Title
A context sensitive approach to highway development in coastal Louisiana

Author
Gesing,, Christopher G., P.E.

Publication Date
2003-08-24

A CONTEXT SENSITIVE APPROACH TO HIGHWAY DEVELOPMENT IN COASTAL LOUISIANA

Christopher G. Gesing, P.E. (Phone: 412-269-4636, Email: cgesing@mbakercorp.com), Michael Baker Jr., Inc., Airside Business Park, 100 Airside Drive, Moon Township, PA 15108, Fax: 412-375-3989

Abstract: The Louisiana Department of Transportation and Development (LADOTD), in cooperation with the Federal Highway Administration–Louisiana Division (FHWA-LA), proposed to construct a four-lane fully controlled access elevated highway on new location with bridges spanning navigable waterways. Identified as the LA 1 Improvements Project, the proposed facility would be approximately 17 miles in length, generally parallel Louisiana Highway 1 (LA 1) and would extend from Louisiana Highway 3235 (LA 3235) west of Golden Meadow to Louisiana Highway 3090 (LA 3090) at its intersection with LA 1, north of Port Fourchon. The project traverses some of most ecologically unique and sensitive areas in Louisiana, and perhaps the nation. The success of the project's location and environmental studies and environmental impact statement (EIS) is attributed to LADOTD's and FHWA-LA's environmental stewardship, cooperative partnering with federal and state resource agencies, and the context sensitive approach employed and environmental commitments made to reach a consensus on a selected alignment that best balanced the project needs with the overall impacts. The project has received national attention as a "landmark effort in environmental streamlining" and a model by which other projects should be developed.

Introduction

Louisiana Highway 1 (LA 1) from I-10 at Port Allen to LA 3090 at Port Fourchon is designated as a principal arterial of the National Highway System (NHS). The NHS was created with the signing of the National Highway System Designation Act of 1995 and designated 160,955 miles of interstate highway and other roads that are critical for the economy, defense and mobility of the nation. These highways provide access to major ports, airports, rail stations, public transit facilities and other border crossings. LA 1 is included as part of the NHS because of its intermodal link to the nation's energy supply.

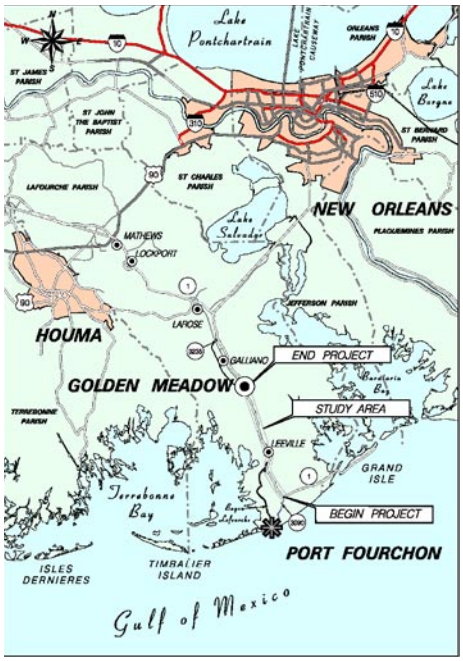


Fig. 1. Regional study area.

In the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the United States Congress designated certain highway corridors of national significance to be included in the National Highway System. Twenty-one "High Priority Corridors" were so designated mainly in regions that were not well served by the existing Interstate Highway System. Since 1991, Congress has amended the ISTEA legislation, identifying additional high priority corridors. The Department of Transportation and Related Agencies Appropriations Act of 2002 further amended ISTEA, adding LA 1 from Grand Isle to its intersection with U.S. 90 as High Priority Corridor No. 44.

