SCI-823-10.~~31~~ 13

PID No. 79977

S.R. 823 Over Lucasville-Minford Road (CR-28)

Structure Type Study Submittal

Prepared for:
Ohio Department of Transportation
District 9
650 Eastern Ave.
Chillicothe, Ohio 45601

November 30, 2006
Prepared by:

TranSystems®

TABLE OF CONTENTS

Table of Contents | ***Page No.***

TranSystems

BRIDGE TYPE STUDY NARRATIVE

1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of new left and right overpass structures that will carry the proposed S.R. 823 bypass over Lucasville-Minford Road (CR 28). As requested by the Scope of Services, a Bridge Type Study report is to be submitted before any plan development. The purpose of this report is to investigate various span arrangements and superstructure and substructure types in order to determine the most appropriate and economical structure type fulfilling the project requirements. An initial Structure Type Study report dated 7/15/2005 was submitted to the Department and comments, dated 8/29/2005, were in turn received by TranSystems. However, since these dates, the overall project has experienced a change in profile – the original project profile presented in the Preferred Alternative Verification Report (PAVR) submitted July 2005 has been altered in order to reduce the fill heights over culverts and to rebalance the earthwork along the entire project length. The revised profile raises the elevations of the proposed S.R. 823 Mainline over Lucasville-Minford Road from the elevations specified in the July 2005 PAVR by an average of 7'. This revised project profile was approved 2/15/2006 by the Department. In addition to the change in profile, the median width has also been reduced since the PAVR submittal. As a result of the changes in geometry a reevaluation of the bridge type is warranted. This follow-up Structure Type Study presents the results of these reevaluations as well as addressing the comments to the initial study.

2. Design Criteria

The proposed structure types are designed according to the current version of the Ohio Department of Transportation Bridge Design Manual (BDM) and the 2002 AASHTO Standard Specifications for Highway Bridges, 17th Edition. Horizontal clearances (clear zone width and horizontal sight distance) and vertical clearances are based on the Ohio Department of Transportation Location and Design Manual (L&D), Volume One – Roadway Design.

3. Subsurface Conditions and Foundation Recommendation

DLZ Ohio, Inc. performed the subsurface exploration for the proposed bridge and prepared the Preliminary Bridge Foundation Recommendations. It is included in Appendix E.

In summary, four (4) test borings (TR-11, TR-12, TR-13 and TR-14) were drilled and all encountered sandstone bedrock between 38 and 43 feet below the existing ground surface. Generally cohesive soils were encountered from the bottom of the 3"-6" topsoil layer to the top of the bedrock. The cohesive soils ranged from sandy silt (A-4a) to clay (A-7-6), and were generally soft to very stiff.

Based on the alternatives considered for this study, only one foundation type was considered applicable for the substructure elements. As the location of bedrock is at moderate depths, the HP pile foundation appears to be best suited for all alternatives' substructure locations. Both the rear and forward abutment foundations will be on compacted embankment fill. Subsequently, it is recommended that the abutment piles not be driven until the majority of primary consolidation settlement of both the in-situ soil, which may be compressible, and the embankment has occurred. This will avoid having high down-drag forces that could significantly reduce the load-carrying capacity of the piles. Additionally, the piles could be sleeved to prevent any possible down-drag forces.

HP14x73 piles with a maximum design load of 95 tons are assumed for this Bridge Type Study. Since the piles will be driven to refusal onto hard bedrock, the feasibility of using steel points will be investigated as required by Section 202.2.3.2.a of the ODOT Bridge Design Manual.

Preliminary MSE wall evaluations were also performed by DLZ Ohio, Inc. and are presented in Appendix E. These wall evaluations reveal that MSE walls can not be used at the rear and forward abutment locations. The analysis by DLZ indicates factors of safety, for global stability, that are very close to the minimum recommended values. Due to the inadequate stability factors of safety, MSE walls are not recommended and the settlement of the MSE walls was not investigated. Subsequently, the stability and settlement of spill through slopes was performed. The preliminary evaluations by DLZ reveal that the slope stability is inadequate for the undrained condition. The use of wick drains and monitoring of pore water pressures is recommended to maintain a drained condition under the embankments. DLZ also recommends the embankment be built in stages (30' max) to maintain stability of the embankment. Additional details regarding instrumentation and other construction controls will be included in a forthcoming DLZ report on the Lucasville-Minford embankment construction. Please refer to Appendix E for further information and details regarding MSE wall evaluations.

4. Roadway

The purpose of this project is to construct a new bypass state route around the town of Portsmouth, Ohio. The proposed alignment will carry two lanes of traffic, 15 plus miles in either direction, from an interchange with US 52 just east of Portsmouth to another interchange with US 23, located north of Portsmouth in Valley Township.

