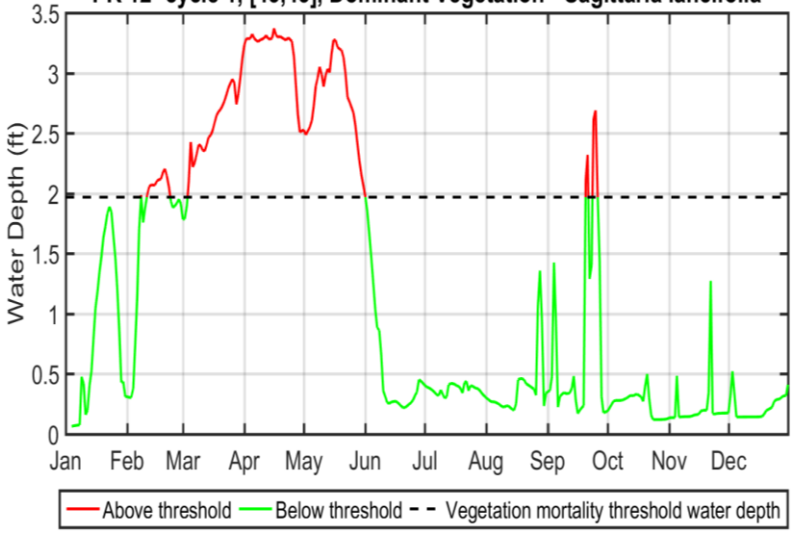
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Above threshold
Below threshold
Vegetation mortality threshold water depth


PR 12- cycle 1, [43,43], Dominant Vegetation - Sagittaria lancifolia
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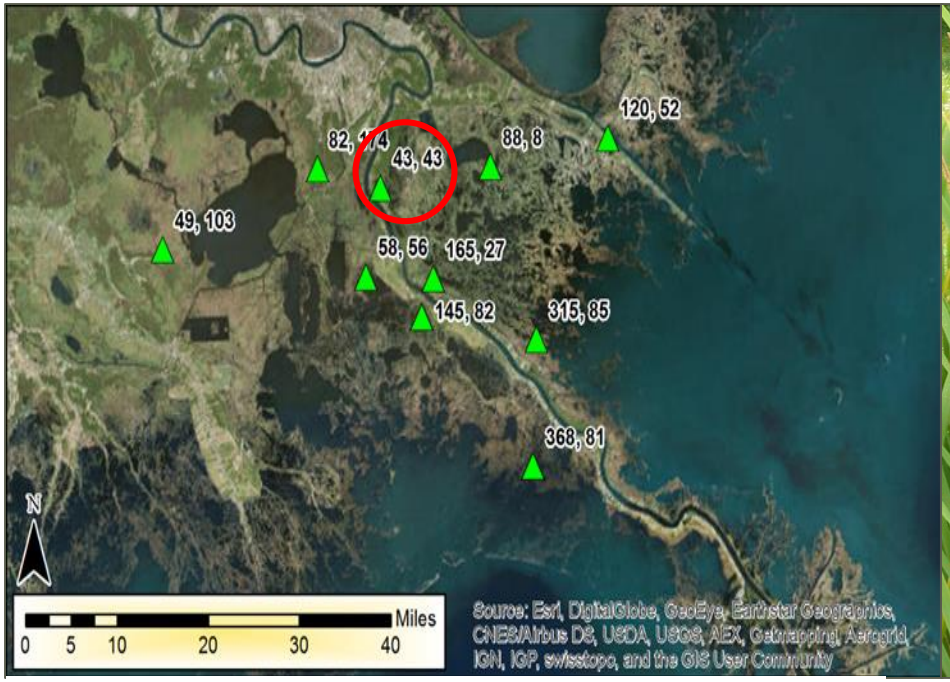
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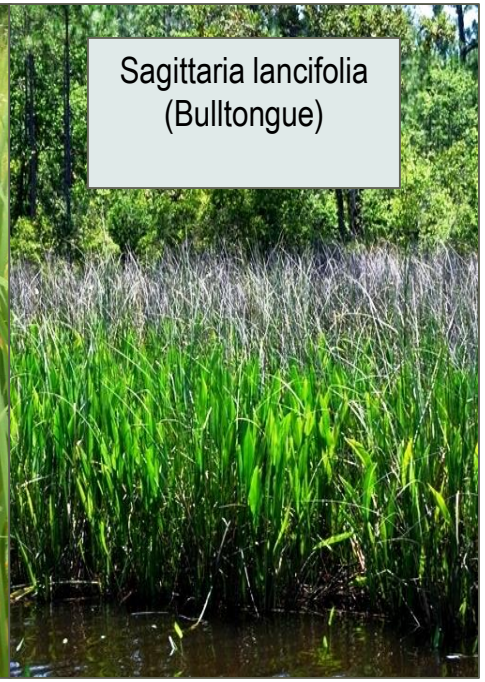
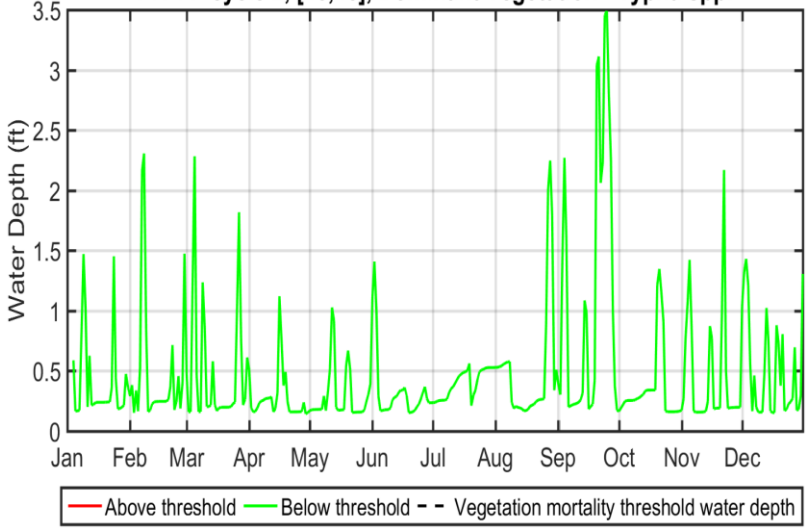

Sagittaria lancifolia (Bulltongue)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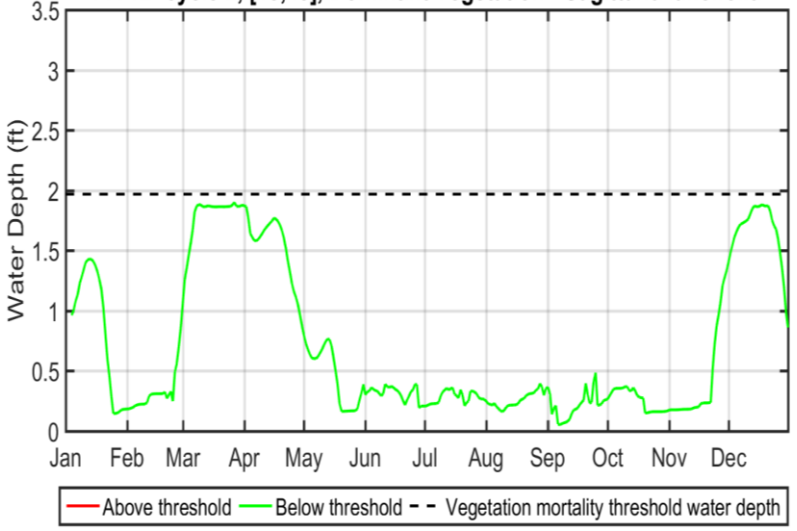
Vegetation mortality threshold water depth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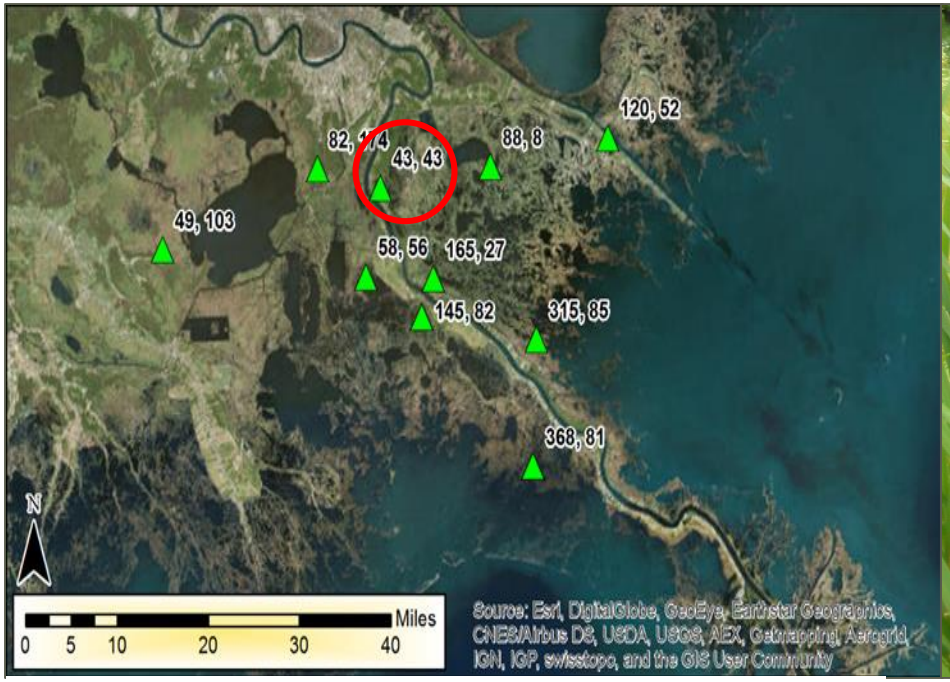
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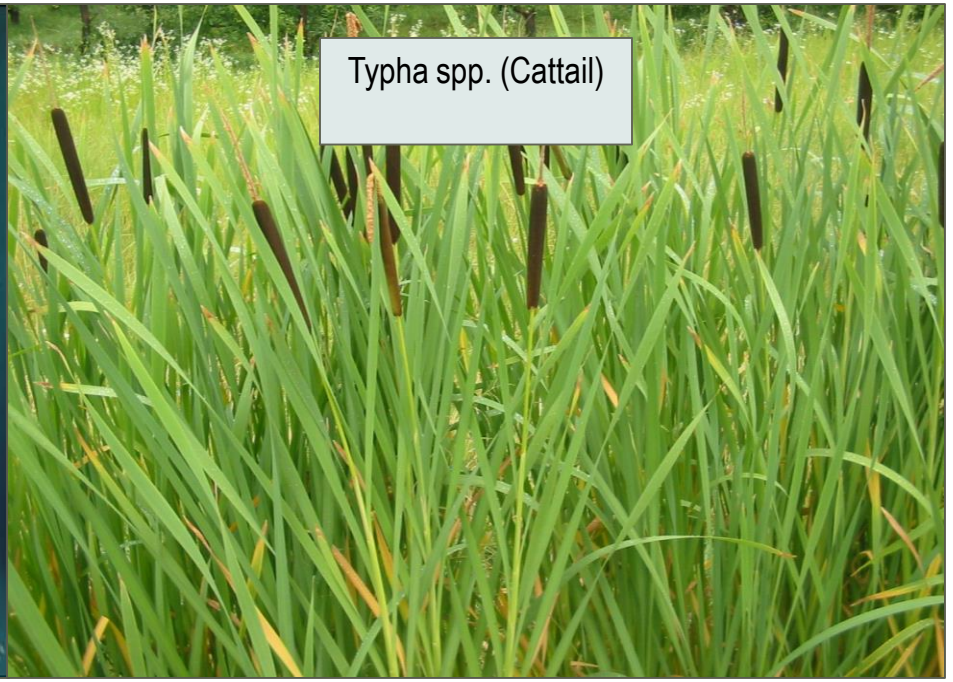
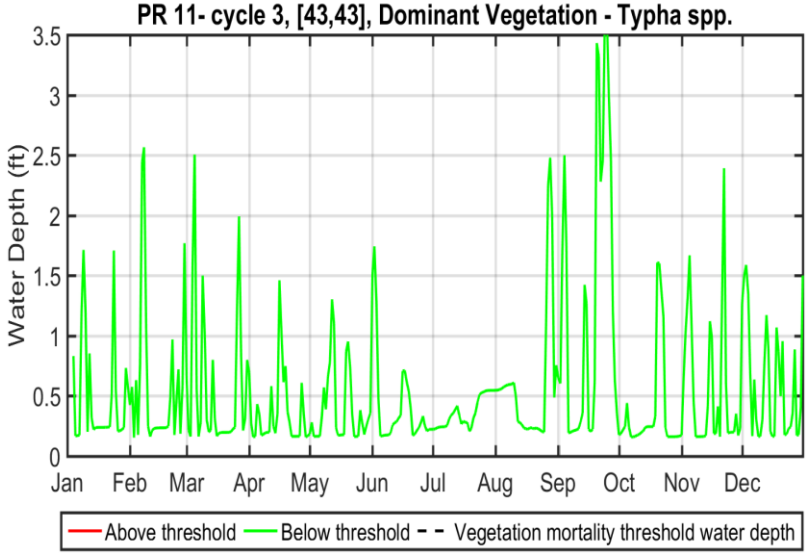

Typha spp. (Cattail)


PR 11- cycle 3, [43,43], Dominant Vegetation - Typha spp.
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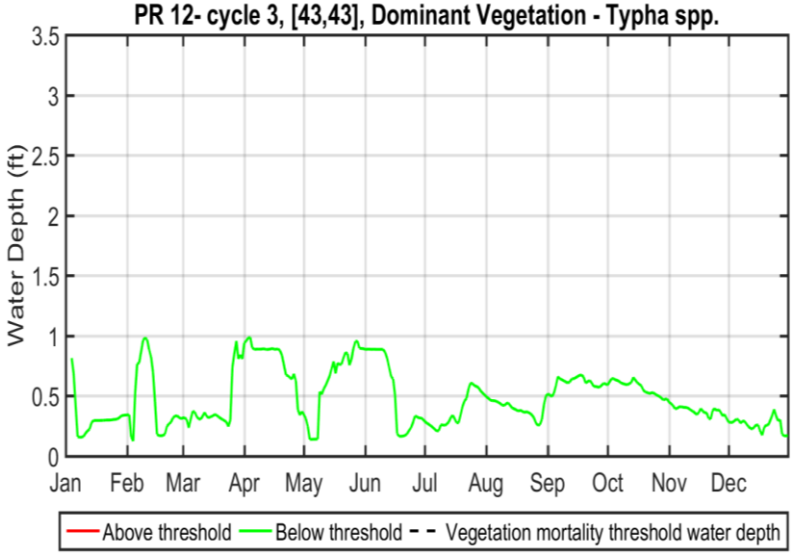
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Above threshold
Below threshold
Vegetation mortality threshold water depth

VEGETATION TESTS (ONE DECADE SIMULATIONS)

Test 2 - (80% height) representative hydrograph				
	Acres (2020)	Acres (2030)	Y10 Loss (2030-2020)	% Loss Y10
Barataria	273,950	268,807	5,143	2%
Breton	136,799	124,301	12,498	9%
MR Delta	52,752	42,022	10,730	20%
Total	463,501	435,130	28,371	**6%**
Test 4 - (50% height) representative hydrograph				
	Acres (2020)	Acres (2030)	Y10 Loss (2030-2020)	% Loss Y10
Barataria	273,950	239,617	34,333	13%
Breton	136,799	117,235	19,564	14%
MR Delta	52,752	38,177	14,575	28%
Total	463,501	395,029	68,472	**15%**
Test 3 - (20% height) representative hydrograph				
	Acres (2020)	Acres (2030)	Y10 Loss (2030-2020)	% Loss Y10
Barataria	273,950	168,272	105,678	39%
Breton	136,799	103,044	33,755	25%
MR Delta	52,752	20,605	32,147	61%
Total	463,501	291,921	171,580	**37%**

