Barataria Terrebonne Use Attainability Analysis

An Ecoregional Approach to Dissolved Oxygen Criteria Development

LOUISIANA DEPARTMENT OF **ENVIRONMENTAL QUALITY**
:FOR ALL YOUR ENVIRONMENTS

Overview
Part 1: The Ecoregion Approach

- Problem Definition
- Ecoregion Framework
- Selection of Reference Sites
- Dissolved Oxygen Protocol Document

Overview
Part 2: The UAA

- Initiation of UAA Study
- Data Collection and Monitoring
- Data Analysis
- Results

Problem

- 5 mg/L (freshwater) and 4 mg/L (estuarine) were adopted without consideration of Louisiana-specific data or conditions
- Natural conditions (i.e., little or no flow, soft stream bottoms, etc.) in Louisiana streams often cause dissolved oxygen to drop below the nationally recommended criteria.
- The use of inappropriate criteria results in a number of erroneous 303(d) listings in areas that have few or no man-made pollution sources
- Inaccurate or unnecessary TMDLS waste a lot of $$$$!

Grand Bayou at Bayou Corn

- Least impacted natural stream surrounded by wetlands
- Low flow, low gradient
- Rated as “good to excellent” for habitat
- High level of natural organic input
- Silt and organic substrate; mucky/muddy bottom

- Least impacted canal/hydrologically modified water body
- Previously dredged water body
- Open marsh; no canopy
- Tidally influenced; high level of erosion
- Mucky/muddy bottom
- Highly inaccessible by general public; requires a boat

Canal east of Montegut, LA

TMDL – A four letter word!

- LDEQ TMDLs
  - 6 Subsegments (water sheds) in the Barataria Basin
  - 16 Subsegments in the Terrebonne
- EPA TMDLs
  - 3 Subsegments in the Barataria Basin
  - 21 Subsegments in the Terrebonne
- Many TMDL model results demonstrate that a 5 mg/L criterion will not be met even when all point sources and nonpoint sources are eliminated
  - Can indicate that the current criteria is not appropriate and needs to be refined

Solution

- Individual or site specific UAA studies have identified many areas that are least impacted, but do not meet a 5 mg/L criterion due to natural conditions
- Site specific UAAs are time-consuming
- LDEQ does not have manpower and $$$ to conduct a UAA on every water body in the state that may require a criteria change

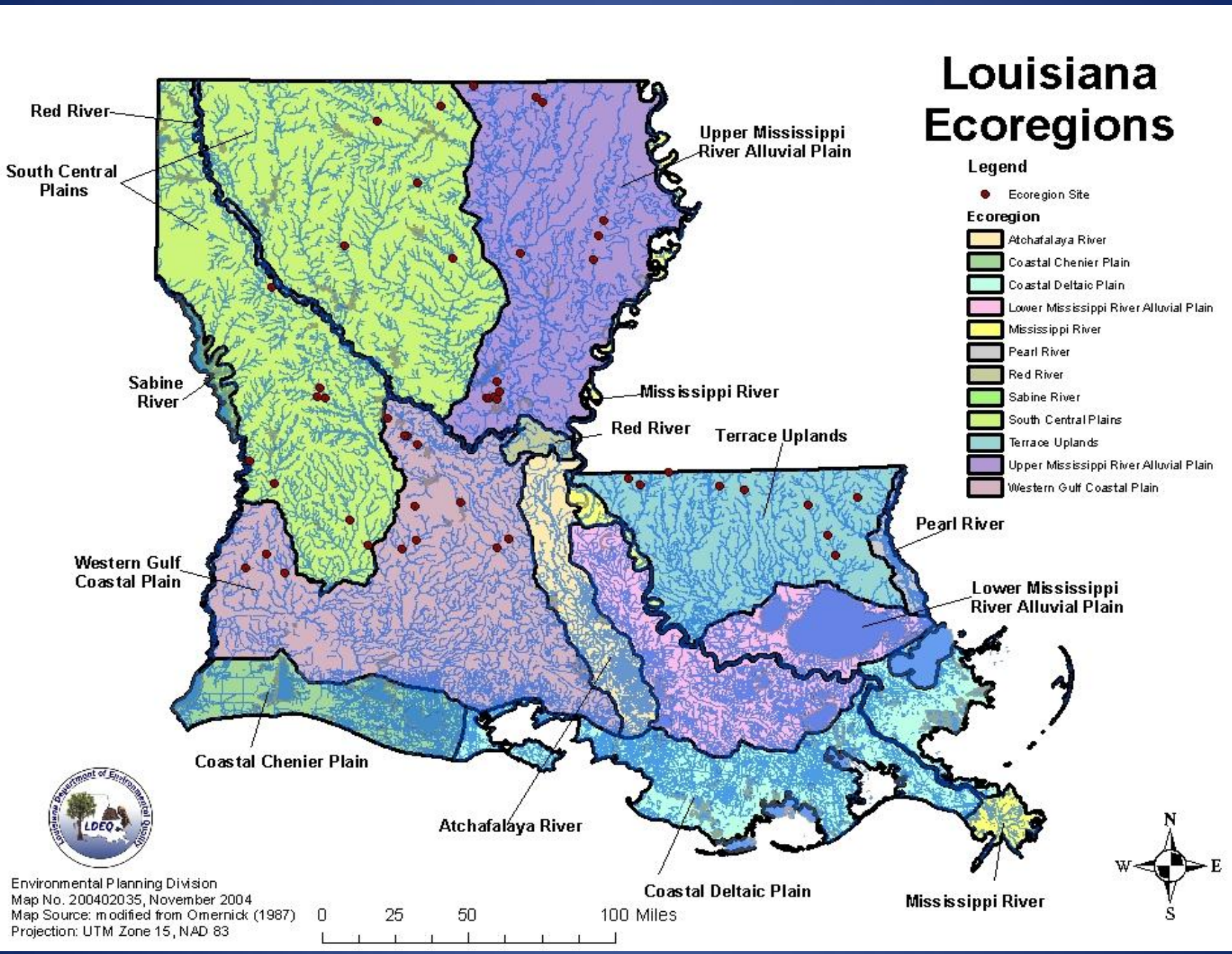
Solution

The Ecoregion Approach

Water quality and aquatic life are more likely to be similar within an ecoregion. Natural conditions in "least impacted" water bodies of an ecoregion represent the best attainable conditions of most water bodies within that ecoregion. Therefore, the fish and wildlife propagation use and corresponding ecological conditions in "least impacted reference waters" are the basis for defining the DO criteria in specified ecoregions and water body types in Louisiana.

