THE OHIO RIVER BRIDGES

SECTION 5 - EAST END BRIDGE OVER OHIO RIVER

KYTC ITEM NO. 5-745.00

SECTION 4 SCOUR ANALYSIS

(Supplement to Section 5 Hydraulics Report)

OCTOBER 31, 2011

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Prepared for:
PB AMERICAS, INC.

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1.0 INTRODUCTION

This report is a supplement to the Section 5 East End Bridge - Hydraulic and Scour Analysis Report, dated September 20, 2011. Its purpose is to document the scour analysis for the **Section 4** approach span piers on the Kentucky Approach. These piers lie between stations 167+81.96 (End Bent 1) and 187+50.96 (Common Pier).

2.0 DATA COLLECTION

2.1 General

The hydraulic data necessary for the scour analysis was extracted from the 2-D SMS/FESWMS model (documented in the Hydraulic and Scour Report for **Section 5**). The representative pier configuration was obtained from Lochner for **Section 4** (see **Appendix A**), and the geotechnical boring data for **Section 4** was provided by Stantec (see **Appendix B**).

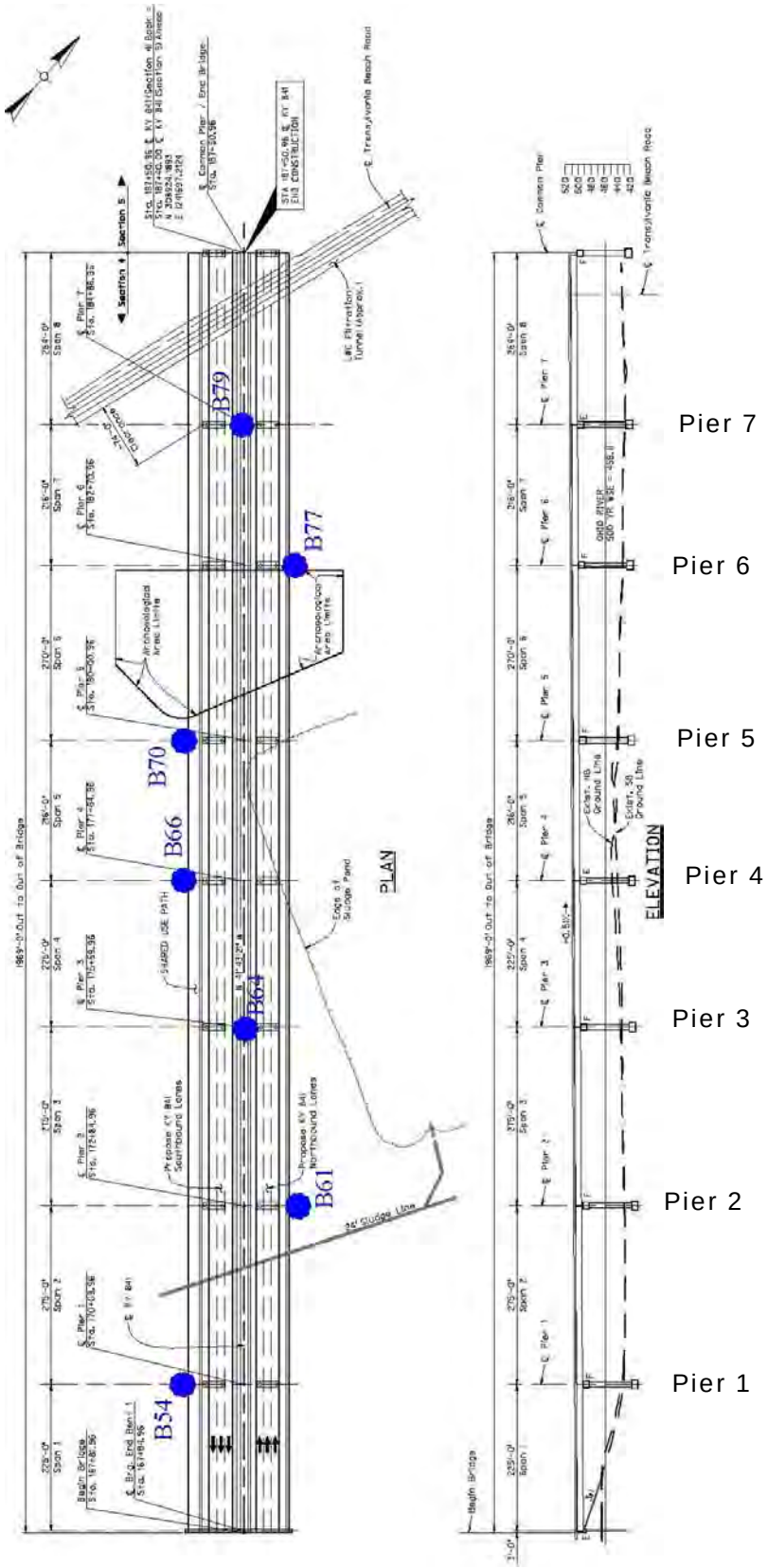
2.2 Soil Particle Sizes

Data from draft geotechnical borings was used in the scour analysis. The bed soil consists mainly of sands and clays with d50 ranging from 0.0039 mm to 0.13 mm and d95 from 0.049 mm to 12.0 mm, as shown in **Table 1**. The general soil boring plan is shown in **Figure 1**. This drawing was prepared from the Stantec boring log location information for this study and is for illustrative purposes only. Excerpts from the boring logs and lab testing pertinent to the bridge crossing are presented in **Appendix B**.

Table 1: Grain Size Summaries at Proposed Bridge Crossing

Structure Element	Boring Number	Station	Offset	Sample Depth (ft)	d50 (mm)	d95 (mm)
Pier 1	B54	170+10	86’ LT	1.2 / 3.5	0.13	12.0
Pier 2	B61	172+85	69’ RT	3	0.0053	0.26
Pier 3	B64	175+60	6’ RT	3	0.0065	0.079
Pier 4	B66	177+85	86’ LT	4.6	0.041	0.31
Pier 5	B70	180+01	86’ LT	3	0.007	0.2
Pier 6	B77	182+71	69’ RT	3.6 / 5.0	0.069	0.32
Pier 7	B79	184+87	6’ LT	3	0.0039	0.049

Figure 1: General Soil Boring Locations



The Section 4 piers (Kentucky approach) in the overbank area are typically dry at the normal pool stage and begin to experience flow before the 10-yr (10%) storm discharge. For purposes of scour analysis, **Table 2** summarizes maximum velocities within the vicinity of each of the approach piers for the 100-yr (1%) and the 500-yr (0.2%) storms.

Table 2: Summary of Maximum Velocities and Corresponding Flow Depths

		100-Year Event		***500-Year Event***	
Pier No.	**Node No.**	**Velocity** (ft/s)	**Depth** (ft)	**Velocity** (ft/s)	**Depth** (ft)
Pier 1	4605	0.417	7.995	1.381	13.159
Pier 2	4113	1.076	24.685	1.972	29.852
Pier 3	4116	2.142	15.981	3.025	21.128
Pier 4	4120	3.563	6.601	4.367	11.706
Pier 5	4617	2.717	13.504	3.481	18.592
Pier 6	4626	3.005	19.996	3.717	25.160
Pier 7	5412	2.992	21.043	3.730	26.200

Figure 2 graphically depicts the calculated flow regimes of each pier, identified as 1-7 beginning at the bank on the Kentucky side of the Ohio River. The SMS/FESWMS output can be found in the SECTION 5 - Hydraulic and Scour Analysis Report, dated September 20, 2011. The hydraulic flow parameters are summarized in **Table 2**, and with the geotechnical particle sizes for each pier in **Appendix B**, Pier Drag Report chart.

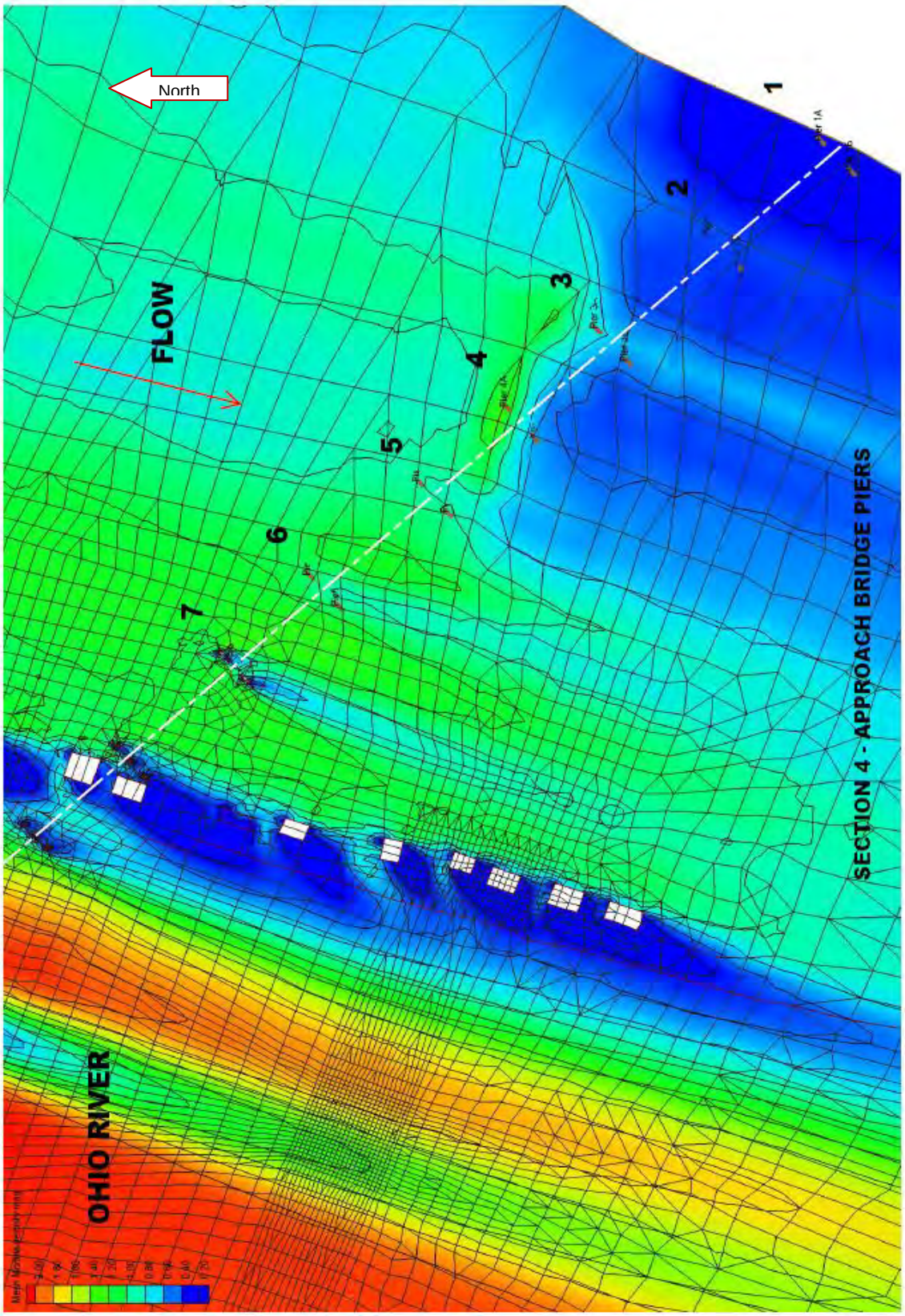


Figure 2: Velocity Magnitude, 1% Storm Event (451.7 ft NAVD88)

3.0 SCOUR ANALYSIS

3.1 Methodology

The scour analysis was performed in accordance with the methodology outlined in the Federal Highway Administration (FHWA) Hydraulic Engineering Circular (HEC) No. 18. These methods were used to develop predictions of long-term, contraction, and local scour at piers and abutments. In accordance with general practice, the 100-yr (1%) storm was used as the scour analysis design event.

For this supplemental report, scour analysis was only performed for the Section 4 (Kentucky Approach) piers.

Hydraulic parameters necessary to complete the scour analysis were taken from the SMS/FESWMS model results. The FESWMS node numbers used to perform the scour analysis are shown in **Appendix C** in the Total Scour Inputs (from FESWMS) table.

3.2 Theoretical Predicted Scour

Total scour depths shown in **Tables 3 and 4** are composed of three scour components: long-term, contraction, and local (which is composed of the pier scour). The total scour depths for the 100-year event are shown graphically in the scour plot in **Figure 3**. The detailed scour calculations are provided in **Appendix C**.

3.2.1 Long-term Scour Component

The USACE Louisville, Kentucky District was contacted to obtain available historical data documenting changes to streambed geometry and elevations over time. Both the Water Management Section of the Engineering Division and the Navigation Information Section of the Operations Division were consulted. Both offices indicated that historical streambed data is only available for a few specific sections of the Ohio River in the vicinity of the locks and dams where scour problems have occurred, and that none of those data sets would be applicable to the river reach requested.

A review of area mapping indicates that the nearest existing bridge crossing is the I-65 JFK Memorial Bridge at River Station 602.9. Due to the proximity of the I-65 bridge to the McAlpine dam and any influences caused by the dam structure, and since this crossing is 7.4 miles downstream, historical streambed surveys and inspection reports for that structure cannot be relied upon to provide a conclusion regarding streambed variations over time at the proposed bridge location. The nearest highway crossing upstream from the study site is in Trimble County which is much too far upstream to be used for guidance in making assumptions.

A level-three (HEC-20) analysis involving sediment routing within the contributing watersheds can sometimes be useful to predict sediment transport, but establishing a mathematical model would require a substantial historical data set as well as substantial analysis time. Lack of data coupled with the knowledge that the downstream control in place at the McAlpine Lock maintains the normal pool condition of the Ohio River a steady, slow velocity (less than 2.0 fps) led to the conclusion that aggradation or degradation of the streambed is likely negligible in comparison to other scour components, and that not enough data is available to develop a prediction based on mathematical analysis. For these reasons, the long-term scour component of the overall scour estimate was assumed to be zero feet.

Table 3: Theoretical Scour Depths (ft) for the 100-yr Storm by Pier

	Pier						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Boring Number	B54	B61	B64	B66	B70	B77	B79
Modeled Bed Elevations***	430.5	427.9	432.3	434.3	437.6	434	430.2
Bed Rock Elevation***	330.5	331.4	333.8	333.3	334.3	335.8	334.7
Competent Rock Elevation***	329.7	331.4	331.1	333.1	334.3	335.5	334.5
Long-term (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contraction (ft)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Local (ft)	2.5	10.7	14.5	15.9	15.8	17.3	11.7
***Total Scour**(ft)*	**3.0**	**11.1**	**14.9**	**16.3**	**16.3**	**17.7**	**12.1**
Total Scour Elevation	**427.5**	**416.8**	**417.4**	**418.0**	**421.3**	**416.3**	**418.1**

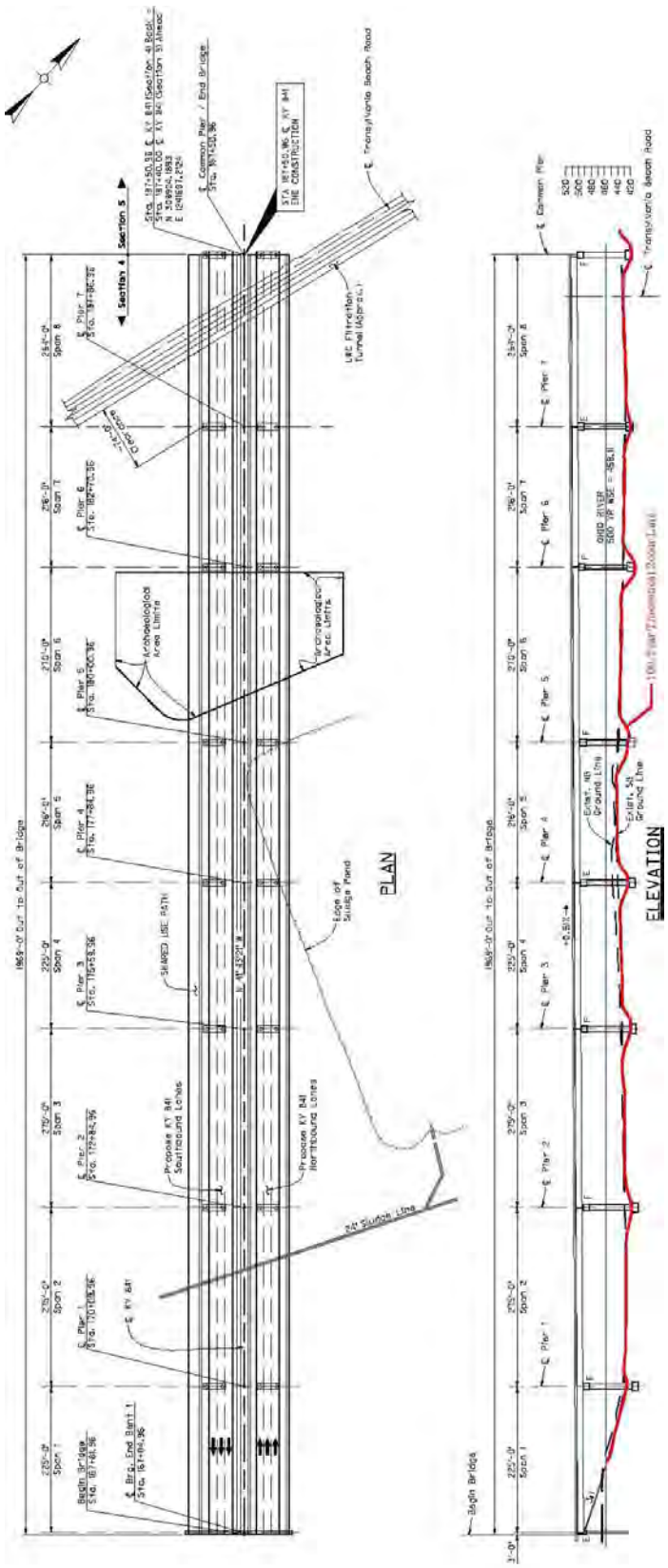
*** from geotechnical data

Table 4: Theoretical Scour Depths (ft) for the 500-yr Storm by Pier

	Pier						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Boring Number	B54	B61	B64	B66	B70	B77	B79
Modeled Bed Elevations***	430.5	427.9	432.3	434.3	437.6	434	430.2
Bed Rock Elevation***	330.5	331.4	333.8	333.3	334.3	335.8	334.7
Competent Rock Elevation***	329.7	331.4	331.1	333.1	334.3	335.5	334.5
Long-term (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contraction (ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Local (ft)	11.0	14.5	17.4	18.8	18.4	19.6	13.3
***Total Scour**(ft)*	**12.9**	**16.3**	**19.2**	**20.6**	**20.3**	**21.4**	**15.1**
Total Scour Elevation	**417.6**	**411.6**	**413.1**	**413.7**	**417.3**	**412.6**	**415.1**

*** from geotechnical data

Figure 3: Theoretical Scour for the 100-year Storm



3.2.2 Contraction Scour Component

Contraction scour was computed by spreadsheet using Laursen's equations as recommended in HEC-18. Initially, critical velocity was completed using hydraulic properties for the bridge and approach sections from HEC-RAS output to determine whether the live-bed or clear-water scour equation was appropriate. The live-bed scour equation was determined to be applicable for the left overbank (Piers 1 - 7). The proposed bridge configuration spans the entire 100-yr floodplain and therefore does not contain abutment fills, so local abutment scour was not considered separately.

3.2.3 Local Scour Component

For the East End Bridge, local pier scour is clearly the controlling scour mechanism. Piers 1 - 7 each consist of two elliptical columns founded on drilled shafts to bedrock. For this reason, these piers were modeled as "simple" piers under the HEC-18 methodology.

The local pier scour equation recommended by HEC-18 contains correction factors for pier nose shape, angle of attack of flow, bed condition and armoring. The angle of attack for the piers was reported as resultant vectors in the two-dimensional FESWMS model relative to the centerline of the piers (see Pier Drag Report in **Appendix B**). Depending on the distance from the vector to the pier, the measured angle of attack varied from approximately 21 to 31 degrees.

The correction factor for bed condition (K_3) accounts for the fact that maximum scour may be 10 to 30 percent greater than computed by the local pier scour equation. The K_3 factor was set to 1.1, which corresponds to the most typical condition of plane-bed through small dunes (up to 9 m high).

HEC-18 recommends that new bridge piers and foundations be designed to accommodate the predicted scour, rather than attempt to protect the piers with scour countermeasures.

4.0 REFERENCES AND DATA SOURCES

1. Wilbur Smith Associates, *Section 5 East End Bridge - Hydraulic and Scour Analysis Report*, September 20,2011.

2. U.S. Department of Transportation, Federal Highway Administration, *Evaluating Scour at Bridges*, Hydraulic Engineering Circular No. 18, 4th Edition, March 2001.

3. Stantec, *Draft Summary Particle Sizes and Boring Logs*, October 4, 2011.

4. U.S. Department of Transportation, Federal Highway Administration, *User's Manual for FESWMS FST2DH*, Publication No. FHWA-RD-03-053, September 2002.

5. HEC-RAS, US Army Corps of Engineers, *Version 4.1.0*, 2010.

6. Surfacewater Modeling System, Environmental Modeling Systems Incorporated, *Version 9.2*, 2007.

7. Finite Element Surface-Water Modeling System: Two-Dimensional Flow in a Horizontal Plane, U.S. Federal Highways Administration, *Version 3.2.2*.