Elevation Criteria:
Year 1 (2020): Land > 0.0295 mNAVD88
Year 10 (2030): Land > 0.0644 mNAVD88

SYNERGY:
MARSH CREATION & DIVERSIONS

	2017 MP Scenario	Trigger Threshold	Model Naming Convention
FWOA-A	Medium (S04)	200,000 cfs	S04 - TO40G001
Alt2-A	Medium (S04)	200,000 cfs	S04 - TO40G002
Alt4-A	Medium (S04)	200,000 cfs	S04 - TO40G004
Alt5-A	Medium (S04)	200,000 cfs	S04 - TO40G005
Alt6-A	Medium (S04)	200,000 cfs	S04 - TO40G006
Alt7-A	Medium (S04)	200,000 cfs	S04 - TO40G007
Alt8-A	Medium (S04)	200,000 cfs	S04 - TO40G008
FWOA-B	Medium (S04)	***600,000 cfs***	S04 - TO40G100
Alt8-B	Medium (S04)	***600,000 cfs***	S04 - TO40G108
FWOA-C	***High (S03)***	200,000 cfs	S03 - TO40G001
Alt8-C	***High (S03)***	200,000 cfs	S03 - TO40G008

TO40 – MARSH CREATION ALTERNATIVES

Land area in UBA, LBA, BRT ecoregions:

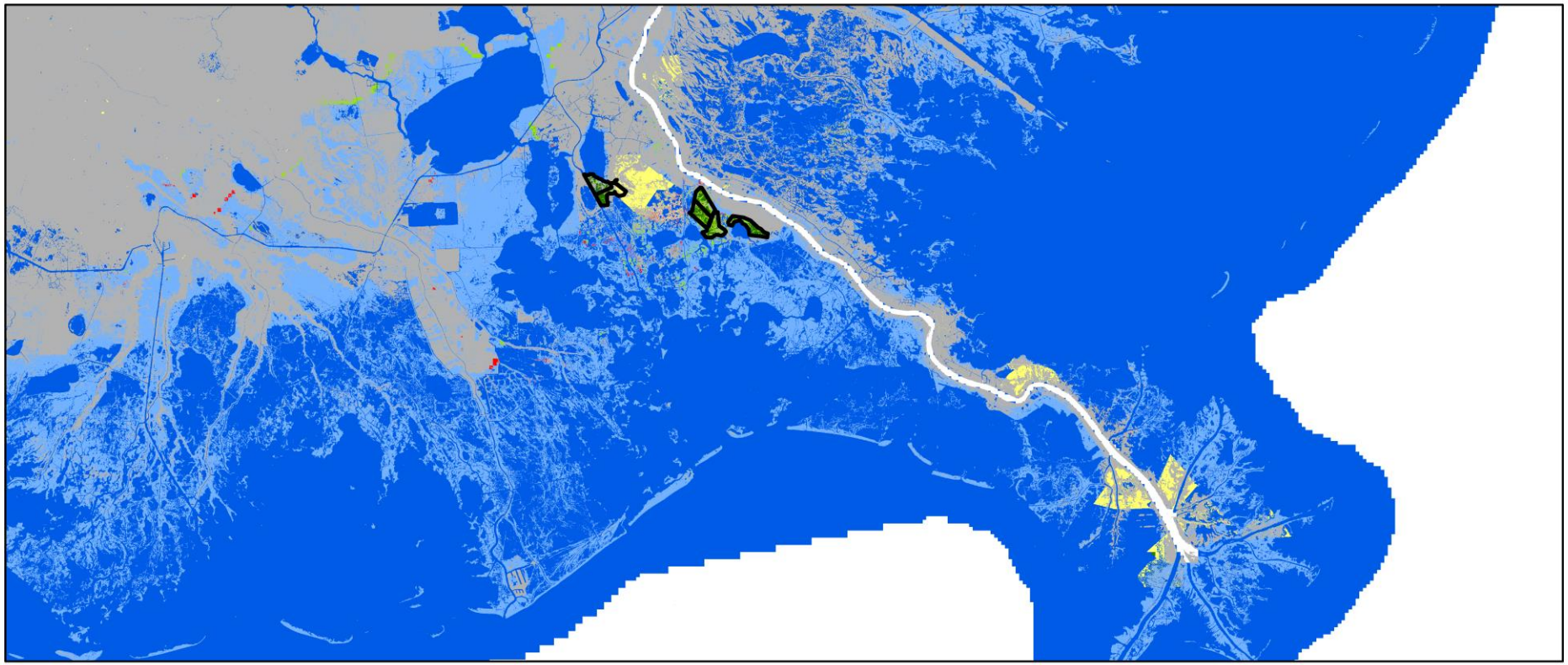
	Year 0	Year 1	Year 50	Year 50 Difference
	acres	*acres*	*acres*	*acres*
FWOA-A	1,080,296	1,071,103	754,982	-
Alt2-A	1,080,296	1,076,065	752,080	-2,902
Alt4-A	1,080,296	1,075,501	752,470	-2,512
Alt5-A	1,080,296	1,077,290	758,215	3,232
Alt6-A	1,080,296	1,075,895	759,969	4,986
Alt7-A	1,080,296	1,075,804	757,730	2,748
Alt8-A	1,080,296	1,074,786	762,195	7,213
FWOA-B	1,080,296	1,071,137	713,581	-
Alt8-B	1,080,296	1,074,819	719,846	6,266
FWOA-C	1,080,296	1,071,064	635,814	-
Alt8-C	1,080,296	1,074,260	633,719	-2,095

FUTURE WITHOUT ACTION A

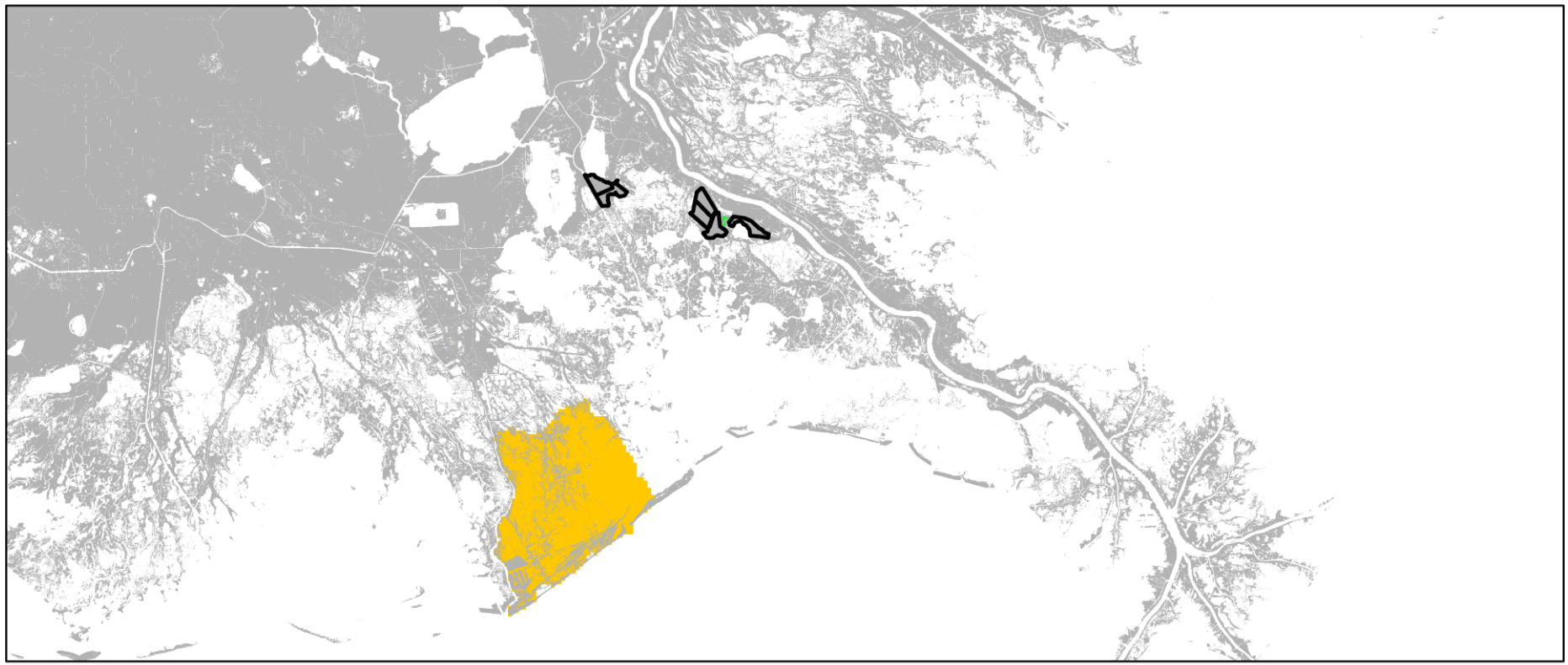
2017 MP **Medium Scenario (S04)** Future Without Action plus:

- Mid Breton Sediment Diversion active from year 0
  - 0 cfs when Mississippi River Q < **200k cfs**
  - 35k cfs when Mississippi River Q = 1.0m cfs
- Mid Barataria Sediment Diversion active from year 0
  - 0 cfs when Mississippi River Q < **200k cfs**
  - 75k cfs when Mississippi River Q = 1.25m cfs
- Real time control on Davis Pond and Caernarvon
  - Use existing control rules based upon 5 ppt and 15 ppt thresholds in receiving basins