Ecoregions

- Ecoregions are a concept that has been utilized by other states and supported by EPA
- LDEQ conducted ecoregion work in the early 1990's
- However, certain pieces of the process were missing:
  - UAA Guidance and protocols
  - Agreement on criteria derivation process
  - Implementation of ecoregional criteria


Louisiana Ecoregions
Legend
Ecoregion Site
Ecoregion
Atchafalaya River
Coastal Chenier Plain
Coastal Deltaic Plain
Lower Mississippi River Alluvial Plain
Mississippi River
Pearl River
Red River
Sabine River
South Central Plains
Terrace Uplands
Upper Mississippi River Alluvial Plain
Western Gulf Coastal Plain
Red River
South Central Plains
Upper Mississippi River Alluvial Plain
Sabine River
Mississippi River
Red River
Terrace Uplands
Pearl River
Western Gulf Coastal Plain
Lower Mississippi River Alluvial Plain
Coastal Chenier Plain
Atchafalaya River
Coastal Deltaic Plain
Mississippi River
N
W
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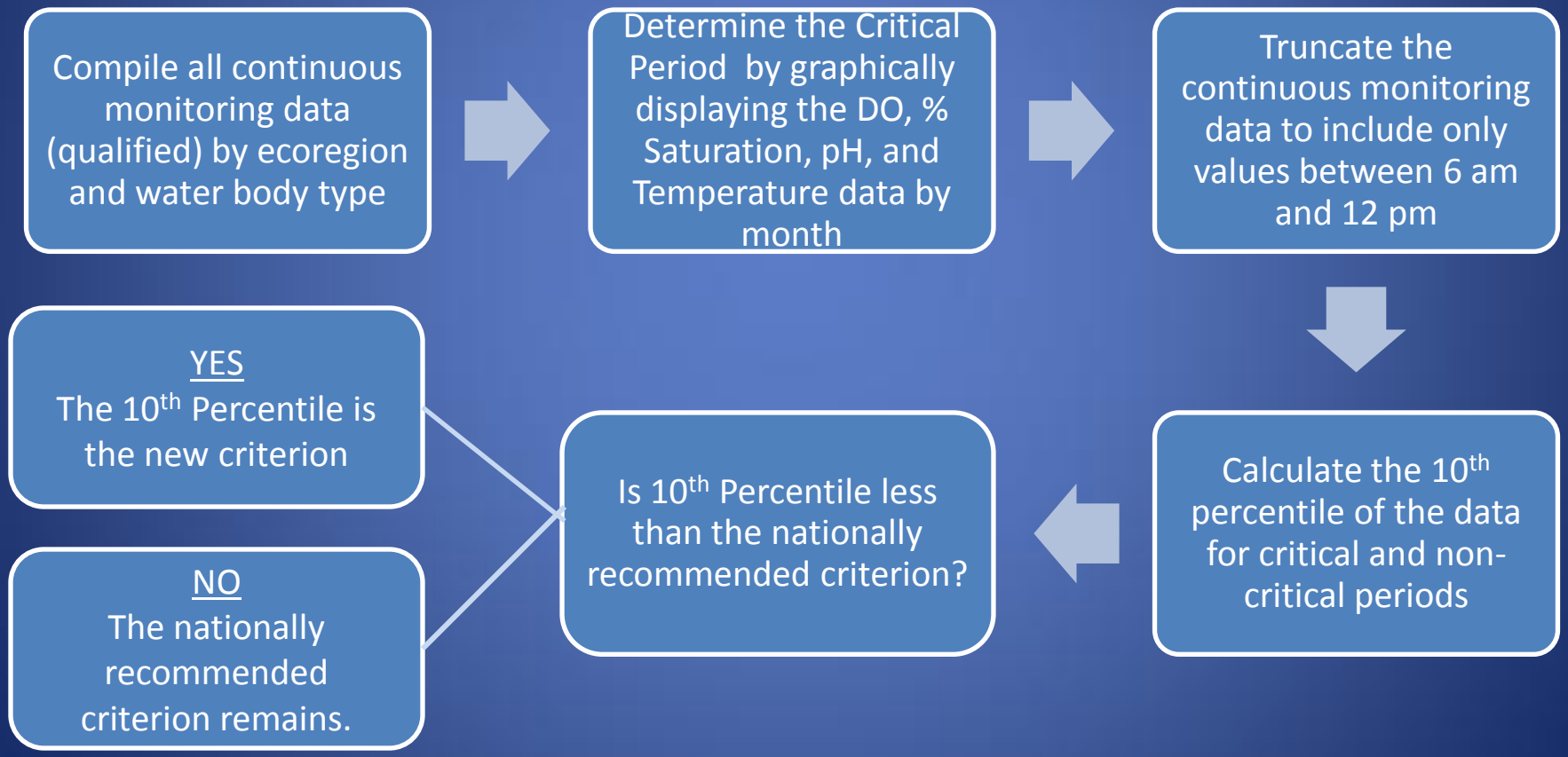
25
50
100 Miles
Environmental Planning Division
Map No. 200402035, November 2004
Map Source: modified from Omernick (1987)
Projection: UTM Zone 15, NAD 83