An interchange with Lucasville-Minford Road is planned as part of the bypass. Due to the interchange configuration, each structure of the Lucasville-Minford crossing has a unique cross section. The left structure's cross section consists of three 12'-0" travel lanes with 6'-0" median shoulder and 10'-0" outside shoulder. Including a 1'-6" inside median parapet and a 1'-6" outside straight face deflector parapet yields a left structure deck width of 55'-0" out to out.

The right structure has a variable width cross section due to a tapered acceleration lane. From left to right, this bridge's cross section consists of a 1'-6" median parapet, a 6'-0" median shoulder, two 12'-0" travel lanes, a tapered acceleration ramp, an 10'-0" wide shoulder and a 1'-6" outside parapet.

Horizontal and vertical sight distances, in accordance with the design standards, have been provided for all alternatives considered.

Alignment & Profile: The proposed SR 823 horizontal geometry is along a tangent alignment across the entire length of both the left and right structures. The profile grade line for both bridge sections will be located at the inside edge of pavement, which is 11'-0" from the centerline of construction of S.R. 823. This profile lies within a 1300' vertical curve with P.V.I. at Station 535+00.00, elevation = 742.19, g_1 = -2.90% and g_2 = 4.00%. The horizontal and vertical geometry for all alternatives considered are the same. Embankment slopes will be a maximum 2:1 in order to minimize right-of-way impacts.

The existing Lucasville-Minford Road will remain on similar horizontal and vertical alignment. The cross section will be widened from 2-lanes, to a 3-lane cross section with 36'-0" pavement width. The proposed alignment is tangent under the structure. The proposed vertical profile of Lucasville-Minford Road is in a vertical curve under the structure. The vertical curve is 500' long, PVI = 20+00.00, Elev. = 714.26, g_1 = -0.80% and g_2 = +2.80%.

Vertical and Horizontal Clearances: Since the proposed vertical alignment for all overpass structures on this project was dictated by the overall design of the new bypass profile, vertical clearance was not a critical design issue for any alternative proposed herein. For this report, more than 15'-0" of preferred vertical clearance could be provided for any alternative.

The 23'-0" clear zone from edge of traveled way is based on Figure 600-1E of the ODOT L&D Manual, Volume One. The information input into Figure 600-1E is as follows:

1. existing Lucasville-Minford Road may be classified as a Rural Major Collector and the design speed is 55 mph;
2. the design year ADT for Lucasville Minford Road is 6000 per the June 2005 letter from ODOT's Office of technical Services.
3. proposed Lucasville-Minford will have open drainage and ditch slopes of 6:1 are proposed

Using the identified parameters of items 1) through 3) in Figure 600-1E results in the minimum horizontal clear zone width of 23'-0".

Drainage Design - The collection of storm water runoff will be addressed off of the bridge, thus scuppers will not be required. The type of drainage system will be investigated as part of the preliminary design.

Utilities - No utilities will be placed on the bridge. However, lighting and ITS conduits will be provided as necessary.

Maintenance of Traffic - While the new bridges are under construction, traffic will be maintained on the existing Lucasville-Minford Rd. It is anticipated that there will be limited closures during construction for beam setting.

5. Proposed Structure Configurations

Structure: As per the Scope of Services, we investigated several bridge types and alternates as part of this type study.

Two (2) alternatives have been evaluated in this Bridge Type Study, and are designated as Alternatives 1 and 2. The appropriate structure types that were considered are outlined in the Structure Type Alternative Table.

Structure Type Alternative		1	2
Superstructure Type Description		Prestressed Concrete Girders 60" Modified AASHTO Type 4	Continuous rolled beam W36 Rolled Beam Grade 50W
Proposed Beam Spacing	Left Bridge	6 Spaces at 8'-2"	6 Spaces at 8'-2"
	Right Bridge	6 Spaces at 8'-1" 1 Variable Space	6 Spaces at 8'-1" 1 Variable Space
No. of Spans		3	3
Abutment Type		Stub Type abutments (Semi Integral Type)	Stub Type abutments (Semi Integral Type)
No. of Piers		2	2
Pier Type		Cap and Column	Cap and Column
Substructure Orientation		23°52'35"	23°52'35"
Approximate Bridge Length		259.75	259.75
Approximate Structure Depth Slab Haunch Beam Total		 8.5" 2" 60" 70.5" (5.875')	 8.5" 2" 36" 46.5" (3.875')

Alternatives Discussion:

As stated above, various span configurations were investigated and were refined to the three span configurations shown. As mentioned previously, MSE wall stability analyses performed by DLZ Ohio, Inc. identified stability concerns/issues with the proposed MSE walls. Consequently, DLZ recommended that 2:1 spill through slopes be used for all alternatives. Considering the location of Lucasville-Minford Road and the lengths of the spill through slopes three span arrangements were investigated. All of the span arrangements considered the relocation an existing stream under the bridge. The stream will be relocated to pass under Lucasville-Minford Road, through a new culvert at approximately station 22+25.