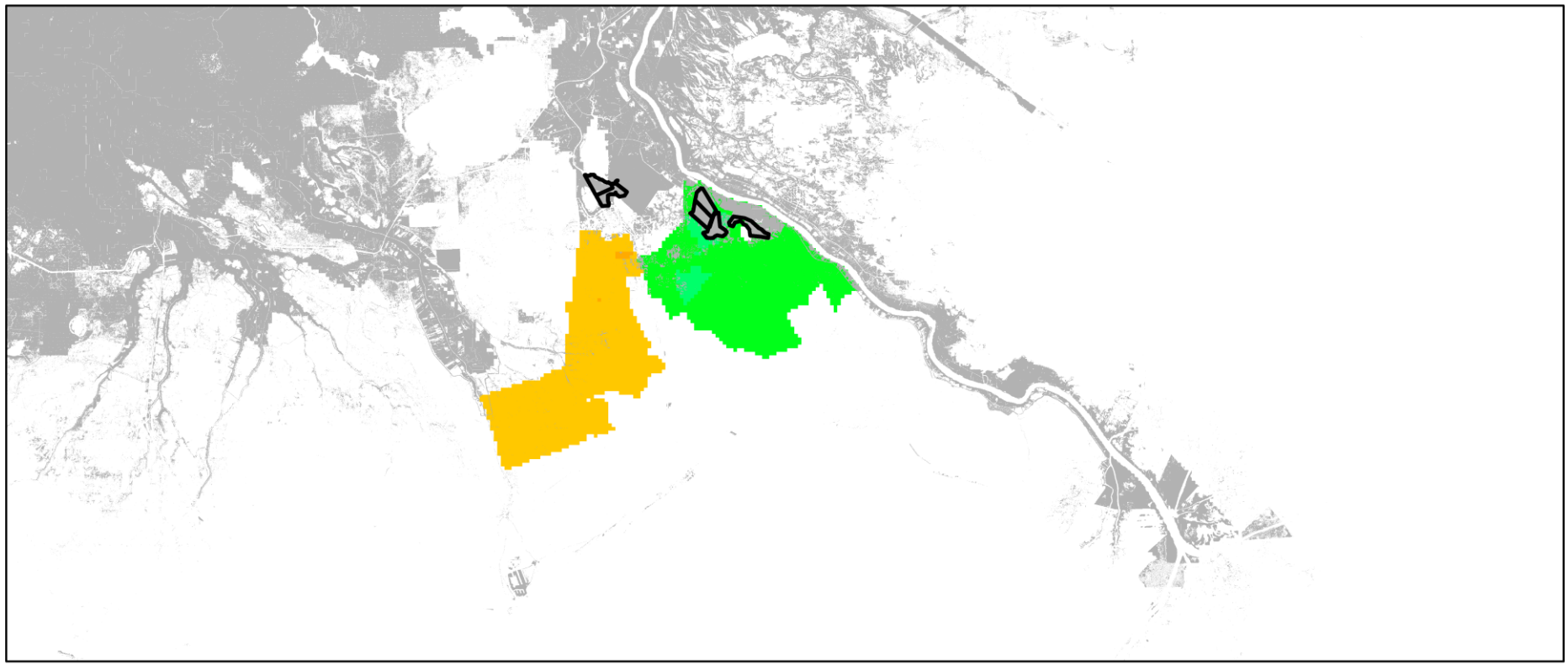
ALTERNATIVE 8-A LAND CHANGE



ALTERNATIVE 8-A SALINITY IMPACT



ALTERNATIVE 8-A SALINITY IMPACT

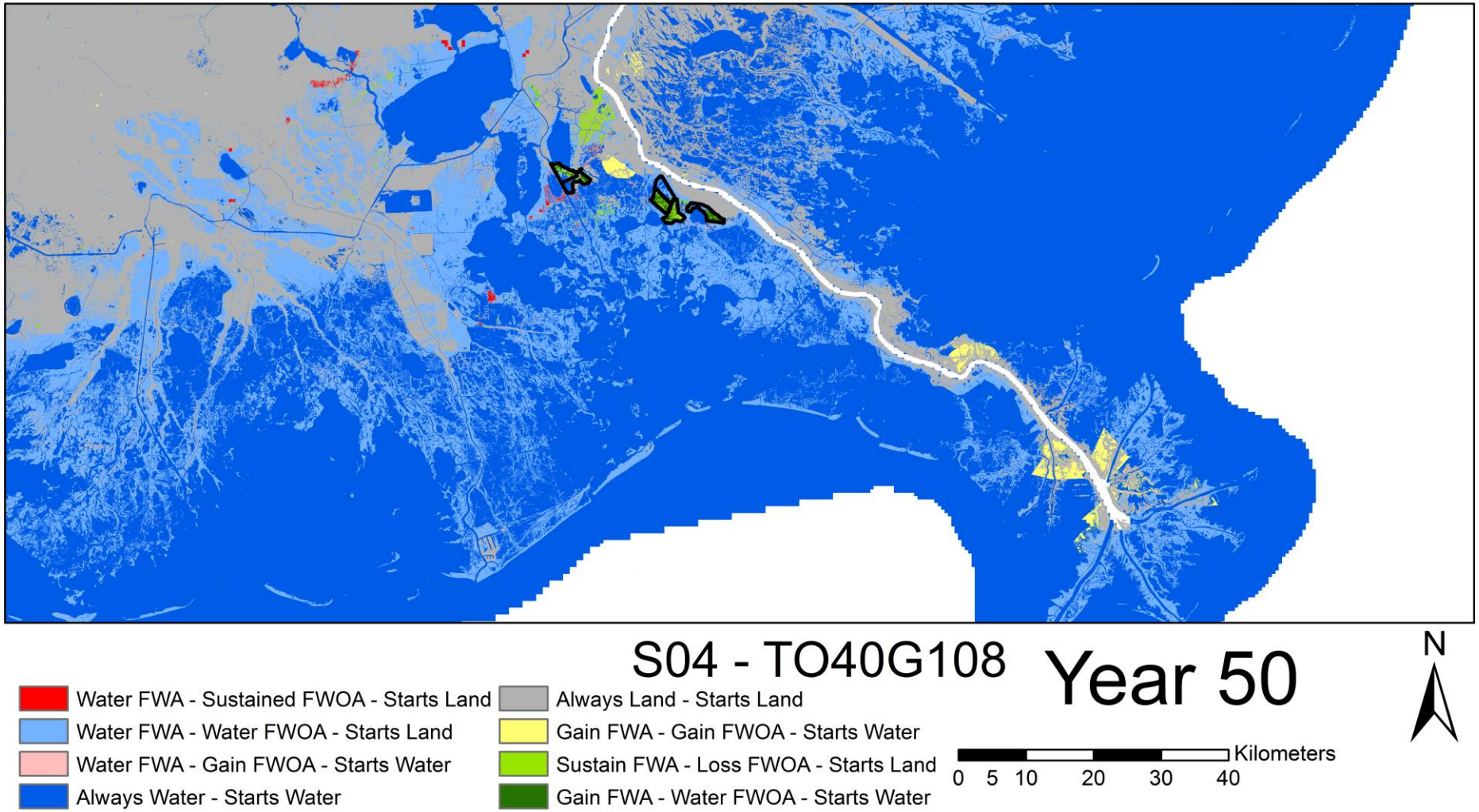


FUTURE WITHOUT ACTION B

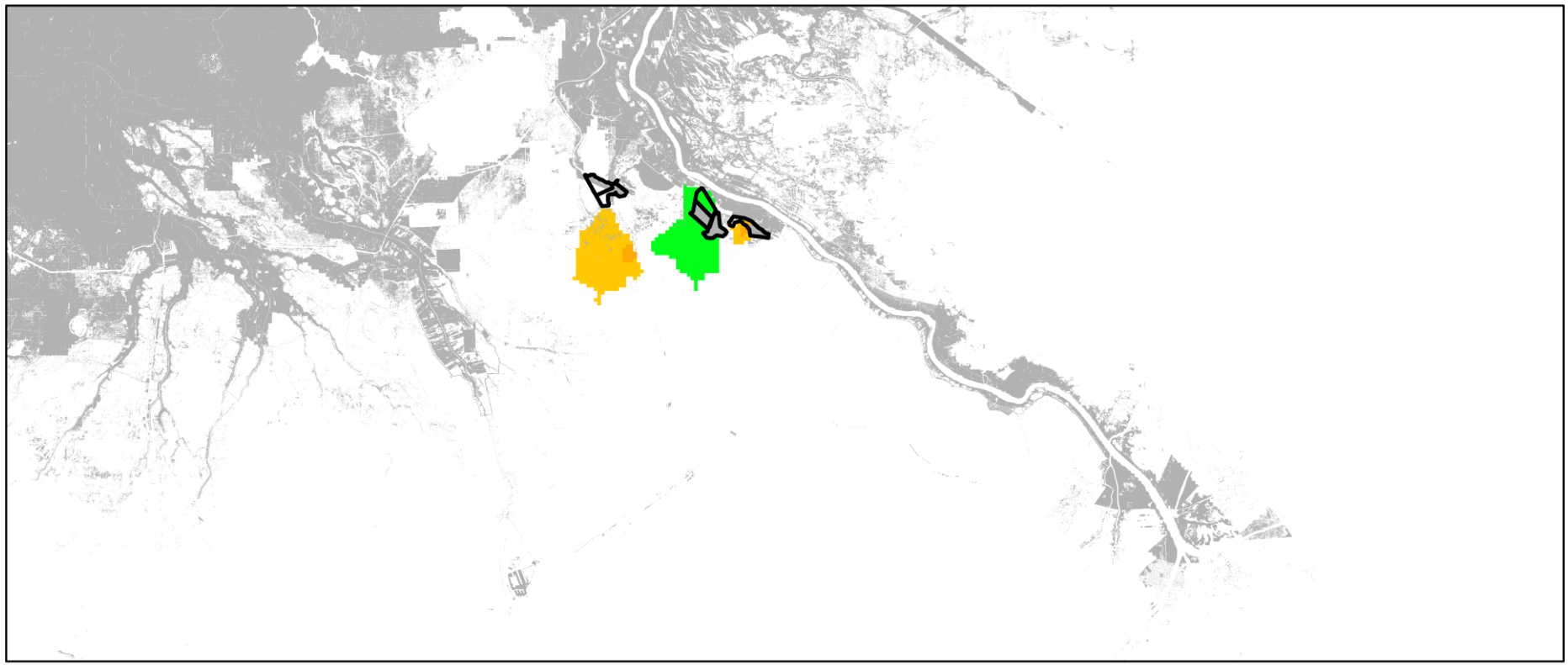
2017 MP **Medium Scenario (S04)** Future Without Action plus:

- Mid Breton Sediment Diversion active from year 0
  - 0 cfs when Mississippi River Q < **600k cfs**
  - 35k cfs when Mississippi River Q = 1.0m cfs
- Mid Barataria Sediment Diversion active from year 0
  - 0 cfs when Mississippi River Q < **600k cfs**
  - 75k cfs when Mississippi River Q = 1.25m cfs
- Real time control on Davis Pond and Caernarvon
  - Use existing control rules based upon 5 ppt and 15 ppt thresholds in receiving basins

ALTERNATIVE 8-B
LAND CHANGE



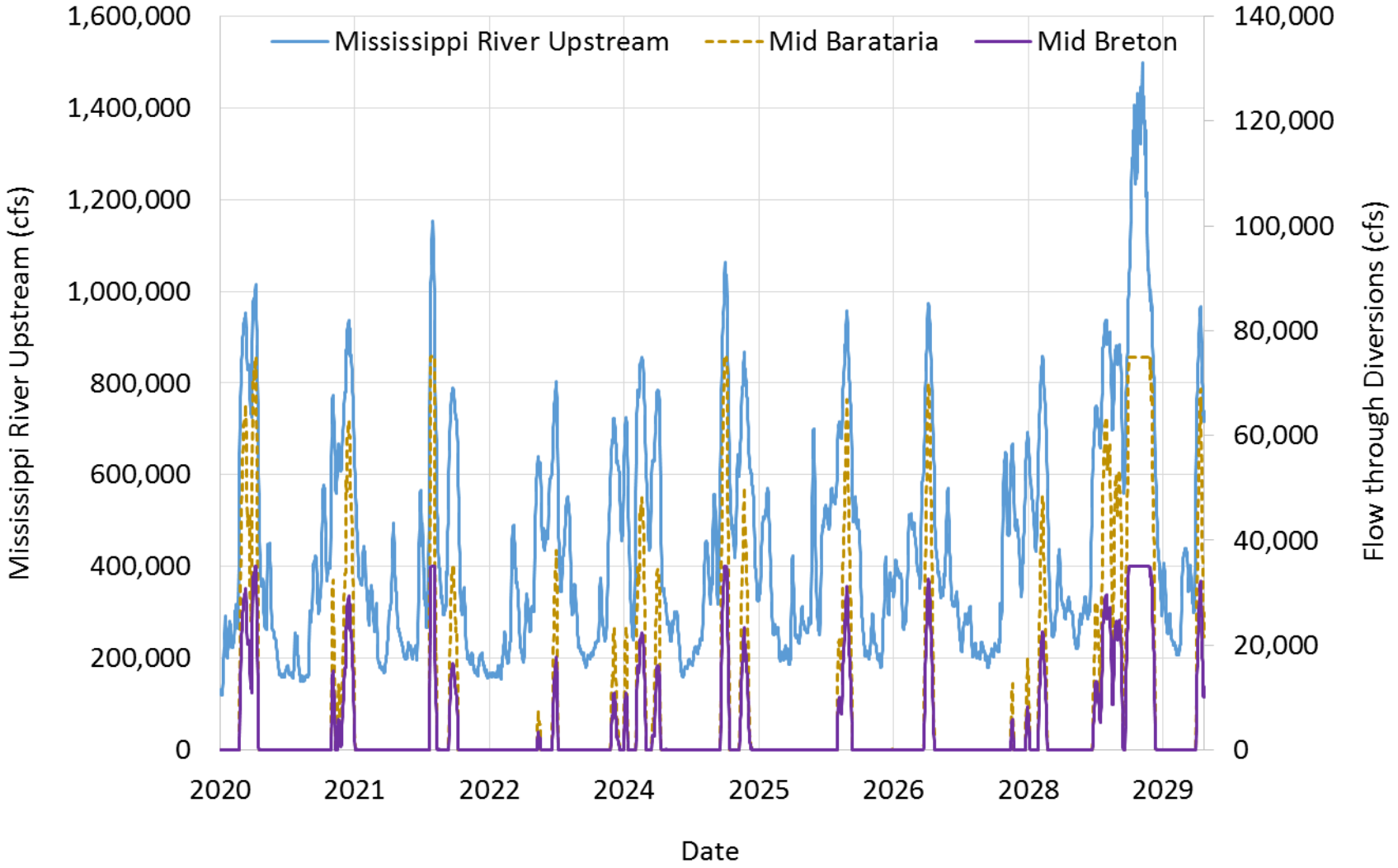
ALTERNATIVE 8-B SALINITY IMPACT



OPTIMIZING DIVERSION OPERATIONS

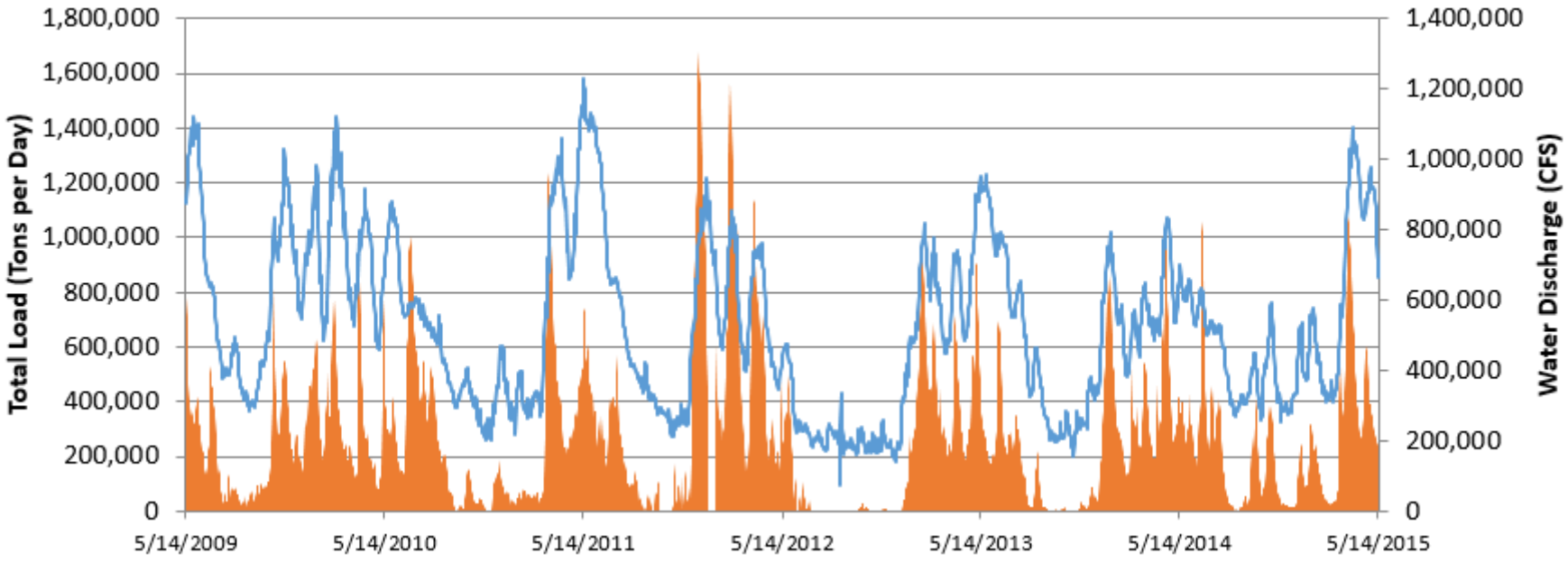
- Reference trigger: 600,000 cfs
- Parameters to be examined:
  - Trigger discharge
  - Opening time (relative to hydrograph)
  - Duration (how long a pulse should/need to be)
  - Frequency (how many times a year)
- Desired operation plan:
  - Simple
  - Practical
  - Implementable