Ecoregion DO Criteria Development Protocol

- Initial focus of the UAA was on Barataria and Terrebonne basin boundaries, study of the sites and ecoregion delineations revealed that “ecoregional” criteria are appropriate
- EPA Region 6 and LDEQ develop an “agreed upon” standardized protocol to derive dissolved oxygen criteria in the Barataria and Terrebonne basins and for use in-future ecoregional UAAs
- Protocol includes reference site criteria selection, criteria derivation, and assessment procedures

Ecoregion DO Criteria Development Protocol

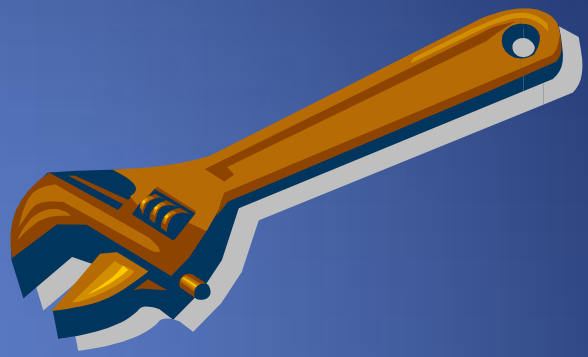


Selection of Reference Sites

- Reference site criteria are:
  - The entire watershed should be without any unusual or unique morphological or hydrological characteristics that are not exhibited by any other water body within the ecoregion
  - No significant point or nonpoint sources should discharge to or impact the water body. Examples of significant nonpoint sources could be agricultural activities, urban developments, silviculture activities, gravel mining, etc.
  - The water body should be natural, preferably with no hydromodification.
  - The water body should have a site that is accessible to the sampling crew
  - The water body should be able to be sampled with gear of choice for ecoregion and water body type

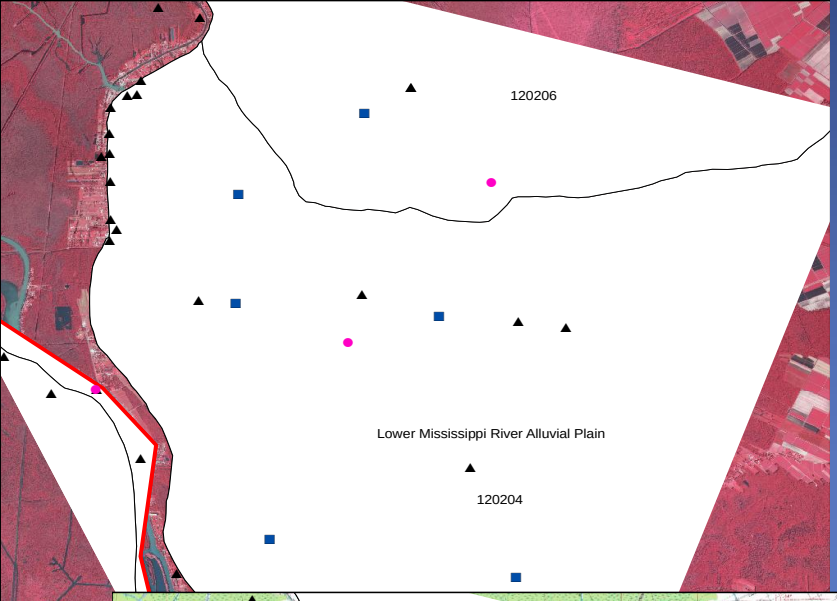
Tools Used for Reference Site Selection

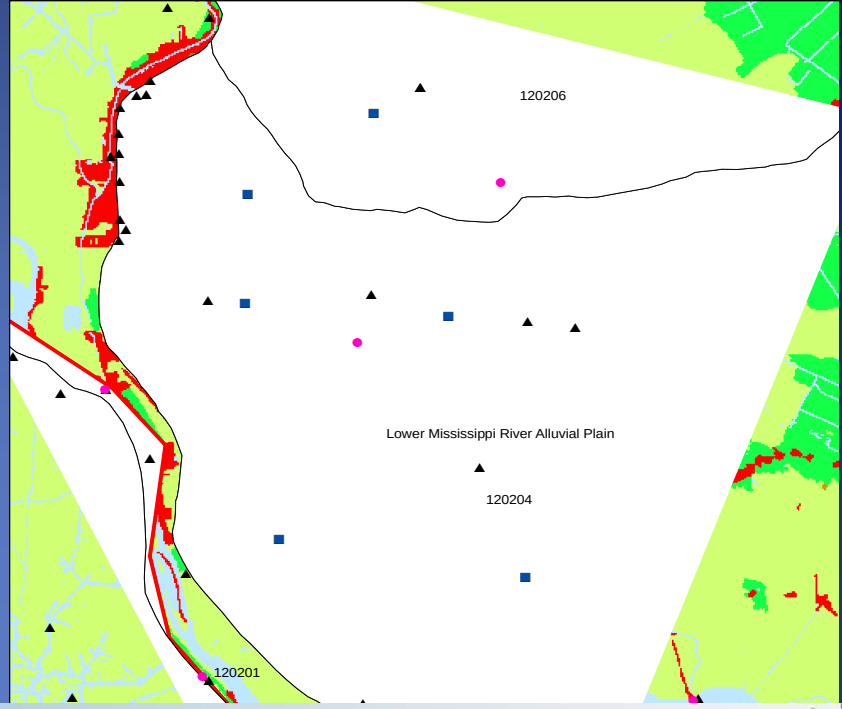
- Land use maps
- Aerial photography
- Satellite imagery
- Point source inventories