8. U.S. Department of Transportation, Federal Highway Administration, River Engineering for Highway Encroachments – Highways in the River Environment, Hydraulic Design Series Number 6, Publication no. FHWA NHI 10-004, December 2001.

APPENDIX A: BRIDGE AND APPROACH DRAWINGS

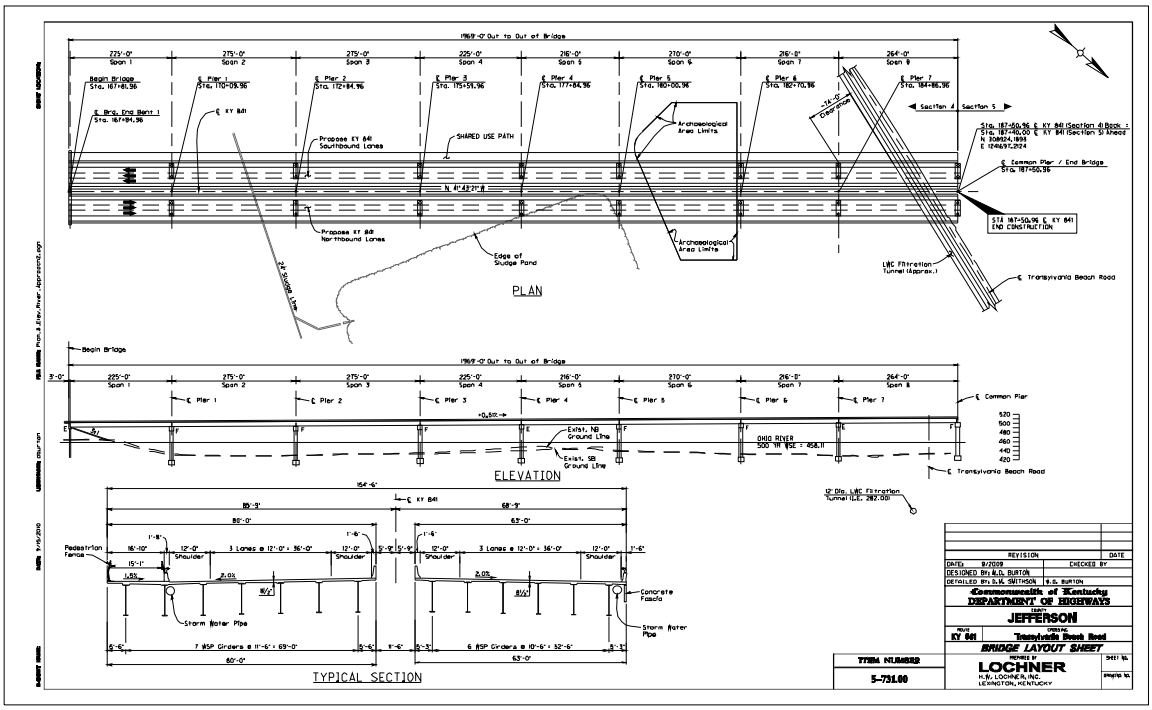
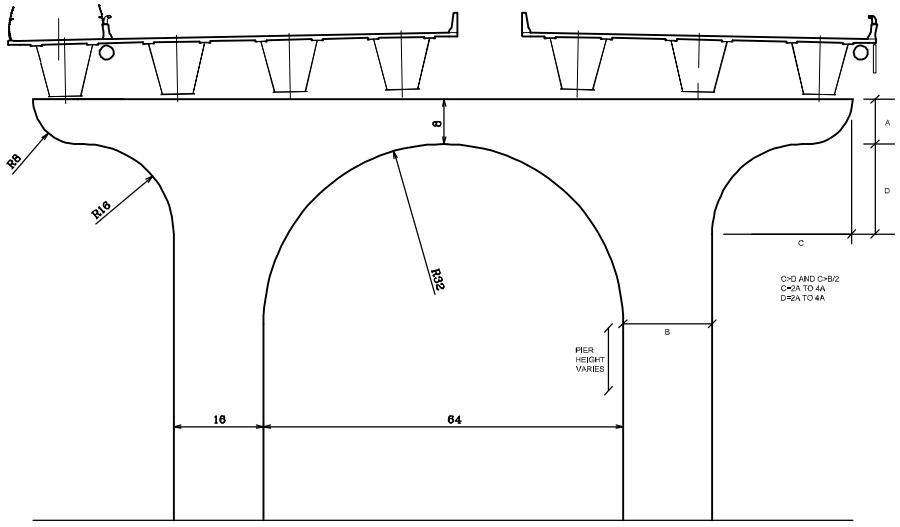


FIGURE 4
REVISED DESIGN OF SECTION 4 KY APPROACH STRUCTURE



RIVER APPROACH NORTH BOUND AND SOUTH BOUND
PIERS 1-6 PROPORTIONAL DESIGN AESTHETICS

APPENDIX B: GEOTECHNICAL DATA

PIER DRAG REPORT

FESWMS			100 year			500 year			Geotech Data			
Pier no.	Pier ID	Elem no.	Approach Flow Vel (m/s)	Depth (m)	Angle (deg)	Approach Flow Vel (m/s)	Depth (m)	Angle (deg)	Boring ID	Depth (m)	D50 (mm)	D95 (mm)
1	Pier 1A	4358	0.098	1.709	28.237	0.419	3.282	24.901	B56	2.1 / 5.0	0.52	18
2	Pier 1B	4605	0.127	2.437	24.615	0.421	4.011	21.832	B54	1.2 / 3.5	0.13	12
3	Pier 2A	4113	0.328	7.524	21.329	0.601	9.099	22.624	B61	3	0.0053	0.26
4	Pier 2B	4357	0.285	7.527	23.92	0.56	9.1	23.38	B59/B62	3	0.0046	0.041
5	Pier 3A	4116	0.653	4.871	28.626	0.922	6.44	28.106	B64	3	0.0065	0.079
6	Pier 3B	4117	0.509	6.416	30.295	0.756	7.991	29.717				
7	Pier 4A	4120	1.086	2.012	27.911	1.331	3.568	28.243				
8	Pier 4B	4367	0.495	4.672	25.462	0.863	6.241	28.893	B66	4.6	0.041	0.31
9	Pier 5A	4369	0.818	3.537	26.507	1.028	5.095	27.505				
10	Pier 5B	4617	0.828	4.116	30.134	1.061	5.667	29.531	B70	3	0.007	0.2
11	Pier 6A	4626	0.916	6.095	29.44	1.133	7.669	29.17	B77	3.6 / 5.0	0.069	0.32
12	Pier 6B	4850	0.837	6.093	27.062	1.092	7.68	27.892	B75	3	0.025	0.32
-	Pier 7A	5412	0.912	6.414	24.92	1.137	7.986	25.42	B79	3	0.0039	0.049
-	Pier 7B	5937	0.813	6.723	24.01	0.974	8.297	26.23	B78	3	0.034	0.04

Data Sources
Hydraulic: SMS/FESWMS 100yr and 500 yr, WSA 9/20/2011
Geotech: Draft Grain Size Summary Table/Boring Logs, Stantec, 10/4/2011

East End Bridge-Section 4 Boring Plan

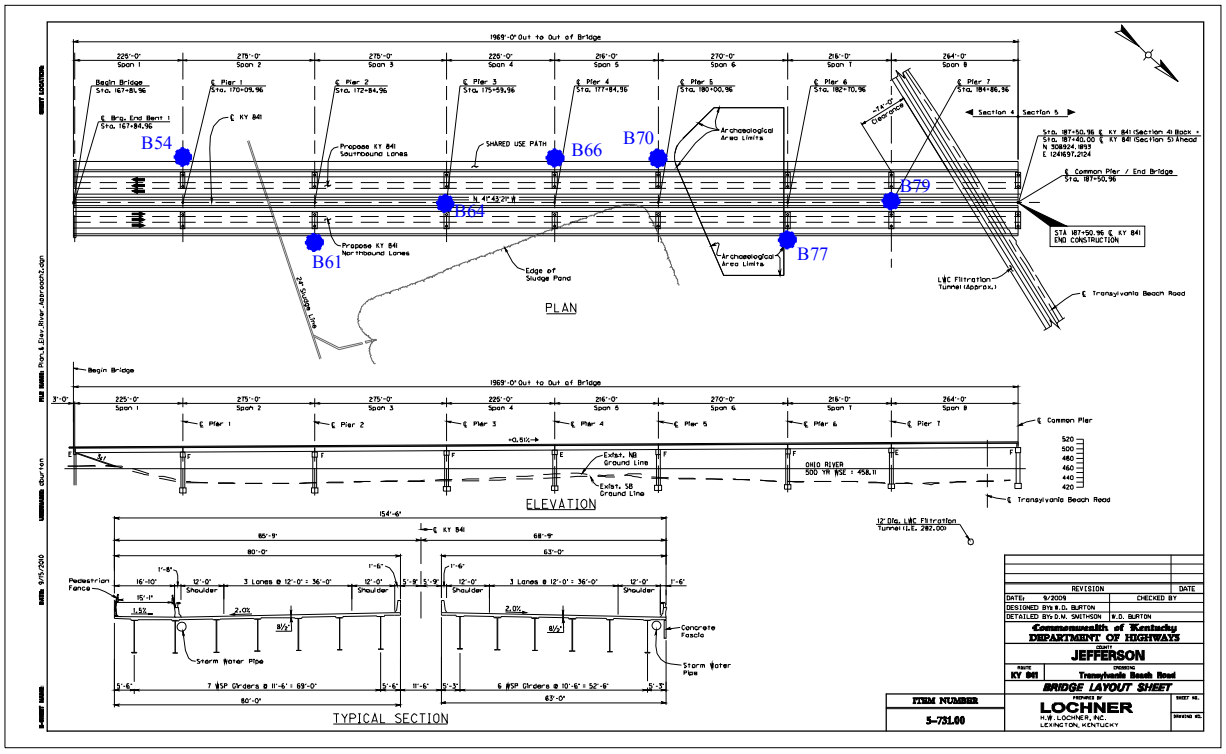


FIGURE 4
REVISED DESIGN OF SECTION 4 KY APPROACH STRUCTURE

BRIDGES

DRAFT

Stantec

East End Approach -- Section 4

Jefferson County, Kentucky

Item No. 5-731.00

Re: Available Grain Size Information from Borings near Proposed East End Approach

Date: 10/4/2011

Boring Location			Depth Interval	Classification[1]			
Boring No.	Station	Offset	(Feet)	Unified	AASHTO	D_{50} (mm)	D_{95} (mm)
B-51	167+84.96	6 LT	2.5' - 3.0'	CL-ML	A-4	0.028	0.42
			5.0' - 6.0'	CL	A-6	0.02	0.34
			15.0' - 16.5'; 20.0' - 21.5'; 25.0' - 26.5'	SM	A-2-4	0.19	19
			30.0' - 31.5'; 35.0' - 36.5'; 40.0 - 41.5'; 45.0' - 46.5'; 50.0' - 51.5'	SP-SM	A-1-b	0.6	18
			55.0' - 56.5'	N/A	N/A	0.64	14
			60.0' - 61.5'; 65.0' - 66.5'	SW	A-1-b	1.1	16
			70.0' - 71.5'	N/A	N/A	0.43	2.4
			75.0' - 76.5'; 80.0' - 81.5'	SW-SM	A-1-b	0.86	6.8
			85.0' - 86.5'	N/A	N/A	0.38	1.7
			90.0' - 91.5'; 95.0' - 96.0'; 100.0' - 101.5'	SW-SM	A-1-b	0.69	9.2
			105.0' - 106.5'	N/A	N/A	1.3	19
			110.0' - 111.5'; 115.0' - 116.5'	SP-SM	A-1-b	0.79	16
			120.0' - 121.5'; 125.0' - 126.5'	SP-SM	A-3	0.31	1.9
B-53	167+84.96	74 RT	5.0' - 5.5'	CL	A-4	0.024	0.42
			15.0' - 16.5'; 20.0' - 21.5'; 25.0' - 26.5'; 30.0' - 31.5'	SP-SM	A-1-b	0.72	22
			35.0' - 36.5'	N/A	N/A	0.71	15
			40.0' - 41.5'; 45.0' - 46.5'	SW-SM	A-1-a	1.9	21
			50.0' - 51.5'	N/A	N/A	1.1	23
			55.0' - 56.5'; 60.0 - 61.5'	SW-SM	A-1-b	1.2	18
			65.0' - 66.5'	N/A	N/A	0.9	6.2
			70.0' - 71.5'	N/A	N/A	0.14	0.35
			75.0' - 76.5'; 80.0' - 81.5'	SW-SM	A-1-b	0.91	10
			85.0' - 86.5'	N/A	N/A	0.79	2.4
			90.0' - 91.5'; 95.0' - 96.0'	SP-SM	A-1-b	0.45	4.8
			100.0' - 101.5'	N/A	N/A	0.075	12
			105.0' - 106.5'; 110.0' - 111.5'	SW-SM	A-1-b	1.2	17
			115.0' - 116.5'	N/A	N/A	1.1	13
			120.0' - 121.5'; 125.0' - 126.0'	SW-SM	A-1-b	0.71	8.2
B-54	170+09.96	86 LT	2.0' - 2.5'	CL	A-7-6	0.016	1.4
			4.0' - 5.5'; 10.0' - 11.5	SC	A-6	0.13	12
			15.0' - 16.5'	N/A	N/A	0.42	22
			20.0' - 21.5'; 25.0' - 26.5'; 30.0' - 31.5'	SW-SM	A-1-b	0.66	12
			35.0' - 36.5'	N/A	N/A	0.69	7.9
			40.0' - 41.5'; 45.0' - 46.5'	SP-SM	A-1-b	0.54	13
			50.0' - 51.5'	N/A	N/A	1.1	13
			55.0' - 56.5'; 60.0' - 61.5'	SP-SM	A-1-b	0.49	3.6
			65.0' - 66.5'	N/A	N/A	1.9	17
			70.0' - 71.5'; 75.0' - 76.5'	SW	A-1-b	1.2	11
			80.0' - 81.5'	N/A	N/A	0.81	19
			85.0' - 86.5'; 90.0' - 91.5'	SP	A-3	0.31	1.9
			95.0' - 96.5'	N/A	N/A	0.89	2.8
B-56	170+17.96	6 RT	2.4' - 2.9'	SC-SM	A-2-4	0.21	10
			5.0' - 5.8'	SC	A-4	0.11	18
			7.0' - 8.5'; 10.0' - 11.5'; 15.0' - 16.5'	SC	A-2-4	0.52	18
			20.0' - 21.5'	N/A	N/A	0.91	14
			25.0' - 26.5'; 30.0' - 31.5'	SW-SM	A-1-b	1.4	14
			35.0' - 36.5'	N/A	N/A	1.1	17
			40.0' - 41.5'; 45.0' - 46.5'	SM	A-1-b	1.1	20.1
			50.0' - 51.5'	N/A	N/A	0.91	17
			55.0' - 56.5'; 60.0' - 61.5'	SW-SM	A-1-b	0.92	13
			65.0' - 66.0'	N/A	N/A	0.69	13
			70.0' - 71.5'; 75.0' - 76.5'	SW-SM	A-1-b	0.91	18
			80.0' - 81.5'	N/A	N/A	0.59	28
			85.0' - 86.5'; 90.0' - 91.5'	SP	A-1-b	0.48	4.3
			95.0' - 96.0'	N/A	N/A	0.28	1.6
			100.0' - 101.5'; 105.0' - 106.4'	SW-SM	A-1-b	0.79	0.87

1 N/A -- Represents 200 Wash Gradation, a complete classification was not performed.

BRIDGES

DRAFT

Stantec

East End Approach – Section 4

Jefferson County, Kentucky

Item No. 5-731.00

Re: Available Grain Size Information from Borings near Proposed East End Approach

Date: 10/4/2011

Boring Location			Depth Interval	Classification[1]			
Boring No.	Station	Offset	(Feet)	Unified	AASHTO	D_{50} (mm)	D_{95} (mm)
B-59	172+84.96	6 LT	2.0' - 2.5'	CL	A-7-6	0.0058	0.56
			5.6' - 6.1'	CL	A-7-6	0.0051	0.058
			10.3 - 10.8'	CL	A-7-6	0.0046	0.041
			15.0' - 15.4'	CL	A-6	0.019	0.24
			17.0' - 18.5'; 20.0' - 21.5'	ML	A-4	1.9	20.1
			25.0' - 26.5'; 30.0' - 31.5'; 35.0' - 36.5'	SW-SM	A-1-b	1.1	14
			40.0' - 41.5'	N/A	N/A	0.6	6
			45.0' - 46.5; 50.0' - 51.5'	SW-SM	A-1-b	1.6	13
			55.0' - 56.5'	N/A	N/A	0.95	7
			60.0' - 61.5'; 65.0' - 66.5'	SP-SM	A-1-b	0.77	5.2
			70.0' - 71.5'; 75.0' - 76.5'	CL	A-4	0.4	0.029
			80.0' - 81.5'	N/A	N/A	0.69	1.8
			85.0' - 86.5'; 90.0' - 91.5'; 95.0' - 96.0'	SW-SM	A-1-b	0.81	6.9
B-61	172+84.96	69 RT	2.3' - 2.8'	CL	A-7-6	0.0072	9
			6.0' - 6.5'	CL	A-7-6	0.0071	0.55
			10.2' - 10.7'	CL	A-7-6	0.0053	0.26
			15.5' - 16.0'	CL	A-4	0.027	0.26
			20.0' - 21.5'	N/A	N/A	--	0.35
			25.0' - 26.5'; 30.0' - 31.5'; 35.0' - 36.5'	SW-SM	A-1-b	1.4	18
			40.0' - 41.5'	N/A	N/A	0.78	6.6
			45.0' - 46.5'; 50.0' - 51.5'	SP-SM	A-3	0.26	5.2
			55.0' - 56.5'	N/A	N/A	0.44	1.8
			60.0' - 61.5'; 65.0' - 66.5'	SP-SM	A-3	0.34	1.8
			70.0' - 71.5'; 75.0' - 76.5'	CL-ML	A-4	0.068	2.9
			80.0' - 81.5'	N/A	N/A	0.99	10
			85.0' - 86.5'; 90.0' - 91.5'; 95.0' -96.1'	SW-SM	A-1-b	0.94	26
B-62	172+59.96	86 LT	2.0' - 2.5'	CH	A-7-6	0.0036	0.039
			5.0' - 5.5'	CL	A-7-6	0.0051	0.053
			10.0' - 10.5'	CL	A-6	0.009	3.5
			15.0' - 15.5'	CL-ML	A-4	0.04	0.32
			20.0' - 20.5'	CL	A-4	0.027	0.33
			25.0' - 25.6'; 30.0' - 31.5'	GP-GM	A-1-b	5.4	37
			35.0' - 36.5'; 40.0' - 41.5'	SW-SM	A-1-b	1.1	34
			45.0' - 46.5'	N/A	N/A	0.95	5.8
			50.0' - 51.5'; 55.0' - 56.5'	SW-SM	A-1-b	0.73	5.9
			60.0' - 61.5'	N/A	N/A	0.9	9.5
			65.0' - 66.5'; 70.0' - 71.5'	SW-SM	A-1-b	0.76	8.4
			75.0' - 76.5'	N/A	N/A	0.6	35
			80.0' - 81.5'; 85.0' - 86.5'; 90.0' - 91.5'	SP-SM	A-3	0.2	4
			95.0' - 96.5'	N/A	N/A	1.7	10.2
B-64	175+59.96	6 RT	2.0' - 3.6'	CL	A-7-6	0.0049	0.05
			5.0' - 5.5'	CL	A-7-6	0.0045	0.053
			10.0' - 10.5'	CL	A-7-6	0.0065	0.079
			15.0' - 15.5'	CL	A-6	0.023	0.28
			20.0' - 21.5'	N/A	N/A	0.088	0.32
			25.0' - 26.5'	N/A	N/A	0.1	9
			30.0' - 31.5'; 35.0' - 36.5'; 40.0' - 41.5'	SW-SM	A-1-b	1.2	18
			45.0' - 46.5'	N/A	N/A	0.66	8
			50.0' - 51.5'; 55.0' - 56.5'	SW-SM	A-1-b	0.8	10
			60.0' - 61.5'	N/A	N/A	0.72	2.1
			65.0' - 66.5'; 70.0' - 71.5'; 75.0' - 76.5'	SP-SM	A-1-b	0.8	18
			80.0' - 81.5'	N/A	N/A	0.4	5.2
			85.0' - 86.5'; 90.0' - 91.5'; 95.0' - 95.5'	SM	A-2-4	0.12	21

1 N/A -- Represents 200 Wash Gradation, a complete classification was not performed.

DRAFT

East End Approach -- Section 4

Jefferson County, Kentucky

Item No. 5-731.00

Re: Available Grain Size Information from Borings near Proposed East End Approach