LA 1 between Golden Meadow, Leeville, and Port Fourchon, Louisiana, is a rural two-lane arterial highway that is vital to the citizens who live and work in south Lafourche Parish for hurricane and tropical storm evacuation; work related and shopping commutes; shipping of shellfish and finfish harvested in the Barataria-Terrebonne National Estuary (BTNE) waters; access to Port Fourchon and Grand Isle, Louisiana's only inhabited barrier island, and support services to the expanding offshore oil and gas activities in the Central Gulf of Mexico. The region produces approximately 18 percent of the domestic crude oil, 26 percent of the domestic natural gas, and unloads 13 percent of the nation's imported crude oil through the Louisiana Offshore Oil Port (LOOP) (LA 1 Task Force 1999).

The existing lift bridge at Leeville is the "critical link" in the region's transportation system and connects Port Fourchon and Grand Isle to the mainland. The highway ceases to function during periods of heavy bayou marine traffic and bridge maintenance or repair. LA 1 also becomes impassable during inclement weather and was most recently inundated with tidal waters from Tropical Storm Isadore and Hurricane Lili in September 2002 and Tropical Storm Bill in June 2003.

Over the past decade, LA 1 has been the subject of numerous studies by federal and state agencies, which all concluded that the highway does not adequately serve the region's industries and stakeholders, all of them heavily reliant on this transportation lifeline.

The Coastal Environment

Louisiana accounts for up to 40 percent of the coastal salt marshes in the 48 contiguous United States and 80 percent of the nation's coastal wetlands loss. Marsh loss in Louisiana is of particular concern because the marshes are the most extensive in the nation and are believed to be largely responsible for the high productivity of estuarine-dependent species in the north-central Gulf of Mexico. Louisiana is losing wetlands at a rate of 25–35 square miles per year. The losses are due to a combination of human and natural factors, including subsidence, shoreline erosion, freshwater and sediment deprivation, saltwater intrusion, oil and gas canals, navigation channels and herbivory (LADNR 2001, GOMFMC 1998).

Fig. 2. Leeville Bridge – Looking North

The BTNE encompasses an area of approximately 6,300 square miles in the Mississippi Deltaic Plain and is bordered by the Mississippi and Atchafalaya Rivers. The estuary supports one of the most prolific and profitable fisheries in the nation and is designated as essential fish habitat (EFH) for a number of species including post-larval and juvenile white shrimp, brown shrimp, red drum (redfish), and Spanish mackerel. The area is widely known for its hunting and fishing and the waters off Port Fourchon and Grand Isle are considered to be one of the top ten fishing spots in the world.

The Barataria and Terrebonne Basins are estimated to have lost between 24 percent and 35 percent of the wetlands that were observed during inventories conducted in 1932. Half of this loss was to brackish and saline marsh, and approximately one-third was to freshwater marsh. This loss was attributed primarily to high subsidence rates, as well as altered hydrology (i.e., navigation channels), nutria herbivory, and wind-induced shoreline erosion. It is estimated that by the year 2050 between 17 percent and 19 percent of the total current marsh habitat within the Barataria and Terrebonne Basins will be lost, and as much as 32 percent of the saline marsh will be lost to open water habitat (LADNR 1998).

Fig. 3. LA 1 at Leeville.
(Photo Courtesy of NOAA)

This loss of wetlands could have both economic and ecological impacts. Open water is far less productive than marsh habitat, and this change could affect a fisheries resource that is estimated by the National Marine Fisheries Service (NMFS) to comprise approximately 20 percent of the nation's total fisheries harvest (LADNR 1998).

The region lies within the Mississippi Flyway and either is home to or is in the migration path for one-half of the bird species of North America. Wildlife populations, such as waterfowl, could also be impacted by a reduction in coastal marsh, which is a critical habitat for approximately 70% of the waterfowl utilizing the Mississippi and Central flyways. Loss of vegetated wetlands could also increase storm surge damage due to a reduction of natural flood barriers.