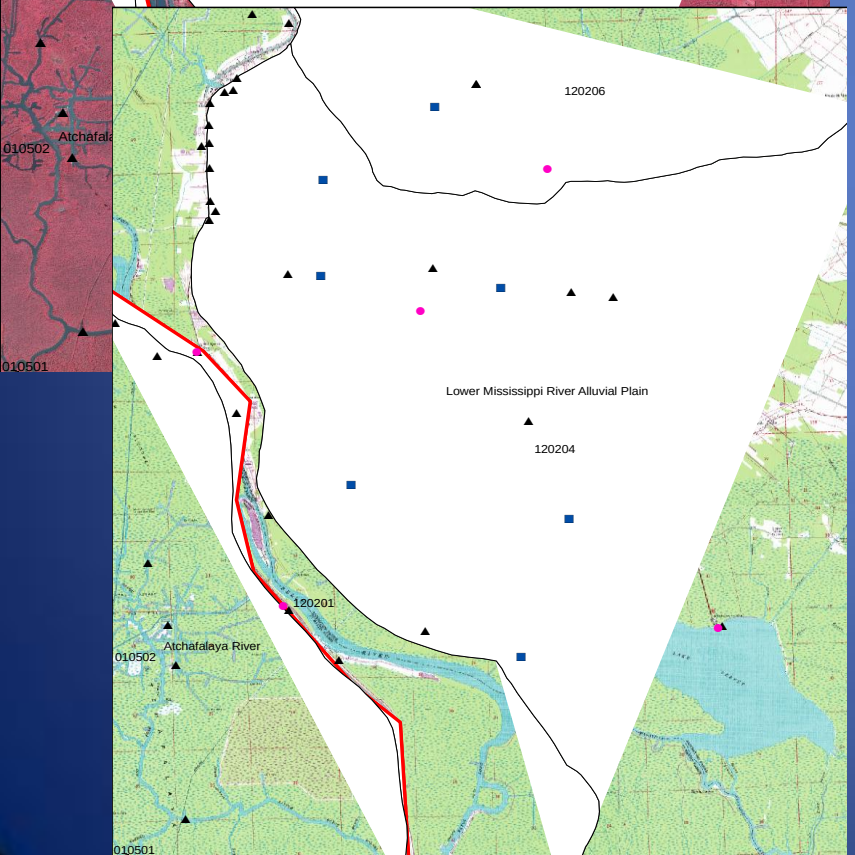


- Salinity maps and water body maps
- Hydrological studies and local experts consulted
- Both on-the-ground and aerial reconnaissance surveys conducted

All of above was used to identify potential areas within LDEQ's ecoregion delineations


120206
Lower Mississippi River Alluvial Plain
120204


120206
Lower Mississippi River Alluvial Plain
120204
120201


010502
Atchafala
010501
120206
Lower Mississippi River Alluvial Plain
120204
120201
Atchafalaya River
010502
010501

Part 2: The BT UAA

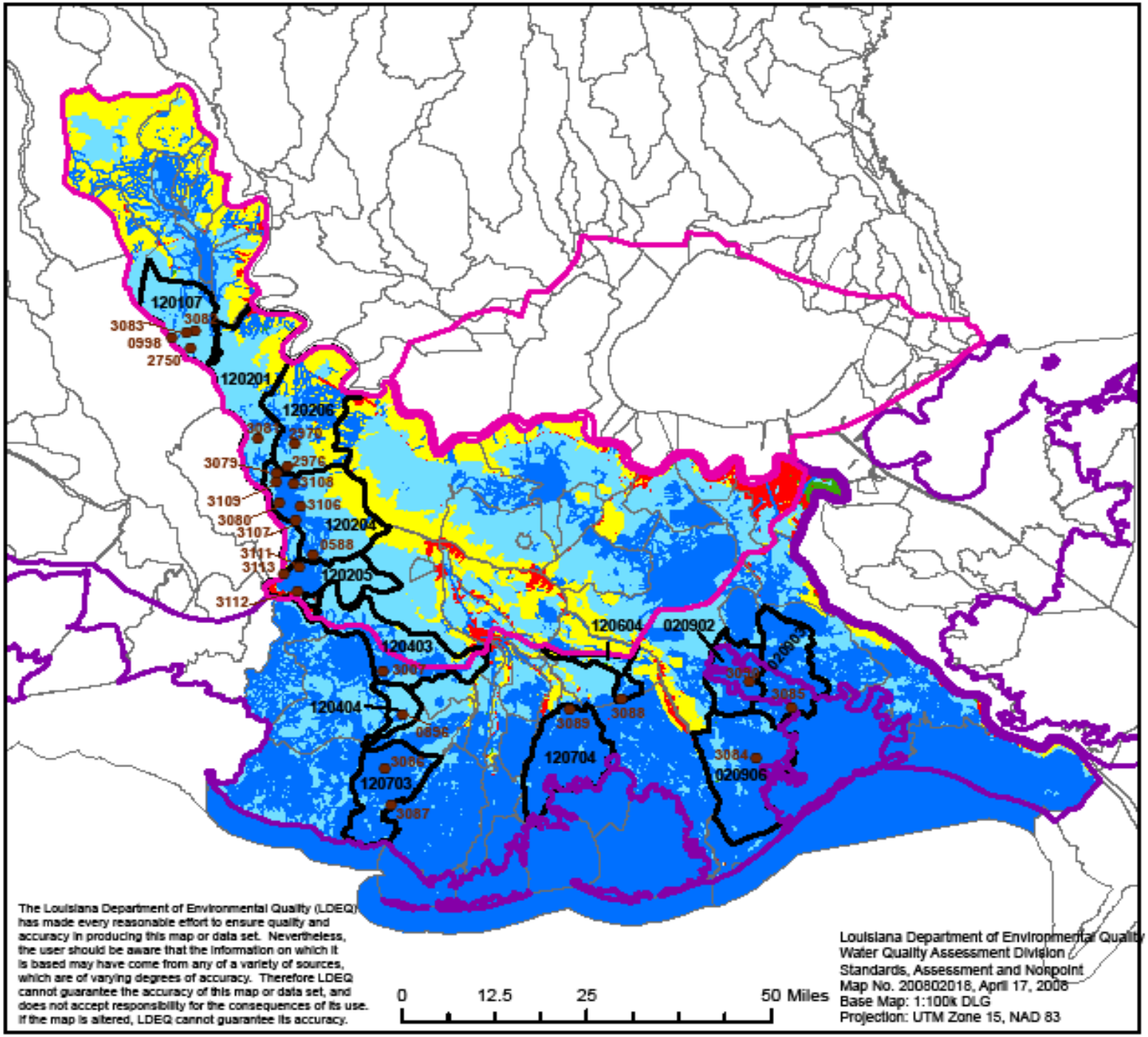
Goals of the UAA – A "data-driven" process