HISTORICAL HYDROGRAPH



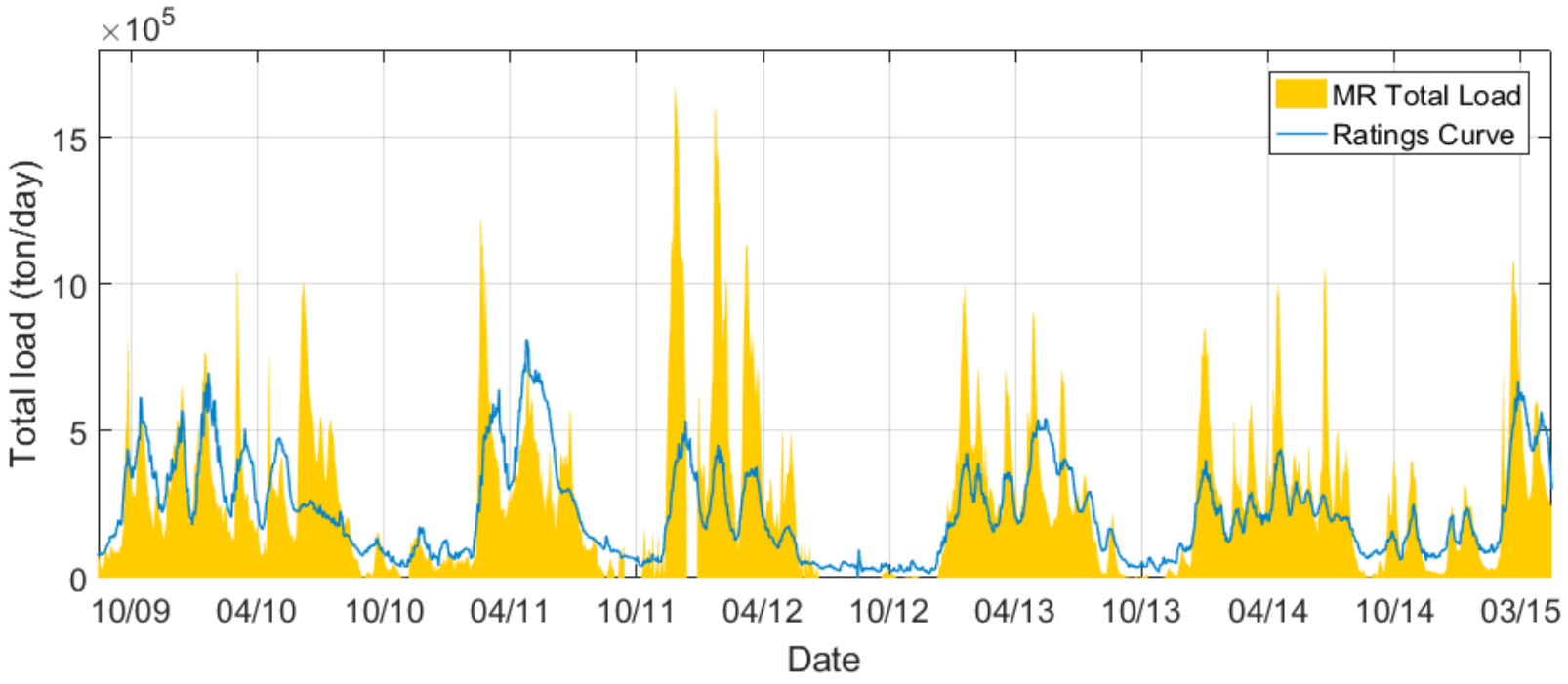
RIVER-SIDE ANALYSIS

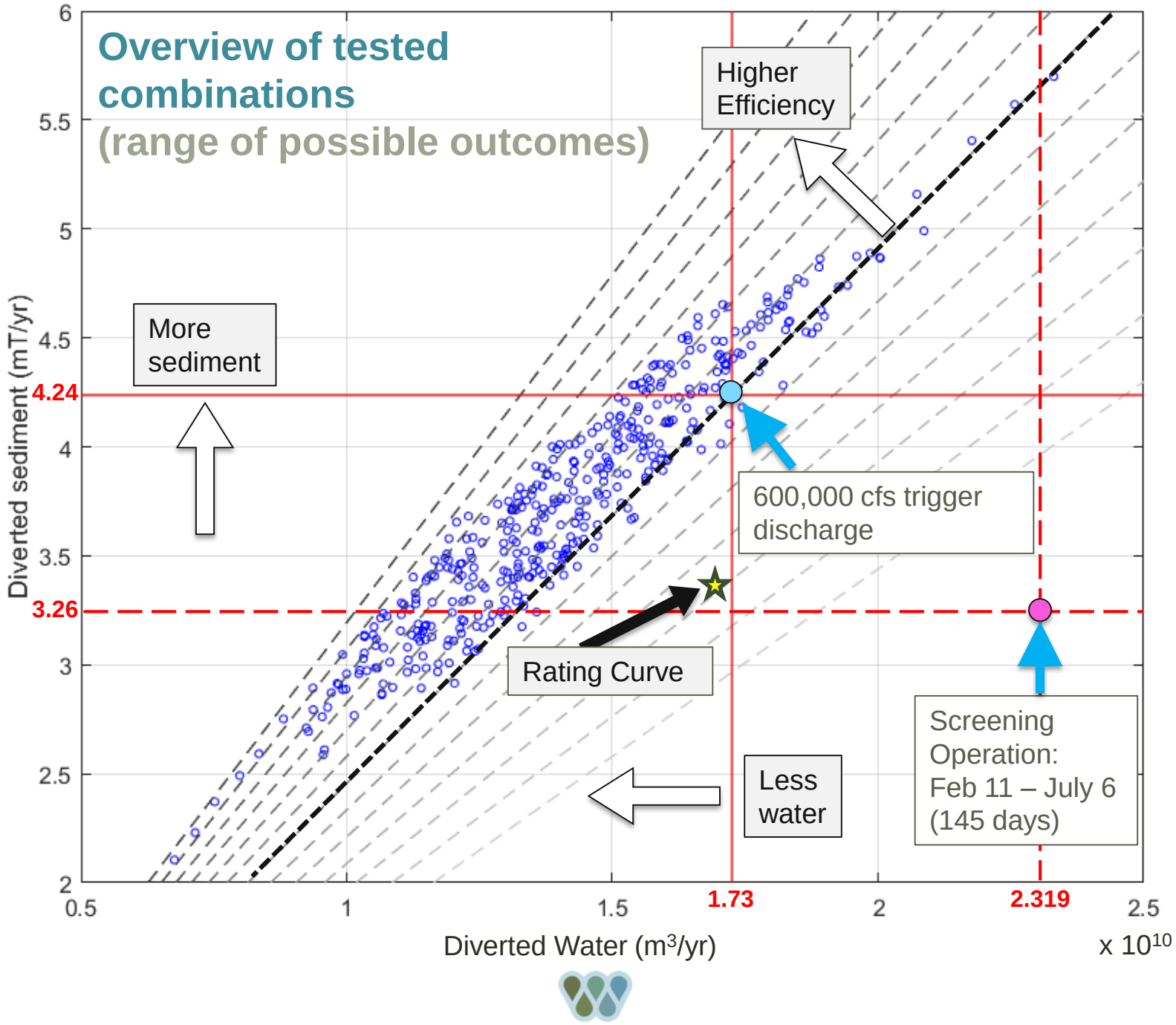
- Objective: optimize the diversion operation – specifically determine “when”, “how often”, and “for how long”
- Goal: max diverted sediment load & min water volume



RIVER-SIDE ANALYSIS

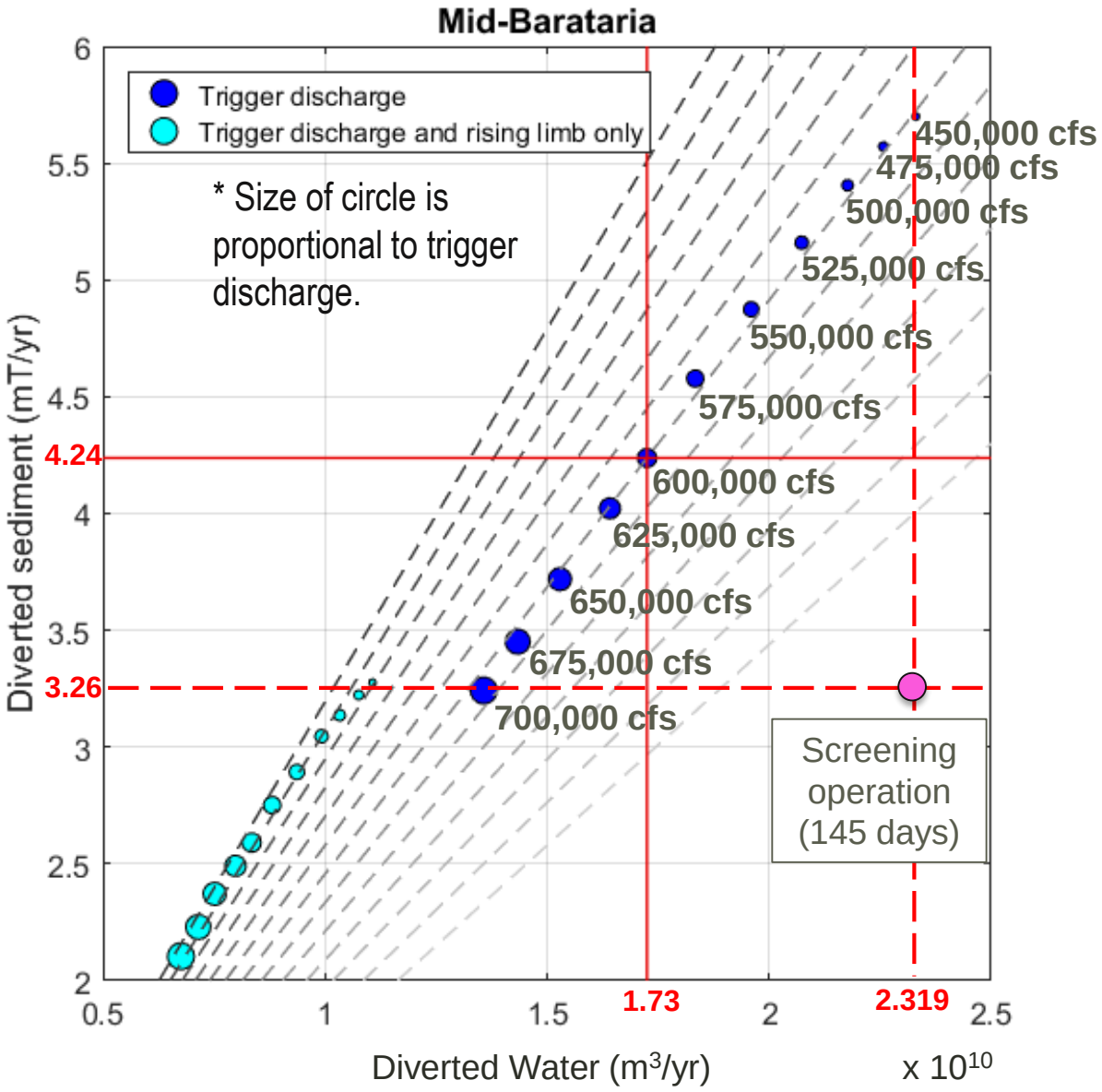
- Implications of using rating curve
- Importance of using Belle Chasse




Overview of tested combinations
(range of possible outcomes)
Higher Efficiency
More sediment
600,000 cfs trigger discharge
Rating Curve
Less water
Screening Operation:
Feb 11 – July 6
(145 days)
Diverted sediment (mT/yr)
Diverted Water (m3/yr)
x 10^10
4.24
3.26
1.73
2.319
6
5.5
5
4.5
4
3.5
3
2.5
2
0.5
1
1.5
2
2.5

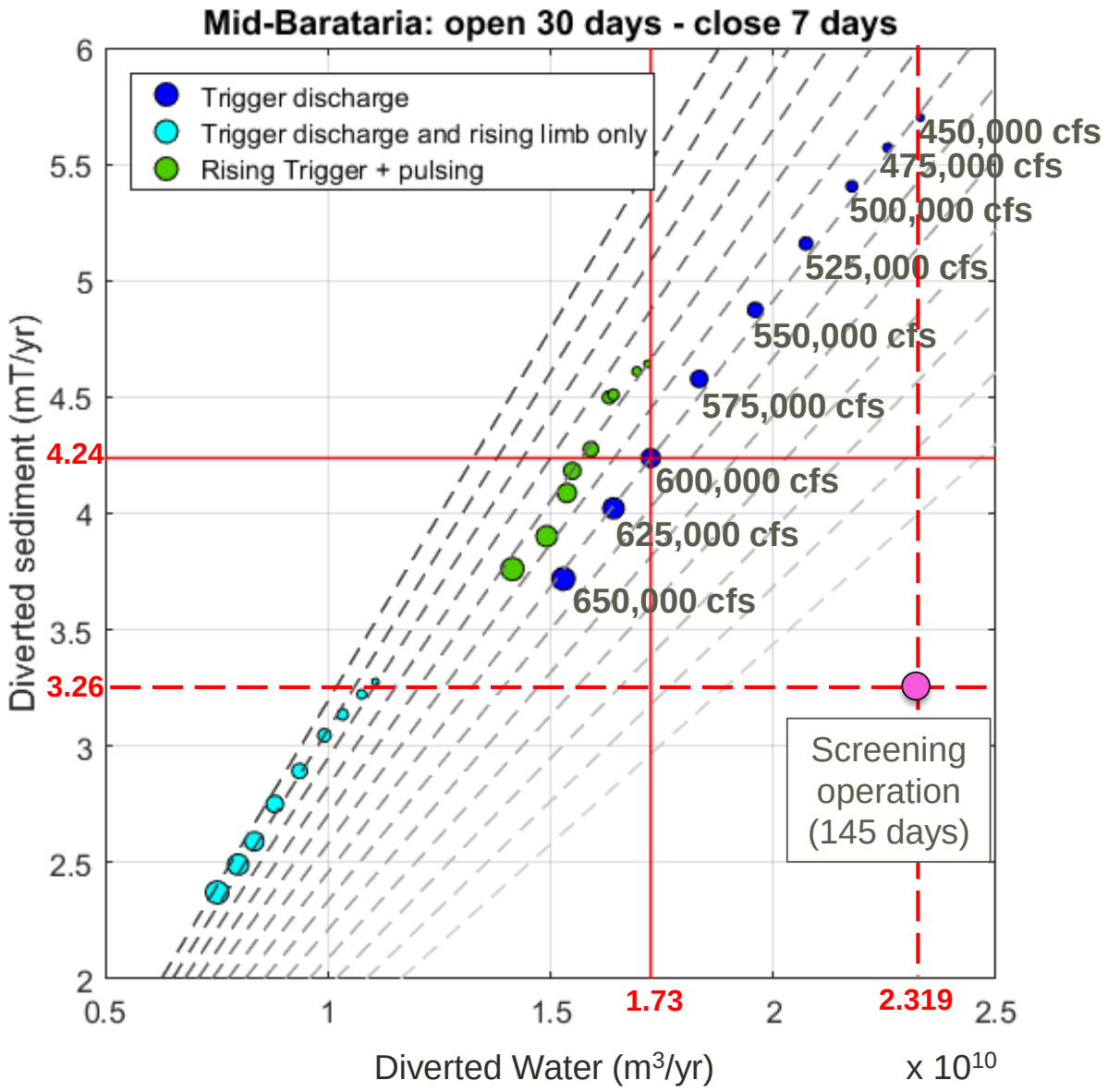
TRIGGER DISCHARGE & RISING LIMB

- **Trigger discharge**
  - ❖ Stay open when river discharge is above $Q_{trigger}$
- **Trigger discharge and rising limb only**
  - ❖ Stay open when river discharge is above $Q_{trigger}$ and is on rising limb.



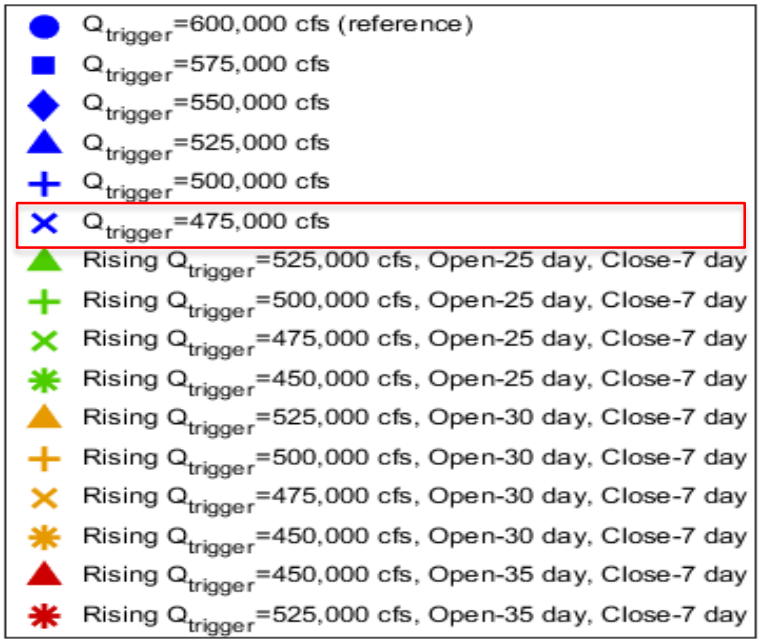
RISING LIMB TRIGGER + PULSING

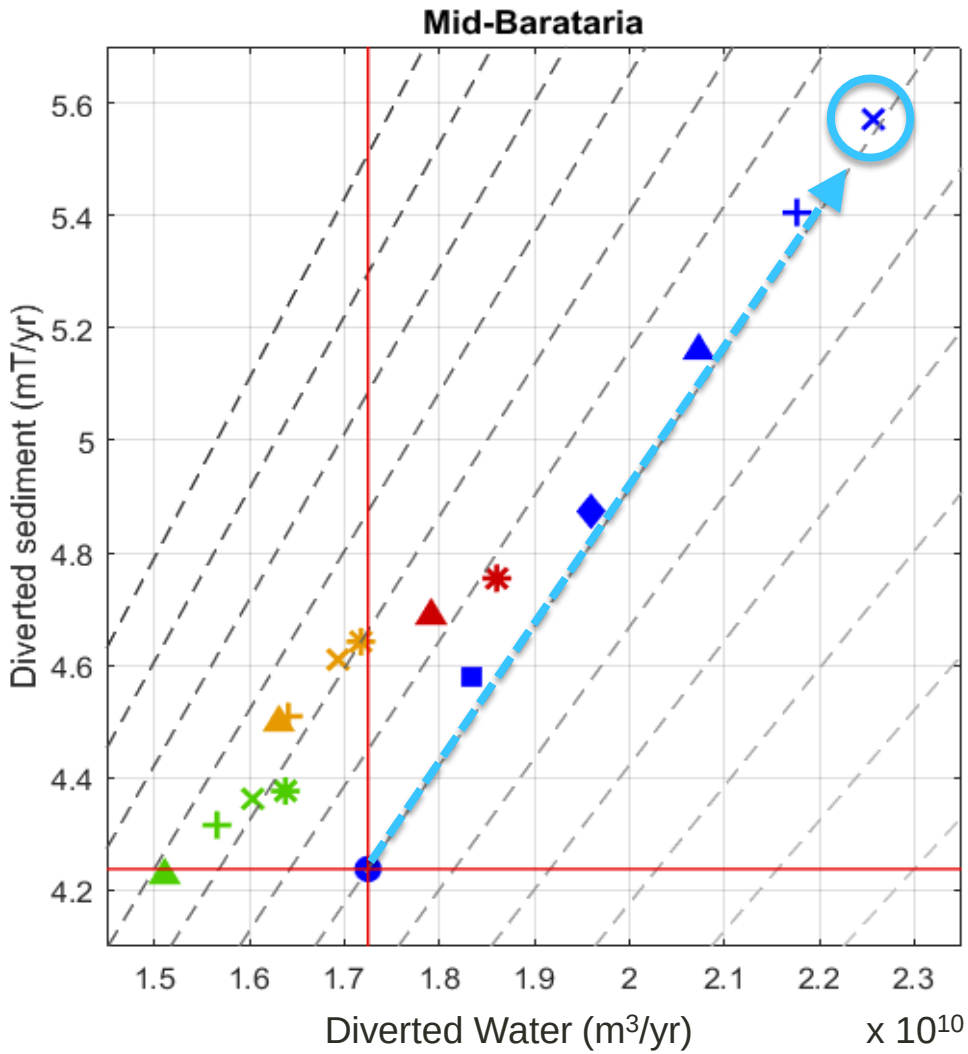
- **Rising Trigger + Pulsing**
  - Open when river discharge reaches $Q_{trigger}$ and is on rising limb
  - Stay open for no less than T_{open} days
  - Stay close for no less than T_{close} days