Alternative 1

Span configuration: Alternative 1 is a three span bridge with spans of 76'-0", 107'-9", 76'-0". The overall bridge length is 259.75' centerline of abutment to centerline of abutment. This span arrangement allows for the use of stub abutments and meets the horizontal clearances required at the piers. The 2:1 spill through slopes allow for the proposed ditches required for drainage and meet clear zone grading requirements. The spill through slopes and stub abutments were used to determine the locations of both abutments. Pier 1 was placed at the clear zone and Pier 2 placed to make both end spans the same. The substructures are oriented with a 23°52'35" LF skew to be parallel to Lucasville-Minford Road.

Substructure:
Abutments: Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal on bedrock. The details of the abutments will follow ODOT Standard Construction Drawings.

Piers: The proposed piers are cap and column type piers consistent with section 204.5 of the BDM for use at highway grade separations. The pier heights will be approximately 40' for both piers. The proposed piers will be supported on HP 14x73 piles with a design capacity of 95-tons per pile, driven to refusal on bedrock.

Superstructure:
The preliminary design for this alternative is 7 - 60" AASHTO Type 4 prestressed beams, spaced at 8'-2", for the left bridge and 8 - 60" AASHTO Type 4 prestressed beams for the right. The right structure has a variable width due to a tapering acceleration lane. The exterior beam on the right side was set parallel to the taper and the remaining beams placed parallel to the centerline of SR 823. This arrangement has 6 equal beam spaces at 8'-1" and 1 variable beam space, tapering from 8'-11 ¾ to 3'-8 7/8". Both bridges will have constant 3'-0" overhangs and will accommodate the HS25 design loadings. The structures will be simple span for non-composite dead loads and continuous for superimposed and live loads. In accordance with the BDM the beams are also checked for a simply supported condition under all loads except the future wearing surface. This analysis indicates that standard concrete strengths of 5000 psi at release and 7000 psi final are required. It is worth noting that the beam size could be reduced to if 8000psi final strengths and steel diaphragms were used. Discussions with Ohio Prestressers Association indicate higher concrete strength and shipping feasibility were not of particular concern or reason for additional cost (please refer to the attached documentation). The left bridge width will be 52'-0" from toe to toe of parapets with an overall bridge deck width of 55'-0, while the right bridge will be 60'-5 3/4" max to 55'-2 7/8" min toe to toe of parapets, and 63'-5 3/4" max to 58'-2 7/8" min overall bridge width. Deck thickness, including a 1" monolithic wearing surface, is 8 1/2".

The initial bridge construction cost for Alternative 1 is estimated to be $4,560,000 in year 2008 dollars. The present life cycle maintenance costs for this alternative are estimated to be $1,472,000, resulting in a total estimated ownership cost of $6,032,000 in year 2008 dollars.

Alternative 2

Span configuration: Alternative 2 is similar to Alternative 1 except with a steel superstructure. The spans are held the same as used for Alternative 1.

Substructure:
The substructure types will be the same as for Alternative 1. Pier heights and abutment depths will be slightly increased due to the shallower superstructure.

Superstructure:
The preliminary design for this alternative is 7 – W36 Grade 50W rolled beams, spaced at 8'-2", for the left bridge and 8 – W36 Grade 50W rolled beams at the right bridge. The right structure has a variable width due to a tapering acceleration lane. The exterior beam on the right side was set parallel to the taper and the remaining beams placed parallel to the centerline of SR 823. This arrangement has 6 equal beam spaces at 8'-1" and 1 variable beam space, tapering from 8'-11 ¾ to 3'-8 7/8". Both bridges will have

constant 3'-0" overhangs and will accommodate the HS25 design loadings. Deck thickness, including a 1" monolithic wearing surface, is 8 1/2".

The initial bridge construction cost for Alternative 2 is estimated to be $3,840,000 in year 2008 dollars. The present life cycle maintenance costs for this alternative are estimated to be $2,468,000, resulting in a total estimated ownership cost of $6,308,000 in year 2008 dollars.

6. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 1**, which consists of three span 60" AASHTO Type 4 prestressed concrete beams with semi-integral abutments and cap and column piers for both the left and right structures. See Appendix B for the Site Plan and Structure Details.