1. Select "least-impacted" reference sites in each basin, including a variety of water body types and salinity regimes in the ecoregion.
2. Analyze existing and new continuous monitoring dissolved oxygen data to identify daily ranges (diurnal curves) and seasonal trends.
3. Evaluate fish data to characterize the biological community at reference sites.
4. Develop appropriate and protective dissolved oxygen criteria to support the Fish and Wildlife Propagation Use based on reference stream data.

Initiation

- Site selection began in early 2005
- Existing data in the two basins were identified
- Availability of existing water quality and biological data were considered in reference site selection
- 26 reference sites were selected in the Barataria and Terrebonne Basins

Land Use for Barataria and Terrebonne Basins



Study Site
Study Subsegment
Subsegment
Lower Mississippi River Alluvial Plain
Coastal Deltaic Plain

Land Use

- Wetlands
- Forest
- Rangeland
- Agriculture
- Urban
- Barren
- Water

N
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S

The Louisiana Department of Environmental Quality (LDEQ) has made every reasonable effort to ensure quality and accuracy in producing this map or data set. Nevertheless, the user should be aware that the information on which it is based may have come from any of a variety of sources, which are of varying degrees of accuracy. Therefore LDEQ cannot guarantee the accuracy of this map or data set, and does not accept responsibility for the consequences of its use. If the map is altered, LDEQ cannot guarantee its accuracy.

Louisiana Department of Environmental Quality
Water Quality Assessment Division
Standards, Assessment and Nonpoint
Map No. 20080201B, April 17, 2008
Base Map: 1:100k DLG
Projection: UTM Zone 15, NAD 83

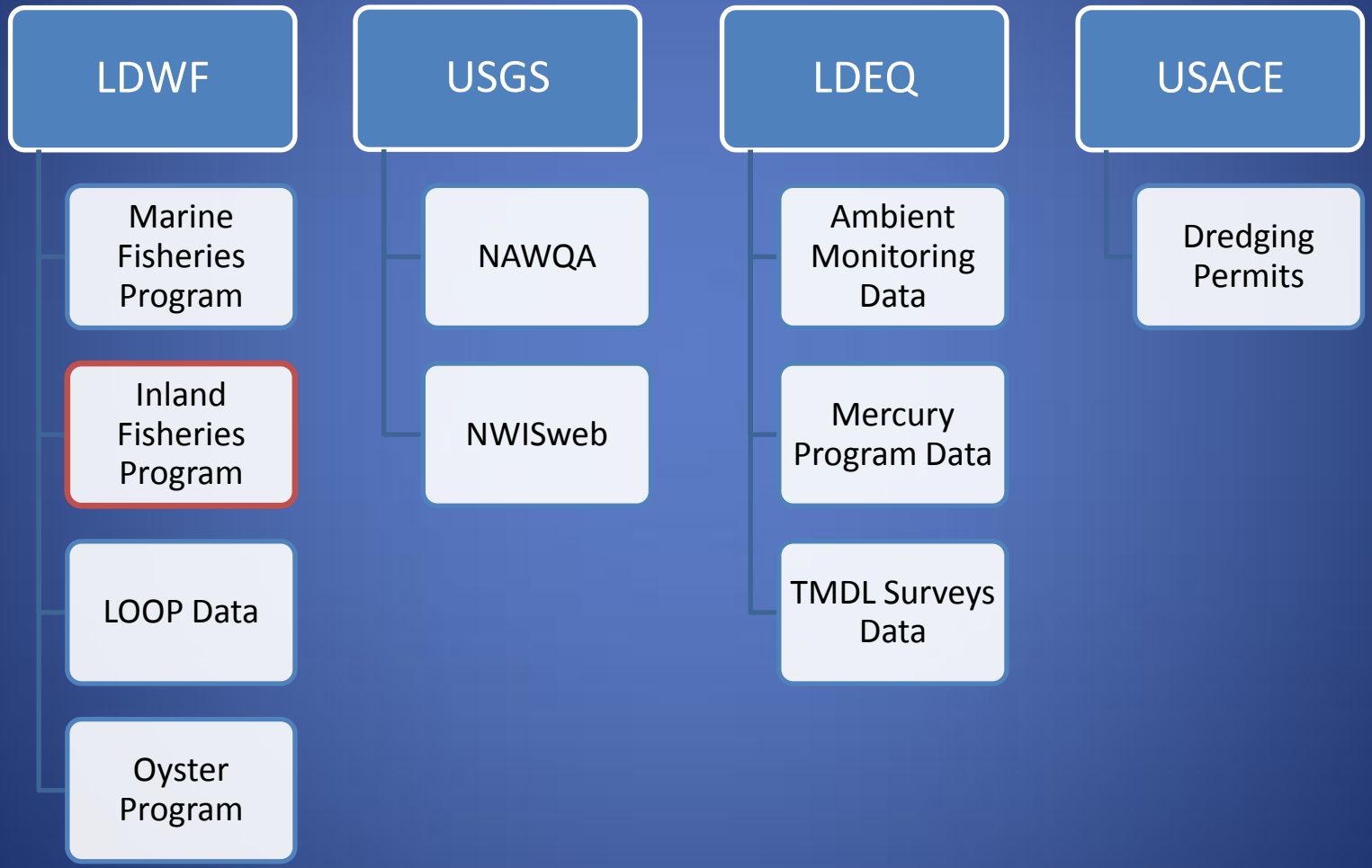
DEQ LOUISIANA

Grand Bayou

Bay Rambo

Lake Verret

Data Collection: Existing water quality and biological data were collected and compiled.