The Transportation Challenge

Improving the existing facility was not considered feasible because the two-lane roadway is not sufficient to adequately provide for the anticipated traffic volumes. Existing soil conditions would not support at-grade roadway construction without extensive excavation of existing material and the placement of fill to support the new roadway. Soil subsidence rates between 2.1 and 3.5 feet per century could, in some circumstances, make it impossible, to maintain a "design" vertical roadway profile. And reconstructing the entire existing roadway above the minimum requirements of the 100-year base flood elevation would impact residences and businesses adjacent to the highway and create community disruption during reconstruction.

In order to provide a transportation system that adequately serves the region's needs, the Louisiana Department of Transportation and Development (LADOTD), in cooperation with the Federal Highway Administration–Louisiana Division (FHWA-LA), proposed to construct a four-lane fully controlled access elevated highway on new location with bridges spanning navigable waterways. A fixed-span, high-level bridge would span Bayou Lafourche and the Southwestern Louisiana Canal. Identified as the LA 1 Improvements Project, the proposed facility would be approximately 17 miles in length generally parallel LA 1 and would extend from Louisiana Highway 3235 (LA 3235) west of Golden Meadow to Louisiana Highway 3090 (LA 3090) at its intersection with LA 1, north of Port Fourchon. Access to the proposed facility would be limited to on and off ramps and two-lane connector roads constructed on new location at proposed interchange locations at LA 3235, LA 1 at Leeville, and LA 3090.

On May 5, 1999, a notice of intent (NOI) was published in the *Federal Register* (Vol. 64, Number 86) to prepare an Environmental impact statement (EIS), and in September 1999, the LADOTD initiated studies to prepare the EIS.

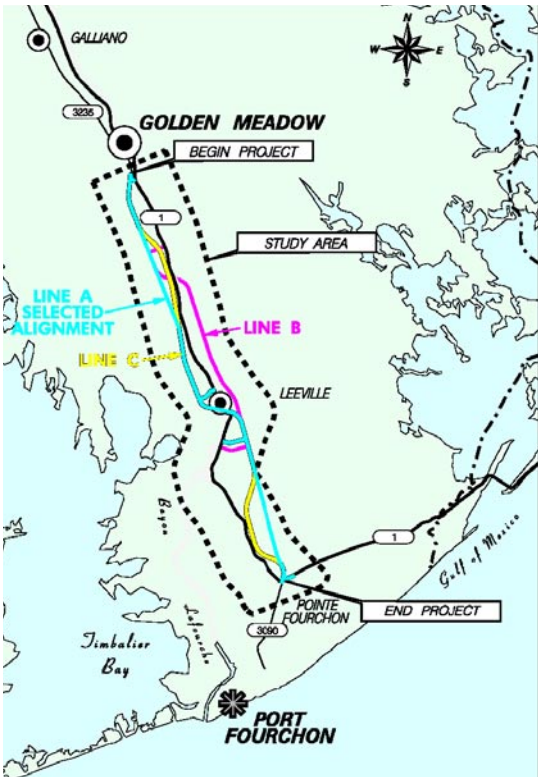


Fig. 4. Study Area and EIS Alignments

A Context Sensitive Project Approach

The project's study area encompassed some of the most ecologically unique and sensitive areas in Louisiana, and perhaps the nation, and traversing the area with a highway on new location would present major environmental challenges. In the spirit of environmental stewardship and streamlining, a context sensitive project approach was employed to develop a transportation facility that fit the physical setting and preserved scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility.

The LADOTD and the FHWA-LA promoted a cooperative partnership with federal and state resource agencies to develop the project. Early and frequent consultation and coordination with resource agencies including the U.S. Army Corps of Engineers (COE), the National Marine Fisheries Service (NMFS), the U.S. Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (FWS) formed the foundation of the context sensitive project approach. Facets of this context sensitive project approach, and the coordination and consultation considered instrumental in the project's success follow.

Early Agency Scoping

Prior to issuing the NOI, the LADOTD and the FHWA-LA met with the federal and state resource agencies to conduct an early scoping session to discuss the project purpose and need, the possible transportation solutions to satisfy that need, the envisioned scope of the environmental studies supporting the preparation of an EIS, permits, and mitigation.

