Louisiana Demonstration Project:

Maree Michel & Creek Bridges GRS-IBS Project

Final Technical Brief
April 2015

HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

U.S.Department of Transportation
Federal Highway Administration

FOREWORD

The purpose of the Highways for LIFE (HfL) pilot program is to accelerate the use of innovations that improve highway safety and quality while reducing congestion caused by construction. **LIFE** is an acronym for **L**onger-lasting highway infrastructure using **I**nnovations to accomplish the **F**ast construction of **E**fficient and safe highways and bridges.

Specifically, HfL focuses on speeding up the widespread adoption of proven innovations in the highway community. Such "innovations" encompass technologies, materials, tools, equipment, procedures, specifications, methodologies, processes, and practices used to finance, design, or construct highways. HfL is based on the recognition that innovations are available that, if widely and rapidly implemented, would result in significant benefits to road users and highway agencies.

Although innovations themselves are important, HfL is as much about changing the highway community's culture from one that considers innovation something that only adds to the workload, delays projects, raises costs, or increases risk to one that sees it as an opportunity to provide better highway transportation service. HfL is also an effort to change the way highway community decision makers and participants perceive their jobs and the service they provide.

The HfL pilot program, described in Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) Section 1502, includes funding for demonstration construction projects. By providing incentives for projects, HfL promotes improvements in safety, construction-related congestion, and quality that can be achieved through the use of performance goals and innovations. This report documents one such HfL demonstration project.

Additional information on the HfL program is at www.fhwa.dot.gov/hfl.

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16. Abstract

As a part of the HfL initiative, the FHWA provided a $376,572 grant to the Louisiana Department of Transportation (LADOTD) to replace two structurally deficient bridges over the Maree Michel Creek & Unnamed Creek. The bridge over the Unnamed Creek was a 24.1-foot by 20-foot treated timber trestle bridge, while the bridge over Maree Michel Creek was a 23.9-foot by 59-foot treated timber trestle bridge. The project was located on LA 91 in Vermilion Parish, between Gueydan to the north and the White Lake Conservation Area to the south. The small-scale project was intended to eliminate costs from the use of pile foundations by replacing two structurally deficient bridges over the Maree Michel Creek and Unnamed Creek. This project, selected and included into the Preservation Bridge (On System) Program for fiscal year 2012-2013, was a pilot for geosynthetic reinforced soil-integrated bridge system (GRS-IBS) construction. GRS-IBS and prefabricated bridge elements and systems (PBES) were the two innovations on this project.

The project was let on August 14, 2013, and the construction began in November, 2014. The project is expected to be completed by August, 2015.

The total construction costs incurred by LADOTD on this project, including mobilization and traffic control, were $3,062,056.10. The mobilization costs were $280,000.00, and the traffic control costs were $20,000.

17. Key Words	18. Distribution Statement
Highways for LIFE, geosynthetic reinforced soil, integrated bridge system, GRS-IBS, ABC, PBES	No restriction. This document is available to the public through the Highways for LIFE website: www.fhwa.dot.gov/hfl

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Unclassified	Unclassified	29	

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SI* (MODERN METRIC) CONVERSION FACTORS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
(none)	mil	25.4	micrometers	µm
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	millimeters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela per square meter	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	Newtons	N
lbf/in^2 (psi)	poundforce per square inch	6.89	kiloPascals	kPa
k/in^2 (ksi)	kips per square inch	6.89	megaPascals	MPa
		DENSITY		
lb/ft^3 (pcf)	pounds per cubic foot	16.02	kilograms per cubic meter	kg/m^3

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
µm	micrometers	0.039	mil	(none)
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela per square meter	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	Newtons	0.225	poundforce	lbf
kPA	kiloPascals	0.145	poundforce per square inch	lbf/in^2 (psi)
MPa	megaPascals	0.145	kips per square inch	k/in^2 (ksi)

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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ABBREVIATIONS AND SYMBOLS

ABC	accelerated bridge construction
ADT	average daily traffic
CATEX	Categorical Exclusion
CMU	concrete masonry unit
CPI	consumer price index
DOT	department of transportation
FHWA	Federal Highway Administration
GRS	geosynthetic reinforced soil
HfL	Highways for LIFE
IBS	integrated bridge system
IRI	International Roughness Index
LADOTD	Louisiana Department of Transportation and Development
LTRC	Louisiana Transportation Research Center
PBES	prefabricated bridge elements and systems
RSF	reinforced soil foundation
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

INTRODUCTION

HIGHWAYS FOR LIFE DEMONSTRATION PROJECTS

Highways for LIFE (HfL) is the Federal Highway Administration's (FHWA) initiative to advance longer-lasting and promote efficient and safe construction of highways and bridges using innovative technologies and practices. The HfL program provides incentive funding to highway agencies to try proven but little-used innovations on eligible Federal-aid construction projects. The HfL team prioritizes projects that use innovative technologies, manufacturing processes, financing, contracting practices, and performance measures that demonstrate substantial improvements in safety, congestion, quality, and cost-effectiveness. An innovation must be one the applicant State has never or rarely used, even if it is standard practice in other States. Recognizing the challenges associated with deployment of innovations, the HfL program provides incentive funding for up to 15 demonstration construction projects a year. The funding amount typically totals up to 20 percent of the project cost, but not more than $5 million.

The HfL program promotes project performance goals that focus on the expressed needs and wants of highway users. They are set at a level that represents the best of what the highway community can do, not just the average of what has been done. The goals are categorized into the following categories:

- **Safety**
  - Work zone safety during construction—Work zone crash rate equal to or less than the preconstruction rate at the project location.
  - Worker safety during construction—Incident rate for worker injuries of less than 4.0, based on incidents reported on Occupational Safety and Health Administration (OSHA) Form 300.
  - Facility safety after construction—Twenty percent reduction in fatalities and injuries in 3-year average crash rates, using preconstruction rates as the baseline.
- **Construction Congestion**
  - Faster construction —Fifty percent reduction in the time highway users are impacted, compared to traditional methods.
  - Trip time during construction — Less than 10 percent increase in trip time compared to the average preconstruction speed, using 100 percent sampling.
  - Queue length during construction—A moving queue length of less than 0.5 miles in a rural area or less than 1.5 miles in an urban area (in both cases at a travel speed 20 percent less than the posted speed).
- **Quality**
  - Smoothness—International Roughness Index (IRI) measurement of less than 48 in/mi.
  - Noise—Tire-pavement noise measurement of less than 96.0 A-weighted decibels (dB(A)), using the onboard sound intensity (OBSI) test method.

- **User Satisfaction**
    - An assessment of how satisfied users are with the new facility compared to its previous condition and with the approach used to minimize disruption during construction. The goal is a measurement of 4 or more on a 7-point Likert scale.

PROJECT OVERVIEW

As a part of the HfL initiative, the FHWA provided a $376,572 grant to the Louisiana Department of Transportation (LADOTD) to replace two structurally deficient bridges over the Maree Michel Creek & Unnamed Creek.(1) The bridge over the Unnamed Creek was a 24.1-foot by 20-foot treated timber trestle bridge, while the bridge over Maree Michel Creek was a 23.9-foot by 59-foot treated timber trestle bridge. The project, selected and included into the Preservation Bridge (On System) Program for fiscal year 2012-2013, was a pilot for geosynthetic reinforced soil-integrated bridge system (GRS-IBS) construction. Accelerated bridge construction (ABC) techniques were used on this project; the innovations included GRS-IBS and prefabricated bridge elements and systems (PBES).