Date: 10/4/2011

Boring No.	Boring Location: Station	Boring Location: Offset	Depth Interval (Feet)	Classification[1]: Unified	Classification[1]: AASHTO	D_{50} (mm)	D_{95} (mm)
B-66	177+84.96	86 LT	2.0' - 2.5'	CL	A-7-6	0.0058	0.13
			5.0' - 6.8'	CH	A-7-6	0.004	0.075
			10.0 - 10.5	CL-ML	A-4	0.07	0.33
			15.0' - 15.5'	CL-ML	A-4	0.041	0.31
			20.0' - 21.5'; 25.0' - 26.5'	CL-ML	A-4	0.044	0.3
			30.0' - 31.5'	N/A	N/A	22	12.6
			35.0' - 36.5'; 40.0' - 41.5'	SW-SM	A-1-a	2	24
			45.0' - 46.5'	N/A	N/A	1.7	19
			50.0' - 51.5'; 55.0' - 56.5'	SW-SM	A-1-b	1.3	17
			60.0' - 61.5'	N/A	N/A	1.1	14
			65.0' - 66.5'; 75.0' - 76.5'	SP-SM	A-1-b	1.1	29
			80.0' - 81.5'	N/A	N/A	1.1	33
			85.0' - 86.5'; 90.0' - 91.5'	SP	A-3	0.3	14
			95.0' - 95.5'	N/A	N/A	1.8	29
			100.0' - 100.5'	N/A	N/A	0.3	23
B-70	180+00.96	86 LT	2.0' - 2.5'	CL	A-6	0.013	0.17
			5.0' - 5.5'	CL	A-6	0.015	0.23
			10.0' - 10.5'	CL	A-6	0.007	0.2
			15.0' - 15.8'	SM	A-4	0.89	0.33
			17.0' - 18.5'	N/A	N/A	0.09	0.34
			20.0' - 21.5'; 25.0' - 26.5'	CL-ML	A-4	0.04	0.31
			30.0' - 31.5'	N/A	N/A	1.1	16
			35.0' - 36.5'; 40.0 - 41.5'	SW-SM	A-1-b	1.1	10
			45.0' - 46.5'	N/A	N/A	1.3	15
			50.0' - 51.5'; 55.0' - 56.5'	SW-SM	A-1-b	1.3	18
			60.0' - 61.5'	N/A	N/A	0.39	2.5
			65.0' - 66.5'; 70.0' - 71.5'	SW-SM	A-1-b	0.88	7.5
			75.0' - 76.5'	N/A	N/A	1.3	6.5
			80.0' - 81.5'	N/A	N/A	1.7	30
			85.0' - 86.5'; 90.0' - 91.5'	SM	A-1-b	0.5	3.3
			95.0' - 95.5'; 100.0' - 101.5'	SW-SM	A-1-b	0.69	12
B-75	182+70.96	6 LT	2.6' - 3.1'	CL	A-6	0.0075	0.23
			5.0' - 5.5'	SM	A-2-4	0.13	0.35
			10.0' - 10.5'	CL	A-6	0.025	0.32
			15.0' - 16.5'; 20.0' - 21.5'	SM	A-4	0.09	0.34
			25.0' - 26.5'	N/A	N/A	0.15	0.45
			30.0' - 31.5'	N/A	N/A	6	33
			35.0' - 36.5'; 40.0' - 41.5'; 45.0' - 46.5'	SW-SM	A-1-b	1.5	13
			50.0' - 51.5'	N/A	N/A	1.1	9
			55.0' - 56.5'; 60.0' - 61.5'	SP	A-1-b	0.6	7.5
			65.0' - 66.5'	N/A	N/A	0.71	2.9
			70.0' - 71.5; 75.0' - 76.5'	SW-SM	A-1-b	1.3	9
			80.0' - 81.5'	N/A	N/A	0.89	1.9
			85.0' - 86.5'; 90.0' - 91.5'	SW-SM	A-1-b	0.7	6
			95.0' - 95.5'	N/A	N/A	0.89	9.5
B-77	182+70.96	69 RT	2.0' - 2.5'	CL	A-6	0.016	0.35
			5.0' - 5.5'	CL	A-6	0.009	0.28
			12.0' - 13.5'; 15.0' - 16.5'	CL-ML	A-4	0.069	0.32
			20.0' - 21.5'	N/A	N/A	0.088	0.35
			25.0' - 26.5'	N/A	N/A	0.11	0.55
			30.0' - 31.5'	N/A	N/A	3	11.4
			35.0' - 36.5'; 40.0' - 41.5'; 45.0' - 46.5'	SM	A-1-b	0.59	11.2
			50.0' - 51.5'	N/A	N/A	0.91	2.0
			55.0' - 56.5'; 60.0' - 61.5'; 65.0' - 66.5'	SW-SM	A-1-b	0.85	4.8
			70.0' - 71.5'	N/A	N/A	3.5	14
			75.0' - 76.5'; 80.0' - 81.5'	SW-SM	A-1-b	1.2	12
			85.0' - 86.5'; 90.0' - 91.5'	SW	A-1-b	0.95	9.5
			95.0' - 96.5'	N/A	N/A	0.8	2.2

1 N/A -- Represents 200 Wash Gradation, a complete classification was not performed.

DRAFT

East End Approach – Section 4

Jefferson County, Kentucky

Item No. 5-731.00

Re: Available Grain Size Information from Borings near Proposed East End Approach

Date: 10/4/2011

Boring No.	Boring Location: Station	Boring Location: Offset	Depth Interval (Feet)	Classification[1]: Unified	Classification[1]: AASHTO	D_{50} (mm)	D_{95} (mm)
B-78	184+86.96	86 LT	2.0' - 2.5'	CL	A-6	0.0071	0.09
			5.0' - 5.5'	CH	A-7-6	0.005	0.075
			10.0' - 10.5'	CH	A-7-6	0.0034	0.04
			15.0' - 15.5'	CL	A-6	0.018	0.2
			20.0' - 21.5'; 25.0' - 26.5'	CL-ML	A-4	0.038	0.31
			30.0' - 31.5'	N/A	N/A	3.5	10.7
			35.0' - 36.5'; 40.0' - 41.5'	SP-SM	A-1-b	1.4	10.3
			45.0' - 46.5'	N/A	N/A	0.11	0.7
			50.0' - 51.5'; 55.0' - 56.5'	SP-SM	A-1-b	0.94	6.5
			60.0' - 61.5'	N/A	N/A	1.1	14
			70.0' - 71.5'; 75.0 - 76.5'	SW-SM	A-1-b	1	11
			80.0' - 81.5'; 85.0' - 86.5'	SP-SM	A-1-b	0.49	7
			90.0' - 91.5'	N/A	N/A	0.9	15
B-79	184+86.96	6 LT	2.0' - 4.0'	CL	A-6	0.007	0.12
			5.0' - 7.0'	CH	A-7-6	0.0037	0.041
			10.0' - 12.0'	CH	A-7-6	0.0039	0.049
			15.0' - 16.5'; 20.0' - 21.5'	ML	A-4	0.07	0.32
			25.0' - 26.5'	N/A	N/A	0.9	0.4
			30.0' - 31.5'; 35.0' - 36.5'; 40.0' - 41.5'	SW-SM	A-1-b	0.97	0.95
			45.0' - 46.5'	N/A	N/A	1	8
			50.0' - 51.5'; 55.0' - 56.5'	SM	A-1-b	0.74	6.3
			60.0' - 61.5'	N/A	N/A	0.89	2
			65.0' - 66.5'; 70.0' - 71.5'	SW-SM	A-1-b	0.91	4.2
			75.0' - 76.5'	N/A	N/A	1.1	3.5
			80.0' - 81.5'; 85.0' - 86.5'	SP-SM	A-1-b	0.49	9.1
			90.0' - 91.5'	N/A	N/A	0.9	7
			95.0' - 96.5'	N/A	N/A	0.4	14

1 N/A -- Represents 200 Wash Gradation, a complete classification was not performed.

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***50***	Immediate Water Depth ***32.2 (08/31/11)***	Start Date ***08/31/2011***	Hole Type ***core***
Surface Elevation ***463.6'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***168.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.335918***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635784***	

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
5		**DRAFT**							**Boring advanced with 4.25" augers, NQ System utilized to sample bedrock, Drilling Mud was not added to boring @ 1**
10									
15									
20									
25		**Overburden**: *overburden.*							
30									
35									
40									
45									
50									

Top of Rock = 128.0' Elevation = 335.6' | Base Weathered Rock = 128.0' Elevation = 335.6' | RDZ = 128.0' Elevation = 335.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***50***	Immediate Water Depth ***32.2 (08/31/11)***	Start Date ***08/31/2011***	Hole Type ***core***
Surface Elevation ***463.6'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***168.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.335918***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635784***	

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
55		**DRAFT**							
60									
65									
70									
75		**Overburden**: *overburden.*							
80									
85									
90									
95									
100									

Top of Rock = 128.0' Elevation = 335.6' | Base Weathered Rock = 128.0' Elevation = 335.6' | RDZ = 128.0' Elevation = 335.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***50***	Immediate Water Depth ***32.2 (08/31/11)***	Start Date ***08/31/2011***	Hole Type ***core***
Surface Elevation ***463.6'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***168.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.335918***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635784***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
105		**DRAFT**							105
110		**Overburden**: *overburden.*							110
115									115
120									120
125									125
335.6	128.0		(Begin Core)						
130									130
135				20 / 20	10.0	10.0	100		135
									138.0
140		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*							**soft zone @ 139.1-139.7** 140
145				61 / 58	10.0	10.0	100		**RCS-1 @ 142.8-143.6** 145
									148.0
150				57 / 50	10.0	10.0	100		150

Top of Rock = 128.0' Elevation = 335.6' | Base Weathered Rock = 128.0' Elevation = 335.6' | RDZ = 128.0' Elevation = 335.6' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***50***	Immediate Water Depth ***32.2 (08/31/11)***	Start Date ***08/31/2011***	Hole Type ***core***
Surface Elevation ***463.6'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***168.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.335918***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635784***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
155		**DRAFT**		57 / 50	10.0	10.0	100		**fossiliferous @ 150.3-150.6 vertical fracture @ 151-151.6** 155
		Limestone & Shale: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*							158.0
160				96 / 96	10.0	10.0	100		160
165									165
295.6	168.0								**RCS-2 @ 166.7-167.7** 168.0
170									170
175		(Bottom of Hole 168.0')							175
180									180
185									185
190									190
195									195
200									200

Top of Rock = 128.0' Elevation = 335.6' | Base Weathered Rock = 128.0' Elevation = 335.6' | RDZ = 128.0' Elevation = 335.6' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***51***	Immediate Water Depth ***31.2 (09/05/11)***	Start Date ***09/01/2011***	Hole Type ***core and sample***
Surface Elevation ***465.4'***	Static Water Depth ***NA***	End Date ***09/05/2011***	Rig_Number ***1050 ATV***
Total Depth ***158.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336011***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635526***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows SDI (JS)	Sample Type	Remarks
		DRAFT						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
		Overburden: *Clay, brown, moist, some sand.*	1	2.0-4.0	2.0		ST	
			2	5.0-7.0	2.0		ST	
455.4	10.0							
		Overburden: *Sand, light brown, moist, fine grained.*	3	10.0-12.0	2.0		ST	
450.4	15.0							
			1	15.0-16.5	1.2	3-3-1	SPT	
			2	20.0-21.5	0.6	1-2-1	SPT	
			3	25.0-26.5	0.6	2-3-3	SPT	
		Overburden: *Sand, brown, moist, fine grained, very loose to dense, some silt, some gravel.*	4	30.0-31.5	0.6	3-3-2	SPT	
			5	35.0-36.5	0.1	1-2-1	SPT	**Drilling mud added to the boring at a depth of 35.0 ft below the ground surface @ 35**
			6	40.0-41.5	0.1	0-0-0	SPT	
			7	45.0-46.5	1.0	1-2-4	SPT	

Top of Rock = 128.7' Elevation = 336.7' | Base Weathered Rock = 128.7' Elevation = 336.7' | RDZ = 128.7' Elevation = 336.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***51***	Immediate Water Depth ***31.2 (09/05/11)***	Start Date ***09/01/2011***	Hole Type ***core and sample***
Surface Elevation ***465.4'***	Static Water Depth ***NA***	End Date ***09/05/2011***	Rig_Number ***1050 ATV***
Total Depth ***158.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336011***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635526***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows SDI (JS)	Sample Type	Remarks
			8	50.0-51.5	1.5	0-1-3	SPT	
410.4	55.0	**Overburden**: *Sand, brown, moist, fine grained, very loose to dense, some silt, some gravel.*						
		DRAFT	9	55.0-56.5	1.2	5-4-9	SPT	
			10	60.0-61.5	1.5	6-7-12	SPT	
			11	65.0-66.5	1.5	8-8-13	SPT	
			12	70.0-71.5	1.5	8-13-24	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*	13	75.0-76.5	1.5	14-17-22	SPT	
			14	80.0-81.5	1.2	8-9-12	SPT	
			15	85.0-86.5	1.5	6-10-17	SPT	
			16	90.0-91.5	1.5	15-13-15	SPT	
			17	95.0-96.5	1.5	9-10-10	SPT	

Top of Rock = 128.7' Elevation = 336.7' | Base Weathered Rock = 128.7' Elevation = 336.7' | RDZ = 128.7' Elevation = 336.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***51***	Immediate Water Depth ***31.2 (09/05/11)***	Start Date ***09/01/2011***	Hole Type ***core and sample***
Surface Elevation ***465.4'***	Static Water Depth ***NA***	End Date ***09/05/2011***	Rig_Number ***1050 ATV***
Total Depth ***158.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336011***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635526***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows / Sample Type / SDI (JS)	Remarks
		Overburden	18	100.0-100.3	0.3	50/0.30' SPT	
105		**DRAFT**	19	105.0-106.5	0.8	24-13-12 SPT	105
110			20	110.0-111.5	1.5	50-35-34/0.50' SPT	110
115		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*	21	115.0-116.5	1.5	21-24-25 SPT	115
120			22	120.0-121.5	1.5	8-7-8 SPT	120
125			23	125.0-126.5	1.5	32-45-50/0.50' SPT	125
336.7	128.7	(Begin Core)					
130							Vertical Fracture @ 129.3-129.7 130
135			36 / 36	10.0	8.1	81	135
140		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*	52 / 52	10.0	8.6	86	138.7 140
145							RCS-1 @ 145.4-146.2 145
150			68 /	10.0	10.0	100	148.7 150

Top of Rock = 128.7' Elevation = 336.7' | Base Weathered Rock = 128.7' Elevation = 336.7' | RDZ = 128.7' Elevation = 336.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***51***	Immediate Water Depth ***31.2 (09/05/11)***	Start Date ***09/01/2011***	Hole Type ***core and sample***
Surface Elevation ***465.4'***	Static Water Depth ***NA***	End Date ***09/05/2011***	Rig_Number ***1050 ATV***
Total Depth ***158.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336011***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.635526***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows / Sample Type / SDI (JS)	Remarks
		Overburden	68				
155		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*	68 / 68	10.0	10.0	100	RCS-2 @ 153.9-154.8 155
306.7	158.7						158.7
160		**DRAFT** (Bottom of Hole 158.7')					160
165							165
170							170
175							175
180							180
185							185
190							190
195							195
200							200

Top of Rock = 128.7' Elevation = 336.7' | Base Weathered Rock = 128.7' Elevation = 336.7' | RDZ = 128.7' Elevation = 336.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***52***	Immediate Water Depth ***35.6 (09/07/11)***	Start Date ***09/06/2011***	Hole Type ***core***
Surface Elevation ***465.5'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***159.3'***	Driller ***Danny Jessie***	Latitude(83) ***38.336060***	***GQ-1211***
Location ***167+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635503***	***Jeffersonville, New Albany, and Charlestown***

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10									
15									
20									
25		**Overburden**: *overburden.*							
30									
35									
40									**Drilling mud added to the boring at a depth of 40.0 ft below the ground surface @ 40**
45									
50									

Top of Rock = 128.6' Elevation = 336.9'
Base Weathered Rock = 131.2' Elevation = 334.3'
RDZ = 131.2' Elevation = 334.3'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***52***	Immediate Water Depth ***35.6 (09/07/11)***	Start Date ***09/06/2011***	Hole Type ***core***
Surface Elevation ***465.5'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***159.3'***	Driller ***Danny Jessie***	Latitude(83) ***38.336060***	***GQ-1211***
Location ***167+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635503***	***Jeffersonville, New Albany, and Charlestown***

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
55		**DRAFT**							
60									
65									
70									
75		**Overburden**: *overburden.*							
80									
85									
90									
95									
100									

Top of Rock = 128.6' Elevation = 336.9'
Base Weathered Rock = 131.2' Elevation = 334.3'
RDZ = 131.2' Elevation = 334.3'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***52***	Immediate Water Depth ***35.6 (09/07/11)***	Start Date ***09/06/2011***	Hole Type ***core***
Surface Elevation ***465.5'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***159.3'***	Driller ***Danny Jessie***	Latitude(83) ***38.336060***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635503***	

Lithology Elevation	Lithology Depth	Description	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		Overburden						
		Rock Core						
105		**DRAFT**						105
110		**Overburden**: *overburden.*						110
115								115
120								120
125								125
336.9	128.6	(Begin Core)						
130								130
135		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*	12 / 12	9.4	8.5	90		135
								138.0
140			42 / 35	10.0	10.0	100		140
145								145 RCS-1 @ 146.1-146.7
								148.0
150			46 / 46	11.3	11.3	100		150

Top of Rock = 128.6' Elevation = 336.9'
Base Weathered Rock = 131.2' Elevation = 334.3'
RDZ = 131.2' Elevation = 334.3'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***52***	Immediate Water Depth ***35.6 (09/07/11)***	Start Date ***09/06/2011***	Hole Type ***core***
Surface Elevation ***465.5'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***159.3'***	Driller ***Danny Jessie***	Latitude(83) ***38.336060***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635503***	

Lithology Elevation	Lithology Depth	Description	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		Overburden						
		Rock Core						
155		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*	46 / 46	11.3	11.3	100		RCS-2 @ 153.2-154.2 155
306.2	159.3							159.3
160		**DRAFT**						160
165		(Bottom of Hole 159.3')						165
170								170
175								175
180								180
185								185
190								190
195								195
200								200

Top of Rock = 128.6' Elevation = 336.9'
Base Weathered Rock = 131.2' Elevation = 334.3'
RDZ = 131.2' Elevation = 334.3'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***53***	Immediate Water Depth ***51.2 (09/07/11)***	Start Date ***09/07/2011***	Hole Type ***core and sample***
Surface Elevation ***463.2'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***167.9'***	Driller ***Danny Jessie***	Latitude(83) ***38.336206***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 74.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635386***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		DRAFT							**Boring advanced with 4.25" augers @ 1**
		Overburden: *Clay, brown, moist, some sand.*		1	2.0-4.0	2.0		ST	**NQ coring system utilized to sample bedrock @ 3**
				2	5.0-7.0	1.5		ST	
10 453.2	10.0								**Boring moved 5.0' RT to drill off of driveway @ 9**
		Overburden: *Sand, brown, moist, fine to medium grained, some clay.*		3	10.0-12.0	1.5		ST	
15 448.2	15.0			1	15.0-16.5	1.1	2-4-2	SPT	
				2	20.0-21.5	0.5	4-6-7	SPT	
				3	25.0-26.5	0.5	3-4-3	SPT	
		Overburden: *Sand, brown, moist, fine grain, very loose to dense, some silt, some gravel.*		4	30.0-31.5	0.7	0-1-0	SPT	
				5	35.0-36.5	0.6	0-1-0	SPT	
				6	40.0-41.5	1.0	6-8-10	SPT	
				7	45.0-46.5	1.0	9-24-21	SPT	
50 413.2	50.0								

Top of Rock = 127.2' Elevation = 336.0' | Base Weathered Rock = 127.2' Elevation = 336.0' | RDZ = 127.2' Elevation = 336.0' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***53***	Immediate Water Depth ***51.2 (09/07/11)***	Start Date ***09/07/2011***	Hole Type ***core and sample***
Surface Elevation ***463.2'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***167.9'***	Driller ***Danny Jessie***	Latitude(83) ***38.336206***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 74.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635386***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		DRAFT		8	50.0-51.5	1.5	8-13-15	SPT	
				9	55.0-56.5	1.5	13-19-21	SPT	**Drilling mud added to the boring at a depth of 55.0 ft below the ground surface @ 55**
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*		10	60.0-61.5	1.5	7-10-11	SPT	
				11	65.0-66.5	1.5	7-13-18	SPT	
70 393.2	70.0								
		Overburden: *Silt, light brown, wet, fine grained, hard, some sand.*		12	70.0-71.5	0.5	14-22-33	SPT	
75 388.2	75.0								
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		13	75.0-76.5	1.2	6-10-21	SPT	
				14	80.0-81.5	1.5	10-9-13	SPT	
				15	85.0-86.5	1.5	10-15-21	SPT	
				16	90.0-91.5	1.5	13-14-22	SPT	
				17	95.0-96.5	1.5	14-21-30	SPT	
100363.2	100.0								