LADOTD proposed constructing the facility using "end on" construction techniques as a means of minimizing disturbance to the marsh vegetation. "End on" construction uses temporary, movable support structures extending from completed spans to support the construction of the adjacent span. The temporary support structures are then disassembled and reassembled on the newly completed span and construction of the new span continues. The resource agencies concurred with LADOTD's proposed construction technique.

Special Environmental Studies and Mitigation Measures

Shading Analysis

Agency concerns were raised regarding the effects the shadow created by the elevated highway would have on the marsh grass below. The NMFS indicated that this shading effects information was important in reviewing a Preferred Alignment recommendation.

A comprehensive literature review did not identify any published studies documenting the shading effect on the health of smooth cordgrass (Spartina alternifolia), the dominant coastal wetland plant in the study

area. The NMFS provided an unpublished study that evaluated the effectiveness of marsh recolonization as a result of changes to the historic bottom elevation or compaction of marsh soils. The study findings were inconclusive and were not directly applicable to the LA 1 improvements project. Vegetation impacts of the LA 1 improvements project would be minimized through the proposed "end-on" construction technique. The study also acknowledged the lack of research and did not address the impacts of shading to an established stand of Spartina.

A comprehensive literature review also did not identify any published studies quantifying the amount of sunlight needed to maintain smooth cordgrass health. According to one horticultural reference, Spartina alternifolia prefers partial shade or partial sun to full sun.

In the absence of published studies, two simplified analyses were performed.

Fig. 5. Smooth Cordgrass (Spartina alternifolia)

First, for each alignment, the length of north-south or east-west oriented roadway through area wetlands was determined. For this analysis, north-south oriented was defined as mainline and ramp centerlines with a bearing between –45˚ and +45˚ from North. The results are presented in table 1. Line A, the selected alignment, had the least mainline length through emergent marsh and both the least east-west oriented mainline and least east-west oriented connector road lengths through emergent marsh.

Second, an analysis was performed to determine the length of time an area would be shaded based on a north-south oriented typical section. The shadow cast from the elevated highway varies with the time of day and corresponding position of the sun. The longest shadows are cast near sunrise and sunset, but are of the shortest duration.

The shaded length decreases until the sun is oriented above and perpendicular to the highway, and then increases until sunset (see table 2).

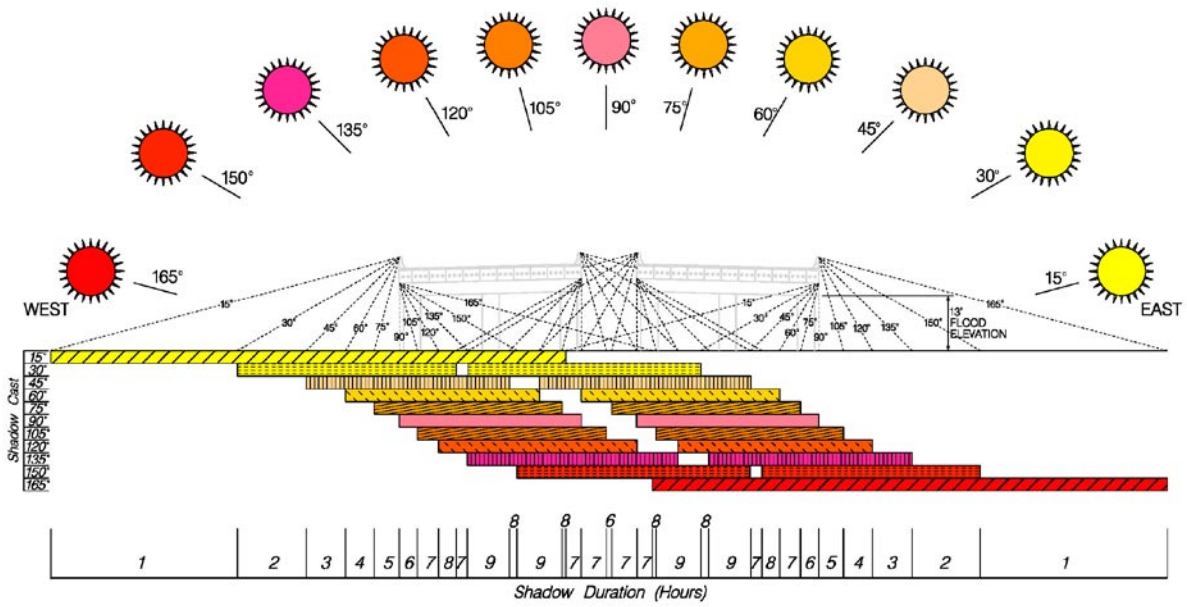
For study purposes, a minimum lower chord elevation of 13 feet NGVD was used for the mainline portions of the preliminary alignments. This minimum elevation exceeded the 100-year base flood elevation as defined by the Federal Emergency Management Agency (FEMA). Final elevations would be established during final design. This elevation did not preclude sunlight from reaching the underlying vegetation. Of the approximately 260 feet of shadow cast, nearly 50 percent of the length would be shaded for two hours or less, while approximately 25 percent of the length would be shaded for eight or nine hours. The analysis did not consider the complexities of water reflectivity or diffused/indirect sunlight.