Our recommendation for Alternative 1 is based on the following items:

- This Alternative appears to be the most economical from the 2 alternates studied,
- Prestressed concrete beams tend to have lower maintenance costs than painted steel,

APPENDIX A

Cost Summary

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Lucasville - Minford Road L&R

STRUCTURE TYPE STUDY

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

ALTERNATIVE COST SUMMARY

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Alternative Cost	Life Cycle Maintenance Cost	Total Relative Ownership Cost
1	3	76'-0" - 107'-9" - 76'-0"	259.75	15 Prestressed I-Girders, 7 on the Left Bridge and 8 on the Right Bridge	Modified AASHTO Type 4 (60")	**$2,228,000**	**$1,051,000**	**$524,600**	**$760,700**	**$4,560,000**	**$1,472,000**	**$6,032,000**
2	3	76'-0" - 107'-9" - 76'-0"	259.75	15 Steel Beams, 7 on the Left Bridge and 8 on the Right Bridge	W36 Beam Grade 50W	**$1,835,000**	**$927,000**	**$441,900**	**$640,800**	**$3,840,000**	**$2,468,000**	**$6,308,000**

NOTES:

1. Structure incidental cost allowance includes provision for structure excavation, porous backfill, sealing of concrete surfaces, structural steel painting, bearings, and crushed aggregate slope protection costs.
2. Estimated construction cost does not include existing structure removal (if any), which should be quantified seperately, if required.

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S.R. 823 over Lucasville - Minford Road L&R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - SUPERSTRUCTURE

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Girder Section	Concrete Girder Cost	Subtotal Superstructure Cost	Construction Complexity Factor	Subtotal Superstructure Cost
1	3	76'-0" - 107'-9" - 76'-0"	259.75	261.75	1038	$608,300	$260,400	$106,500	15 Prestressed I-Girders, 7 on the Left Bridge and 8 on the Right	Modified AASHTO Type 4 (60")	$1,252,400	$2,228,000	0%	**$2,228,000**

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	1	4.26	4.26
Parapets	1	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	55.00	39.0	3.9	51.4
Right Bridge	0.71	60.56	42.9	4.3	55.7

Note: Deck width is out to out
10% of deck area allowed for haunches and overhangs.

QC/QA Concrete, Class QSC2
Unit Cost ($/cu. yd):

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$586.00

Based on parapet and slab percentages of total concrete area

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 285 lbs of reinforcing steel per cubic yard of deck concrete

	Year 2004	Annual Escalation	Year 2008
Deck Reinforcing	$0.77	3.5%	$0.88

Prestressed Concrete Girders
Unit Costs:

	Year 2005		Annual Escalation	Year 2008		No. Required	
AASHTO Type IV Beams							$0
Pier Diaphragms	$1,800	ea.	3.5%	$2,070	ea.	0	$0
Abutment Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	0	$0
Intermediate Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	117	$161,460
Modified Type 4 I-Beams (60")	$250	per ft.	3.5%	$280	ea.	3896.25	$1,090,950
						TOTAL =	**$1,252,410**

Construction Complexity Factor
Percent of Superstructure = 0% Due to Deck forming, Screed and Varying Girder Spaces

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 116 ft
Area = 323 sq. yd.

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$144.00	3.5%	$165.00

Expansion Joints
Unit Costs ($/Lin.Ft.):

	Cost Ratio	Year 2004	Annual Escalation	Year 2008
Modular Expansion Joints (2001 Price)	1.00	$310.00	3.5%	$394.41

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STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - SUBSTRUCTURE

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

SUBSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment & Wingwall Cost	Additional Crane Cost	Subtotal Substructure Cost
1	3	76'-0" - 107'-9" - 76'-0"	15 Prestressed I-Girders, 7 on the Left Bridge and 8 on the	Modified AASHTO Type 4 (60")	$266,100	$60,600	$251,600	$41,300	$356,800	$0	$75,000	**$1,051,000**

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (Spread Footing)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	181	$421.00	3.5%	$483.00	$87,420
Stem	170	$421.00	3.5%	$483.00	$82,110
Footings	200	$421.00	3.5%	$483.00	$96,600
Total	551				$266,100

Pier QC/QA Concrete, Class QSC1 Cost: (Drilled Shaft)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	0	$421.00	3.5%	$483.00	$0
Columns	0	$421.00	3.5%	$483.00	$0
Footings	0	$421.00	3.5%	$483.00	$0
Total Cost					$0

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	453	$421.00	3.5%	$483.00	$218,800
Wingwalls	68	$421.00	3.5%	$483.00	$32,800

Note: 15% of abutment volume allowed for wingwalls.

Epoxy Coated Reinforcing Steel Unit Cost ($/lb):

Assume 125 lbs of reinforcing steel per cubic yard of pier concrete.
Assume 90 lbs of reinforcing steel per cubic yard of abutment concrete.