Top of Rock = 127.2' Elevation = 336.0' | Base Weathered Rock = 127.2' Elevation = 336.0' | RDZ = 127.2' Elevation = 336.0' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***53***	Immediate Water Depth ***51.2 (09/07/11)***	Start Date ***09/07/2011***	Hole Type ***core and sample***
Surface Elevation ***463.2'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***167.9'***	Driller ***Danny Jessie***	Latitude(83) ***38.336206***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 74.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635386***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
358.2	105.0	**Overburden**: *Clay, gray, wet, fine grained, stiff, some sand.*	Overburden	18	100.0-101.5	0.5	10-3-8	SPT	
		DRAFT		19	105.0-106.5	1.1	12-30-42	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		20	110.0-111.5	1.5	9-12-19	SPT	
				21	115.0-116.5	0.6	13-11-16	SPT	
				22	120.0-121.5	1.5	21-17-20	SPT	
				23	125.0-126.5	1.5	43-36-32/0.50'	SPT	
336.0	127.2	(Begin Core)	Rock Core						
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*		15 / 15	11.3				138.5
				34 / 28	10.0				**RCS-1 @ 145.5-146.1**
				24 /	10.0				148.5

Top of Rock = 127.2' Elevation = 336.0'
Base Weathered Rock = 127.2' Elevation = 336.0'
RDZ = 127.2' Elevation = 336.0'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***53***	Immediate Water Depth ***51.2 (09/07/11)***	Start Date ***09/07/2011***	Hole Type ***core and sample***
Surface Elevation ***463.2'***	Static Water Depth ***NA***	End Date ***09/07/2011***	Rig_Number ***1050 ATV***
Total Depth ***167.9'***	Driller ***Danny Jessie***	Latitude(83) ***38.336206***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***167+84.96 74.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635386***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		DRAFT		20					**fossiliferous @ 150.6-150.9**
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*		24 / 20	10.0				158.5
				32 / 32	9.4				
295.3	167.9								167.9 **RCS-2 @ 167-167.6**
		(Bottom of Hole 167.9')							

Top of Rock = 127.2' Elevation = 336.0'
Base Weathered Rock = 127.2' Elevation = 336.0'
RDZ = 127.2' Elevation = 336.0'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***54***	Immediate Water Depth ***17.8 (09/13/11)***	Start Date ***09/12/2011***	Hole Type ***core and sample***
Surface Elevation ***430.5'***	Static Water Depth ***NA***	End Date ***09/13/2011***	Rig_Number ***1050 ATV***
Total Depth ***140.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336373***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+09.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636315***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No.	Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows SDI (JS)	Sample Type	Remarks
		DRAFT								**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3 Boring was staked on slope, dozer work was needed to clear a path to stake, elevation change of 2.0' due to dozer cut @ 6**
				ST-1		2.0-4.0	2.0		ST	
5				SPT-1		4.0-5.5	1.5	9-13-12	SPT	
10		**Overburden**: *Sand, brown, moist, fine to medium grained, very loose to medium dense, some clay, some gravel.*		SPT-2		10.0-11.5	0.9	6-2-2	SPT	
15				SPT-3		15.0-16.5	0.8	1-1-1	SPT	
20 410.5	20.0									**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
				SPT-4		20.0-21.5	0.7	4-6-7	SPT	
25										
				SPT-5		25.0-26.5	1.5	4-9-14	SPT	
30				SPT-6		30.0-31.5	0.6	6-5-8	SPT	
35		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*		SPT-7		35.0-36.5	0.7	9-8-7	SPT	
40				SPT-8		40.0-41.5	1.5	8-11-17	SPT	
45				SPT-9		45.0-46.5	1.5	10-12-17	SPT	
50										

Top of Rock = 100.0' Elevation = 330.5' | Base Weathered Rock = 100.8' Elevation = 329.7' | RDZ = 100.8' Elevation = 329.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***54***	Immediate Water Depth ***17.8 (09/13/11)***	Start Date ***09/12/2011***	Hole Type ***core and sample***
Surface Elevation ***430.5'***	Static Water Depth ***NA***	End Date ***09/13/2011***	Rig_Number ***1050 ATV***
Total Depth ***140.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336373***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+09.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636315***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No.	Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows SDI (JS)	Sample Type	Remarks
		DRAFT		SPT-10		50.0-51.5	1.5	9-18-15	SPT	
55										55
				SPT-11		55.0-56.5	1.5	16-18-18	SPT	
60				SPT-12		60.0-61.5	1.5	10-8-13	SPT	60
65				SPT-13		65.0-66.5	1.5	17-8-13	SPT	65
70				SPT-14		70.0-71.5	1.5	18-30-31	SPT	70
75		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*		SPT-15		75.0-76.5	1.0	15-18-27	SPT	75
80				SPT-16		80.0-81.5	1.2	13-15-15	SPT	80
85				SPT-17		85.0-86.5	1.5	12-13-13	SPT	85
90				SPT-18		90.0-91.5	1.5	17-8-8	SPT	90
95				SPT-19		95.0-96.5	1.5	10-8-20	SPT	95
100330.5	100.0		(Begin Core)							100

Top of Rock = 100.0' Elevation = 330.5' | Base Weathered Rock = 100.8' Elevation = 329.7' | RDZ = 100.8' Elevation = 329.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***54***	Immediate Water Depth ***17.8 (09/13/11)***	Start Date ***09/12/2011***	Hole Type ***core and sample***
Surface Elevation ***430.5'***	Static Water Depth ***NA***	End Date ***09/13/2011***	Rig_Number ***1050 ATV***
Total Depth ***140.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336373***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+09.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636315***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**	0 / 0	7.5	7.0	93		105
								107.5
110			37 / 32	5.9	5.9	100		110
								113.4
115			45 / 38	10.0	10.0	100		115
120		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*						120
								123.4 **RCS-1 @ 123.4-124.1**
125			43 / 43	10.0	10.0	100		125
130								130
								133.4 **RCS-2 @ 132.5-133.2**
135			68 / 68	7.3	7.3	100		135
140	289.8	140.7						140
								140.7
145		(Bottom of Hole 140.7')						145
150								150

Top of Rock = 100.0' Elevation = 330.5' | Base Weathered Rock = 100.8' Elevation = 329.7' | RDZ = 100.8' Elevation = 329.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***55***	Immediate Water Depth ***NA***	Start Date ***09/12/2011***	Hole Type ***core***
Surface Elevation ***438.3'***	Static Water Depth ***NA***	End Date ***09/12/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.2'***	Driller ***Danny Jessie***	Latitude(83) ***38.336521***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636110***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3 Boring was staked on slope, dozer work was needed to clear a path to stake, boring moved ahead station 8.0' from stake to provide working area, elevation change of 3.0' due to dozer cut @ 6** 5
10								10
15								15
20								20
25		**Overburden**: *overburden.*						25
30								**Drilling mud added to the boring at a depth of 30.0 ft below the ground surface @ 30** 30
35								35
40								40
45								45
50								50

Top of Rock = 105.2' Elevation = 333.1' | Base Weathered Rock = 105.2' Elevation = 333.1' | RDZ = 105.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***55***	Immediate Water Depth ***NA***	Start Date ***09/12/2011***	Hole Type ***core***
Surface Elevation ***438.3'***	Static Water Depth ***NA***	End Date ***09/12/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.2'***	Driller ***Danny Jessie***	Latitude(83) ***38.336521***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636110***	

Lithology Elevation	Lithology Depth	Description	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		Overburden / Rock Core						
55		**DRAFT**						55
60								60
65								65
70								70
75		**Overburden**: *overburden.*						75
80								80
85								85
90								90
95								95
100								100

Top of Rock = 105.2' Elevation = 333.1' | Base Weathered Rock = 105.2' Elevation = 333.1' | RDZ = 105.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***55***	Immediate Water Depth ***NA***	Start Date ***09/12/2011***	Hole Type ***core***
Surface Elevation ***438.3'***	Static Water Depth ***NA***	End Date ***09/12/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.2'***	Driller ***Danny Jessie***	Latitude(83) ***38.336521***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636110***	

Lithology Elevation	Lithology Depth	Description	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		Overburden / Rock Core						
105 333.1	105.2	**Overburden**: *overburden.* (Begin Core)						105
110		**DRAFT**	38 / 38	7.8	7.4	95		110
113.0								
115			30 / 25	5.0	5.0	100		**Soft Zone @ 114.6-115.2** 115
118.0								**Soft Zone @ 116.9-117.1**
120		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*	39 / 31	10.0	10.0	100		120 **RCS-1 @ 121.4-122.1**
125								125
128.0								**fossiliferous @ 125.8-126.2**
130			59 / 59	8.2	8.2	100		130
135 302.1	136.2							135 **RCS-2 @ 134.9-135.8**
136.2								
140		(Bottom of Hole 136.2')						140
145								145
150								150

Top of Rock = 105.2' Elevation = 333.1' | Base Weathered Rock = 105.2' Elevation = 333.1' | RDZ = 105.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***56***	Immediate Water Depth ***26.0 (09/09/11)***	Start Date ***09/08/2011***	Hole Type ***core and sample***
Surface Elevation ***439.1'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336544***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636079***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		DRAFT							**Boring advanced with 4.25" augers @ 1**
				1	2.0-4.0	1.5		ST	
5									5
				2	5.0-7.0	1.0		ST	
				1	7.0-8.5	1.0	7-6-6	SPT	**NQ coring system utilized to sample bedrock @ 3**
10		**Overburden**: *Sand, brown, moist, fine to medium grain, loose to medium dense, some clay, some gravel.*							10
				2	10.0-11.5	1.0	12-8-1	SPT	**Boring was staked on slope, dozer work was needed to clear a path to stake, boring moved ahead station 8.0' from stake to provide working area, elevation change of 3.3' due to dozer cut @ 6**
15									15
				3	15.0-16.5	0.5	3-2-5	SPT	
20	419.1	20.0							20
		Overburden: *Sand, light brown, moist, fine grained, loose, some silt, some gravel.*		4	20.0-21.5	1.0	4-2-2	SPT	
25	414.1	25.0							25
				5	25.0-26.5	1.2	4-5-5	SPT	
30									30
				6	30.0-31.5	1.5	7-5-7	SPT	**Drilling mud added to the boring at a depth of 30.0 ft below the ground surface @ 30**
35									35
		Overburden: *Sand, brown to gray, wet, fine to medium grained, loose to very dense, poorly graded, some gravel.*		7	35.0-36.5	1.5	13-10-10	SPT	
40									40
				8	40.0-41.5	1.5	10-6-8	SPT	
45									45
				9	45.0-46.5	1.5	10-9-10	SPT	
50									50

Top of Rock = 106.2' Elevation = 332.9' | Base Weathered Rock = 106.2' Elevation = 332.9' | RDZ = 106.2' Elevation = 332.9' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***56***	Immediate Water Depth ***26.0 (09/09/11)***	Start Date ***09/08/2011***	Hole Type ***core and sample***
Surface Elevation ***439.1'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336544***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636079***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		DRAFT		10	50.0-51.5	1.5	11-9-10	SPT	
55									55
				11	55.0-56.5	1.5	17-10-10	SPT	
60									60
				12	60.0-61.5	1.5	28-27-24	SPT	
65									65
				13	65.0-66.5	1.5	6-7-11	SPT	
70									70
				14	70.0-71.5	1.5	15-13-8	SPT	
75		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, loose to very dense, poorly graded, some gravel.*							75
				15	75.0-76.5	1.5	14-18-22	SPT	
80									80
				16	80.0-81.5	1.2	9-10-11	SPT	
85									85
				17	85.0-86.5	1.5	17-18-22	SPT	
90									90
				18	90.0-91.5	1.0	8-11-12	SPT	
95									95
				19	95.0-96.5	1.5	17-8-5	SPT	
100									100

Top of Rock = 106.2' Elevation = 332.9' | Base Weathered Rock = 106.2' Elevation = 332.9' | RDZ = 106.2' Elevation = 332.9' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN*** Item Number: ***5-731.00***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge*** Project Manager: ***Mark Litkenhus***

Hole Number ***56***	Immediate Water Depth ***26.0 (09/09/11)***	Start Date ***09/08/2011***	Hole Type ***core and sample***
Surface Elevation ***439.1'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.336544***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+17.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636079***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, loose to very dense, poorly graded, some gravel.*		20	100.0-101.5	1.5	26-23-28	SPT	105
332.9	106.2		(Begin Core)	21	105.0-106.2	1.2	28-32-50/0.20'	SPT	
110		**DRAFT**		40 / 40	7.3	7.3	100		110
113.5									
115				50 / 47	5.0	5.0	100		115 **RCS-1 @ 115.8-116.6 soft zone @ 116.6-116.8**
118.5									
120		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*		50 / 46	10.0	10.0	100		120
125									125 **fossiliferous @ 127-127.3**
128.5									
130				64 / 64	8.2	8.2	100		130 **RCS-2 @ 129.6-130.3**
135									135
302.4	136.7								136.7
140		(Bottom of Hole 136.7')							140
145									145
150									150

Top of Rock = 106.2' Elevation = 332.9' | Base Weathered Rock = 106.2' Elevation = 332.9' | RDZ = 106.2' Elevation = 332.9' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN*** Item Number: ***5-731.00***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge*** Project Manager: ***Mark Litkenhus***

Hole Number ***57***	Immediate Water Depth ***43.2 (09/08/11)***	Start Date ***09/08/2011***	Hole Type ***core***
Surface Elevation ***443.9'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***152.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336661***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+18.46 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635917***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3 Boring was drilled on slope, dozer work was needed to clear a path to stake, boring offset 8.5' from stake to provide working area, elevation change 3.0' due to dozer cut @ 6** 5
10									10
15									15
20									20
25		**Overburden**: *overburden.*							25
30									30
35									35
40									40
45									**Drilling mud added to the boring at a depth of 45.0 ft below the ground** 45
50									50

Top of Rock = 111.3' Elevation = 332.6' | Base Weathered Rock = 112.1' Elevation = 331.8' | RDZ = 112.1' Elevation = 331.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***57***	Immediate Water Depth ***43.2 (09/08/11)***	Start Date ***09/08/2011***	Hole Type ***core***
Surface Elevation ***443.9'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***152.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336661***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+18.46 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635917***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
								surface @ 45
55		DRAFT						55
60								60
65								65
70								70
75		**Overburden**: *overburden.*						75
80								80
85								85
90								90
95								95
100								100

Top of Rock = 111.3' Elevation = 332.6' | Base Weathered Rock = 112.1' Elevation = 331.8' | RDZ = 112.1' Elevation = 331.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***57***	Immediate Water Depth ***43.2 (09/08/11)***	Start Date ***09/08/2011***	Hole Type ***core***
Surface Elevation ***443.9'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***152.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336661***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+18.46 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635917***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
105		**Overburden**: *overburden.*						105
110								110
332.6	111.3	(Begin Core)						
115		DRAFT	16 / 16	5.7	5.2	91		**weathered @ 111.3-112.1** **Vertical Fracture @ 114.2-114.3** 115
117.0								
120			40 / 35	10.0	10.0	100		120
125								125
127.0								
130		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*	64 / 58	10.0	10.0	100		**RCS-1 @ 129.4-130.1 fossiliferous @ 130.7-131** 130
135								135
137.0								
140			88 / 85	10.0	10.0	100		**calcite @ 140.1-140.6** 140
145								145
147.0								**RCS-2 @ 146.2-147**
150			84 / 84	5.0	5.0	100		150

Top of Rock = 111.3' Elevation = 332.6' | Base Weathered Rock = 112.1' Elevation = 331.8' | RDZ = 112.1' Elevation = 331.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***57***	Immediate Water Depth ***43.2 (09/08/11)***	Start Date ***09/08/2011***	Hole Type ***core***
Surface Elevation ***443.9'***	Static Water Depth ***NA***	End Date ***09/08/2011***	Rig_Number ***1050 ATV***
Total Depth ***152.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336661***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***170+18.46 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.635917***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
291.9	152.0			84 / 84	5.0	5.0	100		152.0

DRAFT

(Bottom of Hole 152.0')

Top of Rock = 111.3' Elevation = 332.6'
Base Weathered Rock = 112.1' Elevation = 331.8'
RDZ = 112.1' Elevation = 331.8'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***58***	Immediate Water Depth ***15.3 (08/29/11)***	Start Date ***08/26/2011***	Hole Type ***core***
Surface Elevation ***429.0'***	Static Water Depth ***NA***	End Date ***08/29/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336929***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636964***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
									Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3
									Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20

DRAFT

Overburden: *overburden.*

Top of Rock = 96.0' Elevation = 333.0'
Base Weathered Rock = 97.2' Elevation = 331.8'
RDZ = 97.2' Elevation = 331.8'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***58***	Immediate Water Depth ***15.3 (08/29/11)***	Start Date ***08/26/2011***	Hole Type ***core***
Surface Elevation ***429.0'***	Static Water Depth ***NA***	End Date ***08/29/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336929***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636964***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							55
60									60
65									65
70		**Overburden**: *overburden.*							70
75									75
80									80
85									85
90									90
95									95
333.0	96.0		(Begin Core)						
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		20 / 20	2.0	1.9	95		**weathered @ 96-97.2** 98.0
100				20 / 18	10.0	10.0	100		100

Top of Rock = 96.0' Elevation = 333.0' | Base Weathered Rock = 97.2' Elevation = 331.8' | RDZ = 97.2' Elevation = 331.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***58***	Immediate Water Depth ***15.3 (08/29/11)***	Start Date ***08/26/2011***	Hole Type ***core***
Surface Elevation ***429.0'***	Static Water Depth ***NA***	End Date ***08/29/2011***	Rig_Number ***1050 ATV***
Total Depth ***136.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.336929***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636964***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		20 / 18	10.0	10.0	100		105
									Soft Zone @ 106.1-106.2 108.0
110				42 / 34	10.0	10.0	100		110
115		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*							**RCS-1 @ 112-112.8** 115
									118.0
120				75 / 70	10.0	9.7	97		120
125									125
									128.0 **RCS-2 @ 128.6-129.6**
130				86 / 86	8.0	8.0	100		130
135									135
293.0	136.0								136.0
140		(Bottom of Hole 136.0')							140
145									145
150									150

Top of Rock = 96.0' Elevation = 333.0' | Base Weathered Rock = 97.2' Elevation = 331.8' | RDZ = 97.2' Elevation = 331.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***59***	Immediate Water Depth ***15.2 (08/29/11)***	Start Date ***08/29/2011***	Hole Type ***core and sample***
Surface Elevation ***428.3'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.337077***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636758***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
427.3	1.0	**Overburden**: *Topsoil.*						
		DRAFT	1	2.0-4.0	2.0		ST	**Boring advanced with 4.25" augers @ 1**
5								5
			2	5.0-7.0	2.0		ST	**NQ coring system utilized to sample bedrock @ 3**
10		**Overburden**: *Clay, brown, moist, some sand.*						10
			3	10.0-12.0	2.0		ST	
15								15
411.3	17.0		4	15.0-17.0	0.5		ST	
			1	17.0-18.5	0.6	0-0-0	SPT	**Drilling mud added to the boring at a depth of 17.0 ft below the ground surface @ 17**
20								20
		Overburden: *Clay, brown, moist, very soft to stiff, some sand.*	2	20.0-21.5	0.8	2-4-6	SPT	
25 403.3	25.0							25
			3	25.0-26.5	0.8	2-5-9	SPT	
30								30
			4	30.0-31.5	1.0	5-9-11	SPT	
35								35
			5	35.0-36.5	1.5	7-11-12	SPT	
		Overburden: *Sand, brown and gray, wet, fine to medium grained, very loose to dense, some clay.*						
40								40
			6	40.0-41.5	1.5	6-8-10	SPT	
45								45
			7	45.0-46.5	1.5	7-5-7	SPT	
50								50

Top of Rock = 95.6' Elevation = 332.7' | Base Weathered Rock = 96.6' Elevation = 331.7' | RDZ = 96.6' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***59***	Immediate Water Depth ***15.2 (08/29/11)***	Start Date ***08/29/2011***	Hole Type ***core and sample***
Surface Elevation ***428.3'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.337077***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636758***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
			8	50.0-51.5	1.5	10-17-15	SPT	
		DRAFT						
55								55
			9	55.0-56.5	1.5	7-8-10	SPT	
60		**Overburden**: *Sand, brown and gray, wet, fine to medium grained, very loose to dense, some clay.*						60
			10	60.0-61.5	1.5	15-13-14	SPT	
65								65
			11	65.0-66.5	1.5	16-11-8	SPT	
70 358.3	70.0							70
			12	70.0-71.5	1.5	0-0-4	SPT	
75		**Overburden**: *Clay, dark gray, wet, soft to hard, some silt.*						75
			13	75.0-76.5	1.5	5-17-17	SPT	
80 348.3	80.0							80
			14	80.0-81.5	1.5	8-12-13	SPT	
85								85
			15	85.0-86.5	1.2	8-8-11	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*						
90								90
			16	90.0-91.5	0.8	7-11-19	SPT	
95 332.7	95.6	(Begin Core)	17	95.0-95.6	0.6	15-50/0.10'	SPT	**Rock in bottom of split-spoon @ 95-96 weathered @ 95.6-96.6**
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*	0 / 0	2.6	2.6	100	98.2	
100			24 / 22	10.0	10.0	100		100

Top of Rock = 95.6' Elevation = 332.7' | Base Weathered Rock = 96.6' Elevation = 331.7' | RDZ = 96.6' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***59***	Immediate Water Depth ***15.2 (08/29/11)***	Start Date ***08/29/2011***	Hole Type ***core and sample***
Surface Elevation ***428.3'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.7'***	Driller ***Danny Jessie***	Latitude(83) ***38.337077***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.636758***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		24 / 22	10.0	10.0	100		highly fractured soft zone @ 103.5-104.5 highly fractured soft zone @ 106.1-106.9 RCS-1 @ 107.4-108.2
108.2									
110									
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (40%), gray, silty.*		29 / 29	10.0	9.2	92		
115									
118.2									fossiliferous @ 115.9-116.2 fossiliferous @ 117-117.3
120									
				57 / 57	7.5	7.5	100		RCS-2 @ 121.1-122
125									
302.6	125.7								125.7
130		(Bottom of Hole 125.7')							
135									
140									
145									
150									