Data Collection: Monitoring

- Sampling began in May, 2005
- Each reference site monitored monthly in an attempt to identify seasonal variations:
  - Continuous field monitors (DO, % DO Sat, pH, Temp, etc.)
  - Fish data collected via electroshocking, rotenone sets, and catfish traps
- EPA Region 6 used grant funds to conduct a concurrent study in the Terrebonne basin; data from those 15 sites was added to the DEQ data
- LDEQ coordinated with LDWF Inland Fisheries Program to collect additional fish data concurrently with continuous monitoring data in Lake Verret, Grassy Lake, and Lake Palourde

Fish were collected, identified, and measured in accordance with LDEQ Standard Operating Procedures

Rotenone Sampling on Lake Verret, August 2005

Fish and Wildlife Use Fully Supported

Lake Penchant Bald Eagle

Bayou Copasaw Gator

Uh-Oh

Hurricane Katrina blew through and disrupted the UAA sampling activities; sampling of reference sites stopped before storms in August, 2005. Sampling resumed in February, 2006.

Continuous Monitoring Data Coverage

- DEQ needed sufficient data for each ecoregion and water body type to accurately determine seasonal variations
- Data was collected from May, 2005 through January, 2008
- A total number of 296 sampling events occurred at 26 sites over the 2 ½ year period

Continuous Monitoring Data Coverage

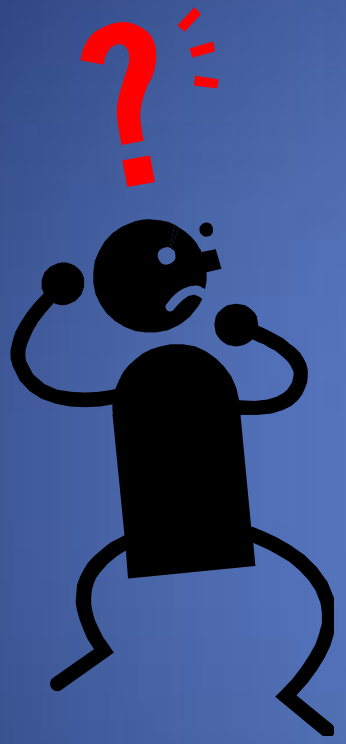
Table B-4. LDEQ continuous monitoring water quality sampling coverage for reference sites in the Barataria and Terrebonne Basins.

CDP – Coastal Deltaic Plain, LMRAP – Lower Mississippi River Alluvial Plain Ecoregions;
X - 2005; ■ - 2006; ● - 2007, □ - 2008.

Ecoregion	Waterbody Type	Subsegment	Site Number	JAN	FEB		APR		JUN	JUL	AUG	SEP	OCT	NOV	DEC
CDP	Bay/Estuary	020903	3085	□	■		●	●	X ■	■	X		●	●	●
CDP	Bay/Estuary	020906	3084	□	■		●	●	■	X ■ ●	●		●	●	●
CDP	Bay/Estuary	120703	3086	□		■	●	●	X ■	●	X		● ●		● ●
CDP	Bay/Estuary	120703	3087	□		■	●	●	X ■	●	X		● ●		● ●
CDP	Canal	120604	3088	□	■		●	●	X ■	●	X		● ●	●	●
CDP	Canal	120704	3089		■		●	●	X ■		X				
CDP	Lake	020902	3090	□		■	●	●	X ■	●	X		●	●	●
CDP	Lake	120404	0896	□	■		●	●	X ■	●	X		● ●	●	●
CDP	Stream	120403	3007	□	■		●	●	X ■	●	X		● ●	●	●
LMRAP	Lake	120204	0588	□	■		●	X ●	●	■	X X	●	●	●	●
LMRAP	Lake	120204	3080	□		■	●	X ●	■	●	X	●		● ●	●
LMRAP	Lake	120204	3106	□		■	●	●	■	X	X	●	●	●	●
LMRAP	Lake	120204	3107	□	■		●	●	■	X	●	●	●	●	●
LMRAP	Lake	120204	3108	□		■	●	●	■	X	X	●		● ●	●
LMRAP	Lake	120204	3109	□		■	●	●	■	X	X	●	●	●	●
LMRAP	Lake	120205	3111	□	■		●	●	■	●	X X	●	●	●	●
LMRAP	Lake	120205	3112		□	■	●	●	■	●	X X	●	●	●	●
LMRAP	Lake	120205	3113	□		■ ■	●	●	●	■	X X		●	●	●
LMRAP	Stream	120107	0998	□		■	●	X ●	■	●	X	●	●	●	●
LMRAP	Stream	120107	2750		■ □		●	X ●	■	●	●	●	●	●	●
LMRAP	Stream	120107	3082			■	●	X ●	■	●	X	●		●	
LMRAP	Stream	120107	3083	□	■		●	X ●	■	●	X	●	●	●	●
LMRAP	Stream	120201	3081		■		●	X ●	■	●	X	●	●		● ●
LMRAP	Stream	120204	3079	□		■	●	X ●	■	●	X	●	●	●	●
LMRAP	Stream	120206	2970	□		■	●	X ●	■	●	X	●	●	●	●