PRELIMINARY FINDINGS

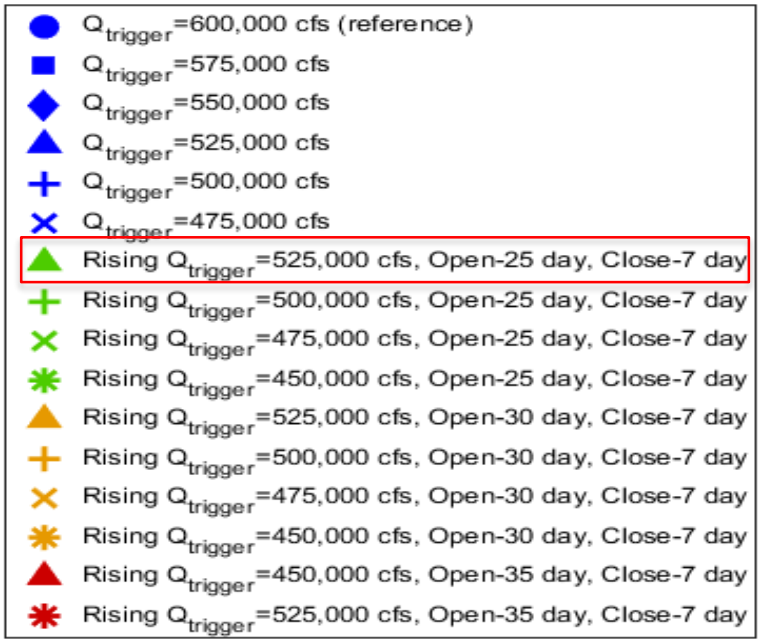
- Trigger discharge could be lower than 600,000 cfs;
- Pulsing with rising limb yields higher efficiency.
- No limit on # of openings/yr

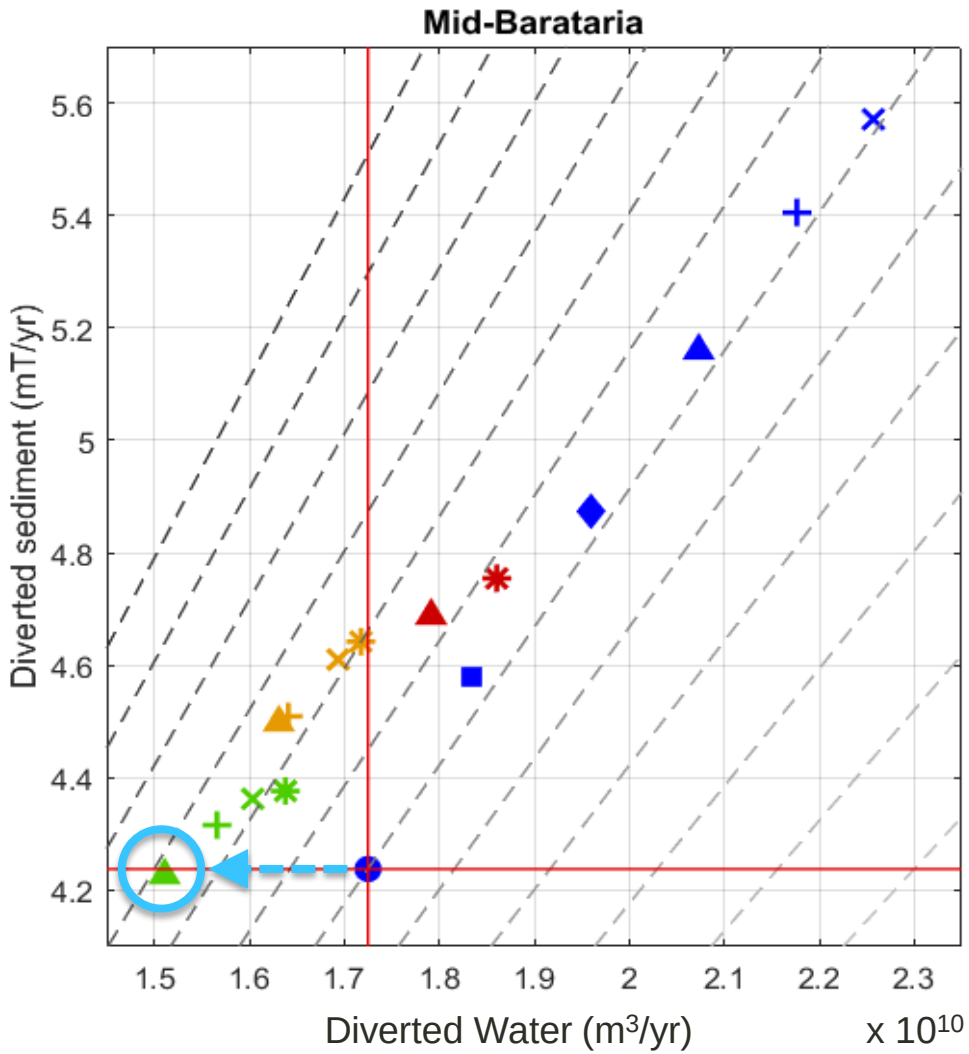




PRELIMINARY FINDINGS

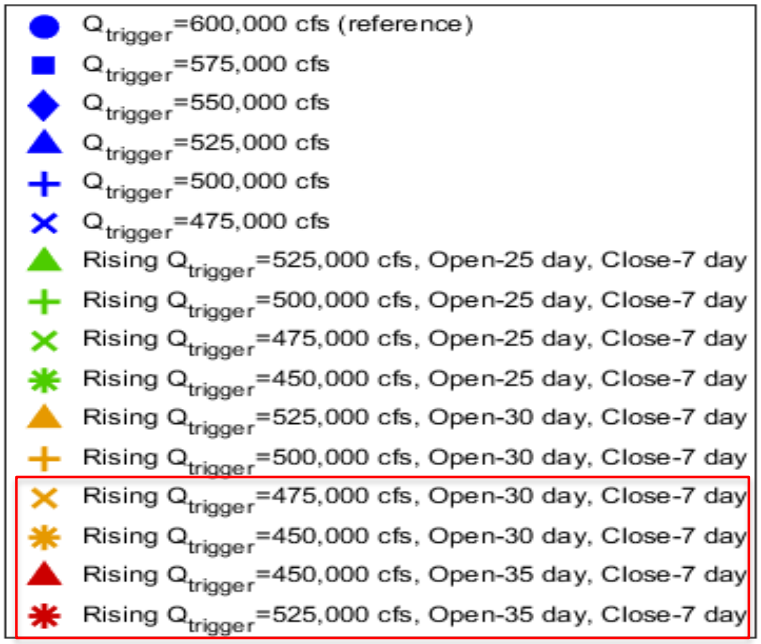
- Alternative approach:
  - Maximize sediment : water efficiency
  - More sediment for the same water as the reference value

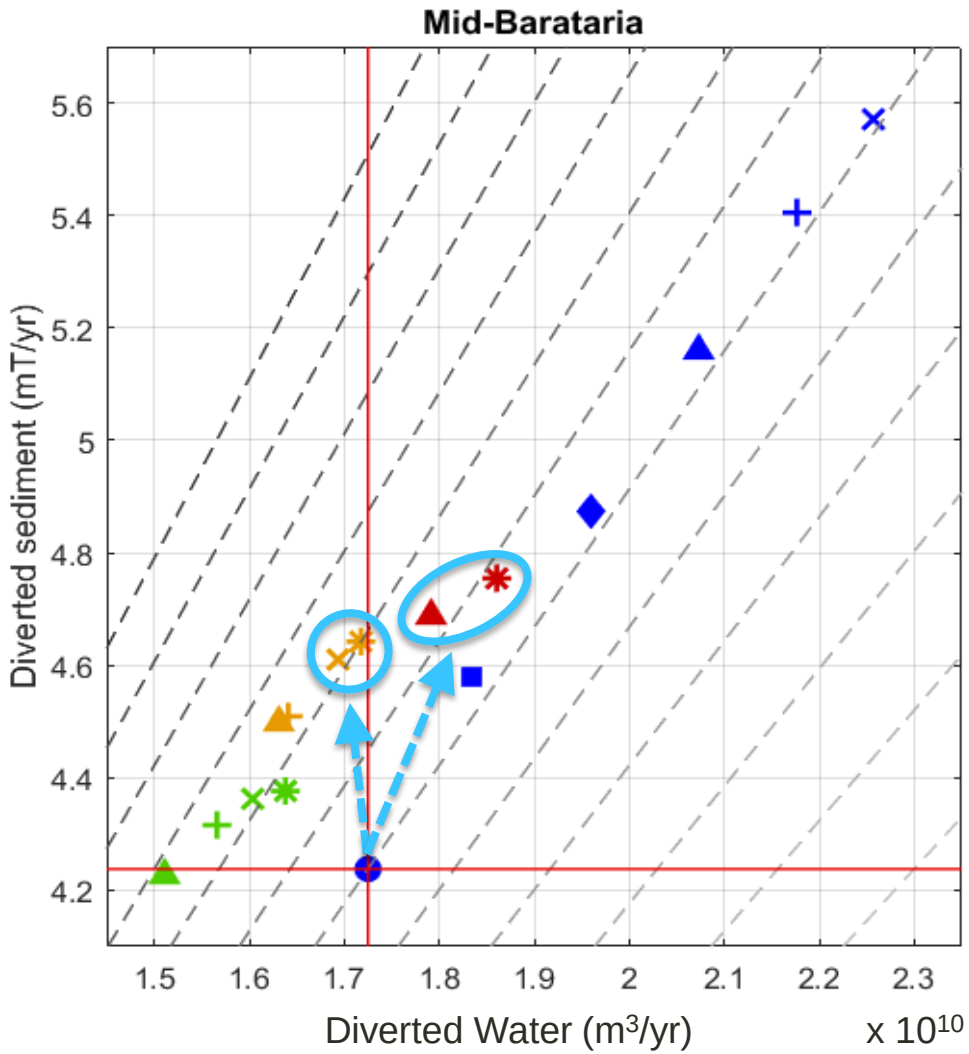




PRELIMINARY FINDINGS

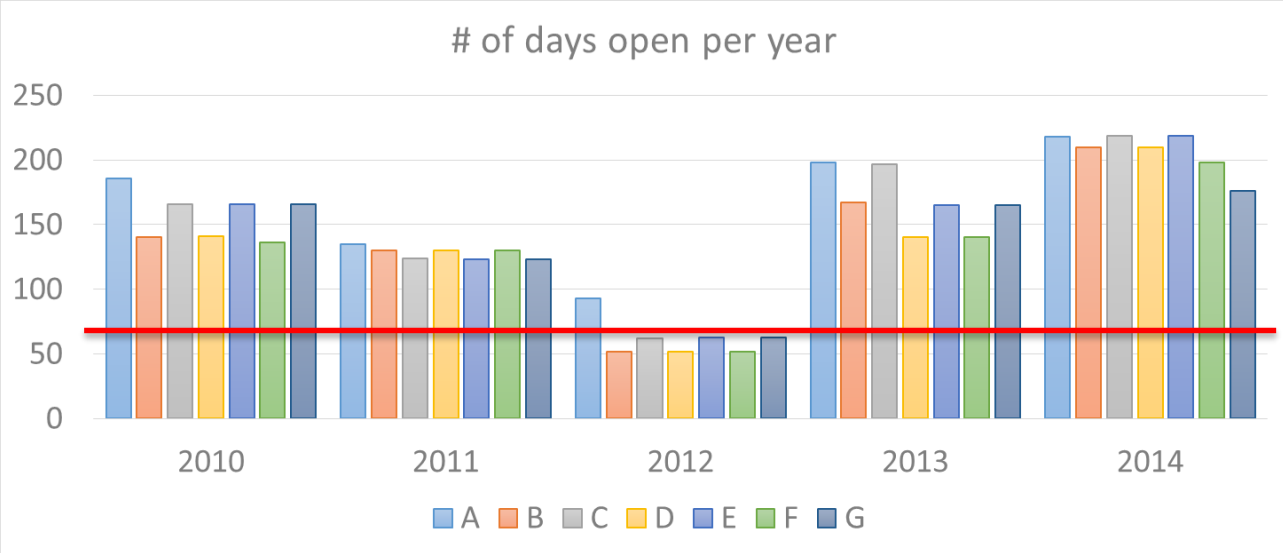
- Alternative approach:
  - Balance between total available sediment and sediment : water efficiency





Average opening days per year

	Q_trigger	T_open	T_close	2010	2011	2012	2013	2014	All years
A	**475,000**	**25**	**7**	186	135	93	198	218	166
B	**500,000**	**25**	**7**	140	130	52	167	210	140
C	**525,000**	**25**	**7**	166	124	62	197	219	154
D	**450,000**	**30**	**7**	141	130	52	140	210	135
E	**475,000**	**30**	**7**	166	123	63	165	219	147
F	**500,000**	**30**	**7**	136	130	52	140	198	131
G	**525,000**	**30**	**7**	166	123	63	165	176	139
All Operation Plans				**157**	**128**	**62**	**167**	**207**	**144**

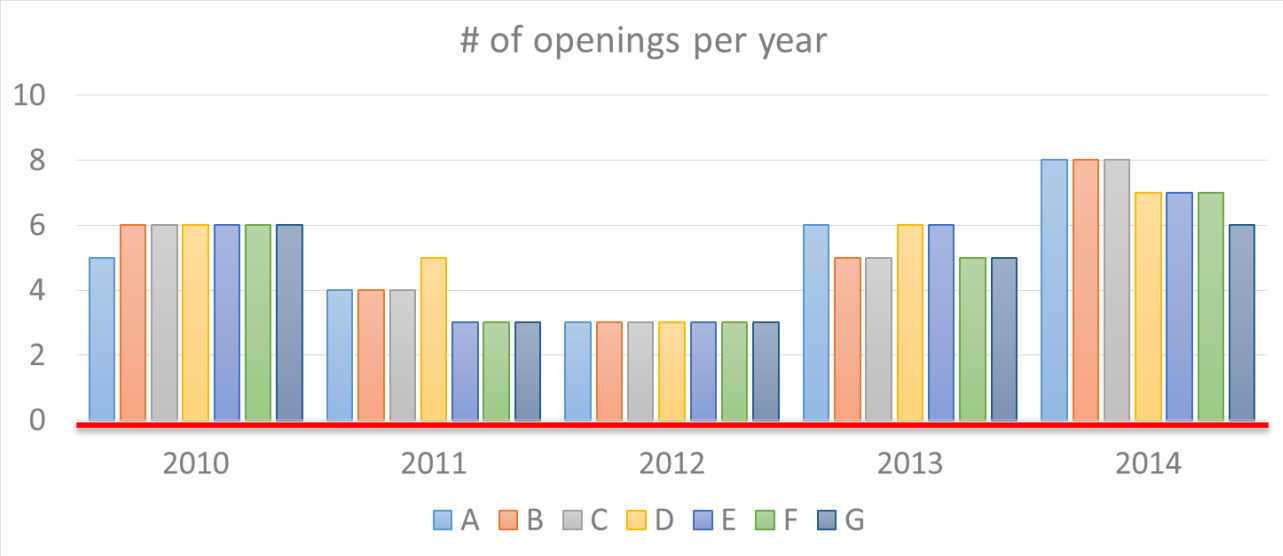


Reference operation plan (600,000 cfs trigger discharge):