Top of Rock = 95.6' Elevation = 332.7' | Base Weathered Rock = 96.6' Elevation = 331.7' | RDZ = 96.6' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***60***	Immediate Water Depth ***16.4 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337100***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636728***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10									
15									**Drilling mud added to the boring at a depth of 17.0 ft below the ground surface @ 17**
20									
25		**Overburden**: *overburden.*							
30									
35									
40									
45									
50									

Top of Rock = 95.2' Elevation = 332.7' | Base Weathered Rock = 96.2' Elevation = 331.7' | RDZ = 96.2' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***60***	Immediate Water Depth ***16.4 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337100***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636728***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							55
60									60
65									65
70		**Overburden**: *overburden.*							70
75									75
80									80
85									85
90									90
95 332.7	95.2		(Begin Core)						95
		Limestone & Shale: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*		29 / 29	2.8	2.6	93		98.0
100				10 / 10	10.0	9.1	91		100

Top of Rock = 95.2' Elevation = 332.7' | Base Weathered Rock = 96.2' Elevation = 331.7' | RDZ = 96.2' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***60***	Immediate Water Depth ***16.4 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/30/2011***	Rig_Number ***1050 ATV***
Total Depth ***125.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337100***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636728***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		10 / 10	10.0	9.1	91		105
110				50 / 45	10.0	10.0	100		108.0 **RCS-1 @ 108.1-109.1** 110
115		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings, fossiliferous. Shale (30%), gray, silty.*							115 **fossiliferous @ 116-116.7** 118.0
120				83 / 83	7.6	7.6	100		120 **RCS-2 @ 123.1-124.1** 125.6
125 302.3	125.6								125
130		(Bottom of Hole 125.6')							130
135									135
140									140
145									145
150									150

Top of Rock = 95.2' Elevation = 332.7' | Base Weathered Rock = 96.2' Elevation = 331.7' | RDZ = 96.2' Elevation = 331.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***61***	Immediate Water Depth ***18.3 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core and sample***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***137.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.337217***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636566***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
		Overburden / Rock Core						
426.9	1.0	**Overburden**: *topsoil.*						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
		DRAFT	1	2.0-4.0	2.0		ST	
			2	5.0-7.0	2.0		ST	
		Overburden: *Clay, brown, moist, sandy.*	3	10.0-12.0	2.0		ST	
412.9	15.0							
		Overburden: *Sand, brown, wet, fine to medium grained, very loose, clayey.*	4	15.0-17.0	0.5		ST	
			1	20.0-21.5	0.7	0-0-1	SPT	**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
402.9	25.0		2	25.0-26.5	0.8	4-5-7	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense, poorly graded, some gravel.*	3	30.0-31.5	0.7	7-10-12	SPT	
			4	35.0-36.5	1.3	5-6-7	SPT	
			5	40.0-41.5	1.5	4-5-8	SPT	
382.9	45.0							
		Overburden: *Sand, brown, wet, fine grained, loose to medium dense.*	6	45.0-46.5	1.5	5-10-8	SPT	

Top of Rock = 96.5' Elevation = 331.4' | Base Weathered Rock = 96.5' Elevation = 331.4' | RDZ = 96.5' Elevation = 331.4' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***61***	Immediate Water Depth ***18.3 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core and sample***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***137.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.337217***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636566***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
		Overburden / Rock Core						
		DRAFT	7	50.0-51.5	1.5	3-5-10	SPT	
			8	55.0-56.5	1.5	3-10-12	SPT	
		Overburden: *Sand, brown, wet, fine grained, loose to medium dense.*	9	60.0-61.5	1.5	12-9-17	SPT	
			10	65.0-66.5	1.5	10-7-4	SPT	
356.7	71.2		11	70.0-71.5	0.6	4-2-4	SPT	
		Overburden: *Clay, gray, wet, medium stiff to very stiff.*	12	75.0-76.5	1.5	10-11-17	SPT	
351.7	76.2							
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to dense, poorly graded, some gravel.*	13	80.0-81.5	0.8	4-8-12	SPT	
			14	85.0-86.5	0.9	3-5-10	SPT	
			15	90.0-91.5	1.5	0-8-10	SPT	
331.4	96.5	(Begin Core)	16	95.0-96.1	1.0	26-31-50/0.10'	SPT	
		Limestone & Shale: *Limestone (60%), gray, coarse grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*	64 / 64	7.5	7.5	100		

Top of Rock = 96.5' Elevation = 331.4' | Base Weathered Rock = 96.5' Elevation = 331.4' | RDZ = 96.5' Elevation = 331.4' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***61***	Immediate Water Depth ***18.3 (08/30/11)***	Start Date ***08/30/2011***	Hole Type ***core and sample***
Surface Elevation ***427.9'***	Static Water Depth ***NA***	End Date ***08/31/2011***	Rig_Number ***1050 ATV***
Total Depth ***137.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.337217***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***172+84.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.636566***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows Sample Type SDI (JS)	Remarks
105		**DRAFT**		64 / 64	7.5	7.5 / 100		104.0
				54 / 48	5.0	5.0 / 100		109.0
110				77 / 69	10.0	10.0 / 100		RCS-1 @ 115.1-115.9
115								119.0
120		**Limestone & Shale**: *Limestone (60%), gray, coarse grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		93 / 89	10.0	10.0 / 100		129.0
125								
130				84 / 84	8.0	8.0 / 100		RCS-2 @ 133.2-134.2
135								
290.9	137.0							137.0
140		(Bottom of Hole 137.0')						
145								
150								

Top of Rock = 96.5' Elevation = 331.4' | Base Weathered Rock = 96.5' Elevation = 331.4' | RDZ = 96.5' Elevation = 331.4' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***62***	Immediate Water Depth ***17.5 (08/23/11)***	Start Date ***08/19/2011***	Hole Type ***core and sample***
Surface Elevation ***431.9'***	Static Water Depth ***NA***	End Date ***08/22/2011***	Rig_Number ***1050 ATV***
Total Depth ***139.8'***	Driller ***Danny Jessie***	Latitude(83) ***38.337485***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637613***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows Sample Type SDI (JS)	Remarks
430.9	1.0	**Overburden**: *Topsoil.*						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
		DRAFT		1	2.0-4.0	2.0	ST	
5								
				2	5.0-7.0	2.0	ST	
10		**Overburden**: *Clay, brown, moist, sandy.*						
				3	10.0-12.0	2.0	ST	
15								
				4	15.0-17.0	2.0	ST	
20 411.9	20.0							
		Overburden: *Sand, brown, moist, fine to medium grained, very loose to medium dense, some gravel, some clay.*		5	20.0-22.0	2.0	ST	**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25				1	25.0-26.5	0.8	4-12-18 SPT	
30				2	30.0-31.5	1.0	3-2-1 SPT	
35 396.9	35.0							
		Overburden: *Sand, brown to gray, wet, fine to medium grained, very loose to very dense, poorly graded, some gravel.*		3	35.0-36.5	1.5	0-0-0 SPT	
40				4	40.0-41.5	1.5	7-11-17 SPT	
45				5	45.0-46.5	1.5	8-9-15 SPT	
50								

Top of Rock = 99.0' Elevation = 332.9' | Base Weathered Rock = 99.0' Elevation = 332.9' | RDZ = 99.0' Elevation = 332.9' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***62***	Immediate Water Depth ***17.5 (08/23/11)***	Start Date ***08/19/2011***	Hole Type ***core and sample***
Surface Elevation ***431.9'***	Static Water Depth ***NA***	End Date ***08/22/2011***	Rig_Number ***1050 ATV***
Total Depth ***139.8'***	Driller ***Danny Jessie***	Latitude(83) ***38.337485***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637613***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
				6	50.0-51.5	1.5	8-14-15	SPT	
55		**DRAFT**		7	55.0-56.5	1.5	4-8-11	SPT	
60		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, very loose to very dense, poorly graded, some gravel.*		8	60.0-61.5	1.5	6-8-10	SPT	
65				9	65.0-66.5	1.5	13-18-15	SPT	
70				10	70.0-71.5	1.5	25-27-34	SPT	
75 356.9	75.0			11	75.0-76.5	1.5	10-9-6	SPT	
80				12	80.0-81.5	1.5	10-12-22	SPT	
85		**Overburden**: *Sand, brown, wet, fine grained, medium dense to dense, some silt, some gravel.*		13	85.0-86.5	1.5	12-15-13	SPT	
90				14	90.0-91.5	0.8	7-7-8	SPT	
95 336.9	95.0			15	95.0-96.5	1.0	3-6-10	SPT	
332.9	99.0	**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense, some gravel.* (Begin Core)							
100					9.0	9.0	100		

Top of Rock = 99.0' Elevation = 332.9' | Base Weathered Rock = 99.0' Elevation = 332.9' | RDZ = 99.0' Elevation = 332.9' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***62***	Immediate Water Depth ***17.5 (08/23/11)***	Start Date ***08/19/2011***	Hole Type ***core and sample***
Surface Elevation ***431.9'***	Static Water Depth ***NA***	End Date ***08/22/2011***	Rig_Number ***1050 ATV***
Total Depth ***139.8'***	Driller ***Danny Jessie***	Latitude(83) ***38.337485***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637613***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
105		**DRAFT**		59 / 53	9.0	9.0	100		108.0
110				61 / 58	10.0	10.0	100		**RCS-1 @ 112-112.7**
115									118.0
120		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		87 / 87	10.0	10.0	100		**RCS-2 @ 126.4-127.2**
125									128.0
130				68 / 63	11.8	11.8	100		
135									
140 292.1	139.8								139.8
145		(Bottom of Hole 139.8')							
150									

Top of Rock = 99.0' Elevation = 332.9' | Base Weathered Rock = 99.0' Elevation = 332.9' | RDZ = 99.0' Elevation = 332.9' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***63***	Immediate Water Depth ***19.3 (08/22/11)***	Start Date ***08/22/2011***	Hole Type ***core***
Surface Elevation ***432.2'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***1050 ATV***
Total Depth ***129.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.337633***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637407***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10									
15									
20									**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25		**Overburden**: *Overburden.*							
30									
35									
40									
45									
50									

Top of Rock = 98.6' Elevation = 333.6' | Base Weathered Rock = 99.6' Elevation = 332.6' | RDZ = 99.6' Elevation = 332.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***63***	Immediate Water Depth ***19.3 (08/22/11)***	Start Date ***08/22/2011***	Hole Type ***core***
Surface Elevation ***432.2'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***1050 ATV***
Total Depth ***129.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.337633***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637407***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							
60									
65									
70									
75		**Overburden**: *Overburden.*							
80									
85									
90									
95									
333.6	98.6		(Begin Core)						
100				55 /	9.4	9.0	96		100

Top of Rock = 98.6' Elevation = 333.6' | Base Weathered Rock = 99.6' Elevation = 332.6' | RDZ = 99.6' Elevation = 332.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***63***	Immediate Water Depth ***19.3 (08/22/11)***	Start Date ***08/22/2011***	Hole Type ***core***
Surface Elevation ***432.2'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***1050 ATV***
Total Depth ***129.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.337633***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637407***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
		DRAFT	52					
105			55 / 52	9.4	9.0	96		105
								108.0
110								110
			40 / 38	10.0	10.0	100		**RCS-1 @ 111-111.7**
115		**Limestone & Shale**: *Limestone (70%), gray, medium grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (30%), gray, silty.*						115
								118.0
120								120
			70 / 70	11.1	11.1	100		**RCS-2 @ 122.1-123**
125								125
303.1	129.1							129.1
130		(Bottom of Hole 129.1')						130
135								135
140								140
145								145
150								150

Top of Rock = 98.6' Elevation = 333.6' | Base Weathered Rock = 99.6' Elevation = 332.6' | RDZ = 99.6' Elevation = 332.6' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***64***	Immediate Water Depth ***19.6 (08/24/11)***	Start Date ***08/23/2011***	Hole Type ***core and sample***
Surface Elevation ***432.3'***	Static Water Depth ***NA***	End Date ***08/24/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.5'***	Driller ***Danny Jessie***	Latitude(83) ***38.337656***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637376***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
431.3	1.0	**Overburden**: *Topsoil.*						
		DRAFT	1	2.0-4.0	2.0		ST	**Boring advanced with 4.25" augers @ 1**
5								5
			2	5.0-7.0	2.0		ST	**NQ coring system utilized to sample bedrock @ 3**
10		**Overburden**: *Clay, brown, moist, sandy.*						10
			3	10.0-12.0	2.0		ST	
15								15
			4	15.0-17.0	2.0		ST	
20 412.3	20.0							20
		Overburden: *Sand, brown, wet, medium to fine grained, very loose, some clay.*	1	20.0-21.5	1.5	0-1-0	SPT	**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25 407.3	25.0							25
		Overburden: *Sand, brown, wet, fine to medium grained, loose, some gravel.*	2	25.0-26.5	1.5	3-3-4	SPT	
30 402.3	30.0							30
			3	30.0-31.5	0.5	0-0-0	SPT	
35								35
			4	35.0-36.5	1.5	3-6-7	SPT	
40		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, very loose to very dense, poorly graded, some gravel.*						40
			5	40.0-41.5	1.5	0-2-3	SPT	
45								45
			6	45.0-46.5	1.5	8-12-15	SPT	
50								50

Top of Rock = 98.5' Elevation = 333.8' | Base Weathered Rock = 101.2' Elevation = 331.1' | RDZ = 101.2' Elevation = 331.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***64***	Immediate Water Depth ***19.6 (08/24/11)***	Start Date ***08/23/2011***	Hole Type ***core and sample***
Surface Elevation ***432.3'***	Static Water Depth ***NA***	End Date ***08/24/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.5'***	Driller ***Danny Jessie***	Latitude(83) ***38.337656***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637376***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		DRAFT		7	50.0-51.5	1.5	3-7-14	SPT	
55				8	55.0-56.5	1.5	4-6-12	SPT	55
60				9	60.0-61.5	1.5	10-18-25	SPT	60
65				10	65.0-66.5	0.4	4-4-4	SPT	65
70		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, very loose to very dense, poorly graded, some gravel.*		11	70.0-71.5	1.0	17-30-27	SPT	70
75				12	75.0-76.5	0.6	8-9-12	SPT	75
80				13	80.0-81.5	1.0	6-10-12	SPT	80
85	347.3 / 85.0			14	85.0-86.5	0.7	4-6-13	SPT	85
90		**Overburden**: *Sand, dark brown, wet, fine grained, very loose to medium dense, some silt, some gravel.*		15	90.0-91.5	0.2	0-0-0	SPT	90
95				16	95.0-96.5	0.8	3-3-5	SPT	95
	333.8 / 98.5		(Begin Core)						
100				26 /	10.0	9.1	91		100

Top of Rock = 98.5' Elevation = 333.8' | Base Weathered Rock = 101.2' Elevation = 331.1' | RDZ = 101.2' Elevation = 331.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***64***	Immediate Water Depth ***19.6 (08/24/11)***	Start Date ***08/23/2011***	Hole Type ***core and sample***
Surface Elevation ***432.3'***	Static Water Depth ***NA***	End Date ***08/24/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.5'***	Driller ***Danny Jessie***	Latitude(83) ***38.337656***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637376***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		DRAFT		20					highly fractured zone @ 100.2-101.2
105				26 / 20	10.0	9.1	91		105
									108.5
110				56 / 45	10.0	10.0	100		110
115		**Limestone & Shale**: *Limestone (60%), gray, medium grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*							Clay seams and shale partings @ 110.3-112.8
									115
									RCS-1 @ 116.7-117.5
									118.5
120				78 / 76	10.0	10.0	100		120
125									vuggy zone @ 121.7-122.5
									RCS-2 @ 124.9-125.7
	303.8 / 128.5								125
									128.5
130		(Bottom of Hole 128.5')							130
135									135
140									140
145									145
150									150

Top of Rock = 98.5' Elevation = 333.8' | Base Weathered Rock = 101.2' Elevation = 331.1' | RDZ = 101.2' Elevation = 331.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***65***	Immediate Water Depth ***19.8 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***437.7'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***1050 ATV***
Total Depth ***145.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337773***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637215***	

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
5	5	**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10	10								
15	15								
20	20								**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25	25	**Overburden**: *Overburden.*							
30	30								
35	35								
40	40								
45	45								
50	50								

Top of Rock = 104.6' Elevation = 333.1' | Base Weathered Rock = 104.9' Elevation = 332.8' | RDZ = 104.9' Elevation = 332.8' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***65***	Immediate Water Depth ***19.8 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***437.7'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***1050 ATV***
Total Depth ***145.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337773***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637215***	

Lithology		Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
Elevation	Depth								
55	55	**DRAFT**							
60	60								
65	65								
70	70								
75	75	**Overburden**: *Overburden.*							
80	80								
85	85								
90	90								
95	95								
100	100								

Top of Rock = 104.6' Elevation = 333.1' | Base Weathered Rock = 104.9' Elevation = 332.8' | RDZ = 104.9' Elevation = 332.8' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***65***	Immediate Water Depth ***19.8 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***437.7'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***1050 ATV***
Total Depth ***145.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.337773***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***175+59.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.637215***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105 333.1	104.6	**Overburden**: *Overburden.*	(Begin Core)						105
		DRAFT		0 / 0	3.4	3.2	94		108.0 **soft zone @ 108-108.2**
110									110
				36 / 19	10.0	10.0	100		
115									115 **soft zone @ 115.6-116.4**
									118.0
120				65 / 63	10.0	10.0	100		120 **RCS-1 @ 119.2-120**
125		**Limestone & Shale**: *Limestone (70%), gray, medium grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (30%), gray, silty.*							125
									128.0
130				85 / 81	10.0	10.0	100		130
135									135
									138.0
140				89 / 89	7.6	7.6	100		140 **RCS-2 @ 139.3-140.1**
145 292.1	145.6								145 145.6
150		(Bottom of Hole 145.6')							150

Top of Rock = 104.6' Elevation = 333.1' | Base Weathered Rock = 104.9' Elevation = 332.8' | RDZ = 104.9' Elevation = 332.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***66***	Immediate Water Depth ***18.1 (08/23/11)***	Start Date ***08/22/2011***	Hole Type ***core and sample***
Surface Elevation ***434.3'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***750 ATV***
Total Depth ***141.0'***	Driller ***Mark Martin***	Latitude(83) ***38.337940***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638143***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
433.3	1.0	**Overburden**: *Topsoil.*							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
		DRAFT		1	2.0-4.0	2.0		ST	
5									5
				2	5.0-7.0	2.0		ST	
		Overburden: *Clay, brown, moist, sandy.*							
10									10
				3	10.0-12.0	2.0		ST	
15 419.3	15.0								15
				4	15.0-17.0	2.0		ST	
20									20
				1	20.0-21.5	1.5	1-0-1	SPT	**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25		**Overburden**: *Sand, brown, wet, fine to medium grained, very loose to loose, some clay.*							25
				2	25.0-26.5	1.5	3-5-5	SPT	
30									30
				3	30.0-31.5	0.5	5-5-2	SPT	
35 399.3	35.0								35
				4	35.0-36.5	1.2	2-4-6	SPT	
40									40
				5	40.0-41.5	1.0	7-8-9	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*							
45									45
				6	45.0-46.5	1.1	4-5-8	SPT	
50									50

Top of Rock = 101.0' Elevation = 333.3' | Base Weathered Rock = 101.2' Elevation = 333.1' | RDZ = 101.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***66***	Immediate Water Depth ***18.1 (08/23/11)***	Start Date ***08/22/2011***	Hole Type ***core and sample***
Surface Elevation ***434.3'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***750 ATV***
Total Depth ***141.0'***	Driller ***Mark Martin***	Latitude(83) ***38.337940***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638143***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
				7	50.0-51.5	1.0	5-5-6	SPT	
55		**DRAFT**		8	55.0-56.5	1.3	10-20-20	SPT	
60				9	60.0-61.5	1.1	5-7-9	SPT	
65				10	65.0-66.5	1.5	5-10-10	SPT	
70				11	70.0-70.7	0.0	30-50/0.20'	SPT	
75		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		12	75.0-76.5	1.3	15-20-25	SPT	
80				13	80.0-81.5	1.3	10-18-21	SPT	
85				14	85.0-86.5	1.5	10-14-16	SPT	
90				15	90.0-91.5	1.1	5-7-8	SPT	
95				16	95.0-96.5	1.0	12-15-16	SPT	
100									

Top of Rock = 101.0' Elevation = 333.3' | Base Weathered Rock = 101.2' Elevation = 333.1' | RDZ = 101.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***66***	Immediate Water Depth ***18.1 (08/23/11)***	Start Date ***08/22/2011***	Hole Type ***core and sample***
Surface Elevation ***434.3'***	Static Water Depth ***NA***	End Date ***08/23/2011***	Rig_Number ***750 ATV***
Total Depth ***141.0'***	Driller ***Mark Martin***	Latitude(83) ***38.337940***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638143***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
333.3	101.0		(Begin Core)	17	100.0-100.5	0.5	50/0.50'	SPT	
105		**DRAFT**		15 / 15	6.0	5.5	92		107.0
110				32 / 28	10.0	9.8	98		RCS-1 @ 113.8-114.6
115									117.0
120		**Limestone & Shale**: *Limestone (60%), gray, medium grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		72 / 65	10.0	10.0	100		
125									127.0
130				42 / 31	10.0	10.0	100		
135									RCS-2 @ 134.3-135.2
140				68 / 59	4.0	4.0	100		137.0
293.3	141.0								141.0
145		(Bottom of Hole 141.0')							
150									