	Year 2004	Annual Escalation	Year 2008
Pier	$0.77	3.5%	$0.88
Abutment	$0.77	3.5%	$0.88

MSE Abutment Unit Cost ($/sq. ft.):

	Total Area (sq. ft.)	Year 2005 Unit Cost	Annual Escalation	Year 2008
Alt. 1	0	$47.50	3.5%	$52.70

Pile Foundation Unit Cost ($/ft.): *HP 14X73 Piles, Furnished & Driven*

Number of Piles		Total Pile Length
166	SEE QUANTITY CALCULATIONS	8,920

Pile Foundation Unit Cost ($/ft.):

	Year 2005 Unit Cost	Annual Escalation	Year 2008
Furnished	$26.47	3.5%	$29.30
Driven	$9.62	3.5%	$10.70
Total			$40.00

Shaft Foundation Unit Cost ($/ft.): 36" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 1	0	SEE QUANTITY CALCULATIONS	0

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2008
$300.00	4.5%	$358.00

Cost of Shafts: $ -

Temporary Shoring and Support Unit Costs ($/sq. ft.):

	Temp. Shoring Area (sq. ft.)	Temp. Girder Support (lump sum)
Alt. 1	0	$ -

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Temporary Shoring	$22.50	3.5%	$25.80
Cofferdam	$32.00	3.5%	$36.70

Additional Crane Cost

$ 75,000

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S.R. 823 over Lucasville - Minford Road L&R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE ALTERNATIVE 1 - QUANTITY CALCULATIONS

By: MTN
Checked: PJP

Date: 11/17/2006
Date: 11/21/2006

Pier Quantities

Pier Location	Cap					Columns					Footing					Total Volume
	Length	Width	Height		Volume	Dia	#	Height		Volume	Width	Height	Length	#	Volume	
Pier 1 L	57	4.5	4.5		1154.3	3	4	34.7		980.2	10	3	10	4	1200	3334
Pier 1 R	65	4.5	4.5		1316.3	3	5	34.7		1225.2	10	3	10	5	1500	4041
Pier 2 L	57	4.5	4.5		1154.3	3	4	37.4		1057.9	10	3	10	4	1200	3412
Pier 2 R	62.25	4.5	4.5		1260.6	3	5	37.4		1322.4	10	3	10	5	1500	4083
																0
																0
																0
Total (Cu.Ft.)					**4885**					**4586**					**5400**	**14871**
Total (Cu.Yd.)					**181**					**170**					**200**	**551**

Pile Quantities

Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*48*	743.7	674.6	70.0	*3360*
Pier 1 L								*16*	710	675.5	35.0	*560*
Pier 1 R								*20*	710	675.5	35.0	*700*
Pier 2 L								*16*	710	682.5	30.0	*480*
Pier 2 R								*20*	710	682.5	30.0	*600*
											0.0	
											0.0	
											0.0	
Fwd. Abut.	0.00	0	0	0	0	0	1	*46*	748	679.5	70.0	*3220*
Total								**166**				**8920**

Abutment Quantities

Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	Depth	Area	Volume	Width	Height	Area		Volume	Width	Depth	Area	No.	Volume	
Rear Abut	137.23	3	5.5	16.6	2281	3	2.7	8.2		1119	6	3	18	1	2470	5871
Fwd. Abut	131.5	3	5.5	16.6	2187	3	4.6	13.8		1815	6	3	18	1	2367	6369
Total (Cu.Ft.)					**4468**					**2934**					**4837**	**12239**
Total (Cu.Yd.)					**165**					**109**					**179**	**453**

36" Drilled Shafts for Piers

Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap. (Kips)	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Fwd. Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Total								**0**				**0**

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	Length	Area	Volume
Rear Abut		0	0	0.0	
RA Wing (L)		0	0	0.0	
RA Wing (R)		0	0	0.0	
Fwd Abut		0	0	0.0	
FA Wing (L)		0	0	0.0	
FA Wing (R)		0	0	0.0	
Total (Sq.Ft.)				**0**	

Superstructure P/S Concrete Quantities

Location	Type of girder	# Girders	Girder Length (ft.)	Total Length (ft.)	Spacing Int.	No. of Int in span	Number of Int Diap. 1 location	Total No. in Span
Span 1	MOD TYPE 4 60	15	76.00	1140	0.00			39
Span 2	MOD TYPE 4 60	15	107.75	1616	0.00			39
Span 3	MOD TYPE 4 60	15	76.00	1140	0.00			39
Span 4		0	0	0	0.00			0
Span 5		0	0	0	0.00			0
Span 6		0	0	0	0.00			0
Span 7		0	0	0	0.00			0
Span 8		0	0	0	0.00			0
Span 9		0	0	0	0.00			0
					Total			117
Total	**MOD TYPE 4 60**	**45**		**3896**				

SCI-823-0.00 - PORTSMOUTH BYPASS
S.R. 823 over Lucasville - Minford Road L&R
STRUCTURE TYPE STUDY - STEEL ROLLED BEAM ALTERNATIVE 2 - SUPERSTRUCTURE