- Average opening days per year: 110;
- Average # of opening per year: 1~2

Average # of openings per year

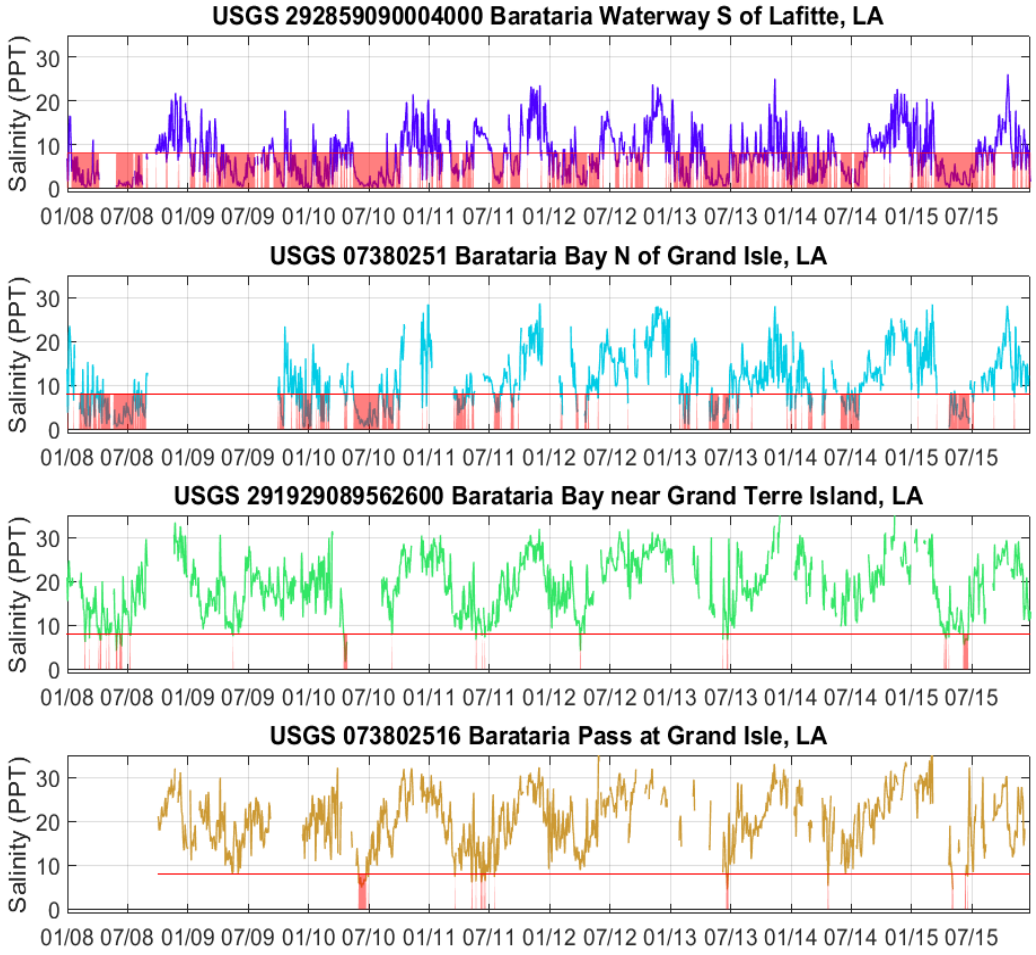
	Q_trigger	T_open	T_close	2010	2011	2012	2013	2014	All years
A	**475,000**	**25**	**7**	5	4	3	6	8	5
B	**500,000**	**25**	**7**	6	4	3	5	8	5
C	**525,000**	**25**	**7**	6	4	3	5	8	5
D	**450,000**	**30**	**7**	6	5	3	6	7	5
E	**475,000**	**30**	**7**	6	3	3	6	7	5
F	**500,000**	**30**	**7**	6	3	3	5	7	5
G	**525,000**	**30**	**7**	6	3	3	5	6	5
	All Operation Plans			**6**	**4**	**3**	**5**	**7**	**5**

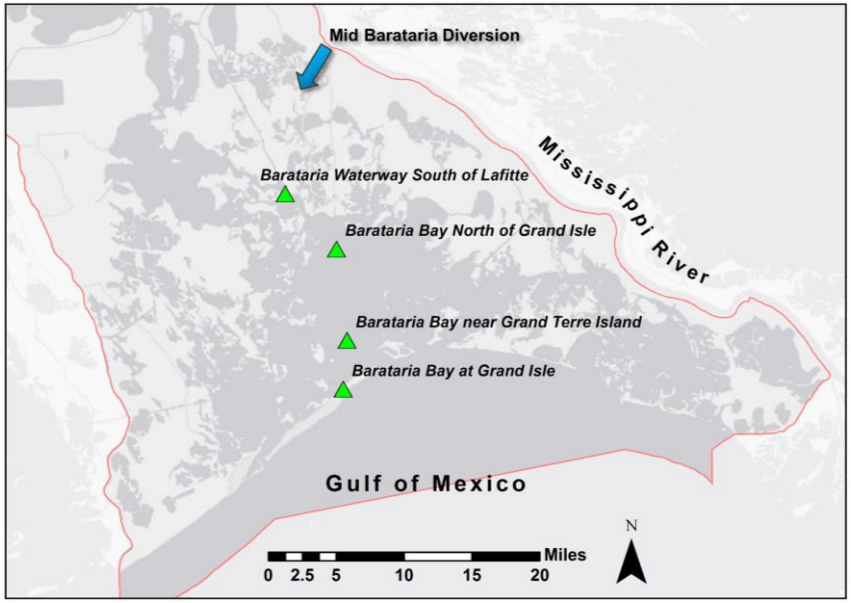


Reference operation plan (600,000 cfs trigger discharge):

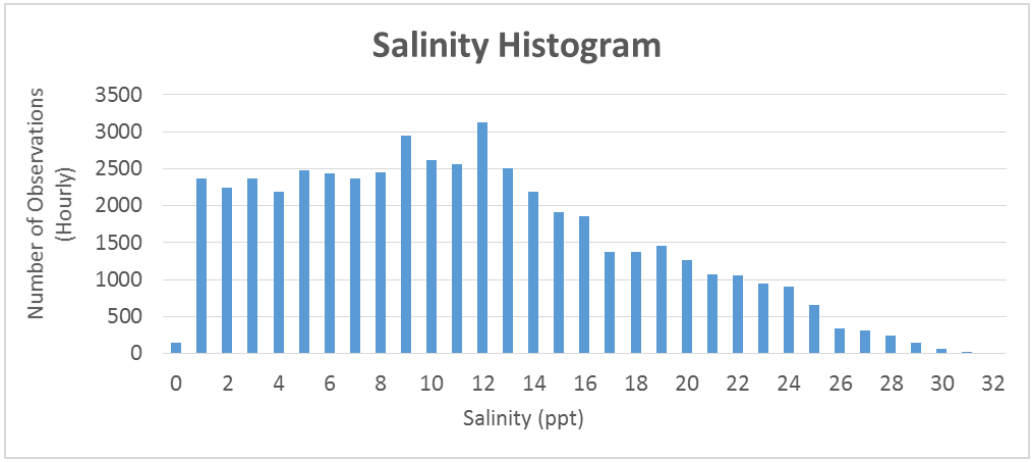
- Average opening days per year: 110;
- Average # of opening per year: 1~2.

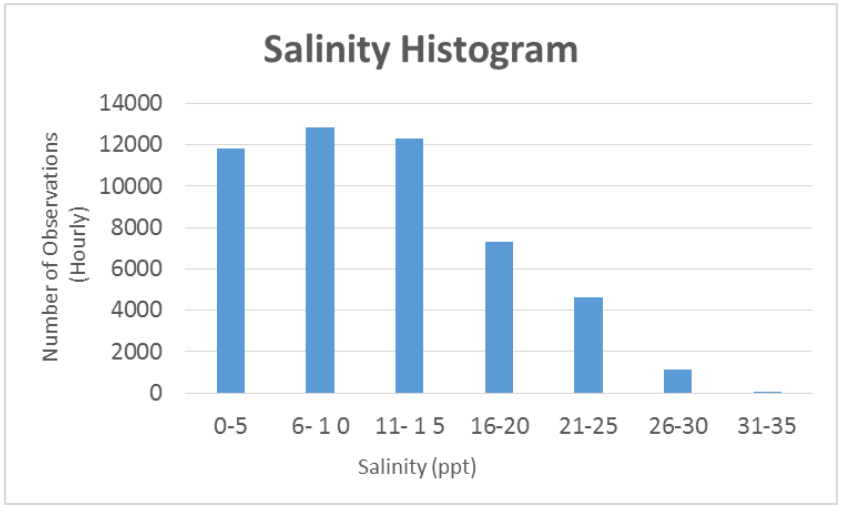
RECEIVING SIDE ANALYSIS: EXISTING CONDITIONS

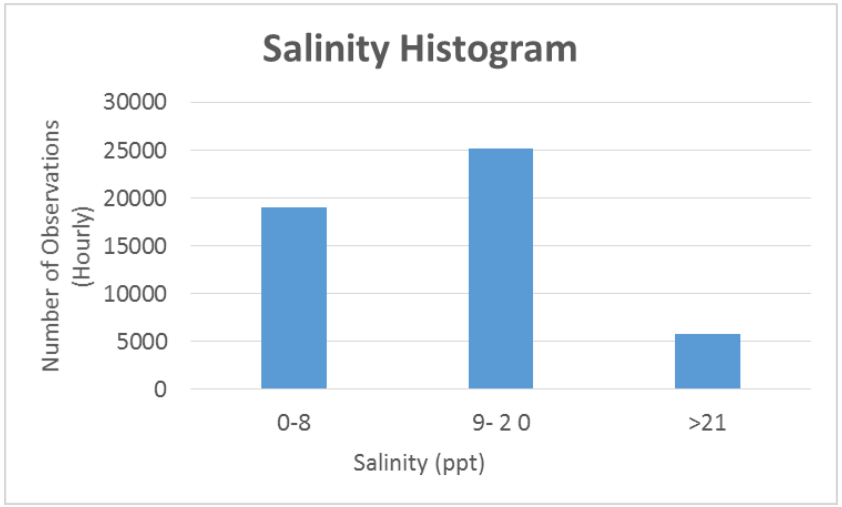




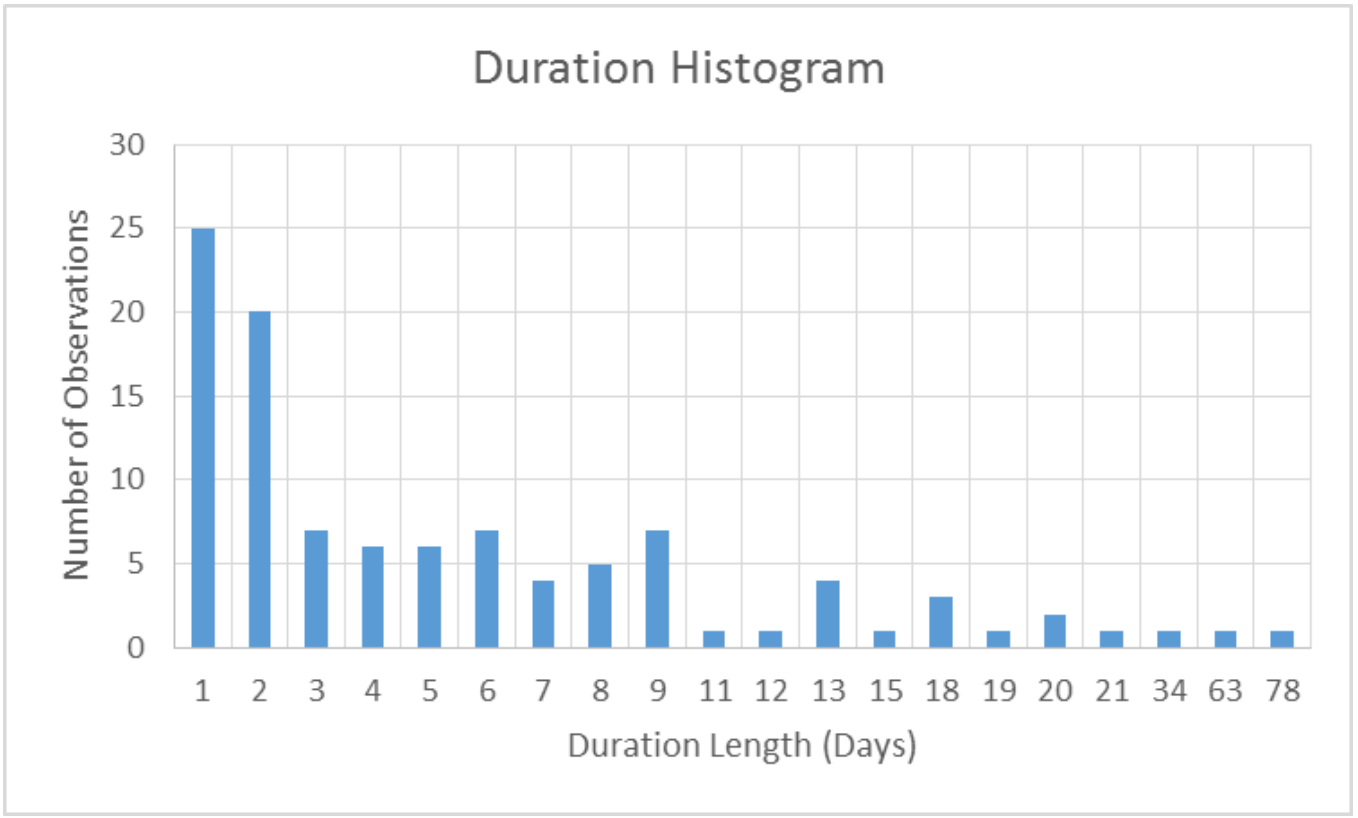
BARATARIA N OF GRAND ISLE
10/1/07-2/12/16





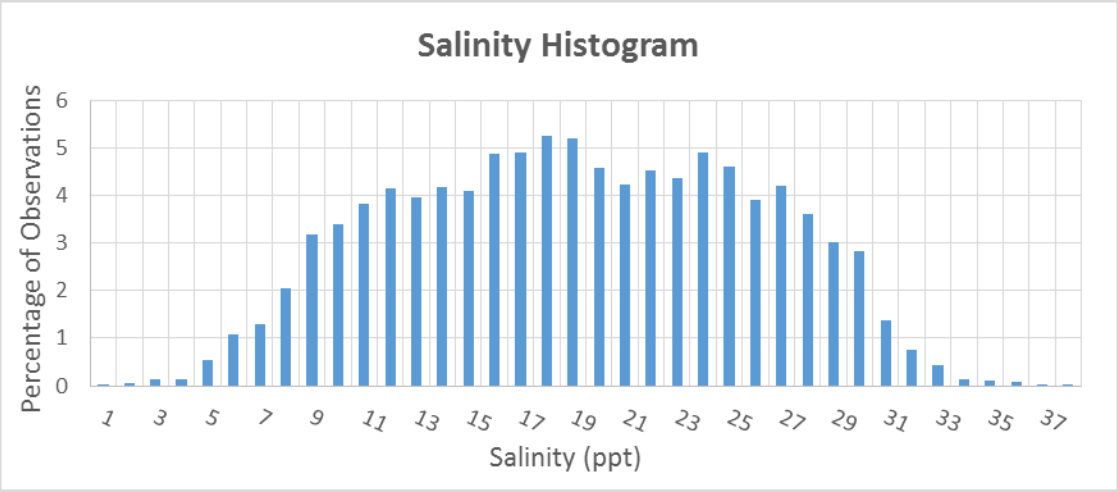


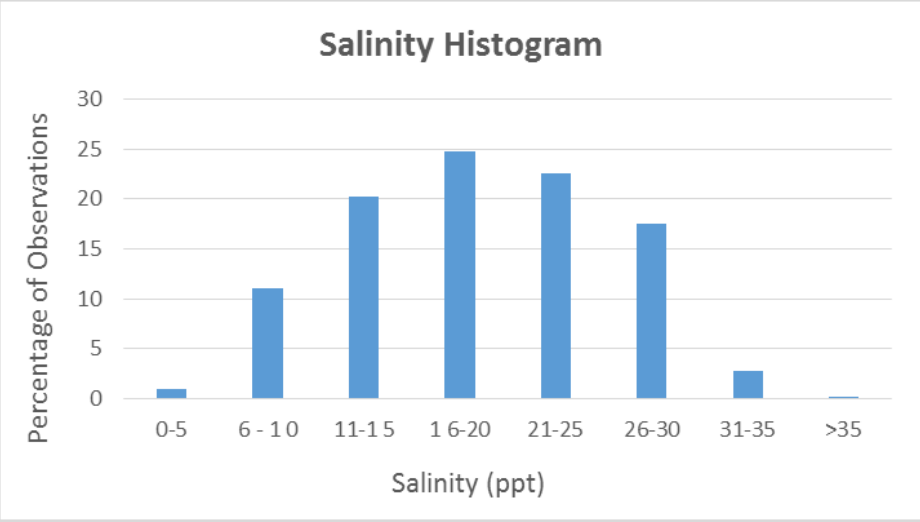
BARATARIA N OF GRAND ISLE
10/1/07-2/12/16