PROJECT DETAILS

PROJECT BACKGROUND AND LOCATION

The project was located on LA 91 in Vermilion Parish, between Gueydan to the north and the White Lake Conservation Area to the south. LA 91 is a RC-2 Roadway Design Class with a design speed of 60 mph. The roadway carried average daily traffic (ADT) of 375 in 2013 and is projected to have an ADT of 450 in 2033. The small-scale project was intended to eliminate costs from the use of pile foundations by replacing two structurally deficient bridges over the Maree Michel Creek and Unnamed Creek. The bridges were two lanes, one in each direction. The Unnamed Creek Bridge (Structure No. 03572120104501) and Maree Michel Canal Bridge (Structure No. 03572120105611) were respectively located 0.45 and 1.6 miles north of LA 3143. In 2013, the ADT values for the Maree Michel Canal and Unnamed Creek Bridges were recorded as 375 vehicles per day. Figure 1 shows the approximate location of the bridges.

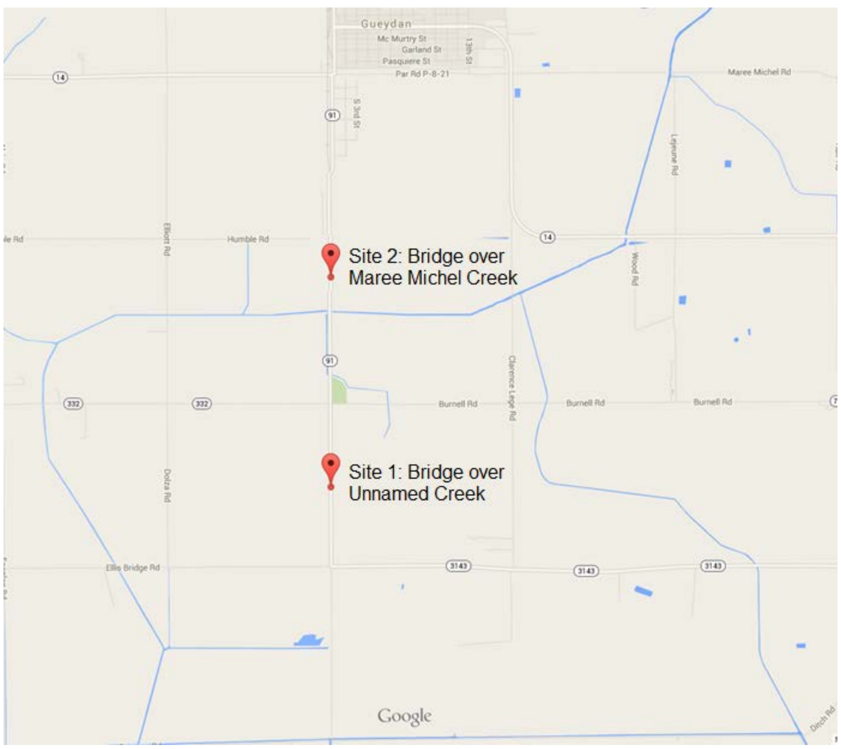

Figure 1. Map. Approximate location of the structurally deficient bridges.

PROJECT DESCRIPTION

Existing Bridge Information

With structural ratings of 21.2 and 32.0, respectively, the Unnamed Creek Bridge and Maree Michel Bridge were deemed structurally deficient and thus qualified for Federal bridge replacement funds (see figure 2). Both bridges were treated timber trestle bridges, had a bituminous road surface, and were built in 1950. The structure specifications of both the bridges are presented below:

Unnamed Creek Bridge- Structure No. 03572120104501

- Structure Length: 20 ft
- Maximum Span length: 19 ft
- Clear Roadway Width: 24.1 ft
- Lane Width: two 11-ft lanes

Maree Michel Canal Bridge- Structure No. 03572120105611

- Structure Length: 59 ft
- Maximum Span length: 19 ft
- Clear Roadway Width: 23.9 ft
- Lane Width: two 11-ft lanes

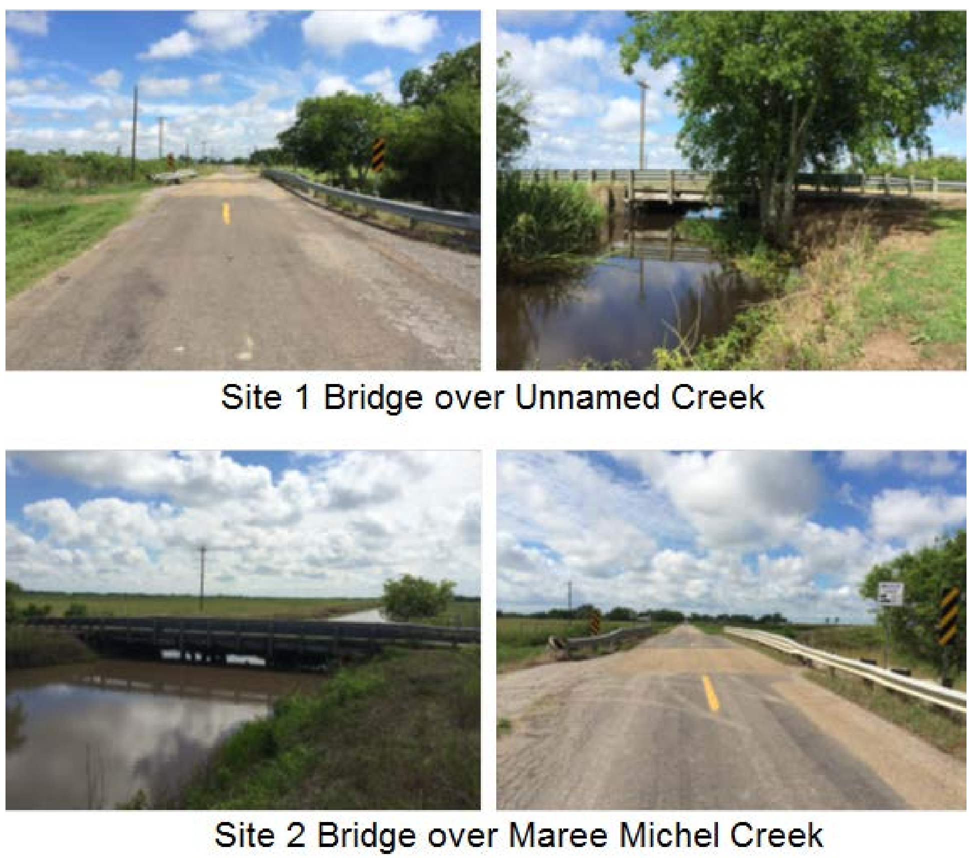

Figure 2. Photos. Existing bridges (before replacement) at Louisiana Vermilion Parish Creeks (courtesy: LADOTD).

Alternatives Considered

The two alternatives considered for this project were:

- The Build Alternative, involving replacement of the bridges.
- The No-Build Alternative that would involve leaving the existing bridges in place.

Per LADOTD, the traditional option on this project would have been a cast-in-place slab bridge with cast-in-place bents and a precast pile foundation.

Project Innovations

Accelerated bridge construction techniques such as GRS-IBS and PBES were used on this project. LADOTD's intent through the use of these techniques was to reduce construction duration and costs, enhance worker and road user safety, and to minimize environmental impacts.