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (Pounds)	Structural Steel Cost	Subtotal Superstructure Cost
2	3	76'-0" - 107'-9" - 76'-0"	259.75	261.75	1038	$608,300	$260,400	$106,500	15 Steel Beams, 7 on the Left Bridge and 8 on the Right Bridge	W36 Beam Grade 50W	788,400	$859,500	**$1,835,000**

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	1	4.26	4.26
Parapets	1	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	55.00	39.0	3.9	51.4
Right Bridge	0.71	60.56	42.9	4.3	55.7

Note: Deck width is out to out
10% of deck area allowed for haunches and overhangs.

QC/QA Concrete, Class QSC2
Unit Cost ($/cu. yd):

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$586.00

Based on parapet and slab percentages
of total concrete area

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 285 lbs of reinforcing steel per cubic yard of deck concrete

	Year 2004	Annual Escalation	Year 2008
Deck Reinforcing	$0.77	3.5%	$0.88

Structural Steel
Unit Costs ($/lb.):

	Cost Ratio	Year 2005	Annual Escalation	Year 2008	
Rolled Beams - Grade 50	n/a	$0.95	3.5%	$1.09	
Level 4 Plate Girders - Grade 50W	n/a	$1.05	3.5%	$1.20	Straight Girders
level 5 Plate Girders - Grade 50W	n/a	$1.20	3.5%	$1.38	Curved Girders

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 116 ft
Area = 323 sq. yd.

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$144.00	3.5%	$165.00

Expansion Joints
Unit Costs ($/Lin.Ft.):

	Cost Ratio	Year 2003	Annual Escalation	Year 2008	
Strip Seal Expansion Joints	1.00	$310.00	3.5%	$394.41	2001 Price

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Lucasville - Minford Road L&R

STRUCTURE TYPE STUDY - STEEL ROLLED BEAM ALTERNATIVE 2 - SUBSTRUCTURE

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

SUBSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment & Wingwall Cost	Subtotal Substructure Cost
2	3	76'-0" - 107'-9" - 76'-0"	15 Steel Beams, 7 on the Left Bridge and 8 on the Right Bridge	W36 Beam Grade 50W	$238,100	$54,200	$238,300	$39,100	$356,800	$0	**$927,000**

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (Spread Footing)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Alt 2 Total Cost
Cap	109	$421.00	3.5%	$483.00	$52,650
Stem	184	$421.00	3.5%	$483.00	$88,870
Footings	200	$421.00	3.5%	$483.00	$96,600
Total	493				$238,100

Pier QC/QA Concrete, Class QSC1 Cost: (Drilled Shaft)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Alt 2 Total Cost
Cap	0	$421.00	3.5%	$483.00	$0
Columns	0	$421.00	3.5%	$483.00	$0
Footings	0	$421.00	3.5%	$483.00	$0
Total Cost					$0

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	429	$421.00	3.5%	$483.00	$207,200
Wingwalls	64	$421.00	3.5%	$483.00	$31,100

Note: 15% of abutment volume allowed for wingwalls.

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 125 lbs of reinforcing steel per cubic yard of pier concrete.
Assume 90 lbs of reinforcing steel per cubic yard of abutment concrete.

	Year 2004	Annual Escalation	Year 2008
Pier	$0.77	3.5%	$0.88
Abutment	$0.77	3.5%	$0.88

MSE Abutment Unit Cost ($/sq. ft.):

	Total Area (sq. ft.)	Year 2005 Unit Cost	Annual Escalation	Year 2008
Alt. 2	0	$47.50	3.5%	$52.70

Pile Foundation Unit Cost ($/ft.): *HP 14x73 Piles, Furnished & Driven*

Number of Piles		Total Pile Length
166	SEE QUANTITY CALCULATIONS	8,920

Pile Foundation Unit Cost ($/ft.):

	Year 2005 Unit Cost	Annual Escalation	Year 2008
Furnished	$26.47	3.5%	$29.30
Driven	$9.62	3.5%	$10.70
Total			$40.00

Shaft Foundation Unit Cost ($/ft.): 36" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 2	0	SEE QUANTITY CALCULATIONS	0

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2008
$300.00	4.5%	$358.00

Cost of Shafts: $ -

Temporary Shoring and Support Unit Costs ($/sq. ft.):

	Temp. Shoring Area (sq. ft.)	Temp. Girder Support (lump sum)
Alt. 2	0	$ -

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Temporary Shoring	$22.50	3.5%	$25.80
Cofferdam	$32.00	3.5%	$36.70

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Lucasville - Minford Road L&R