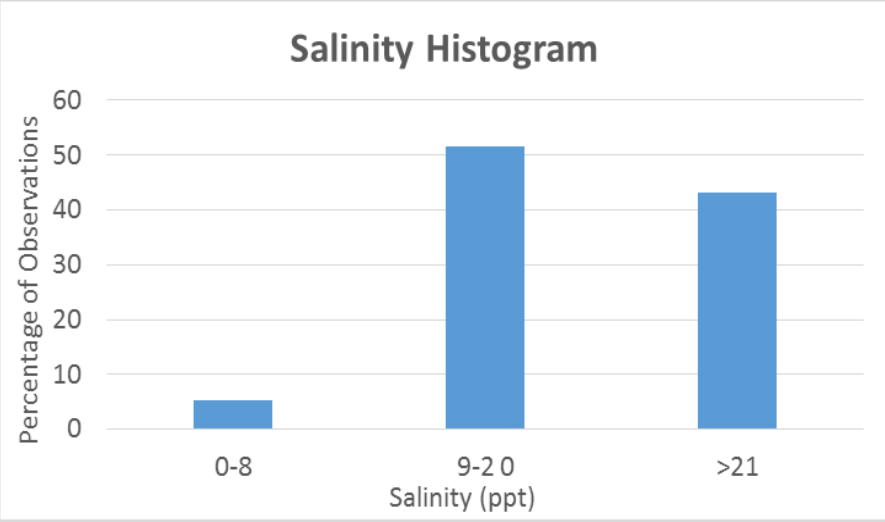


Summary	Oct. 2007-Feb. 2016
Events	104
Average Duration	7 Days
Max Duration	78 Days

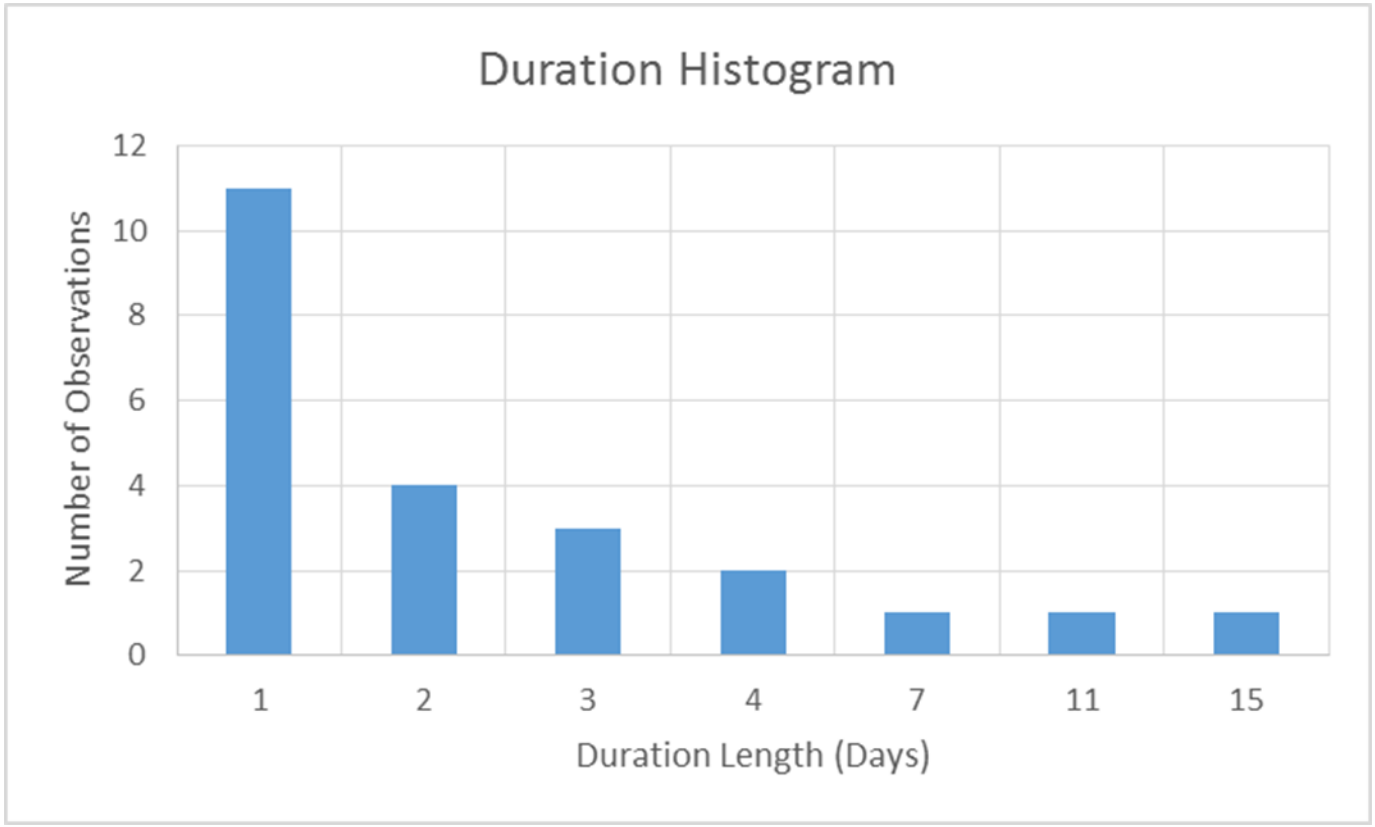
BARATARIA NEAR GRAND TERRE 10/01/07-09/10/15





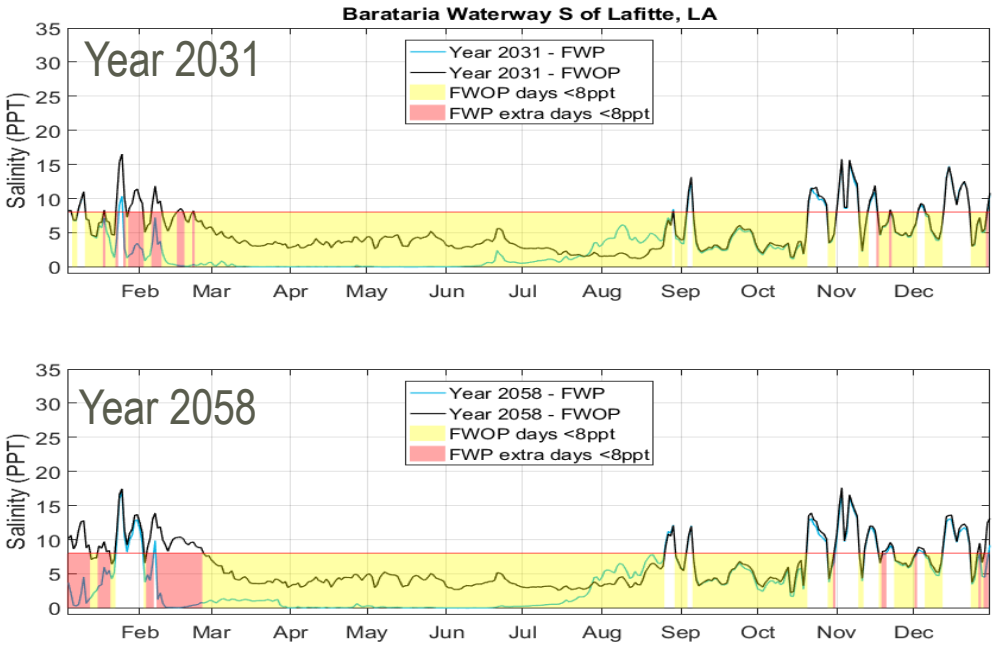


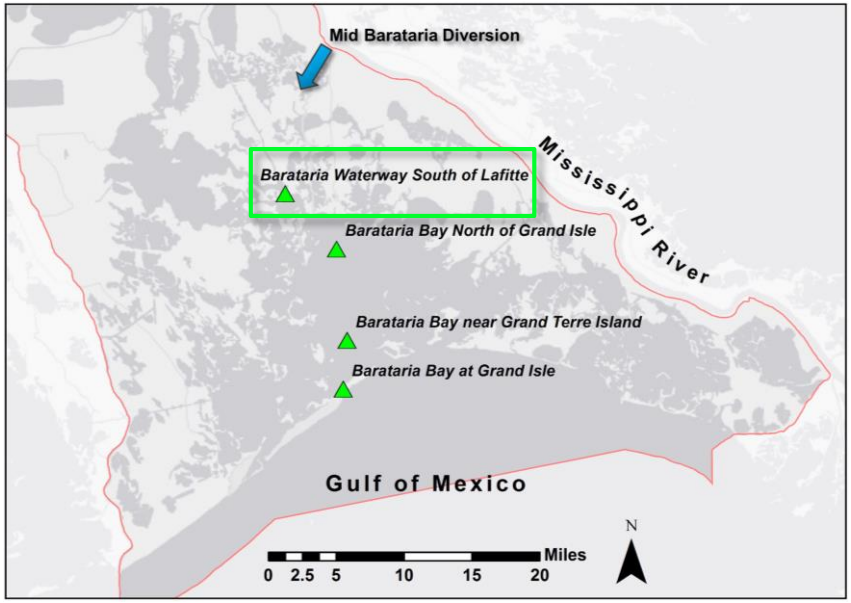
BARATARIA BAY NEAR GRAND TERRE 10/01/07-09/10/15



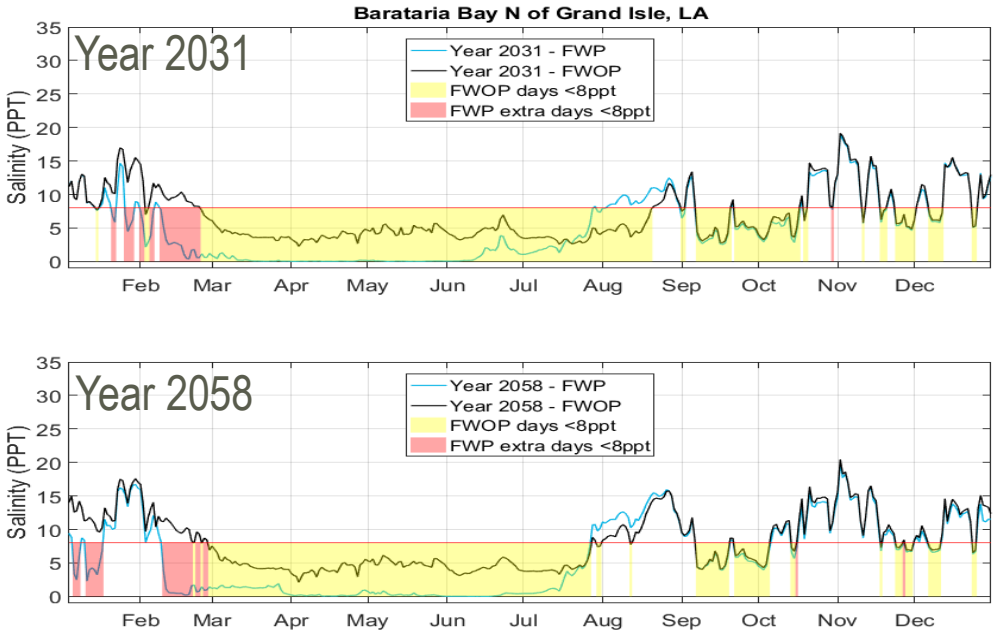
Summary	Oct. 2007-Feb. 2016
Events	23
Average Duration	3 Days
Max Duration	15 Days

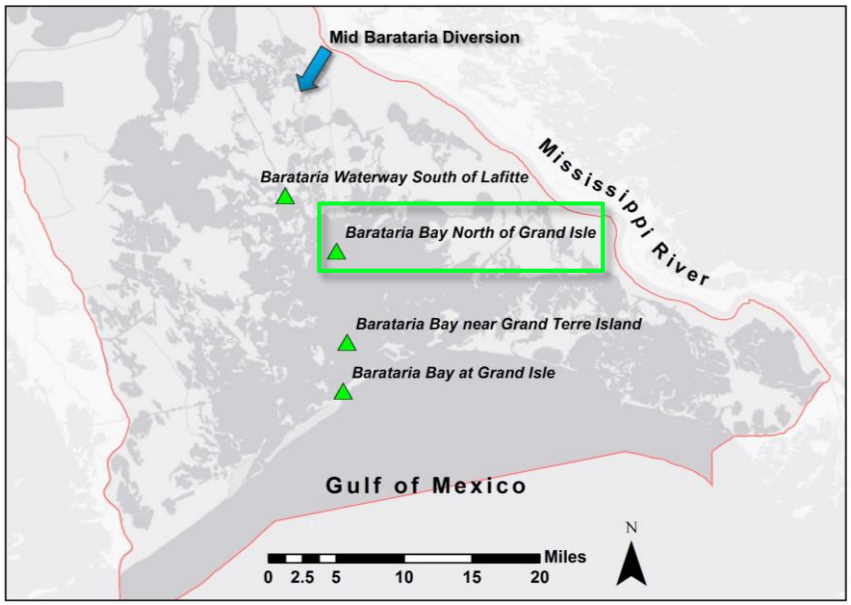
RECEIVING SIDE ANALYSIS: PROJECTED CONDITIONS