Table 1
Length Through Wetlands

Alignment	Estuarine Emergent (mile)	Estuarine Scrub–Shrub (mile)	Total (mile)
Line A (Selected Alignment)			
- NS Mainline	5.45	0.30	5.75
- EW Mainline	0.24	0.02	0.26
- EW Connector Roads	0.13	0.25	0.38
- Total	5.82	0.57	6.39
Line B			
- NS Mainline	5.37	0.61	5.98
- EW Mainline	0.38	0.00	0.38
- EW Connector Roads	0.23	0.03	0.26
- Total	5.98	0.64	6.62
Line C			
- NS Mainline	5.51	0.27	5.78
- EW Mainline	0.39	0.02	0.41
- EW Connector Roads	0.13	0.25	0.38
- Total	6.03	0.54	6.57

Source: LADOTD and Michael Baker Jr., Inc.

The federal cooperating resource agencies agreed that there was no practicable alternative to the proposed construction of Line A, the selected alignment, in wetlands and that the selected alignment included all practicable measures to minimize harm to wetlands. The LADOTD, the FHWA-LA and the federal cooperating resource agencies also agreed that the required mitigation acreage would be the total of the direct and indirect (marsh that would be shaded for four hours or more) wetland impacts (see table 3), allowing up-front mitigation to be in place prior to construction and prior to the vegetated wetland impacts.



Source: LADOTD and Michael Baker Jr., Inc.

Fig. 6. Shadow Length and Duration

Stormwater Runoff Considerations

Agency concerns were also raised regarding the affect that roadway runoff would have on the surrounding tidal wetlands and that stormwater pollution abatement measures should be fully considered.

A comprehensive literature review was conducted to identify studies documenting the affects of highway runoff on expansive, tidally induced marine environments. No published studies were identified. Several studies had been conducted investigating the affects of highway runoff, but these focused on the effects of urban highways with high average daily traffic (ADT) volumes on freshwater systems. These studies were not applicable to the LA 1 improvements project because the proposed highway was a rural, low-volume facility in a tidally influenced marine environment.

Research indicates that runoff from rural highways would generate few substantial impacts with ADTs of less than 30,000 vehicles (Maestri et al. 1988). ADTs for the proposed highway were projected to be less than this amount. Based on this research, no substantial impacts to water quality were expected due to highway runoff.

Table 2
Shadow Length and Duration

Duration (hours)	Transverse Length (feet)	Transverse Length (%)
1	88.33	33.51
2	32.33	12.27
3	18.67	7.08
4	13.67	5.19
5	11.83	4.49
6	9.75	3.70
7	34.17	12.96
8	13.50	5.12
9	41.33	15.68
Total	263.58	100.00

Source: LADOTD and Michael Baker Jr., Inc.