STRUCTURE TYPE STUDY - STEEL ROLLED BEAM ALTERNATIVE 2 - QUANTITY CALCULATIONS

By: MTN Date: 11/17/2006
Checked: PJP Date: 11/21/2006

Pier Quantities																
Pier Location	Length	Cap				Columns					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Dia*	*#*	*Height*		*Volume*	*Width*	*Depth*	*Length*		*Volume*	
Pier 1 L	57	3.5	3.5		698.25	3	4	37.642		1064.29	10	3	10	4	1200	2963
Pier 1 R	65	3.5	3.5		796.25	3	5	37.642		1330.37	10	3	10	5	1500	3627
Pier 2 L	57	3.5	3.5		698.25	3	4	40.392		1142.06	10	3	10	4	1200	3040
Pier 2 R	62.25	3.5	3.5		762.5625	3	5	40.392		1427.57	10	3	10	5	1500	3690
																0
																0
																0
Total (Cu.Ft.)					**2955**					**4964**					**5400**	**13320**
Total (Cu.Yd.)					**109**					**184**					**200**	**493**

Abutment Quantities																
Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*No.*	*Volume*	
Rear Abut	135.1	3	3.54	10.63	1435	3	3.08	9.24		1248	6	3	18	1	2432	5116
Fwd. Abut	133.5	3	3.54	10.62	1418	3	6.6	19.80		2643	6	3	18	1	2403	6464
Total (Cu.Ft.)					**2853**					**3892**					**4835**	**11580**
Total (Cu.Yd.)					**106**					**144**					**179**	**429**

MSE Abutment Wall Quantities					
Abut Location		Wall			
		Height	*Length*	*Area*	*Volume*
Rear Abut		0	0	0.0	
RA Wing (L)		0	0	0.0	
RA Wing (R)		0	0	0.0	
Fwd Abut		0	0	0.0	
FA Wing (L)		0	0	0.0	
FA Wing (R)		0	0	0.0	
Total (Sq.Ft.)				**0**	

Pile Quantities												
Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.								*48*	743.7	674.6	70.0	*3360*
Pier 1 L								*16*	710	675.5	35.0	*560*
Pier 1 R								*20*	710	675.5	35.0	*700*
Pier 2 L								*16*	710	682.5	30.0	*480*
Pier 2 R								*20*	710	682.5	30.0	*600*
											0.0	
											0.0	
											0.0	
Fwd. Abut.								*46*	748	679.5	70.0	*3220*
Total								**166**				**8920**

36" Drilled Shafts for Piers												
Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap. (Kips)	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Fwd. Abut.	0	10	0	0	0	0	1	*0*	0	0	0.0	*0*
Total								**0**				**0**

Superstructure Steel Quantities				
Location	Wt.of girder	# Girders	Girder Length	Total Weight
Section 1	160	15	53.20	127680
Section 2	260	15	43.84	170976
Section 3	194	15	65.68	191129
Section 4	260	15	43.84	170976
Section 5	160	15	53.20	127680
Section 6	0	0	0	0
Section 7	0	0	0	0
Section 8	0	0	0	0
Total				788441

By: MTN
Checked: PJP

Date: 11/17/2006
Date: 11/21/2006

LIFE CYCLE MAINTENANCE COST

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Structural Steel Painting * Cost Per Cycle	Structural Steel Painting * Number of Maintenance Cycles	Structural Steel Painting * Total Life Cycle Cost	Superstructure Sealing Cost Per Cycle	Superstructure Sealing Number of Maintenance Cycles	Superstructure Sealing Total Life Cycle Cost	Approach Pavement Resurfacing Cost Per Cycle	Approach Pavement Resurfacing Number of Maintenance Cycles	Approach Pavement Resurfacing Total Life Cycle Cost
1	3	259.75	15 Prestressed I-Girders, 7 on the Left Bridge and 8 on the Right Bridge	$0	0	$0	$76,900	2	$153,800	$0	10	$0
2	3	259.75	15 Steel Beams, 7 on the Left Bridge and 8 on the Right Bridge	$574,600	2	$1,149,200	$0	0	$0	$0	10	$0

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Bridge Deck Overlay (5) Deck Demo & Chipping	Bridge Deck Overlay (5) Deck Overlay	Bridge Deck Overlay (5) Deck Joint Gland (2)	Bridge Deck Overlay (5) Number of Maintenance Cycles	Bridge Deck Overlay (5) Total Life Cycle Cost	Bridge Redecking (5) Deck Concrete Cost (3)	Bridge Redecking (5) Deck Reinforcing Cost (3)	Bridge Redecking (5) Deck Joint Cost (2)	Bridge Redecking (5) Deck Removal Cost	Bridge Redecking (5) Number of Maintenance Cycles	Bridge Redecking (5) Total Life Cycle Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Initial Construction Cost	Total Relative Ownership Cost
1	3	259.75	15 Prestressed I-Girders, 7 on the Left Bridge and 8 on the Right Bridge	$91,000	$110,300	n/a	1	$201,300	$608,300	$260,400	n/a	$248,500	1	$1,117,200	**$1,472,000**	**$4,560,000**	**$6,032,000**
2	3	259.75	15 Steel Beams, 7 on the Left Bridge and 8 on the Right Bridge	$91,000	$110,300	n/a	1	$201,300	$608,300	$260,400	n/a	$248,500	1	$1,117,200	**$2,468,000**	**$3,840,000**	**$6,308,000**