GRS-IBS technology provides support to the bridge through the use of alternating layers of compacted granular fill and sheets of geosynthetic fabric reinforcement. Contrary to traditional construction techniques, GRS-IBS technology results in reduction of environmental footprint as it eliminates the need for deep/pile foundations that are abrasive to the environment.

PBES technology involves off-site prefabrication of bridge components. The off-site location is typically a fabrication facility staging area near the project site. PBES technology is expected to help agencies achieve increased productivity, reduce material and energy consumption, increase recycling opportunities, improve product quality, and ultimately lower construction costs. The off-site fabrication also eliminates the need for temporary bridges and additional right of way. The fewer on-site activities and complete closure of the bridge is expected reduce worker exposure to falling hazards.

New Bridge Specification

The new Unnamed Creek Bridge is expected to have a 35-foot-long single span and will consist of two 11-foot lanes and two 4-foot shoulders, for a total width of 30 feet. The new Maree Michel Bridge is expected to have a 72-foot-long single span and will consist of two 11-foot lanes and two 4-foot shoulders, for a total width of 30 feet. The ends of both the bridges will be supported by GRS. While the new bridge at the Unnamed Creek will be on the existing alignment, the new bridge at Maree Michel Creek is expected to have a slightly shifted alignment to avoid impacts to a parallel channel.

Per LADOTD, the conditions at the project location made a typical hydraulic analysis impossible; therefore, the sizing and finish grade of the new structure was based on the geometry of the channel.

Environmental Impact

Most of the project area existed within LADOTD's right-of-way. The project limits of the Unnamed Creek Bridge encompassed 2.04 acres, including 1.36 acres of required right-of-way, and the Maree Michel Bridge site encompassed a total 5.34 acres, including 2.463 acres of required right-of-way and 0.624 acres of construction servitude. Views were solicited from concerned parties, including the Department of Army, New Orleans District, Corps of Engineers, US Fish and Wildlife Service, Natural Resources Conservation Service, US Environmental Protection Agency, and the general public. No adverse comments or concerns were received. It was noted that a storm water permit would be required for this project. In addition, the project required no relocations. The project was thus environmentally processed as a Categorical Exclusion (CATEX).

Utility Relocation

This project necessitated the relocation and adjustment of utilities belonging to AT&T and Southwest Louisiana Electric.. DOTD authorized a total of $295,000 for all utility relocations.

Bidding Information

Three bids were received for this project. The winning bid was $3,062,056.10. The contractor was responsible for clearing and grubbing, class II base course, concrete slab span bridge, steel girder span bridge, shoulder wedges, superpave asphaltic concrete, embankment widening, 12 inch type "E" lime treatment, pavement striping, reflectorized markers, and placement of guardrails. Table 1 presents a bid comparison summary.

Table 1. Bid comparison summary.

Bidder	Construction Bid	% Over Low Bid
Estimated Construction Cost	$2,219,254.65	-
Coastal Bridge Co., L.L.C.	$3,062,056.10	0%
Jb James Construction LLC	$3,167,510.07	3%
Gilchrist Construction Co. LLC	$3,999,949.37	31%

Instrumentation Program

LADOTD contracted the Louisiana Transportation Research Center (LTRC) for instrumentation and data collection on this project.

Project Schedule Information

The project letting date was August 14, 2013, and the construction began in November, 2014. With an allocated contract time of 90 working days, the project is expected to be completed by August, 2015. A detailed project schedule is provided in the appendix.

Geotechnical Design

Unnamed Creek Bridge

The subgrade layer of Unnamed Creek Bridge consisted of medium to stiff clay. While the bridge superstructure had a dead load of 160 kips, the live load at beam seat was 237 kips. The reinforced soil foundation (RSF) width was 10.6 feet, and the wall height from top of RSF was 10 feet. The scour depth was approximately 5 feet below the channel bottom.(2)

Figures 3 through 6 provide the plan, elevation, and section views of Unnamed Creek Bridge's GRS abutments and wingwalls.

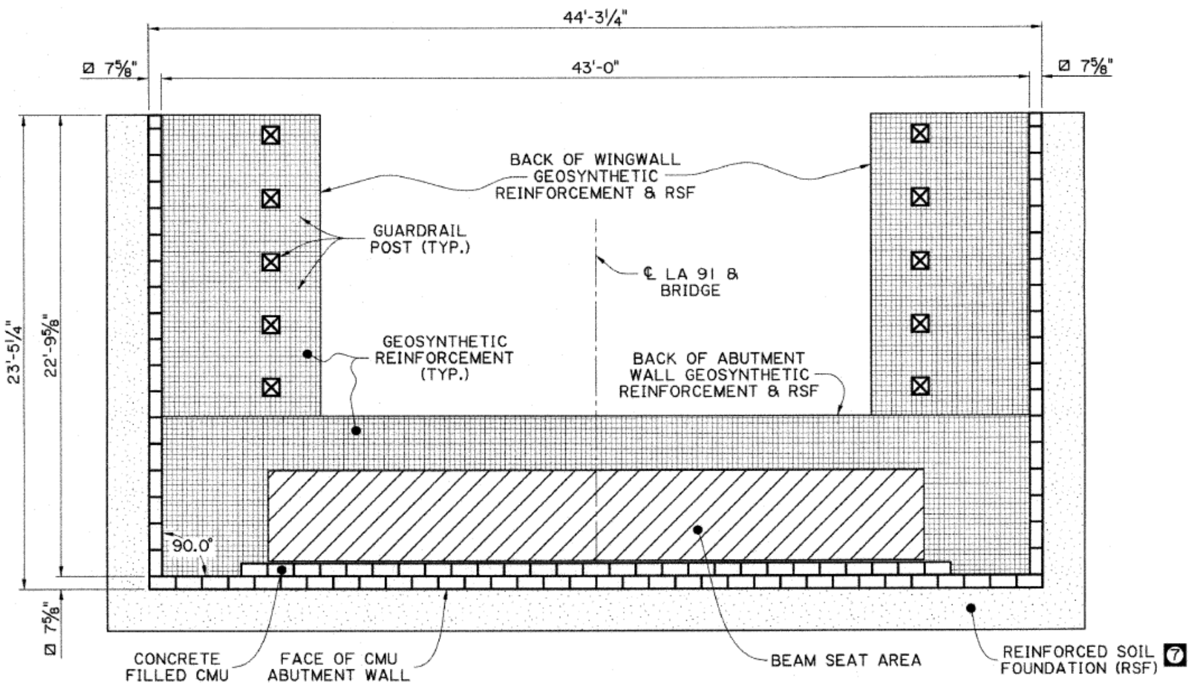

Figure 3. Diagram. GRS abutment plan view of Unnamed Creek Bridge.