Top of Rock = 101.0' Elevation = 333.3' | Base Weathered Rock = 101.2' Elevation = 333.1' | RDZ = 101.2' Elevation = 333.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***67***	Immediate Water Depth ***19.3 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***438.8'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***750 ATV***
Total Depth ***134.5'***	Driller ***Mark Martin***	Latitude(83) ***38.338088***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 31.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637938***	

Lithology		Description	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Overburden / Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	

DRAFT

Overburden: *Overburden.*

Boring advanced with 4.25" augers @ 1

NQ coring system utilized to sample bedrock @ 3

Drilling mud added to the boring at a depth of 20.0 ft below the ground surface, boring offset an additional 25.0' left of centerline to avoid toe of embankment @ 20

Top of Rock = 104.5' Elevation = 334.3'
Base Weathered Rock = 105.0' Elevation = 333.8'
RDZ = 105.0' Elevation = 333.8'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***67***	Immediate Water Depth ***19.3 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***438.8'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***750 ATV***
Total Depth ***134.5'***	Driller ***Mark Martin***	Latitude(83) ***38.338088***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 31.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637938***	

Lithology		Description	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Overburden / Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	

DRAFT

Overburden: *Overburden.*

Top of Rock = 104.5' Elevation = 334.3'
Base Weathered Rock = 105.0' Elevation = 333.8'
RDZ = 105.0' Elevation = 333.8'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***67***	Immediate Water Depth ***19.3 (08/25/11)***	Start Date ***08/24/2011***	Hole Type ***core***
Surface Elevation ***438.8'***	Static Water Depth ***NA***	End Date ***08/25/2011***	Rig_Number ***750 ATV***
Total Depth ***134.5'***	Driller ***Mark Martin***	Latitude(83) ***38.338088***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***177+84.96 31.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.637938***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
334.3	104.5	**Overburden**: *Overburden.*	(Begin Core)						
105									~~fractured~~ zone @ 104.5-107
		DRAFT		18 / 18	7.2	7.2	100		
110									RCS-1 @ 109.3-110.1
									111.7
115				42 / 38	10.0	9.9	99		soft zone @ 116.1-116.4
		Limestone & Shale: *Limestone (60%), gray, medium grained, hard, thin to medium bedded, fossiliferous, shale streaks, stringers and partings. Shale (40%), gray, silty.*							
120									121.7
125				60 / 57	5.0	5.0	100		
									126.7 fossiliferous @ 126.7-127.8
130				49 / 49	7.8	7.8	100		RCS-2 @ 128.5-129.2
135	304.3	134.5							134.5
		(Bottom of Hole 134.5')							
140									
145									
150									

Top of Rock = 104.5' Elevation = 334.3' | Base Weathered Rock = 105.0' Elevation = 333.8' | RDZ = 105.0' Elevation = 333.8' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***70***	Immediate Water Depth ***21.0 (08/18/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***437.6'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***1050 ATV***
Total Depth ***138.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.338376***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638653***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
436.6	1.0	**Overburden**: *Topsoil.*							
		DRAFT		1	2.0-4.0	2.0		ST	**Boring advanced with 4.25" augers @ 1**
5									**NQ coring system utilized to sample bedrock @ 3**
				2	5.0-7.0	2.0		ST	
		Overburden: *Clay, brown, moist, sandy.*							
10				3	10.0-12.0	2.0		ST	
15	422.6	15.0							
				4	15.0-17.0	0.5		ST	
				1	17.0-18.5	1.5	0-1-1	SPT	
20		**Overburden**: *Sand, brown, wet, medium to fine grained, very loose, some clay.*							
				2	20.0-21.5	1.5	0-1-0	SPT	
25	412.6	25.0							
				3	25.0-26.5	1.5	1-1-0	SPT	**Drilling mud added to the boring at a depth of 25.0 ft below the ground surface @ 25**
		Overburden: *Sand, brown, wet, medium grained, very loose, some gravel.*							
30	407.6	30.0							
				4	30.0-31.5	1.0	18-22-28	SPT	
35									
				5	35.0-36.5	1.5	5-8-12	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*							
40				6	40.0-41.5	1.5	5-11-18	SPT	
45									
				7	45.0-46.5	1.5	6-8-13	SPT	
50									

Top of Rock = 103.3' Elevation = 334.3' | Base Weathered Rock = 103.3' Elevation = 334.3' | RDZ = 103.3' Elevation = 334.3' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***70***	Immediate Water Depth ***21.0 (08/18/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***437.6'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***1050 ATV***
Total Depth ***138.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.338376***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638653***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
				8	50.0-51.5	1.5	5-9-12	SPT	
		DRAFT		9	55.0-56.5	1.5	7-10-14	SPT	
				10	60.0-61.5	0.5	5-4-12	SPT	
				11	65.0-66.5	1.5	6-10-18	SPT	
				12	70.0-71.5	1.5	4-8-10	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		13	75.0-76.5	1.1	4-5-9	SPT	
				14	80.0-81.5	0.9	14-19-34	SPT	
				15	85.0-86.5	1.2	7-6-7	SPT	
				16	90.0-91.5	1.5	6-11-14	SPT	
				17	95.0-96.5	1.5	12-14-15	SPT	

Top of Rock = 103.3' Elevation = 334.3' | Base Weathered Rock = 103.3' Elevation = 334.3' | RDZ = 103.3' Elevation = 334.3' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***70***	Immediate Water Depth ***21.0 (08/18/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***437.6'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***1050 ATV***
Total Depth ***138.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.338376***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638653***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
334.3	103.3	**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.* (Begin Core)		18	100.0-101.5	1.5	7-14-14	SPT	
		DRAFT		8 / 8	4.7	4.3	91		
				18 / 18	10.0	9.8	98		108.0
		Limestone & Shale: *Limestone (60%), gray, fine grained, hard, thin to medium bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		21 / 21	10.0	9.0	90		118.0 **RCS-1 @ 121.4-122.1**
				47 / 47	10.0	10.0	100		128.0 **void @ 127-128**
299.6	138.0								138.0 **RCS-2 @ 136.5-137.2**
		(Bottom of Hole 138.0')							**Boring abandoned at 138.0 ft due to core rods hung in boring. Core rods were retrieved and then the boring abandoned @ 138**

Top of Rock = 103.3' Elevation = 334.3' | Base Weathered Rock = 103.3' Elevation = 334.3' | RDZ = 103.3' Elevation = 334.3' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***71***	Immediate Water Depth ***18.0 (08/18/11)***	Start Date ***08/18/2011***	Hole Type ***core***
Surface Elevation ***439.2'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***750 ATV***
Total Depth ***137.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338525***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 24.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638448***	

Lithology		Description	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Overburden / Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5	5	**DRAFT**						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3 boring moved an additional 18.0' left of centerline to avoid toe of embankment, approximate elevation change of 5.0' @ 6**
10	10							
15	15							
20	20							**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25	25	**Overburden**: *Overburden.*						
30	30							
35	35							
40	40							
45	45							
50	50							

Top of Rock = 107.1' Elevation = 332.1' | Base Weathered Rock = 107.6' Elevation = 331.6' | RDZ = 107.6' Elevation = 331.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***71***	Immediate Water Depth ***18.0 (08/18/11)***	Start Date ***08/18/2011***	Hole Type ***core***
Surface Elevation ***439.2'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***750 ATV***
Total Depth ***137.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338525***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 24.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638448***	

Lithology		Description	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Overburden / Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
55	5	**DRAFT**						55
60	10							60
65	15							65
70	20							70
75	25	**Overburden**: *Overburden.*						75
80	30							80
85	35							85
90	40							90
95	45							95
100	50							100

Top of Rock = 107.1' Elevation = 332.1' | Base Weathered Rock = 107.6' Elevation = 331.6' | RDZ = 107.6' Elevation = 331.6' | Louisville Limestone Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN*** Item Number: ***5-731.00***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge*** Project Manager: ***Mark Litkenhus***

Hole Number ***71***	Immediate Water Depth ***18.0 (08/18/11)***	Start Date ***08/18/2011***	Hole Type ***core***
Surface Elevation ***439.2'***	Static Water Depth ***NA***	End Date ***08/18/2011***	Rig_Number ***750 ATV***
Total Depth ***137.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338525***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***180+00.96 24.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.638448***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**Overburden**: *Overburden.*							105
332.1	107.1		(Begin Core)						**weathered zone @ 107.1-107.6**
110		**DRAFT**		55 / 48	9.7	9.0	93		110
115									115
									116.8
120		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (30%), gray, silty.*		48 / 37	10.0	10.0	100		120
125									125 **RCS-1 @ 124.6-125.5**
									126.8
130				66 / 66	10.3	10.3	100		130 **RCS-2 @ 128.6-129.3 vuggy @ 129.8-130.4**
135									135
302.1	137.1								137.1 **soft zone @ 136-136.1**
140		(Bottom of Hole 137.1')							140
145									145
150									150

Top of Rock = 107.1' Elevation = 332.1' | Base Weathered Rock = 107.6' Elevation = 331.6' | RDZ = 107.6' Elevation = 331.6' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN*** Item Number: ***5-731.00***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge*** Project Manager: ***Mark Litkenhus***

Hole Number ***74***	Immediate Water Depth ***12.9 (08/17/11)***	Start Date ***08/16/2011***	Hole Type ***core***
Surface Elevation ***432.7'***	Static Water Depth ***NA***	End Date ***08/17/2011***	Rig_Number ***750 ATV***
Total Depth ***138.2'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338922***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 90.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639290***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3 Boring was originally drilled with 3.25" auger, Boring was re-drilled an additional 4.0' LT of original boring with 4.25" due to the previous augers drilling an off-centered boring @ 6 Drilling mud added to the boring at a depth of 15.0 ft below the ground surface, @ 15** 5
10									10
15									15
20									20
25		**Overburden**: *overburden.*							25
30									30
35									35
40									40
45									45
50									50

Top of Rock = 98.2' Elevation = 334.5' | Base Weathered Rock = 99.2' Elevation = 333.5' | RDZ = 99.2' Elevation = 333.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***74***	Immediate Water Depth ***12.9 (08/17/11)***	Start Date ***08/16/2011***	Hole Type ***core***
Surface Elevation ***432.7'***	Static Water Depth ***NA***	End Date ***08/17/2011***	Rig_Number ***750 ATV***
Total Depth ***138.2'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338922***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 90.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639290***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							55
60									60
65									65
70									70
75		**Overburden**: *overburden.*							75
80									80
85									85
90									90
95									95
334.5	98.2		(Begin Core)						
100				39 / 29	8.0	8.0	100		**weathered @ 98.2-99.2** 100

Top of Rock = 98.2' Elevation = 334.5' | Base Weathered Rock = 99.2' Elevation = 333.5' | RDZ = 99.2' Elevation = 333.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***74***	Immediate Water Depth ***12.9 (08/17/11)***	Start Date ***08/16/2011***	Hole Type ***core***
Surface Elevation ***432.7'***	Static Water Depth ***NA***	End Date ***08/17/2011***	Rig_Number ***750 ATV***
Total Depth ***138.2'***	Driller ***Muriell Wethington***	Latitude(83) ***38.338922***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 90.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639290***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		39 / 29	8.0	8.0	100		**soft zone @ 99-99.2** 105
									106.2
110				57 / 57	10.0	10.0	100		110 **soft zone @ 111.4-111.7**
115									115
									116.2 **RCS-1 @ 116.1-116.8**
120		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (30%), dark gray, silty.*		43 / 37	10.0	10.0	100		**soft zone @ 119.1-119.4** 120
125									125
									126.2
130				77 / 75	10.0	10.0	100		130 **RCS-2 @ 131.2-132.1**
135									135
									136.2
294.5	138.2			29 / 29	2.0	2.0	100		138.2
140		(Bottom of Hole 138.2')							140
145									145
150									150

Top of Rock = 98.2' Elevation = 334.5' | Base Weathered Rock = 99.2' Elevation = 333.5' | RDZ = 99.2' Elevation = 333.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***75***	Immediate Water Depth ***13.2 (08/16/11)***	Start Date ***08/16/2011***	Hole Type ***core and sample***
Surface Elevation ***433.3'***	Static Water Depth ***NA***	End Date ***08/16/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.339071***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639085***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
432.3	1.0	**Overburden**: *Topsoil.*						**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
		DRAFT	1	2.0-4.0	2.0		ST	
5								
			2	5.0-7.0	1.5		ST	
		Overburden: *Clay, brown, moist, some sand.*						
10								
			3	10.0-12.0	2.0		ST	
15 418.3	15.0							
			1	15.0-16.5	1.5	1-0-0	SPT	**Drilling mud added to the boring at a depth of 15.0 ft below the ground surface @ 15**
		Overburden: *Sand, brown, wet, fine to medium grained, very loose, some clay.*						
20 413.3	20.0							
			2	20.0-21.5	1.2	2-1-1	SPT	
25		**Overburden**: *Sand, gray, wet, fine to medium grained, very loose to medium dense, some clay.*						
			3	25.0-26.5	0.8	3-4-14	SPT	
30 403.3	30.0							
			4	30.0-31.5	0.6	7-19-18	SPT	
35								
			5	35.0-36.5	0.8	4-6-7	SPT	
40		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*						
			6	40.0-41.5	1.5	5-8-9	SPT	
45								
			7	45.0-46.5	1.3	50-50-50/0.50'	SPT	**Rock in split-spoon drive shoe @ 45-46.5**
50								

Top of Rock = 98.0' Elevation = 335.3' | Base Weathered Rock = 98.2' Elevation = 335.1' | RDZ = 98.2' Elevation = 335.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***75***	Immediate Water Depth ***13.2 (08/16/11)***	Start Date ***08/16/2011***	Hole Type ***core and sample***
Surface Elevation ***433.3'***	Static Water Depth ***NA***	End Date ***08/16/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.339071***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639085***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
			8	50.0-51.5	1.5	9-15-18	SPT	
		DRAFT						
55								55
			9	55.0-56.5	1.5	3-9-13	SPT	
60								60
			10	60.0-61.5	1.5	9-15-16	SPT	
65								65
			11	65.0-66.5	1.1	3-6-11	SPT	
70								70
			12	70.0-71.5	1.5	6-9-12	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*						
75								75
			13	75.0-76.5	1.2	8-13-13	SPT	
80								80
			14	80.0-81.5	1.3	9-7-11	SPT	
85								85
			15	85.0-86.5	1.5	7-8-10	SPT	
90								90
			16	90.0-91.5	1.1	8-11-14	SPT	
95								95
			17	95.0-96.5	1.2	7-8-12	SPT	
335.3	98.0	(Begin Core)						
100			0 / 0	10.0	10.0	100		100

Top of Rock = 98.0' Elevation = 335.3' | Base Weathered Rock = 98.2' Elevation = 335.1' | RDZ = 98.2' Elevation = 335.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***75***	Immediate Water Depth ***13.2 (08/16/11)***	Start Date ***08/16/2011***	Hole Type ***core and sample***
Surface Elevation ***433.3'***	Static Water Depth ***NA***	End Date ***08/16/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.0'***	Driller ***Danny Jessie***	Latitude(83) ***38.339071***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639085***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		0 / 0	10.0	10.0	100		
108.0									**100% water loss throughout 3 runs @ 108**
110				0 / 0	10.0	10.0	100		
115		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), dark gray, silty.*							
118.0									
120				17 / 17	10.0	10.0	100		
125									**RCS-1 @ 125.6-126.5 RCS-2 @ 127.1-127.8**
305.3	128.0								128.0
130		(Bottom of Hole 128.0')							
135									
140									
145									
150									

Top of Rock = 98.0' Elevation = 335.3' | Base Weathered Rock = 98.2' Elevation = 335.1' | RDZ = 98.2' Elevation = 335.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***76***	Immediate Water Depth ***12.4 (08/15/11)***	Start Date ***08/15/2011***	Hole Type ***core***
Surface Elevation ***433.2'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.339093***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639054***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 4.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10									
15									**Drilling mud added to the boring at a depth of 15.0 ft below the ground surface @ 15**
20									
25		**Overburden**: *overburden.*							
30									
35									
40									
45									
50									

Top of Rock = 98.1' Elevation = 335.1' | Base Weathered Rock = 98.5' Elevation = 334.7' | RDZ = 98.5' Elevation = 334.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***76***	Immediate Water Depth ***12.4 (08/15/11)***	Start Date ***08/15/2011***	Hole Type ***core***
Surface Elevation ***433.2'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.339093***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639054***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
55		**DRAFT**							55
60									60
65									65
70									70
75		**Overburden**: *overburden.*							75
80									80
85									85
90									90
95									95
335.1	98.1		(Begin Core)						
100				30 / 22	10.0	8.7	87		100

Top of Rock = 98.1' Elevation = 335.1' | Base Weathered Rock = 98.5' Elevation = 334.7' | RDZ = 98.5' Elevation = 334.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

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Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***76***	Immediate Water Depth ***12.4 (08/15/11)***	Start Date ***08/15/2011***	Hole Type ***core***
Surface Elevation ***433.2'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***1050 ATV***
Total Depth ***128.1'***	Driller ***Danny Jessie***	Latitude(83) ***38.339093***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639054***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
105		**DRAFT**		30 / 22	10.0	8.7	87		105 **void, 100% water loss @ 105-105.8** 108.1
110				28 / 28	10.0	10.0	100		110
115		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), dark gray, silty.*							115 118.1 **RCS-1 @ 117.4-118.1**
120				45 / 38	10.0	10.0	100		120 **RCS-2 @ 121.5-122.3**
125									125
305.1	128.1								128.1
130		(Bottom of Hole 128.1')							130
135									135
140									140
145									145
150									150

Top of Rock = 98.1' Elevation = 335.1' | Base Weathered Rock = 98.5' Elevation = 334.7' | RDZ = 98.5' Elevation = 334.7' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***77***	Immediate Water Depth ***16.6 (08/17/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***434.0'***	Static Water Depth ***NA***	End Date ***08/17/2001***	Rig_Number ***1050 ATV***
Total Depth ***138.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.339210***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.638892***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
433.0	1.0	**Overburden**: *Topsoil.*							
		DRAFT		1	2.0-4.0	2.0		ST	**Boring advanced with 4.25" augers @ 1**
5									5
		Overburden: *Clay, brown, moist, some sand.*		2	5.0-7.0	1.8		ST	**NQ coring system utilized to sample bedrock @ 3**
10									10
422.0	12.0			3	10.0-12.0	0.0		ST	
				1	12.0-13.5	1.5	0-0-0	SPT	
15									15
				2	15.0-16.5	1.5	0-1-0	SPT	
		Overburden: *Clay, brown, wet, very soft, some sand.*							
20				3	20.0-21.5	1.5	0-1-0	SPT	**Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20**
25 409.0	25.0								25
				4	25.0-26.5	1.5	1-1-1	SPT	
		Overburden: *Clay, gray, wet, soft, some sand.*							
30 404.0	30.0								30
				5	30.0-31.5	0.4	3-10-14	SPT	
		Overburden: *Sand, brown to gray, wet, fine to medium grained, medium dense, poorly graded, some gravel.*							
35 399.0	35.0								35
				6	35.0-36.5	0.8	9-10-15	SPT	
		Overburden: *Clay, gray, wet, very stiff, some sand.*							
40 394.0	40.0								40
				7	40.0-41.5	1.0	8-15-15	SPT	
45		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense, poorly graded, some gravel.*							45
				8	45.0-46.5	0.5	6-13-16	SPT	
50									50

Top of Rock = 98.2' Elevation = 335.8' | Base Weathered Rock = 98.5' Elevation = 335.5' | RDZ = 98.5' Elevation = 335.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***77***	Immediate Water Depth ***16.6 (08/17/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***434.0'***	Static Water Depth ***NA***	End Date ***08/17/2001***	Rig_Number ***1050 ATV***
Total Depth ***138.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.339210***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.638892***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
				9	50.0-51.5	0.9	5-9-10	SPT	
		DRAFT							
55									55
				10	55.0-56.5	0.5	6-8-10	SPT	
60									60
				11	60.0-61.5	1.3	4-7-7	SPT	
65									65
				12	65.0-66.5	1.1	4-7-11	SPT	
70									70
				13	70.0-71.5	1.5	7-10-16	SPT	
75		**Overburden**: *Sand, brown to gray, wet, fine to medium grained, medium dense, poorly graded, some gravel.*							75
				14	75.0-76.5	1.4	7-9-13	SPT	
80									80
				15	80.0-81.5	1.2	10-9-13	SPT	
85									85
				16	85.0-86.5	1.2	6-5-10	SPT	
90									90
				17	90.0-91.5	1.5	6-11-17	SPT	
95									95
				18	95.0-96.5	1.5	5-6-9	SPT	
335.8	98.2		(Begin Core)						
100				9 / 4	10.4	10.0	96		**weathered zone @** 100