The LADOTD, through the Louisiana Transportation Research Center (LTRC), has been a sponsor for highway runoff collection systems and bio-filters research at Louisiana State University. The on-going research includes characterizing and controlling urban stormwater where ADTs approach 150,000 vehicles. The highway runoff collection system and bio-filters are being used on Interstate 10 over City Park Lake in Baton Rouge, Louisiana. At this location, Interstate 10 has an ADT of 122,300 vehicles and a bridge span of less than 900 feet.

Although current research did not support the need for a highway runoff collection system, it was decided that the scupper discharge pipes would include additional length so as not to preclude the attachment of a highway runoff collection system, should future research indicate the need for such a system.

Constructibility

Prior to completing the EIS, project constructibility was reviewed by and discussed with representatives from the construction industry. In order to minimize disturbance to the marsh vegetation, the elevated highway would be constructed utilizing “end on” construction methods, except for the fixed-span high-level bridge over Bayou Lafourche and the Southwestern Louisiana Canal at Leeville due to the roadway grade and structure height. Conventional construction techniques would be required for the bridge crossing.

Four techniques for fixed-span high-level bridge construction were discussed with the resource agencies: dredging construction canals, utilizing temporary construction barges as a mat across the marsh areas, constructing temporary low-level bridges using "end on" construction, and constructing temporary haul roads. The resource agencies agreed that all of the construction techniques could be used provided temporary construction impacts were minimized and appropriate mitigation was provided. Haul roads were identified as an acceptable construction technique because the materials used for the haul roads could be used, at the conclusion of construction, to create additional marsh habitat. Dredging was the least desirable construction method due to residual resource impacts, and constructing temporary low-level bridges would be the most costly.

Table 3
Wetland Impacts

Alignment	Direct Impacts (ac)	Indirect Impacts: Length Through Wetlands (mile)	Indirect Impacts: Shaded Width (feet)	**Indirect Impacts (ac)**	**Total Impacts (ac)**
Line A (Selected Alignment)					
- NS Mainline		5.75	124.25	86.6	
- EW Mainline		0.26	99.0	3.1	
- EW Connector Roads		0.38	54.83	2.5	
- Total	5.3	6.39		92.2	97.5
Line B					
- NS Mainline		5.98	124.25	90.1	
- EW Mainline		0.38	99.0	4.6	
- EW Connector Roads		0.26	54.83	1.7	
- Total	6.8	6.62		96.4	103.2
Line C					
- NS Mainline		5.78	124.25	87.1	
- EW Mainline		0.41	99.0	4.9	
- EW Connector Roads		0.38	54.83	2.5	
- Total	5.4	6.57		94.5	99.9

Source: LADOTD and Michael Baker Jr., Inc.

Barges could be used in existing navigable channels for construction and for delivery of materials, but new canals through the marsh vegetation would not be created. Dredging would be limited to those locations where the ramps and connector roads transition from being on structure to being on fill at their connections with LA 3235, LA 1 or LA 3090.

Conclusions

The benefits of a context sensitive project approach were readily measurable. The federal and state resource agencies had few comments on the draft EIS. The EPA reviews all draft EIS's and using a rating system, makes recommendations to the lead federal agency, in this case FHWA-LA, to improve the document. The EPA rated the LA 1 improvements project draft EIS an "LO" or "lack of objection," indicating that the EPA did not identify any potential environmental impacts requiring substantive changes to the preferred alignment identified in the document. An "LO" is EPA's highest rating. The final EIS was produced in less time because there were few comments on the draft EIS to be addressed. Favorable comments were received on the Final EIS.

On January 29, 2003, the FHWA-LA signed a record of decision (ROD) for the LA 1 improvements project, only 44 months after publishing the NOI to prepare an EIS. According to an FHWA study, for FHWA projects that had received a record of decision in 1998, the average amount of time between the NOI and the ROD was 68 months (about 5½ years), with a median value of five years.