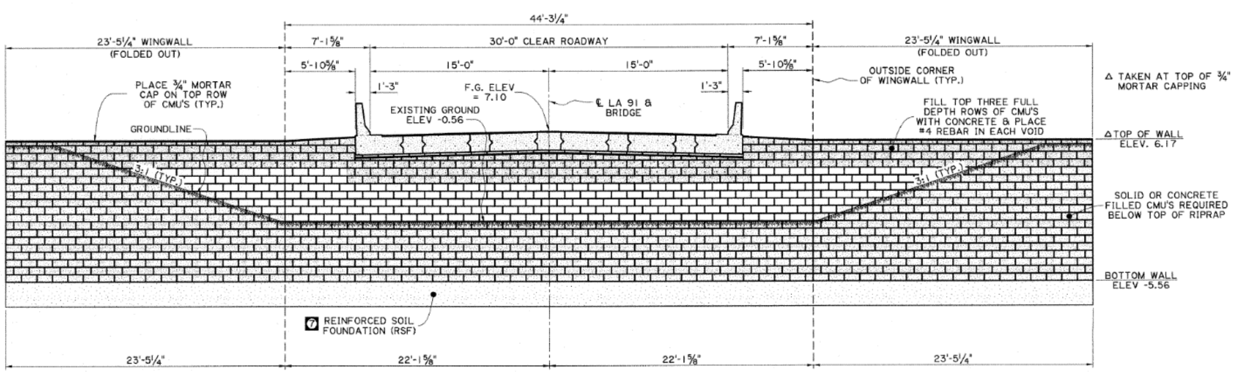

Figure 4. Diagram. GRS abutment elevation view of Unnamed Creek Bridge.

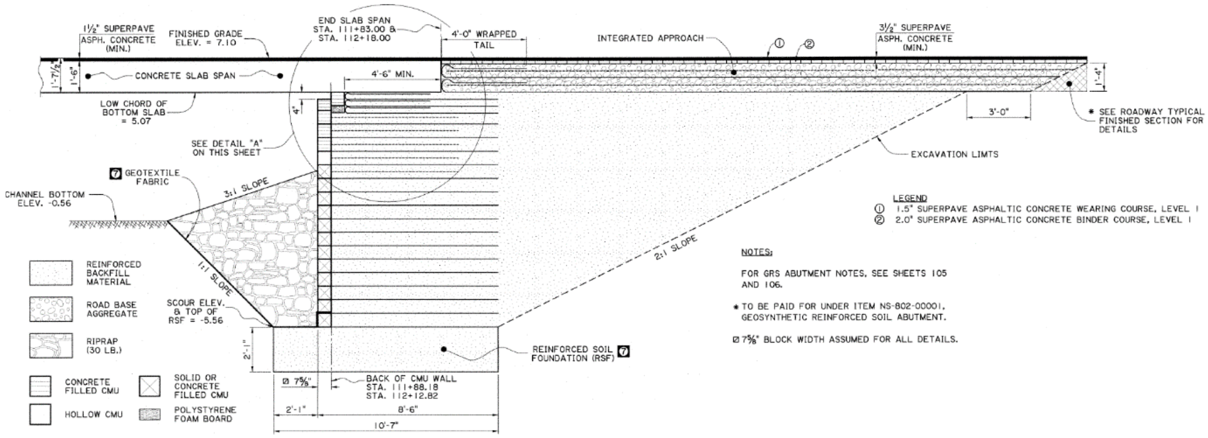

Figure 5. Diagram. GRS abutment section view of Unnamed Creek Bridge.

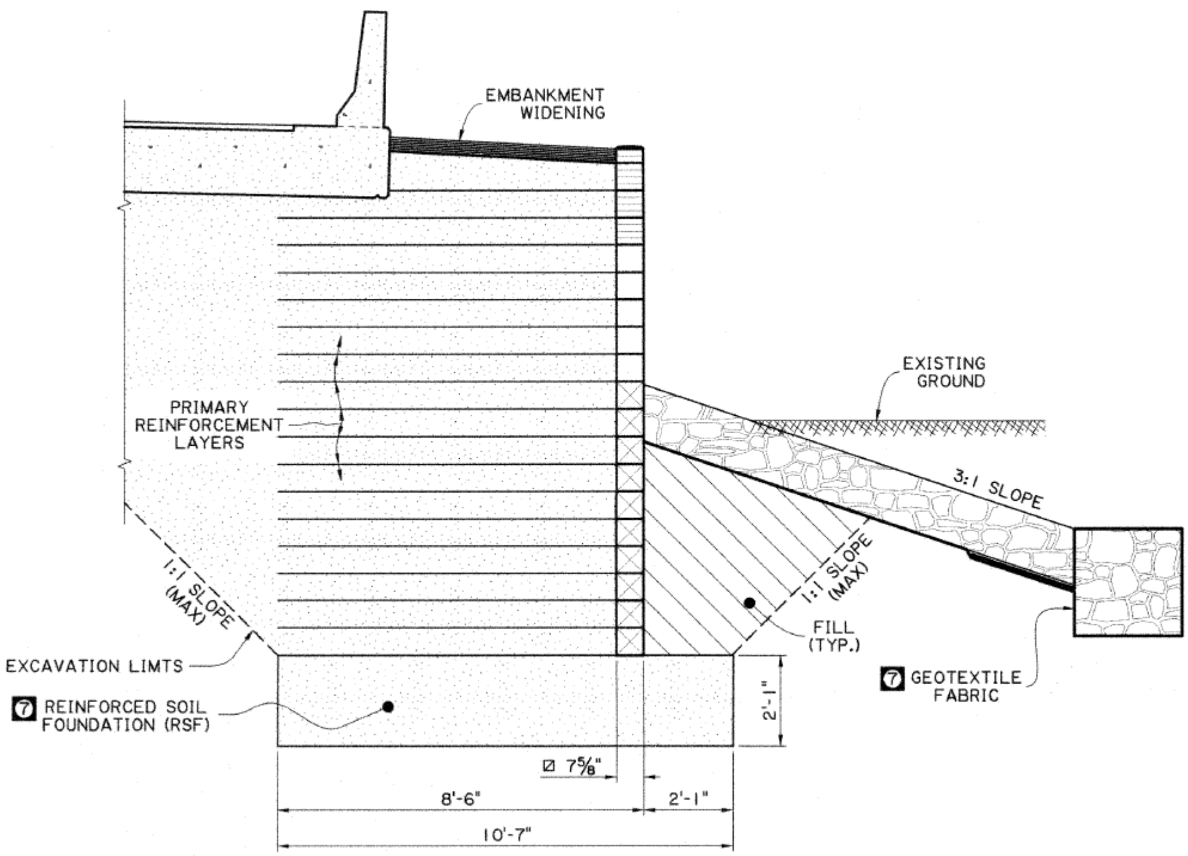

Figure 6. Diagram. GRS abutment wingwall section view of Unnamed Creek Bridge.

Maree Michel Creek Bridge

The subgrade layer of Maree Michel Creek Bridge consisted of stiff to very stiff clay. While the bridge superstructure had a dead load of 282 kips, the live load at beam seat was 320 kips. The RSF width was 8.1 feet, and the wall height from top of RSF was 17.32 feet total wall height

12.91 feet from RSF to beam seat. The scour depth was approximately 5 feet below the channel bottom.(2)

Figures 7 through 10 provide the plan, elevation, and section views of Maree Michel Creek Bridge's GRS abutments and wingwalls.