Biological Data Collected

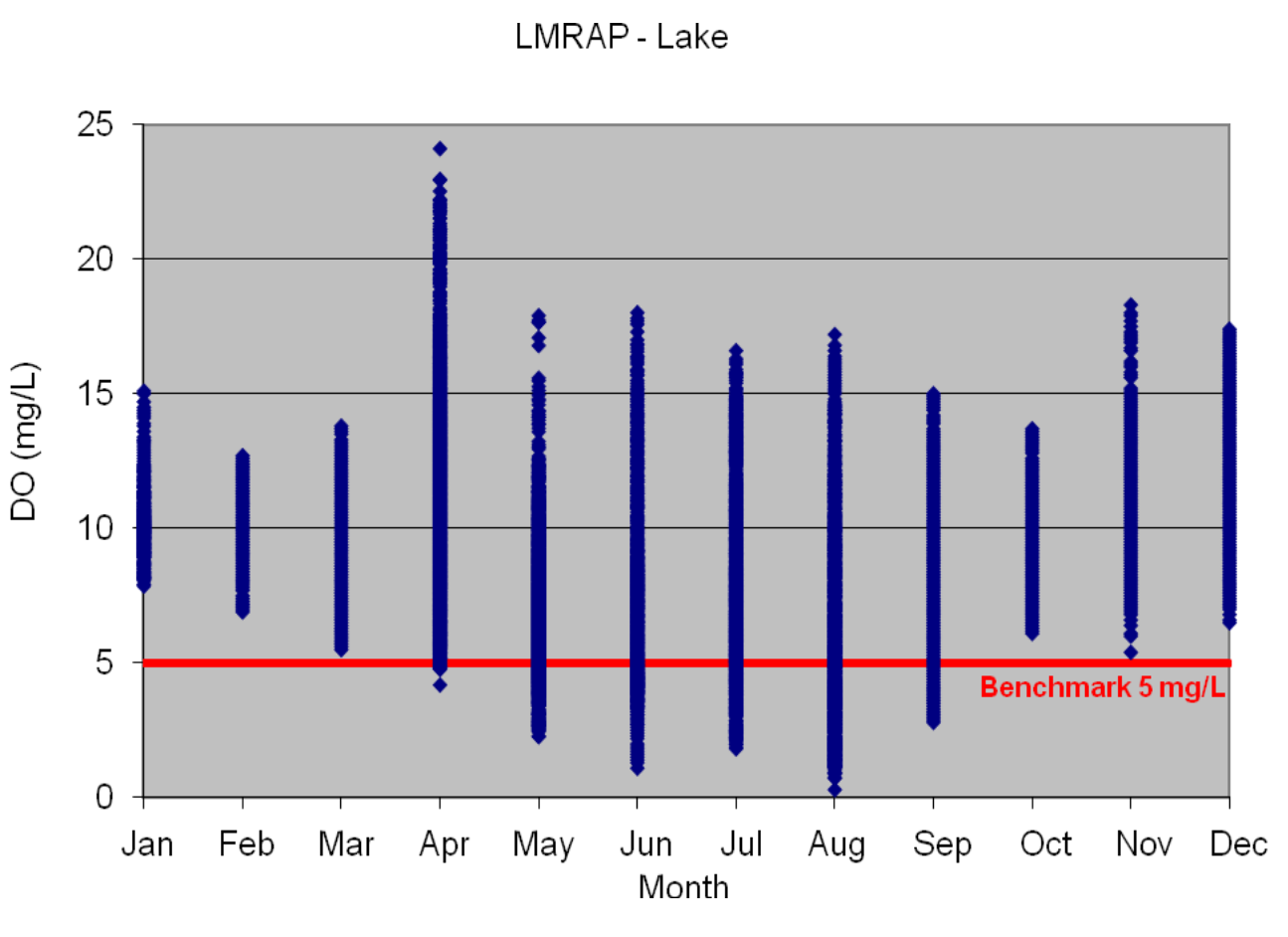
- Fish sampling events took place in May, July, and August of 2005 and in March of 2006
- 26 sampling events at 15 sites
- Electroshocking was used primarily for freshwater streams; rotenone net sets for freshwater lakes
- Other sites were characterized using existing LDWF data
- Estuarine sites were difficult to characterize due to gear problems



Now what do we do with all of this data?