During her February 26, 2003, legislative briefing to the American Association of State Highway and Transportation Officials' (AASHTO), Federal Highway Administrator Mary Peters identified the LA 1 improvements project as representing a "landmark effort in environmental streamlining" and a model by which other projects should be developed.

The project's success is attributed to LADOTD's and FHWA-LA's environmental stewardship, cooperative partnering with federal and state resource agencies, the context sensitive approach employed and environmental commitments made to reach a consensus on a selected alignment that best balanced the project needs with the overall impacts, through some of most ecologically unique and sensitive areas in Louisiana, and perhaps the nation.

The project continues to move forward. The LADOTD has retained a consultant to advance the preliminary alignments developed in the EIS. Surveying, right-of-way acquisition, plan preparation, and permit acquisition are being performed on a compressed schedule. The facility will be constructed in phases, with the first phases funded by bonds and a federal Transportation Infrastructure Finance and Innovation Act (TIFIA) loan. Toll revenues will offset the bond and TIFIA loan indentures. LADOTD anticipates letting the first two construction projects in 2004.

Biographical Sketch: Christopher G. Gesing, P.E. is a transportation project manager and National Environmental Policy Act (NEPA) practitioner. He brings together over 20 years of project management, planning and design of major transportation projects, including highways, bridges, and airports, environmental compliance, wetland replacement, and geographic information systems (GIS) experience. For the past 13 years he has specialized in the preparation of planning and environmental documents for complex transportation corridor studies throughout the United States in both urban and rural settings. This broad base of professional experience enables him to thoroughly understand all facets of the NEPA and other regulatory processes and provide technical direction to multidisciplinary project teams of engineers, environmental scientists, air and noise specialists, planners, architectural historians, archaeologists and GIS and mapping specialists. Mr. Gesing championed Baker's nationally recognized application of GIS to the environmental process, and projects under his direction have been nationally recognized as models for environmental streamlining. He is currently developing LADOTD's Planning/Environmental Manual of Standard Practice, which will establish a standard operating procedure on how LADOTD projects requiring an environmental assessment (EA) or EIS are advanced through the NEPA process. He is a registered professional engineer in several states and received his master of science and bachelor of engineering degrees in civil engineering from Youngstown State University, Youngstown, Ohio.

References

Department of Transportation and Related Agencies Appropriations Act of 2002. Public Law 107-87. 2001. U.S. Government Printing Office.

Federal Highway Administration. 2003. Baseline Information for Environmental Streamlining. Available from the World Wide Web: (http://www.fhwa.dot.gov/environmental/basesum.htm).

Gulf of Mexico Fishery Management Council. 1998. Generic Amendment for Addressing Essential Fish Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster in the Gulf of Mexico and South Atlantic, Coral and Coral Reefs of the Gulf of Mexico.

Intermodal Surface Transportation Efficiency Act of 1991. Public Law 102-240. 1991. U.S. Government Printing Office.

Louisiana Department of Natural Resources. 1998. Coast 2050: Toward a Sustainable Coastal Louisiana.

Louisiana Department of Natural Resources, Coastal Restoration and Management. 2001. Situation Analysis – The Problem. Available from the World Wide Web: (http://www.savelawetlands.org/site/newprob.html).

Louisiana Department of Transportation and Development (LADOTD). 2002. Final Environmental Impact Statement. Louisiana 1 Improvements, Golden Meadow to Port Fourchon, Lafourche Parish. Prepared by Michael Baker Jr., Inc.

Louisiana Highway 1 Project Task Force. 1999. Gateway to the Gulf. An Analysis of Louisiana Highway One.

Maestri, B., M.E. Dorman, and J. Hartigan. 1988. Managing Pollution from Highway Stormwater Runoff. Transportation Research Record.

National Highway System Designation Act of 1995. Public Law 104-59. 1995. U.S. Government Printing Office.