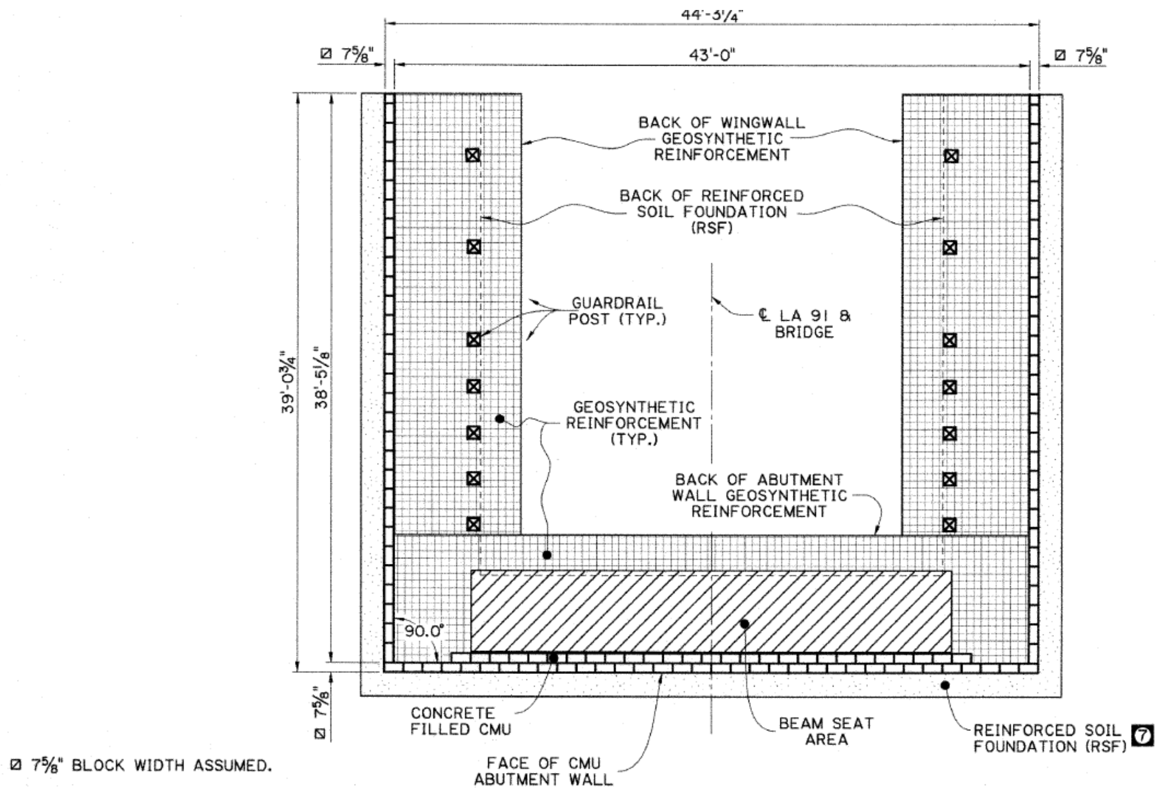

Figure 7. Diagram. GRS abutment plan view of Maree Michel Bridge.

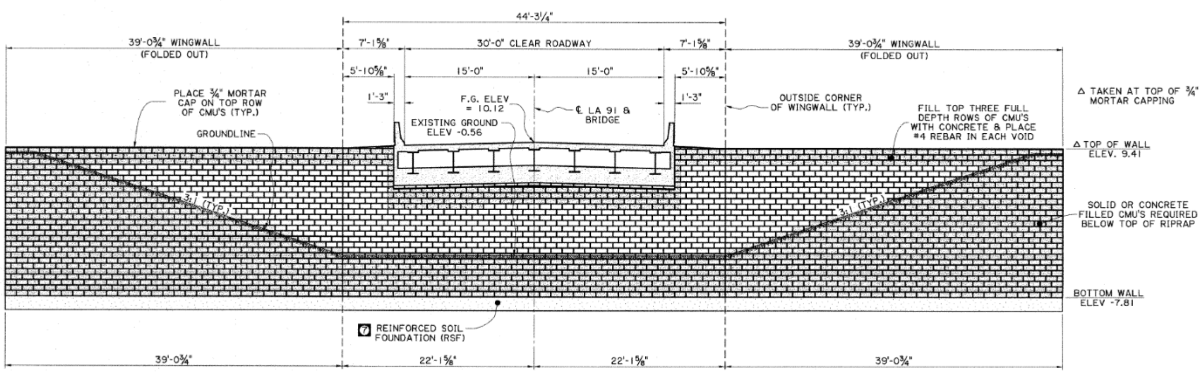

Figure 8. Diagram. GRS abutment elevation view of Maree Michel Bridge.

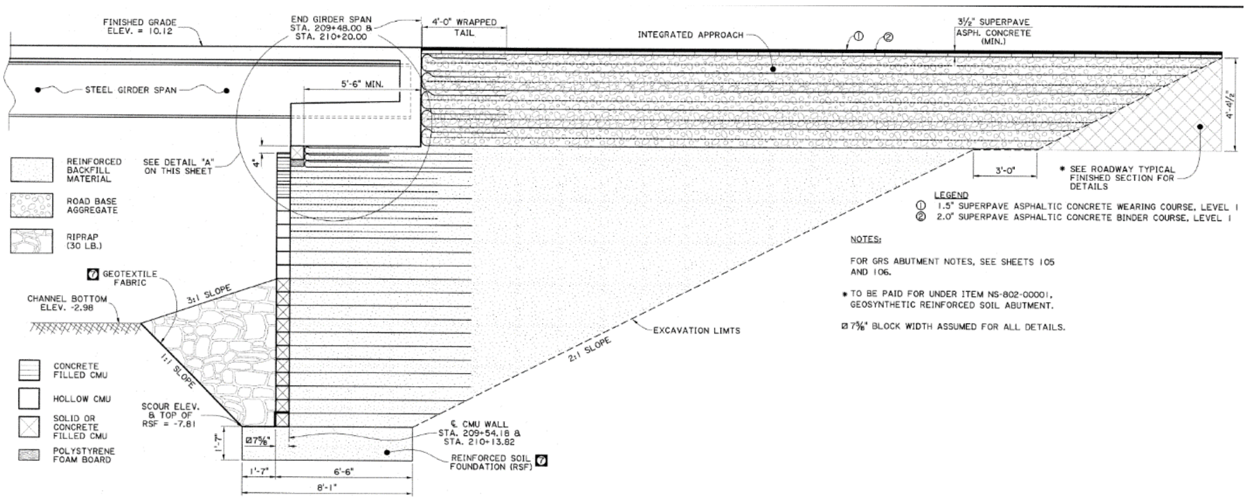

Figure 9. Diagram. GRS abutment section view of Maree Michel Bridge.