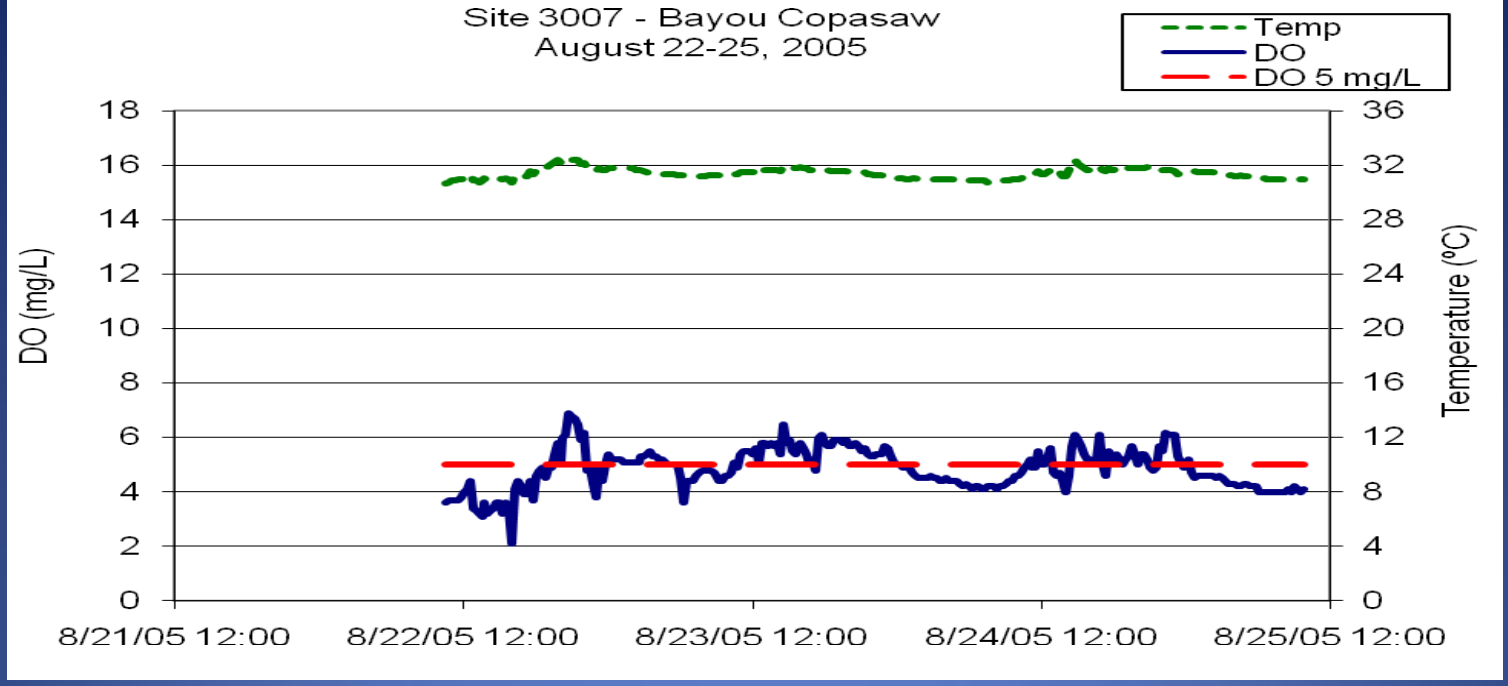
Critical Period = The time period where the data points fall below the national benchmark

Figure C-5. Critical period determination for Lower Mississippi River Alluvial Plain (LMRAP) Ecoregion, Lake waterbody type.
The critical period is April through September.



Fish Data Analysis

- Species Richness, Abundance, and Diversity were calculated for each site
- Key species for each ecoregion were identified
- Data exhibited gear bias
- Rotenone data sets had highest levels of species richness and abundance
- Diversity measurements were often skewed in the large bay areas due to the presence of large schools of a single species



Fish Species	Abundance (# of individuals)
ATLANTIC SPADEFISH	1
BAY ANCHOVY	3
BLACK CRAPPIE	12
BLUEGILL	179
CARP	22
GIZZARD SHAD	3
GOLDEN SHINER	1
GREEN SUNFISH	7
GULF MENHADEN	3
LARGEMOUTH BASS	19
ORANGESPOTTED SUNFISH	1
REDEAR SUNFISH	7
SMALLMOUTH	1
SPOTTED GAR	14
STRIPED MULLET	1
THREADFIN SHAD	5
WARMOUTH	4
WHITE CRAPPIE	2
YELLOW BULLHEAD	2
Total Abundance (# of individuals)	**287**

Critical Periods

Ecoregion	Waterbody Type	Critical Period	Non-Critical Period
CDP	Bay/Estuary	April – August	September – March
CDP	Canal	June – August	September – May
CDP	Lake	June	July – May
CDP	Stream	April – August	September – March
LMRAP	Lake	April – September	October – March
LMRAP	Stream	March – November	December – February

Criteria

Ecoregion	Waterbody Type	Period	National Benchmark (mg/L)	10th percentile of reference data (6 am to 12 pm)	Criteria
CDP	Bay/Estuary	Critical	4	4.5	4.0
CDP	Bay/Estuary	Non-Critical	4	7.1	4.0
CDP	Canal	Critical	4	3.8	3.8
CDP	Canal	Non-Critical	4	5.5	4.0
CDP	Lake	Critical	5	6.0	5.0
CDP	Lake	Non-Critical	5	6.8	5.0
CDP	Stream	Critical	5	3.8	3.8
CDP	Stream	Non-Critical	5	6.3	5.0
LMRAP	Lake	Critical	5	3.3	3.3
LMRAP	Lake	Non-Critical	5	7.9	5.0
LMRAP	Stream	Critical	5	2.3	2.3
LMRAP	Stream	Non-Critical	5	5.4	5.0

Rule Number WQ075

- LDEQ has initiated a rule revising dissolved oxygen criteria for 64 subsegments in the Barataria and Terrebonne basin
- Water body types that will be revised include lakes, streams, canals, and estuarine bays
- LDEQ failed to identify a reference site for the “canal” water body type in the LMRAP ecoregion and those subsegments will be revisited at a later date

Rulemaking Process

1. Rule Authorization from LDEQ Assistant Secretary
2. Rule Development –Draft rule, FEIS and Cost/Benefit Analysis if necessary
3. EPA and LDEQ Concurrence
4. Draft Stage - Notice of Intent Published in State Register; Public Hearing and Comment Period
5. Final Rule published in Louisiana Register
6. EPA Oversight – Certification (40 CFR 131.6)
7. EPA Oversight – Approval/Disapproval (40 CFR 131.21)

The final UAA report and supporting documentation will be made available on the Water Quality Assessment Division's webpage:

http://www.deq.louisiana.gov/portal/tabid/69/Default.aspx

Future Plans

Update the WQMP to include the Dissolved Oxygen Criteria Development Protocol

Utilize protocol in future UAA efforts in the Western Gulf Coastal Plains, Terrace Uplands, and South Central Plains ecoregions

The TEAM