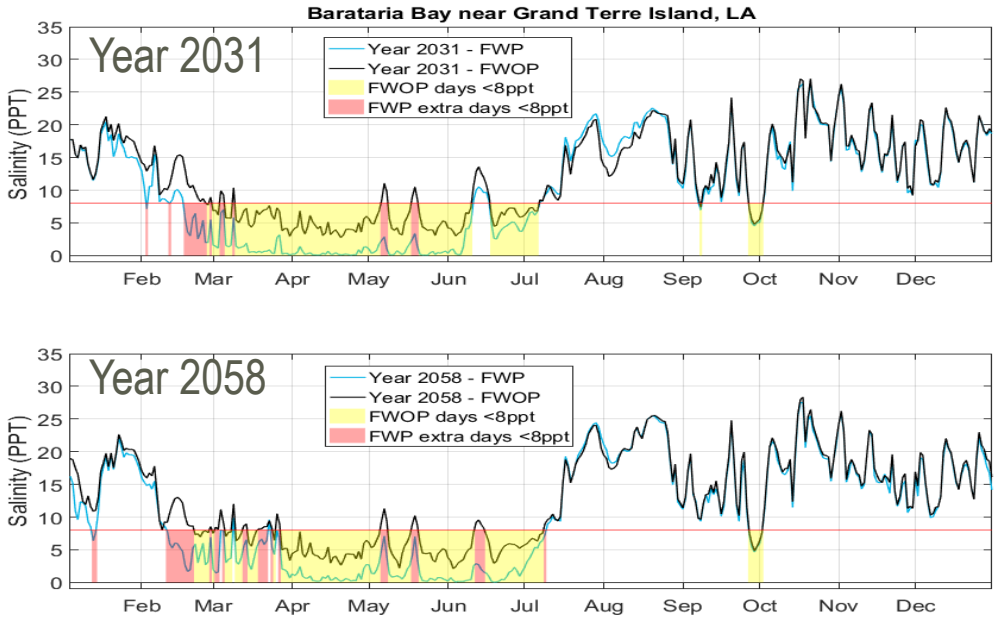


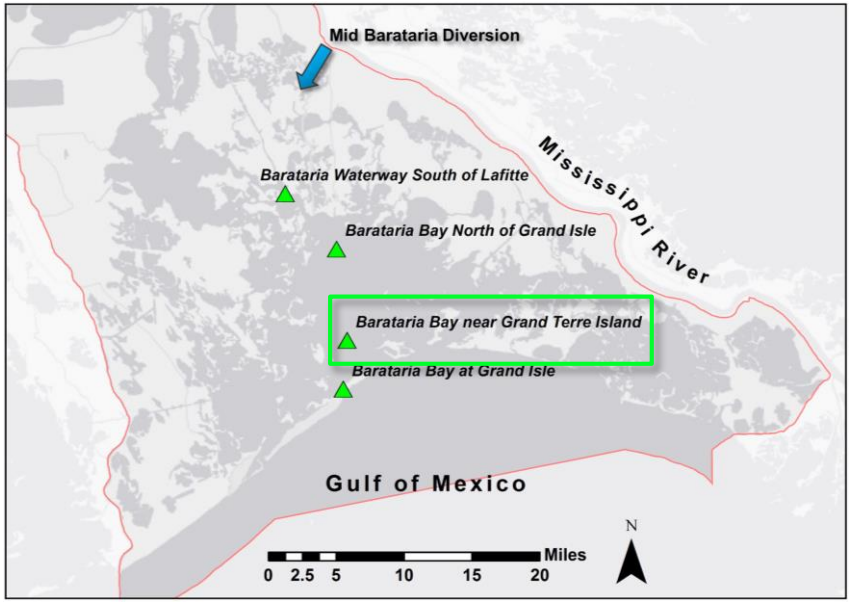
MODEL OUTPUTS: SALINITY



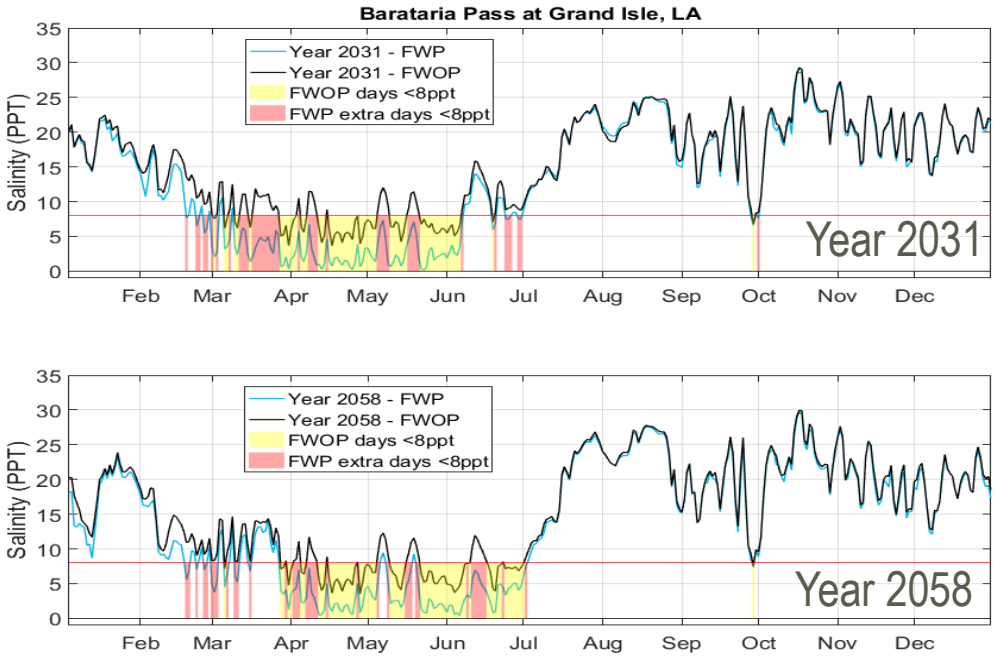


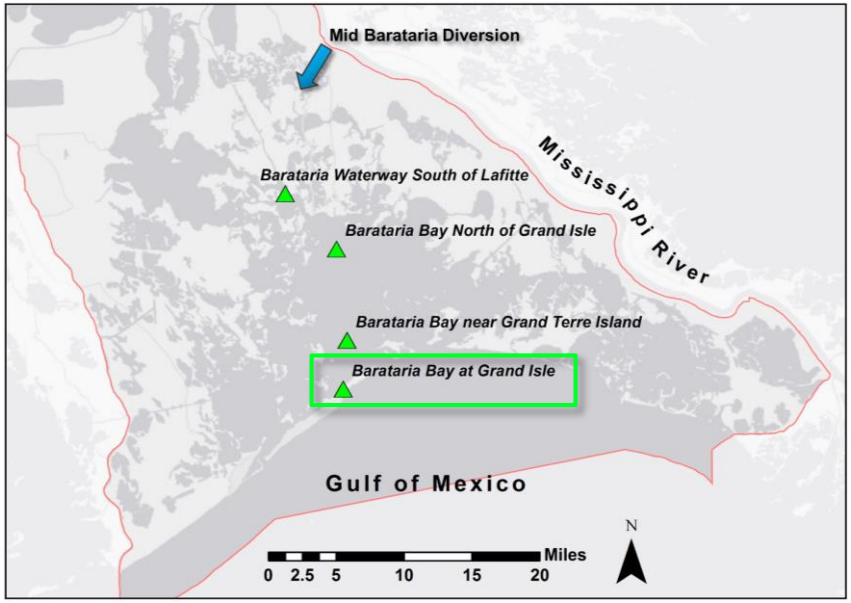
MODEL OUTPUTS: SALINITY



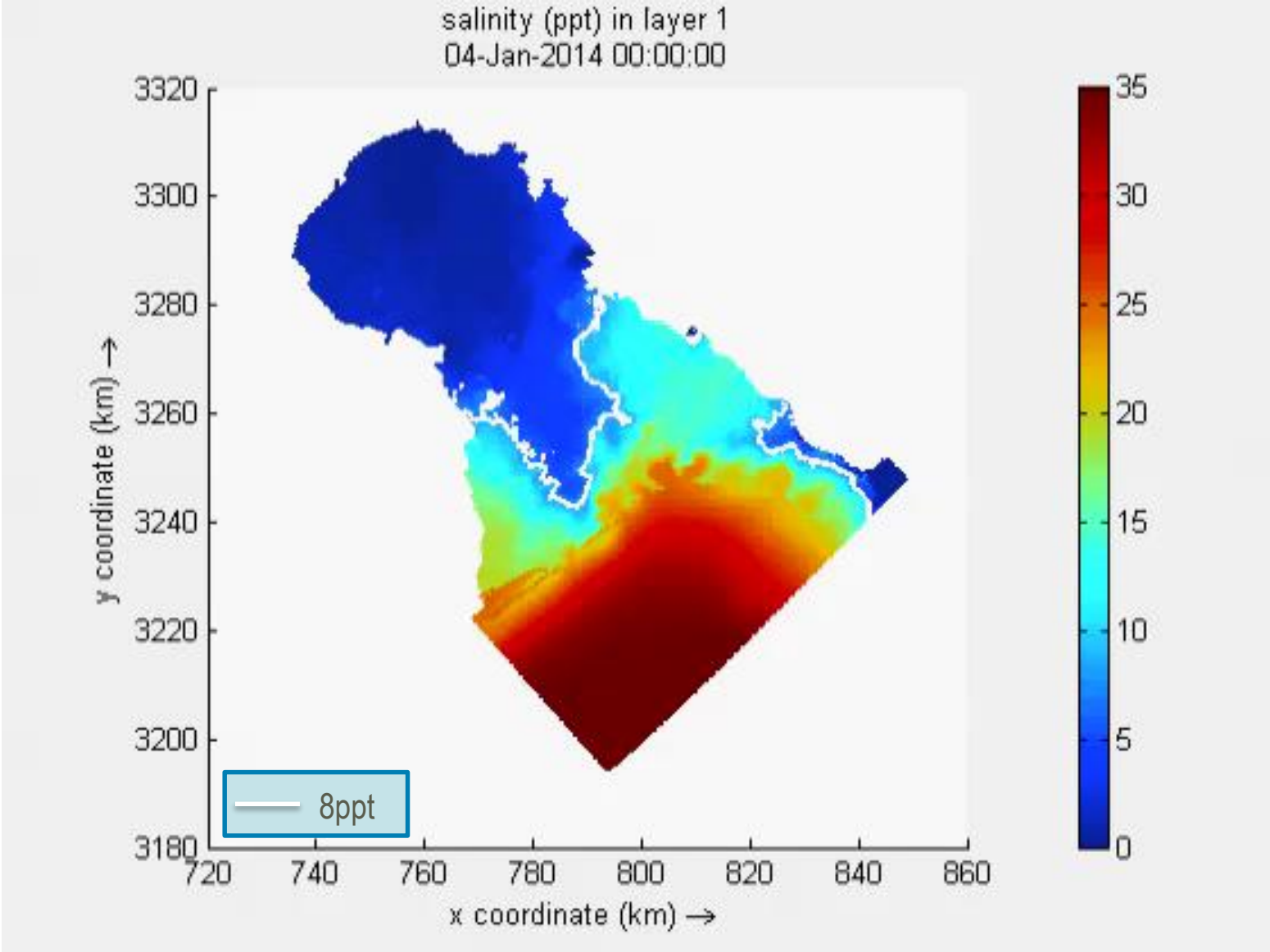


MODEL OUTPUTS: SALINITY

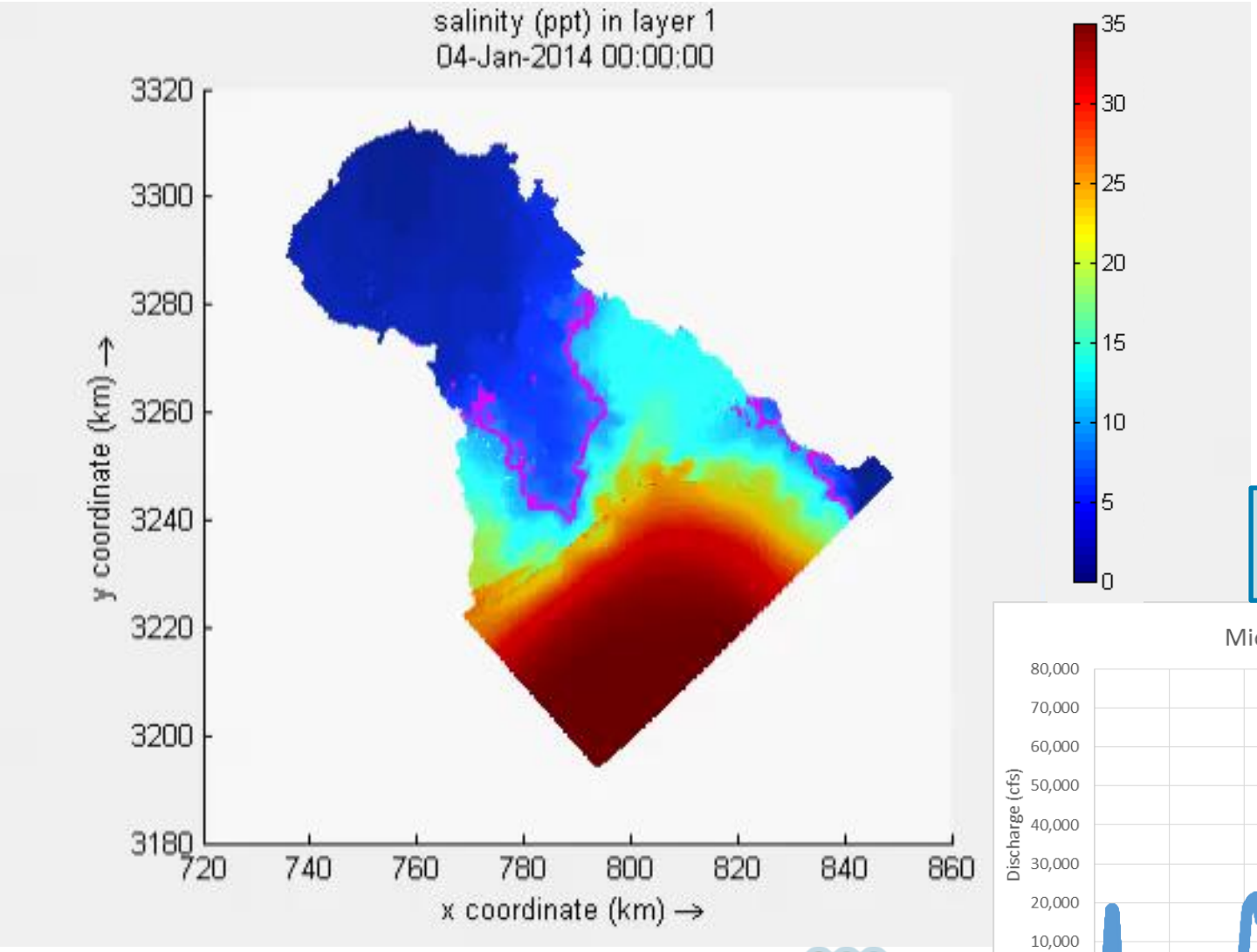




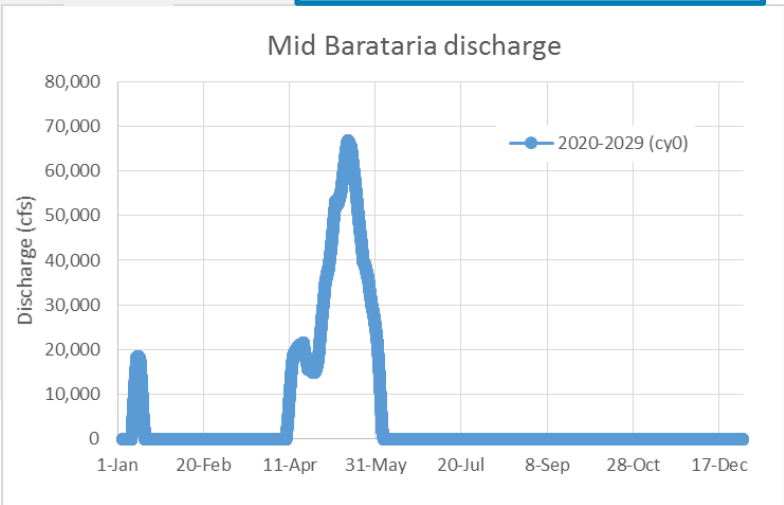
SALINITY DYNAMICS: EXISTING CONDITIONS (2014)



SALINITY DYNAMICS: FUTURE WITH PROJECT



8ppt, FWOP
8ppt, FWP



CLOSING REMARKS

- Optimize operation through simple and implementable plan will:
  - Enhance sediment capture
  - Optimize diverted fresh water volume
- Critical components:
  - Real time monitoring (river side) of water, turbidity (supported by frequent/periodical sediment measurements)
  - Real time monitoring (receiving areas) of salinity, water level, and perhaps select water quality parameters
  - Forecasting tools to support adaptive management of structures
- Operation plans should be balanced between river and receiving sides without losing sight of land building as the ultimate objective

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301 NORTH MAIN STREET, SUITE 2000
BATON ROUGE, LA 70825

(225) 448-2813
WWW.THEWATERINSTITUTE.ORG