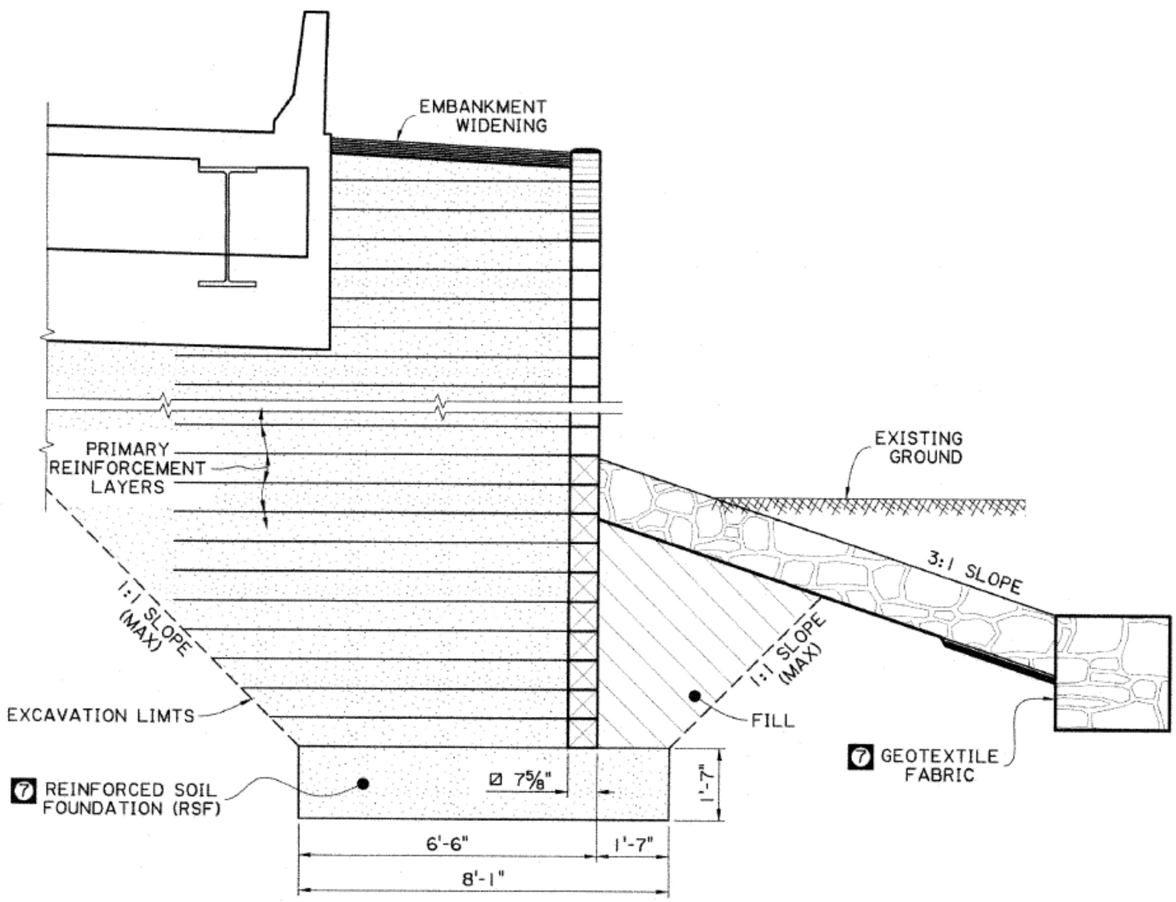

Figure 10. Diagram. GRS abutment wingwall section view of Maree Michel Bridge.

GRS-IBS Construction

LA 91 bridges were chosen as pilot projects for GRS-IBS application primarily because LADOTD felt that GRS-IBS technology would help to save on project costs, minimize environmental impacts, and reduce the duration of construction. The GRS-IBS wall construction consisted of the following major steps:

1. Preparing ground.
2. Placing a row of concrete masonry unit (CMU) block.
3. Placing and compacting a layer of granular fill.
4. Laying a sheet of geosynthetic reinforcement.

The top row of CMUs was covered with a ¾-inch mortar cap that was sloped to drain. The CMUs were staggered to ensure that there were no vertical joints greater than one CMU in height. If a CMU had to be cut, the contractor had to ensure that the side dimension height of the block was not less than 2 inches. If the side dimension height was less than 2 inches, the contractor was required to place mortar in lieu of the CMU. Rebars were inserted into the top three full rows of CMUs. The top three full rows and corner CMUs were filled with concrete, maintaining a 2-inch cover for the rebar. Corrections had to be made for any CMU row alignment deviations greater than 1/4 inch.

The RSF was continuous along the abutment face and wingwalls. The primary geosynthetic reinforcement in the integrated approach had a 8-inch maximum spacing between layers.

LADOTD used geotextile fabric for geosynthetic reinforcement. For scour protection purposes, LADOTD used 30-lb riprap. The fabrication of the steel girders and concrete bridge panels, and clearing and grubbing activities lasted for 160 calendar days. The project construction began in November, 2014. On 29th January, 2015, the installation of the first row of CMU blocks was completed. The Rip Rap installation on the face of the GRS wall was completed on 16th February, 2015. Figures 11 through 16 show the installation of CMU blocks and Rip Rap.

Figure 11. Photo. Installation of first row of blocks (courtesy: LADOTD).

Figure 12. Photo. First row of blocks completed (courtesy: LADOTD).

Figure 13. Photo. Installation of seventh row of blocks and backfill along the side walls (courtesy: LADOTD).


Figure 14. Photo. Installation of eleventh row of blocks (scour line) (courtesy: LADOTD).

Figure 15. Photo. Installation of riprap (courtesy: LADOTD).

Figure 16. Photo. Installation of fifteenth row of blocks and completion of riprap of the face of wall (courtesy: LADOTD).

Prefabricated Bridge Elements and Systems

On this project, LADOTD plans to construct full-depth precast reinforced concrete panels in a controlled environment, which would eliminate weather delays. The panels will be fabricated concurrently with other work and shipped to the site as needed. The LADOTD expects to achieve significant time savings because of offsite panel fabrication. Class AA (M) concrete and deformed reinforcing steel will be used for the precast panels. Figures 17 and 18 provide span details of the bridges.

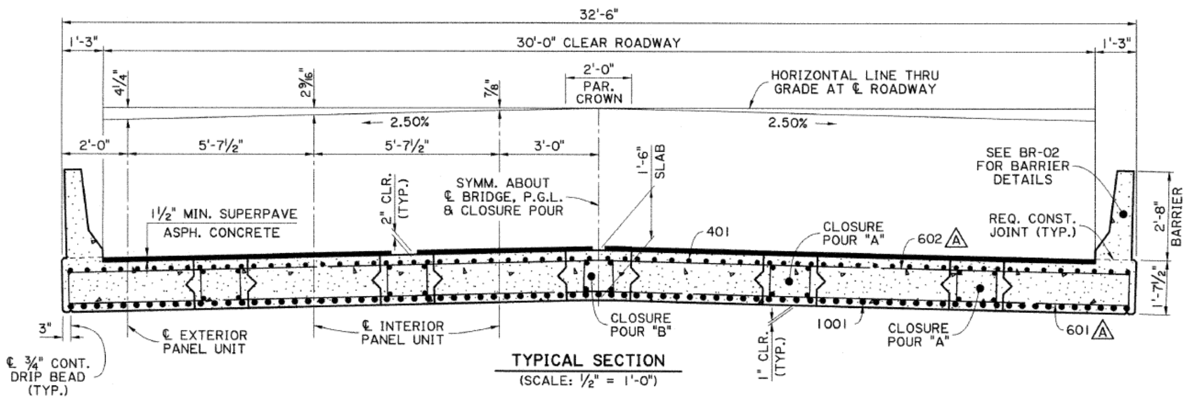

Figure 17. Diagram. A typical section of Unnamed Creek Bridge.