Top of Rock = 98.2' Elevation = 335.8' | Base Weathered Rock = 98.5' Elevation = 335.5' | RDZ = 98.5' Elevation = 335.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***77***	Immediate Water Depth ***16.6 (08/17/11)***	Start Date ***08/17/2011***	Hole Type ***core and sample***
Surface Elevation ***434.0'***	Static Water Depth ***NA***	End Date ***08/17/2001***	Rig_Number ***1050 ATV***
Total Depth ***138.6'***	Driller ***Danny Jessie***	Latitude(83) ***38.339210***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***182+70.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.638892***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows	Sample Type SDI (JS)	Remarks
105		**DRAFT**	9 / 4	10.4	10.0 / 96			98.2-98.5 98.5 water loss @ 100
								108.6
110			31 / 28	10.0	10.0 / 100			RCS-1 @ 110.1-110.8
115								
								118.6
120		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), dark gray, silty.*						void @ 119.2-120.2
125			30 / 24	10.0	9.4 / 94			
								128.6
130								RCS-2 @ 130-130.7
135			48 / 36	10.0	10.0 / 100			
295.4	138.6							138.6
140		(Bottom of Hole 138.6')						
145								
150								

Top of Rock = 98.2' Elevation = 335.8' | Base Weathered Rock = 98.5' Elevation = 335.5' | RDZ = 98.5' Elevation = 335.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

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Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***78***	Immediate Water Depth ***13.2 (08/15/11)***	Start Date ***08/12/2011***	Hole Type ***core and sample***
Surface Elevation ***429.1'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***750 ATV***
Total Depth ***136.0'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339359***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639800***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (%)	SPT Blows	Sample Type SDI (JS)	Remarks
428.1	1.0	**Overburden**: *Topsoil.*						
5		**DRAFT**	1	2.0-4.0	2.0		ST	Boring advanced with 3.25" augers @ 1
			2	5.0-7.0	1.8		ST	NQ coring system utilized to sample bedrock @ 3
10		**Overburden**: *Clay, brown, moist, some sand.*	3	10.0-12.0	2.0		ST	
15			4	15.0-17.0	1.8		ST	
20	409.1	20.0						
		Overburden: *Clay, brown, wet, soft, some sand.*	1	20.0-21.5	1.5	2-1-2	SPT	Drilling mud added to the boring at a depth of 20.0 ft below the ground surface @ 20
25	404.1	25.0						
		Overburden: *Clay, gray, wet, very stiff, some sand.*	2	25.0-26.5	0.8	5-7-9	SPT	
30	399.1	30.0						
		Overburden: *Sand, brown, wet, fine to medium grained, medium dense, poorly graded, some gravel.*	3	30.0-31.5	0.8	6-9-14	SPT	
35	394.1	35.0						
40		**Overburden**: *Sand, brown to gray, fine to medium grained, medium dense to dense, poorly graded, some gravel.*	4	35.0-36.5	1.5	5-6-8	SPT	
			5	40.0-41.5	1.2	9-10-11	SPT	
45			6	45.0-46.5	0.2	7-10-17	SPT	
50								

Top of Rock = 95.0' Elevation = 334.1' | Base Weathered Rock = 95.0' Elevation = 334.1' | RDZ = 95.0' Elevation = 334.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***78***	Immediate Water Depth ***13.2 (08/15/11)***	Start Date ***08/12/2011***	Hole Type ***core and sample***
Surface Elevation ***429.1'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***750 ATV***
Total Depth ***136.0'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339359***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639800***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		Overburden	7	50.0-51.5	1.5	6-10-12	SPT	
55		**DRAFT**						55
			8	55.0-56.5	1.0	3-7-13	SPT	
60								60
			9	60.0-61.5	1.5	4-6-10	SPT	
65								65
			10	65.0-66.5	0.0	11-14-11	SPT	
70								70
			11	70.0-71.5	1.5	9-21-22	SPT	
		Overburden: *Sand, brown to gray, fine to medium grained, medium dense to dense, poorly graded, some gravel.*						
75								75
			12	75.0-76.5	1.2	4-5-7	SPT	
80								80
			13	80.0-81.5	1.2	4-6-13	SPT	
85								85
			14	85.0-86.5	1.2	5-7-9	SPT	
90								90
			15	90.0-91.5	1.5	7-9-14	SPT	
95	334.1 95.0	(Begin Core)						95
		Limestone & Shale: *Limestone (70%), gray, fine grained, hard, thin bedded, fossiliferous shale streaks, stringers and partings. Shale (30%), dark gray, silty.*	43 / 18	2.8	2.8	100		97.8 **45 degree fracture @ 96-96.2**
100			73 / 52	10.0	10.0	100		**Vertical Fracture @** 100

Top of Rock = 95.0' Elevation = 334.1' | Base Weathered Rock = 95.0' Elevation = 334.1' | RDZ = 95.0' Elevation = 334.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***78***	Immediate Water Depth ***13.2 (08/15/11)***	Start Date ***08/12/2011***	Hole Type ***core and sample***
Surface Elevation ***429.1'***	Static Water Depth ***NA***	End Date ***08/15/2011***	Rig_Number ***750 ATV***
Total Depth ***136.0'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339359***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 86.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639800***	

Lithology Elevation	Lithology Depth	Description	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (%)	SPT Blows / SDI (JS)	Sample Type	Remarks
		Overburden						**97.2-97.4 RCS-1 @ 98.7-99.6**
105		**DRAFT**	73 / 52	10.0	10.0	100		105
								107.8
110			52 / 52	10.0	10.0	100		110
115								115
		Limestone & Shale: *Limestone (70%), gray, fine grained, hard, thin bedded, fossiliferous shale streaks, stringers and partings. Shale (30%), dark gray, silty.*						117.8 **vertical fracture @ 115.4-115.7 fossiliferous @ 117.3-117.8**
120			85 / 78	10.0	10.0	100		120
125								125 **RCS-2 @ 124.7-125.9**
								127.8
130			94 / 94	8.2	8.2	100		130
135	293.1 136.0							135 136.0
140		(Bottom of Hole 136.0')						140
145								145
150								150

Top of Rock = 95.0' Elevation = 334.1' | Base Weathered Rock = 95.0' Elevation = 334.1' | RDZ = 95.0' Elevation = 334.1' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***79***	Immediate Water Depth ***12.8 (08/11/11)***	Start Date ***08/10/2011***	Hole Type ***core and sample***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/11/2011***	Rig_Number ***750 ATV***
Total Depth ***126.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339507***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639594***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
429.2	1.0	**Overburden**: *Topsoil.*							
		Overburden: *Clay, brown, moist, some sand.*		1	2.0-4.0	2.0		ST	**Boring advanced with 3.25" augers @ 1**
				2	5.0-7.0	1.6		ST	**NQ coring system utilized to sample bedrock @ 3**
420.2	10.0			3	10.0-12.0	1.0		ST	
		DRAFT		1	15.0-16.5	1.5	3-2-3	SPT	**Drilling mud added to the boring at a depth of 15.0 ft below the ground surface @ 15**
		Overburden: *Sand, brown, wet, fine to medium grained, very loose to medium dense, poorly graded, some clay.*		2	20.0-21.5	0.8	0-1-2	SPT	
				3	25.0-26.5	1.5	2-5-12	SPT	
399.5	30.7			4	30.0-31.5	0.8	12-12-13	SPT	
		Overburden: *Sand, brown to dark gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		5	35.0-36.5	0.8	5-6-6	SPT	
				6	40.0-41.5	1.5	7-7-11	SPT	
				7	45.0-46.5	1.5	10-12-19	SPT	

Top of Rock = 95.5' Elevation = 334.7' | Base Weathered Rock = 95.7' Elevation = 334.5' | RDZ = 95.7' Elevation = 334.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***79***	Immediate Water Depth ***12.8 (08/11/11)***	Start Date ***08/10/2011***	Hole Type ***core and sample***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/11/2011***	Rig_Number ***750 ATV***
Total Depth ***126.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339507***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639594***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) / Run (ft)	Rec. (ft) / Rec (ft)	SPT Blows / Rec (%)	Sample Type / SDI (JS)	Remarks
		DRAFT		8	50.0-51.5	1.5	12-20-20	SPT	
				9	55.0-56.5	1.5	5-6-10	SPT	
				10	60.0-61.5	1.0	12-16-18	SPT	
				11	65.0-66.5	1.5	7-7-10	SPT	
				12	70.0-71.5	1.5	8-8-10	SPT	
		Overburden: *Sand, brown to dark gray, wet, fine to medium grained, medium dense to very dense, poorly graded, some gravel.*		13	75.0-76.5	1.2	23-17-15	SPT	
				14	80.0-81.5	1.3	4-5-8	SPT	
				15	85.0-86.5	1.4	4-6-7	SPT	
				16	90.0-91.5	1.1	8-8-8	SPT	
334.7	95.5		(Begin Core)	17	95.0-95.5	0.3	50/0.50'	SPT	~~weathered @ 95.5-95.7 vertical fracture @ 97.3-97.5~~
		Limestone & Shale: *Limestone (70%), gray, fine grained, hard, thin bedded, fossiliferous shale streaks, stringers and partings. Shale (30%), gray, silty.*		88 / 42	2.6	2.6	100		98.1
				63 / 39	10.0	10.0	100		

Top of Rock = 95.5' Elevation = 334.7' | Base Weathered Rock = 95.7' Elevation = 334.5' | RDZ = 95.7' Elevation = 334.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***79***	Immediate Water Depth ***12.8 (08/11/11)***	Start Date ***08/10/2011***	Hole Type ***core and sample***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/11/2011***	Rig_Number ***750 ATV***
Total Depth ***126.1'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339507***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Lt.***	Geologist ***James Adams***	Longitude(83) ***-85.639594***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**	63 / 39	10.0	10.0	100		**RCS-1 @ 100.8-101.8**
								108.1
110		**Limestone & Shale**: *Limestone (70%), gray, fine grained, hard, thin bedded, fossiliferous shale streaks, stringers and partings. Shale (30%), gray, silty.*	60 / 52	10.0	10.0	100		
115								
								118.1 **fossilferous @ 117-118.3 100% water loss @ 117.01**
120			61 / 65	8.0	8.0	100		**RCS-2 @ 122.5-123.3**
125								
304.1	126.1							126.1
130		(Bottom of Hole 126.1')						
135								
140								
145								
150								

Top of Rock = 95.5' Elevation = 334.7' | Base Weathered Rock = 95.7' Elevation = 334.5' | RDZ = 95.7' Elevation = 334.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***80***	Immediate Water Depth ***14.0 (08/10/11)***	Start Date ***08/10/2011***	Hole Type ***core***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/10/2011***	Rig_Number ***750 ATV***
Total Depth ***125.9'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339530***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639564***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**						**Boring advanced with 3.25" augers @ 1 NQ coring system utilized to sample bedrock @ 3**
10								
15								**Drilling mud added to the boring at a depth of 15.0 ft below the ground surface @ 15**
20								
25		**Overburden**: *overburden.*						
30								
35								
40								
45								
50								

Top of Rock = 96.5' Elevation = 333.7' | Base Weathered Rock = 96.7' Elevation = 333.5' | RDZ = 96.7' Elevation = 333.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***80***	Immediate Water Depth ***14.0 (08/10/11)***	Start Date ***08/10/2011***	Hole Type ***core***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/10/2011***	Rig_Number ***750 ATV***
Total Depth ***125.9'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339530***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639564***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							55
60									60
65									65
70		**Overburden**: *overburden.*							70
75									75
80									80
85									85
90									90
95									95
333.7	96.5		(Begin Core)						
100		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*		87 / 73	9.4	9.4	100		100

Top of Rock = 96.5' Elevation = 333.7'
Base Weathered Rock = 96.7' Elevation = 333.5'
RDZ = 96.7' Elevation = 333.5'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***80***	Immediate Water Depth ***14.0 (08/10/11)***	Start Date ***08/10/2011***	Hole Type ***core***
Surface Elevation ***430.2'***	Static Water Depth ***NA***	End Date ***08/10/2011***	Rig_Number ***750 ATV***
Total Depth ***125.9'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339530***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 6.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639564***	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
105		**DRAFT**		87 / 73	9.4	9.4	100		**RCS-1 @ 101.2-102.2** 105
110				79 / 64	10.0	9.6	96		110
115		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*							115
120				82 / 76	10.0	10.0	100		120
125									**RCS-2 @ 122.1-123.1** 125
304.3	125.9								
130		(Bottom of Hole 125.9')							130
135									135
140									140
145									145
150									150

Top of Rock = 96.5' Elevation = 333.7'
Base Weathered Rock = 96.7' Elevation = 333.5'
RDZ = 96.7' Elevation = 333.5'
Louisville Limestone
Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***81***	Immediate Water Depth ***12.3 (08/09/11)***	Start Date ***08/08/2011***	Hole Type ***core***
Surface Elevation ***431.5'***	Static Water Depth ***NA***	End Date ***08/08/2011***	Rig_Number ***750 ATV***
Total Depth ***138.5'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339647***	***GQ-1211***
Location ***184+86.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639402***	***Jeffersonville, New Albany, and Charlestown***

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
5		**DRAFT**							**Boring advanced with 3.25" augers @ 1**
10									**NQ coring system utilized to sample bedrock @ 3**
15									**Drilling mud added to the boring at a depth of 15.0 ft below the ground surface @ 15**
20									
25		**Overburden**: *Overburded.*							
30									
35									
40									
45									
50									

Top of Rock = 98.0' Elevation = 333.5' | Base Weathered Rock = 99.0' Elevation = 332.5' | RDZ = 99.0' Elevation = 332.5' | Louisville Limestone / Laurel Dolomite

Drilling Firm: Stantec
For: Division of Structural Design
Geotechnical Branch

GEOLOGIST'S SUBSURFACE LOG

Printed: 9/30/11

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***81***	Immediate Water Depth ***12.3 (08/09/11)***	Start Date ***08/08/2011***	Hole Type ***core***
Surface Elevation ***431.5'***	Static Water Depth ***NA***	End Date ***08/08/2011***	Rig_Number ***750 ATV***
Total Depth ***138.5'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339647***	***GQ-1211***
Location ***184+86.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639402***	***Jeffersonville, New Albany, and Charlestown***

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
55		**DRAFT**							
60									
65									
70									
75		**Overburden**: *Overburded.*							
80									
85									
90									
95									
333.5	98.0		(Begin Core)						
100				58 / 47	7.4	7.4	100		~~**Vertical Fracture @**~~

Top of Rock = 98.0' Elevation = 333.5' | Base Weathered Rock = 99.0' Elevation = 332.5' | RDZ = 99.0' Elevation = 332.5' | Louisville Limestone / Laurel Dolomite

GEOLOGIST'S SUBSURFACE LOG

Project ID: ***UNKNOWN***	***Jefferson - LSIORB East End Approach***	Project Type: ***Structure State Bridge***
Item Number: ***5-731.00***		Project Manager: ***Mark Litkenhus***

Hole Number ***81***	Immediate Water Depth ***12.3 (08/09/11)***	Start Date ***08/08/2011***	Hole Type ***core***
Surface Elevation ***431.5'***	Static Water Depth ***NA***	End Date ***08/08/2011***	Rig_Number ***750 ATV***
Total Depth ***138.5'***	Driller ***Muriell Wethington***	Latitude(83) ***38.339647***	***GQ-1211 Jeffersonville, New Albany, and Charlestown***
Location ***184+86.96 69.0' Rt.***	Geologist ***James Adams***	Longitude(83) ***-85.639402***	

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample No. / Std/Ky RQD	Depth (ft) Run (ft)	Rec. (ft) Rec (ft)	SPT Blows Rec (%)	Sample Type SDI (JS)	Remarks
								98-98.3
105		**DRAFT**	58 / 47	7.4	7.4	100		105.4 105
110			11 / 11	10.0	2.8	28		**rock not recovered, ground up by core barrel @ 108.1-115.4** 110
115								115.4 115
120		**Limestone & Shale**: *Limestone (60%), gray, fine grained, hard, thin bedded, shale streaks, stringers and partings. Shale (40%), gray, silty.*	73 / 64	5.0	5.0	100		**RCS-1 @ 116.8-117.5** 120.4 120
125			100 / 90	5.0	5.0	100		125.4 125
130			92 / 84	10.0	10.0	100		**RCS-2 @ 128.1-129** 130
135								135.4 135
293.0	138.5		0 / 0	3.1	1.6	52		138.5 **rock not recovered, ground up by core barrel @ 137-138.5**
140		(Bottom of Hole 138.5')						140
145								145
150								150

Top of Rock = 98.0' Elevation = 333.5' | Base Weathered Rock = 99.0' Elevation = 332.5' | RDZ = 99.0' Elevation = 332.5' | Louisville Limestone / Laurel Dolomite

APPENDIX C: DETAILED SCOUR CALCULATIONS

100 YEAR SIMPLE PIER SCOUR COMPUTATIONS

A ***simple*** pier is a single shaft, column, or multiple columns exposed to the flow. The pier itself is socketed into rock, and no footing is needed.

Project:	Louisville Southern Indiana Ohio River East End Bridge		
Configuration:	Final		
Date:	9/20/2011	**Return Period** (yrs):	100
Prepared by:	LMW **Chkd by:** PXVG	**Flow Type:**	Steady
Methodology:	HEC-18, 4th Edition, Section 6.1	**No. of Piers:**	7
Scour Case:	Simple	**Units:**	English

BED CONDITIONS

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
D_{50}	Diameter at which 50% of the soil grains pass	4.27E-04	1.74E-05	2.13E-05	1.35E-04	2.30E-05	2.26E-04	1.28E-05	ft
D_{95}	Diameter at which 95% of the soil grains pass	3.94E-02	8.53E-04	2.59E-04	1.02E-03	6.56E-04	1.05E-03	1.61E-04	ft
BC	Bed Condition (clear-water, plane bed, small dunes, medium dunes, large dunes)	small dunes	small dunes	small dunes	small dunes	small dunes	small dunes	small dunes	

FLOW DATA

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
θ	Angle of attack	25.0	21.0	29.0	28.0	30.0	29.0	25.0	degrees
y_1	Flow depth directly upstream of the pier	8.0	24.7	16.0	6.6	13.5	20.0	21.0	ft
V_1	Mean velocity of flow directly upstream of the pier	0.42	1.08	2.14	3.56	2.72	3.01	2.99	ft / s
g	Acceleration of gravity	32.2	32.2	32.2	32.2	32.2	32.2	32.2	ft / s^2

PIER DATA

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
PS	Pier shape (Square, Round, Cylindrical, Group, Sharp)	Group	Group	Group	Group	Group	Group	Group	
a_p	Pier stem width	8.0	8.0	8.0	8.0	8.0	8.0	8.0	ft
L_p	Length of pier stem	16.0	16.0	16.0	16.0	16.0	16.0	8.0	ft
C	Number of columns per bent	2.0	2.0	2.0	2.0	2.0	2.0	3.0	
S	Column spacing	80.0	80.0	80.0	80.0	80.0	80.0	40.0	

SIMPLE PIER SCOUR CALCULATIONS

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
Fr_1	Froude number directly upstream of the pier	0.03	0.04	0.09	0.24	0.13	0.12	0.11	
K_1	Correction factor for pier nose shape from Table 6.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
K_2	Correction factor for angle of attack of flow	1.44	1.38	1.49	1.48	1.50	1.49	1.20	
K_3	Correction factor for bed condition from Table 6.3	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
K_4	Correction factor for armoring by bed material size	0.40	1.00	1.00	1.00	1.00	1.00	1.00	
V_R	Velocity ratio required to calculate K_4	1.00	1.00	28.27	19.64	1.00	6.99	42.49	
V_{icD50}	Approach velocity required to initiate scour of the D_{50} at the pier	0.46	0.16	0.16	0.28	0.16	0.42	0.14	ft / s
V_{icD95}	Approach velocity required to initiate scour of the D_{95} at the pier	2.62	0.72	0.42	0.62	0.59	0.75	0.37	ft / s
V_{cD50}	Critical velocity for incipient motion of the D_{50}	1.19	0.49	0.49	0.78	0.49	1.12	0.43	ft / s
V_{cD90}	Critical velocity for incipient motion of the D_{95}	5.37	1.81	1.13	1.54	1.50	1.87	1.01	ft / s

K_w	Correction factor for very wide piers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
K_u	Units correction factor for calculating V_{cD50}	11.17	11.17	11.17	11.17	11.17	11.17	11.17	
y_s	**Single Column Pier Scour**	**2.1**	**8.9**	**12.1**	**13.3**	**13.2**	**14.4**	**11.7**	ft
y_{sm1}	Multiple Column Pier Scour - *Raudkivi Method*	**2.5**	**10.7**	**14.5**	**15.9**	**15.8**	**17.3**	**N/A**	
y_{sm2}	Multiple Column Pier Scour - *Equivalent Pier Method*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
y_{sm3}	Multiple Column Pier Scour - *K_2 Method*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
y_{sm}	**Multiple Column Pier Scour**	**2.5**	**10.7**	**14.5**	**15.9**	**15.8**	**17.3**	**N/A**	ft

EQUATIONS

$$Fr_1 = \frac{V_1}{\left(\sqrt{y_1 g}\right)}$$

$$K_2 = (\text{Cos}\ \theta + \left(\frac{L}{a}\right)\sin\theta)^{0.65} \quad \text{where} \left(\text{L/a}\right)_{\max} = 12$$

$$K_4 = 0.4\left(V_R\right)^{0.15} \quad \text{where}\ \text{V}_\text{R} > 0$$

$$V_R = \frac{V_1 - V_{icD_{50}}}{V_{cD_{50}} - V_{icD_{95}}} > 0$$

$$V_{cD_{50}} = K_u\, y_1^{1/6} D_{50}^{1/3}$$

$$V_{icD_{50}} = 0.645\left(\frac{D_{50}}{a_p}\right)^{0.053} V_{cD_{50}}$$

$$K_w = 2.58\left(\frac{y_1}{a_p}\right)^{0.34} (Fr_1)^{0.65} \text{ for } \frac{\text{V}_1}{\text{V}_{\text{cD}_{50}}} < 1$$

$$K_w = 2\left(\frac{y_1}{a}\right)^{0.13} (Fr_1)^{0.25} \text{for} \frac{V_1}{V_{cD50}} >= 1$$

$$y_s = 2y_1K_1K_2K_3K_4K_w\left(\frac{a_p}{y_1}\right)^{0.65} Fr_1^{0.43}$$

Raudkivi Method: If $s > 5d$,

$$y_{sm1} = 1.2y_s$$

Equivalent Pier Method: If $s < 5d$,

$$y_{sm2} = 2y_1K_1K_2K_3K_4K_w\left(\frac{a_m}{y_1}\right)^{0.65} Fr_1^{0.43}$$

where $K_2 = 1$ and $a_m = a_pC\sin\theta + a_pCos\theta$

K_2 Method: If $s < 5d$,

$$y_{sm3} = 2y_1K_1K_2K_3K_4K_w\left(\frac{a_p}{y_1}\right)^{0.65} Fr_1^{0.43}$$

where $K_2 = (Cos\theta + C\sin\theta)^{0.65}$

TABLES

Table 6.1. Correction (K_1) for Pier Nose Shape

Pier Nose Shape	K_1
Square	1.1
Round	1.0
Cylindrical	1.0
Group	1.0
Sharp	0.9

Table 6.3. Increase in Equilibrium Pier Scour Depths (K_3) for Bed Condition

Bed Condition	Height (m)	K_3
Clear-Water	N/A	1.1
Plane Bed	N/A	1.1
Small Dunes	3 >H >=0.6	1.1
Medium Dunes	9 >H >=3	1.2
Large Dunes	H >=9	1.3

100-YR CONTRACTION SCOUR

		US	Enter SI for Metric or US for English Units		Fill in highlighted cells	

Determine if Live-Bed or Clear-Water Contraction Scour is occuring.
Critical Velocity (V_C) is the velocity of the approach flow that will begin to move the bed material.
If Vc < V , then Live - Bed Contraction Scour is occuring.
if Live - Bed Contraction Scour is not occuring, use Clear-Water Contraction Scour equation.