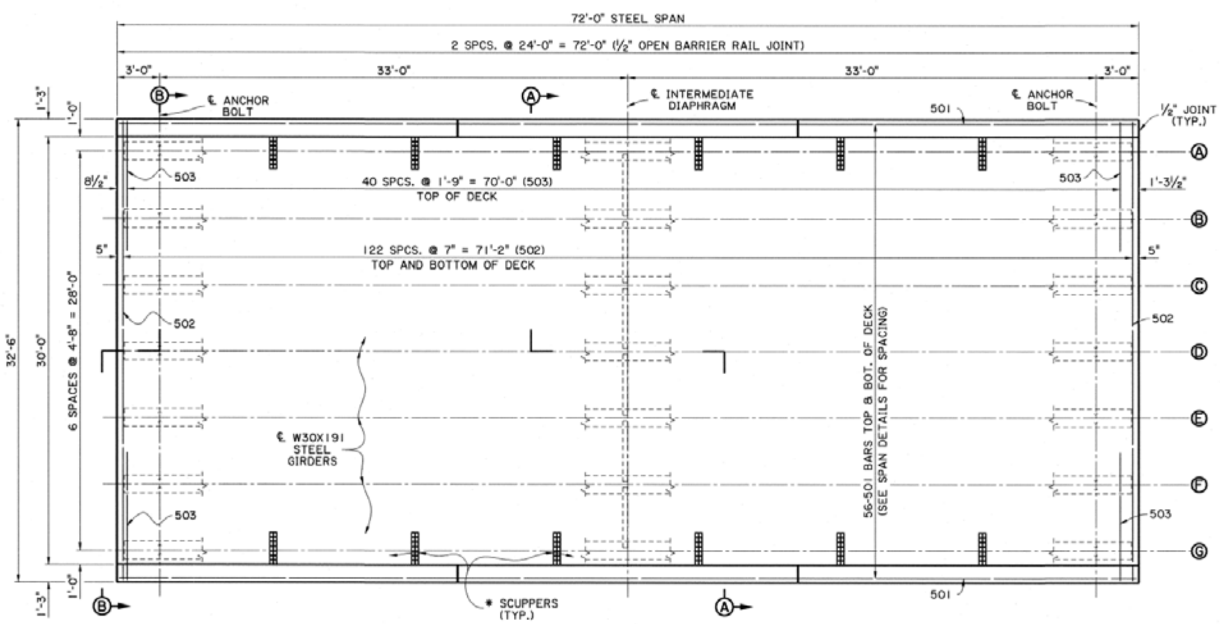

Figure 18. Diagram. Plan view of Maree Michel Bridge span.

LADOTD intends to use a crane lift to facilitate placement of the bridge deck. The crane load chart to be used on this project is presented in the appendix.

HIGHWAYS FOR LIFE PERFORMANCE GOALS

The primary objective of acquiring data on HfL performance goals such as safety, construction congestion, and quality is to quantify project performance and provide an objective basis from which to determine the feasibility of the project innovations and to demonstrate that the innovations can be used to do the following:

- Achieve a safer work environment for the traveling public and workers.
- Reduce construction time and minimize traffic interruptions.
- Produce a high-quality project and gain user satisfaction.

Since this project is still ongoing, the HfL performance goals are yet to be measured. The following subsections provide additional information on the some of the significant factors that influence the HfL performance goals.

TRAVEL TIME

The overall length of the project was approximately 0.546 miles. The replacement of the two bridges and the resulting bridge closures necessitated the use of a detour. Signage about the detour route was placed on LA 14, LA 711, and LA 3143. The posted speed limit on the detour route varies from 35 – 55 MPH. The bridges were replaced in two separate phases in order to maintain access to the area between the bridges at all times. LADOTD estimated that the detour route resulted in an increase of 7.5 minutes in travel time and an additional 5.9 miles in the travel distance. Figure 19 presents the detour route for this project.

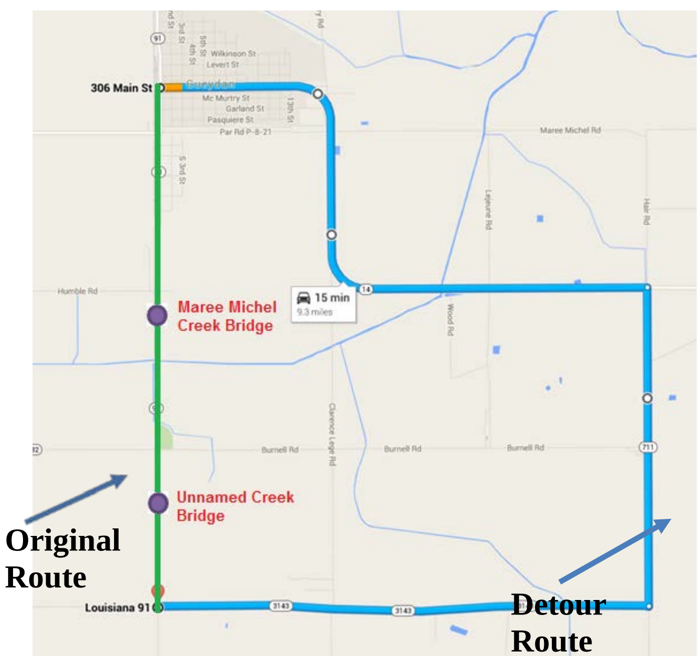

Figure 19. Map. Detour route for LA 91 bridge replacement project.

CONSTRUCTION CONGESTION

Because of lower traffic volumes across the project location, LADOTD anticipates no queuing on this project. In addition, the accelerated construction techniques used on this project are expected to reduce the time highway users were affected.

SOUND AND SMOOTHNESS

While LADOTD plans to collect smoothness data after construction is completed, it does not intend to collect any noise data post-construction.

CONSTRUCTION COSTS

The total construction costs incurred by LADOTD on this project, including mobilization and traffic control, were $3,062,056.10. The mobilization costs were $280,000.00, and the traffic control costs were $20,000.

APPENDIX

Figure 20 shows the project schedule.

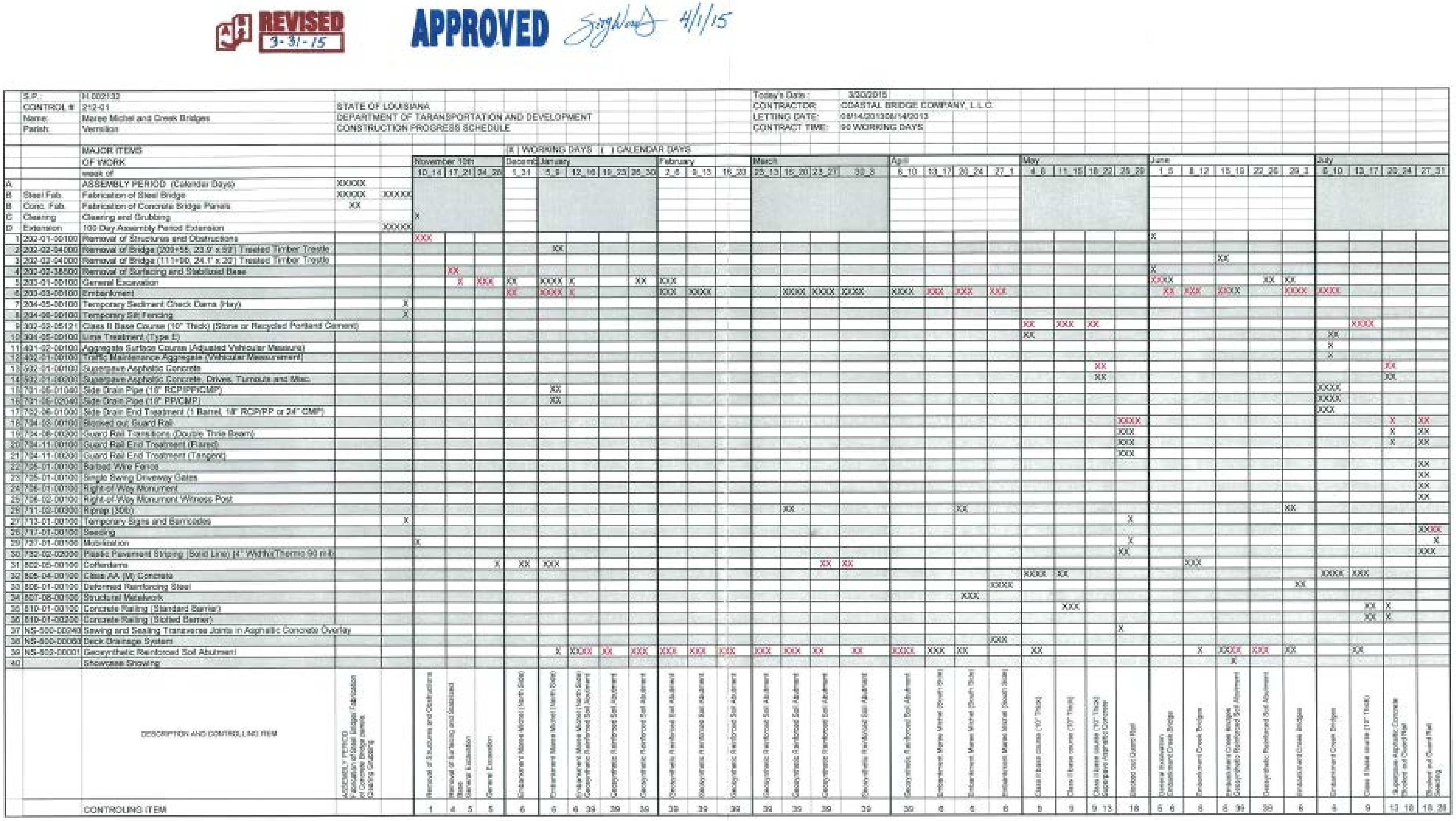

Figure 20. Chart. Project schedule.

Figure 21 shows the crane load specifications.

57,500 lb | 26 ft x 29 ft 6 in (100%) | 360° | 85 %

ft	(0°) 39.0 ft	39.0 ft	53.1 ft	66.9 ft	81.0 ft	95.1 ft	109.3 ft	123.0 ft	132.9 ft	148.3 ft	164.0 ft	ft
						1,000 lb						
	180.0*	-	-	-	-	-	-	-	-	-	-	
10	175,2	164,2	158,7	154,5	130,6	-	-	-	-	-	-	10
12	160,3	150,1	145,2	141,0	127,1	-	-	-	-	-	-	12
14	147,5	137,9	133,7	129,7	118,3	103,9	-	-	-	-	-	14
16	136,0	127,3	123,8	120,0	113,8	99,1	-	-	-	-	-	16
18	126,1	118,0	115,6	112,1	108,6	93,8	73,7	-	-	-	-	18
20	116,1	109,1	107,9	104,6	103,1	88,5	70,0	-	-	-	-	20
24	94,3	91,8	94,2	92,2	91,3	79,0	63,9	54,1	-	-	-	24
28	-	-	80,0	80,8	80,5	71,9	59,0	50,0	43,0	-	-	28
32	-	-	69,3	69,9	69,4	64,9	55,0	46,0	40,2	34,7	-	32
36	-	-	61,0	61,4	60,9	58,6	51,2	42,8	37,6	33,0	26,3	36
40	-	-	-	53,8	53,4	52,5	47,6	39,9	35,2	31,3	26,1	40
48	-	-	-	43,6	43,0	42,2	41,7	34,3	31,1	28,0	24,0	48
56	-	-	-	20,4	35,7	34,7	35,5	30,3	27,1	25,2	22,0	56
64	-	-	-	-	30,1	30,7	29,9	27,3	24,1	22,4	19,8	64
72	-	-	-	-	19,4	26,8	25,7	24,3	21,7	20,1	17,9	72
80	-	-	-	-	-	14,8	22,8	22,3	19,4	18,2	16,3	80
88	-	-	-	-	-	-	19,6	19,8	17,8	16,4	15,0	88
96	-	-	-	-	-	-	14,0	17,3	16,3	15,0	13,5	96
104	-	-	-	-	-	-	-	15,0	14,7	13,6	12,3	104
112	-	-	-	-	-	-	-	-	12,9	12,3	11,4	112
120	-	-	-	-	-	-	-	-	11,3	11,4	10,4	120
128	-	-	-	-	-	-	-	-	-	10,0	9,4	128
136	-	-	-	-	-	-	-	-	-	-	8,0	136
144	-	-	-	-	-	-	-	-	-	-	7,1	144

* with special attachment

47,000 lb | 26 ft x 29 ft 6 in (100%) | 360° | 85 %

ft	39.0 ft	53.1 ft	66.9 ft	81.0 ft	95.1 ft	109.3 ft	123.0 ft	132.9 ft	148.3 ft	164.0 ft	ft
					1,000 lb						
10	164,2	158,7	154,5	130,6	-	-	-	-	-	-	10
12	150,1	145,2	141,0	127,1	-	-	-	-	-	-	12
14	137,9	133,7	129,7	118,3	103,9	-	-	-	-	-	14
16	127,3	123,8	120,0	113,8	99,1	-	-	-	-	-	16
18	118,0	115,6	112,1	108,6	93,8	73,7	-	-	-	-	18
20	108,9	107,6	104,6	103,1	88,5	70,0	-	-	-	-	20
24	90,1	91,4	91,0	90,5	79,0	63,9	54,1	-	-	-	24
28	-	76,4	77,9	77,5	71,9	59,0	50,0	43,0	-	-	28
32	-	66,2	66,7	66,2	64,7	55,0	46,0	40,2	34,7	-	32
36	-	58,1	58,6	58,1	57,2	51,2	42,8	37,6	33,0	26,3	36
40	-	-	51,4	51,0	49,9	47,8	39,9	35,2	31,3	26,1	40
48	-	-	41,4	41,0	40,1	41,0	34,3	31,1	28,0	24,0	48
56	-	-	20,4	33,9	33,9	33,9	30,3	27,1	25,2	22,0	56
64	-	-	-	28,5	29,4	28,4	27,3	24,1	22,4	19,8	64
72	-	-	-	19,4	24,6	23,5	23,9	21,7	20,1	17,9	72
80	-	-	-	-	14,8	20,0	20,0	19,3	18,2	16,3	80
88	-	-	-	-	-	18,1	17,0	17,0	16,2	15,0	88
96	-	-	-	-	-	14,0	15,0	14,5	14,2	13,5	96
104	-	-	-	-	-	-	13,2	12,4	12,6	11,9	104
112	-	-	-	-	-	-	-	11,2	10,7	10,1	112
120	-	-	-	-	-	-	-	9,2	9,4	8,7	120
128	-	-	-	-	-	-	-	-	8,0	7,4	128
136	-	-	-	-	-	-	-	-	-	6,2	136
144	-	-	-	-	-	-	-	-	-	5,3	144

Figure 21. Chart. Crane load specifications.

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REFERENCES

1. Maree Michel and Creek Bridges, Louisiana Department of Transportation and Development. http://wwwapps.dotd.la.gov/administration/public_info/projects/home.aspx?key=83

2. Stephen M. Meunier, Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) Technology, 2013 Louisiana Transportation Conference. http://www.ltrc.lsu.edu/ltc_13/pdf/presentations/S56_Innovative%20Bridge%20Applications%20in%20Louisiana%20Geosynthetic%20Reinforced%20Soil%20Integrated%20Bridge%20System%20(GRS%20IBS)_LTC2013.pdf