Critical Velocity - $K_U y_1^{0.1667} D^{0.3333}$

	LOB	CHAN	ROB		*Source:*	
V_1 =	1.89	6.30	1.29	V_1 - Velocity of the flow at the upstream approach, (m/s, ft/s)	Approach Section	Sta. 595
y_1 =	9.27	66.88	9.03	y - Average depth of flow upstream of the bridge, (m, ft)	Approach Section	
D_{50} =	0.00003	0.00230	0.00079	D_{50} - Particle size in a mixture of which 50 percent are smaller, (m, ft)	soil borings	
K_U =	11.17	11.17	11.17	K_U - (Metric Units = 6.19, English Units = 11.17)		
D_c =	0.0016	0.0219	0.0005	D_c - Critical Diameter for the flow that you are using, (m, ft)	Calculated	
V_C =	0.48	2.97	1.49	V_c - Critical velocity above which bed material of size D_x and smaller will be transported (m/s, ft/s)	Calculated	
$V_c > V_1$	Live	Live	Clear			

Live-Bed Contraction Scour -

	LOB	CHAN	ROB		
y_1 =	9.27	66.88	9.03	y_1 - Average depth in the upstream main channel, (m, ft)	Approach Section
y_0 =	14.71	60.85		y_0 - Existing depth in the contracted section before scour, (m, ft)	Section BR U
Q_1 =	35822.20	775530.30		Q_1 - Flow in the upstream channel transporting sediment, (m^3/s, ft^3/s)	Approach Section
Q_2 =	54614.55	755438.4		Q_2 - Flow in the contracted channel, (m^3/s, ft^3/s)	Section BR U
W_1 =	2047.9	1840		W_1 - Bottom (or top) width of the upstream main channel, (m, ft)	Approach Section
W_2 =	1699.88	2005.93		W_2 - Bottom (or top) width of main channel in the contracted section less the pier width(s), (m, ft)	Section BR U
D_{50} =	0.007925	0.70104	0.240792	D_{50} - Median diameter of the bed material, (mm)	soil borings
ω =	0.0010	0.1000	0.0350	ω - Median fall velocity of the bed material based on the D_{50}, (m/s, ft/s)	HEC-18 Figure 5.8
S_1 =	0.000068	0.000068		S_1 - Slope of energy grade line of main channel, (m/m, ft/ft)	Approach Section
g =	32.2	32.2	32.2	g - Acceleration of gravity (Metric = 9.81m/s^2, English = 32.2ft/s^2)	
V* =	0.142	0.383	0.000	V* - $(\tau_0/\rho)^{½}$ = $(gy_1S_1)^{½}$ shear velocity in the upstream section, (m/s, ft/s)	Calculated
V*/ω =	142.47	3.83	0.00		Calculated
k_1 =	0.69	0.69	0.59	k_1 - Exponents determined on the mode of bed material transport	HEC-18 Table
y_2 =	15.13	61.61	0.00	$y_2 = y_1[(Q_2/Q_1)^{6/7}(W_1/W_2)^{k1}]$	
y_s =	0.42	0.76	N/A	Feet $y_s = y_2 - y_0$ = Scour Depth Below Bed	

Clear-Water Contraction Scour -

	LOB	CHAN	ROB		
Q =			1947.04	Q - Discharge through the bridge or on the set-back overbank area at the bridge associated with W	Section BR U
D_{50} =			0.00079	D_{50} - Median diameter of the bed material, (m, ft) (1m=1000mm, 1ft=304.8mm)	soil borings
W =			71.69	W - Bottom (or top) width of the contracted section less pier width, (m, ft)	Section BR U
y_0 =			12.04	y_0 - Average existing depth in the contracted section, (m, ft)	Section BR U
D_m =	0	0	0.000988	D_m - Diameter of the smallest nontransportable particle in the bed material ($1.25D_{50}$), contracted section (m,ft)	Calculated
K_U =	0.0077	0.0077	0.0077	K_U - (Metric = 0.025, English = 0.0077)	Constant
y_2 =	0.00	0.00	15.21	$y_2 = [K_U Q^2/D_m^{2/3} W_2^{2}]^{3/7}$	
y_s =	N/A	N/A	3.17	Feet $y_s = y_2 - y_0$ = Scour Depth Below Bed	

TOTAL 100 YEAR SCOUR COMPUTATIONS

	Pier						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Boring Number	B54	B61	B64	B66	B70	B77	B79
Modeled Bed Elevations***	430.5	427.9	432.3	434.3	437.6	434	430.2
Bed Rock Elevation***	330.5	331.4	333.8	333.3	334.3	335.8	334.7
Competent Rock Elevation***	329.7	331.4	331.1	333.1	334.3	335.5	334.5
Long-term (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contraction (ft)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Local (ft)	2.5	10.7	14.5	15.9	15.8	17.3	11.7
***Total Scour** (ft)*	**3.0**	**11.1**	**14.9**	**16.3**	**16.3**	**17.7**	**12.1**
Total Scour Elevation	**427.5**	**416.8**	**417.4**	**418.0**	**421.3**	**416.3**	**418.1**

*** from geotechnical data

TOTAL 100 YEAR SCOUR INPUTS (From FESWMS)

Pier #	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Node #	4605	4113	4116	4120	4617	4626	5412
Velocity (m/s)	0.1	0.3	0.7	1.1	0.8	0.9	0.9
Velocity (ft/s)	0.4	1.1	2.1	3.6	2.7	3.0	3.0
Surface Elevation (m)	138.4	138.4	138.4	138.4	138.4	138.4	138.4
Surface Elevation (ft)	454.1	454.1	454.1	454.1	454.1	454.1	454.1
Depth (m)	2.4	7.5	4.9	2.0	4.1	6.1	6.4
Depth (ft)	8.0	24.7	16.0	6.6	13.5	20.0	21.0

500 YEAR SIMPLE PIER SCOUR COMPUTATIONS

A ***simple*** pier is a single shaft, column, or multiple columns exposed to the flow. The pier itself is socketed into rock, and no footing is needed.

Project:	Louisville Southern Indiana Ohio River East End Bridge		
Configuration:	Final		
Date:	9/20/2011	**Return Period** (yrs):	500
Prepared by:	LMW **Chkd by:** PXVG	**Flow Type:**	Steady
Methodology:	HEC-18, 4th Edition, Section 6.1	**No. of Piers:**	7
Scour Case:	Simple	**Units:**	English

BED CONDITIONS

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
D_{50}	Diameter at which 50% of the soil grains pass	4.27E-04	1.74E-05	2.13E-05	1.35E-04	2.30E-05	2.26E-04	1.28E-05	ft
D_{95}	Diameter at which 95% of the soil grains pass	3.94E-02	8.53E-04	2.59E-04	1.02E-03	6.56E-04	1.05E-03	1.61E-04	ft
BC	Bed Condition (clear-water, plane bed, small dunes, medium dunes, large dunes)	small dunes	small dunes	small dunes	small dunes	small dunes	small dunes	small dunes	

FLOW DATA

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
θ	Angle of attack	22.0	23.0	28.0	28.0	30.0	29.0	25.0	degrees
y_1	Flow depth directly upstream of the pier	13.2	29.9	21.1	11.7	18.6	25.2	26.2	ft
V_1	Mean velocity of flow directly upstream of the pier	1.38	1.97	3.02	4.37	3.48	3.72	3.73	ft / s
g	Acceleration of gravity	32.2	32.2	32.2	32.2	32.2	32.2	32.2	ft / s^2

PIER DATA

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
PS	Pier shape (Square, Round, Cylindrical, Group, Sharp)	Group	Group	Group	Group	Group	Group	Group	
a_p	Pier stem width	8.0	8.0	8.0	8.0	8.0	8.0	8.0	ft
L_p	Length of pier stem	16.0	16.0	16.0	16.0	16.0	16.0	8.0	ft
C	Number of columns per bent	2.0	2.0	2.0	2.0	2.0	2.0	3.0	
S	Column spacing	80.0	80.0	80.0	80.0	80.0	80.0	40.0	

SIMPLE PIER SCOUR CALCULATIONS

Variable	Description	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Unit
Fr_1	Froude number directly upstream of the pier	0.07	0.06	0.12	0.22	0.14	0.13	0.13	
K_1	Correction factor for pier nose shape from Table 6.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
K_2	Correction factor for angle of attack of flow	1.40	1.41	1.48	1.48	1.50	1.49	1.20	
K_3	Correction factor for bed condition from Table 6.3	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
K_4	Correction factor for armoring by bed material size	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
V_R	Velocity ratio required to calculate K_4	1.00	1.00	38.90	22.08	1.00	8.54	51.49	
V_{icD50}	Approach velocity required to initiate scour of the D_{50} at the pier	0.49	0.16	0.17	0.31	0.17	0.43	0.14	ft / s
V_{icD95}	Approach velocity required to initiate scour of the D_{95} at the pier	2.84	0.74	0.44	0.68	0.62	0.78	0.38	ft / s
V_{cD50}	Critical velocity for incipient motion of the D_{50}	1.29	0.51	0.52	0.86	0.52	1.17	0.45	ft / s
V_{cD90}	Critical velocity for incipient motion of the D_{95}	5.84	1.87	1.18	1.69	1.58	1.94	1.05	ft / s

K_w	Correction factor for very wide piers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
K_u	Units correction factor for calculating V_{cD50}	11.17	11.17	11.17	11.17	11.17	11.17	11.17	
y_s	**Single Column Pier Scour**	**9.2**	**12.1**	**14.5**	**15.6**	**15.3**	**16.3**	**13.3**	ft
y_{sm1}	Multiple Column Pier Scour - *Raudkivi Method*	**11.0**	**14.5**	**17.4**	**18.8**	**18.4**	**19.6**	**N/A**	
y_{sm2}	Multiple Column Pier Scour - *Equivalent Pier Method*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
y_{sm3}	Multiple Column Pier Scour - *K_2 Method*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
y_{sm}	**Multiple Column Pier Scour**	**11.0**	**14.5**	**17.4**	**18.8**	**18.4**	**19.6**	**N/A**	ft

EQUATIONS

$$Fr_1 = \frac{V_1}{\left(\sqrt{y_1 g}\right)}$$

$$K_2 = (\text{Cos}\ \theta + \left(\frac{L}{a}\right)\sin\theta)^{0.65} \quad \text{where} \left(\text{L/a}\right)_{\max} = 12$$

$$K_4 = 0.4\left(V_R\right)^{0.15} \quad \text{where}\ \ V_R > 0$$

$$V_R = \frac{V_1 - V_{icD_{50}}}{V_{cD_{50}} - V_{icD_{95}}} > 0$$

$$V_{cD_{50}} = K_u\, y_1^{1/6} D_{50}^{1/3}$$

$$V_{icD_{50}} = 0.645\left(\frac{D_{50}}{a_p}\right)^{0.053} V_{cD_{50}}$$

$$K_w = 2.58\left(\frac{y_1}{a_p}\right)^{0.34} (Fr_1)^{0.65} \ \text{for}\ \frac{V_1}{V_{cD_{50}}} < 1$$

$$K_w = 2\left(\frac{y_1}{a}\right)^{0.13} (Fr_1)^{0.25} \ \text{for}\ \frac{V_1}{V_{cD50}} >= 1$$

$$y_s = 2y_1 K_1 K_2 K_3 K_4 K_w \left(\frac{a_p}{y_1}\right)^{0.65} Fr_1^{0.43}$$

$$\text{Raudkivi Method: If } s > 5d, \quad y_{sm1} = 1.2 y_s$$

$$\text{Equivalent Pier Method: If } s < 5d, \quad y_{sm2} = 2y_1 K_1 K_2 K_3 K_4 K_w \left(\frac{a_m}{y_1}\right)^{0.65} Fr_1^{0.43} \quad \text{where } K_2 = 1 \text{ and } a_m = a_p C \sin\theta + a_p Cos\theta$$

$$K_2 \text{ Method: If } s < 5d, \quad y_{sm3} = 2y_1 K_1 K_2 K_3 K_4 K_w \left(\frac{a_p}{y_1}\right)^{0.65} Fr_1^{0.43} \quad \text{where } K_2 = (Cos\theta + C\sin\theta)^{0.65}$$

TABLES

Table 6.1. Correction (K_1) for Pier Nose Shape

Pier Nose Shape	K_1
Square	1.1
Round	1.0
Cylindrical	1.0
Group	1.0
Sharp	0.9

Table 6.3. Increase in Equilibrium Pier Scour Depths (K_3) for Bed Condition

Bed Condition	Height (m)	K_3
Clear-Water	N/A	1.1
Plane Bed	N/A	1.1
Small Dunes	3 >H >=0.6	1.1
Medium Dunes	9 >H >=3	1.2
Large Dunes	H >=9	1.3

500-YR CONTRACTION SCOUR

	US	Enter SI for Metric or US for English Units		Fill in highlighted cells	

Determine if Live-Bed or Clear-Water Contraction Scour is occuring.
Critical Velocity (V_C) is the velocity of the approach flow that will begin to move the bed material.
If Vc < V , then Live - Bed Contraction Scour is occuring.
if Live - Bed Contraction Scour is not occuring, use Clear-Water Contraction Scour equation.

Critical Velocity - $K_U y_1^{0.1667} D^{0.3333}$

	LOB	CHAN	ROB		*Source:*	
V_1 =	2.13	6.69	1.54	V_1 - Velocity of the flow at the upstream approach, (m/s, ft/s)	Approach Section	Sta. 595
y_1 =	14.41	72.11	11.64	y - Average depth of flow upstream of the bridge, (m, ft)	Approach Section	
D_{50} =	0.00003	0.00230	0.00079	D_{50} - Particle size in a mixture of which 50 percent are smaller, (m, ft)	soil borings	
K_U =	11.17	11.17	11.17	K_U - (Metric Units = 6.19, English Units = 11.17)		
D_c =	0.0018	0.0253	0.0008	D_c - Critical Diameter for the flow that you are using, (m, ft)	Calculated	
V_C =	0.52	3.01	1.55	V_c - Critical velocity above which bed material of size D_x and smaller will be transported (m/s, ft/s)	Calculated	
$V_c > V_1$	Live	Live	Clear			

Live-Bed Contraction Scour -

	LOB	CHAN	ROB		
y_1 =	14.41	72.11	11.64	y_1 - Average depth in the upstream main channel, (m, ft)	Approach Section
y_0 =	19.84	66.07		y_0 - Existing depth in the contracted section before scour, (m, ft)	Section BR U
Q_1 =	63387.94	887324.20		Q_1 - Flow in the upstream channel transporting sediment, (m^3/s, ft^3/s)	Approach Section
Q_2 =	87910.19	860702.3		Q_2 - Flow in the contracted channel, (m^3/s, ft^3/s)	Section BR U
W_1 =	2064.56	1840		W_1 - Bottom (or top) width of the upstream main channel, (m, ft)	Approach Section
W_2 =	1710.62	2006.5		W_2 - Bottom (or top) width of main channel in the contracted section less the pier width(s), (m, ft)	Section BR U
D_{50} =	0.007925	0.70104	0.240792	D_{50} - Median diameter of the bed material, (mm)	soil borings
ω =	0.0010	0.1000	0.0350	ω - Median fall velocity of the bed material based on the D_{50}, (m/s, ft/s)	HEC-18 Figure 5.8
S_1 =	0.00007	0.00007		S_1 - Slope of energy grade line of main channel, (m/m, ft/ft)	Approach Section
g =	32.2	32.2	32.2	g - Acceleration of gravity (Metric = 9.81m/s^2, English = 32.2ft/s^2)	
V* =	0.180	0.403	0.000	V* - $(\tau_0/\rho)^{½} = (gy_1S_1)^{½}$ shear velocity in the upstream section, (m/s, ft/s)	Calculated
V/ω =	180.22	4.03	0.00		Calculated
k_1 =	0.69	0.69	0.59	k_1 - Exponents determined on the mode of bed material transport	HEC-18 Table
y_2 =	21.71	66.18	0.00	$y_2 = y_1[(Q_2/Q_1)^{6/7}(W_1/W_2)^{k1}]$	
y_s =	1.87	0.11	N/A	Feet $y_s = y_2 - y_0$ = Scour Depth Below Bed	

Clear-Water Contraction Scour -

	LOB	CHAN	ROB		
Q =			3387.47	Q - Discharge through the bridge or on the set-back overbank area at the bridge associated with W	Section BR U
D_{50} =			0.00079	D_{50} - Median diameter of the bed material, (m, ft) (1m=1000mm, 1ft=304.8mm)	soil borings
W =			80.56	W - Bottom (or top) width of the contracted section less pier width, (m, ft)	Section BR U
y_0 =			15.66	y_0 - Average existing depth in the contracted section, (m, ft)	Section BR U
D_m =	0	0	0.000988	D_m - Diameter of the smallest nontransportable particle in the bed material ($1.25D_{50}$), contracted section (m,ft)	Calculated
K_U =	0.0077	0.0077	0.0077	K_U - (Metric = 0.025, English = 0.0077)	Constant
y_2 =	0.00	0.00	22.12	$y_2 = [K_U Q^2/D_m^{2/3} W_2^{2}]^{3/7}$	
y_s =	N/A	N/A	6.46	Feet $y_s = y_2 - y_0$ = Scour Depth Below Bed	

TOTAL 500 YEAR SCOUR COMPUTATIONS

	Pier						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Boring Number	B54	B61	B64	B66	B70	B77	B79
Modeled Bed Elevations***	430.5	427.9	432.3	434.3	437.6	434	430.2
Bed Rock Elevation***	330.5	331.4	333.8	333.3	334.3	335.8	334.7
Competent Rock Elevation***	329.7	331.4	331.1	333.1	334.3	335.5	334.5
Long-term (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contraction (ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Local (ft)	11.0	14.5	17.4	18.8	18.4	19.6	13.3
***Total Scour** (ft)*	**12.9**	**16.3**	**19.2**	**20.6**	**20.3**	**21.4**	**15.1**
Total Scour Elevation	**417.6**	**411.6**	**413.1**	**413.7**	**417.3**	**412.6**	**415.1**

*** from geotechnical data

TOTAL 500 YEAR SCOUR INPUTS (From FESWMS)

Pier #	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Node #	4605	4113	4116	4120	4617	4626	5412
Velocity (m/s)	0.4	0.6	0.9	1.3	1.1	1.1	1.1
Velocity (ft/s)	1.4	2.0	3.0	4.4	3.5	3.7	3.7
Surface Elevation (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0
Surface Elevation (ft)	459.3	459.3	459.3	459.3	459.3	459.3	459.3
Depth (m)	4.0	9.1	6.4	3.6	5.7	7.7	8.0
Depth (ft)	13.2	29.9	21.1	11.7	18.6	25.2	26.2