Structural Steel Painting:

Structural Steel Area:

	Web Depth (in.)	No. Stringers	Total Span Length (ft.)	Assumed Ave. Bot. Flange Width (in.)	Nominal Exposed Girder Area (sq. ft.)	Secondary Member Allowance	Total Exposed Steel Area (sq. ft.)
Alt. 2	36	15	259.75	12.96	36,001	20%	43,200

Painting Cost per sq. ft.:

	Year 2005	Annual Escalation	Year 2008
Prep.	$6.75	3.5%	$7.48
Prime	$1.75	3.5%	$1.94
Intermed.	$1.75	3.5%	$1.94
Finish	$1.75	3.5%	$1.94
Total	$12.00		$13.30

Superstructure Sealing:

PS Concrete I-Beam Area:

66" Modified AASHTO Type 4

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	12.73	2	25.46
Web		40		2	80.00
Upper Fillets	3	3	4.24	2	8.49
	11	2	11.18	2	22.36
Top Flange		4		2	8.00
Total Exposed Perimeter					186.30 in.

60" AASHTO Type 4

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	12.73	2	25.46
Web		34		2	68.00
Upper Fillets	3	3	4.24	2	8.49
	11	2	11.18	2	22.36
Top Flange		4		2	8.00 in.
Total Exposed Perimeter					174.30

PS Concrete Area:

	No. Stringers	Total Span Length (ft.)	Nominal Exposed Beam Area (sq. ft.)	Secondary Member Allowance	Total Exposed Concrete Area (sq. yd.)
Alt. 1	15	259.75	56,594	10%	6,920

Sealing Cost per sq. yd.:

	Year 2004	Annual Escalation	Year 2008
Epoxy-Urethane Sealer	$9.68	3.5%	$11.11

Bridge Redecking:

Bridge Deck Joint Cost per foot:

	Year 2005	Annual Escalation	Year 2008
Structural Expansion Joint Including Elastomeric Strip Seal	$250.00	3.5%	$277.18

	Bridge Width	No. Joints
Alt. 1	90.00	0
Alt. 2	90.00	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	30,017	$8.28	$248,500
Alt. 2	30,017	$8.28	$248,500

Bridge Deck Overlay (Item 848):

Bridge Deck MSC Overlay Cost per sq. yd.:

	Year 2004	Annual Escalation	Year 2008
Micro Silica Modified Concrete Overlay Using Hydrodemolition (1.25" thick)	$25.58	3.5%	$29.35
Surface Preparation Using Hydrodemolition	$22.85	3.5%	$26.22
Hand Chipping	$37.07	3.5%	$42.54

Bridge Deck MSC Overlay Cost per cu. yd.:

Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only	$144.00	3.5%	$165.24

	Deck Area (3) (sq. ft.)	Deck Area (sq. yd.)	Hand Chipping (sq. yd.)	Variable Thickness Repair (cu. yd.)
Alt. 1	30,017	3,335	83	75
Alt. 2	30,017	3,335	83	75

Assume 25% of deck area requires removal to depth of 4.5" (3.25" additional removal).

Bridge Deck Joint Gland Replacement Cost per foot:

	Year 2005	Annual Escalation	Year 2008
Elastomeric Strip Seal Gland	$62.50	3.5%	$69.29

Assume gland replacement cost equals 25% of original deck joint construction cost.

NOTES:

1. Life cycle maintenance costs assume a 75 -year structure life, and are expressed in present value (2008 construction year) dollars.
2. Bridges are assumed to have semi-integral abutments, therefore no strip seal deck joints will be required except for Alt. 3.
3. See Superstructure Cost sheet.
4. See Alternative Cost Summary sheet.
5. Assume bridge deck overlay at Year 25 and bridge deck replacement at Year 50.
Assume superstructures are painted or sealed on a 25-year recurrence interval.
Assume complete bridge replacement at Year 75.
6. Life cycle maintenance cost differences are assumed to be predominately a function of superstructure maintenance costs.
Consequently, substructure lifecycle maintenance costs are not included in this analysis.

Approach Pavement Resurfacing:

Resurface Perpetual Asphalt Pavement:

Resurfacing Units Costs:

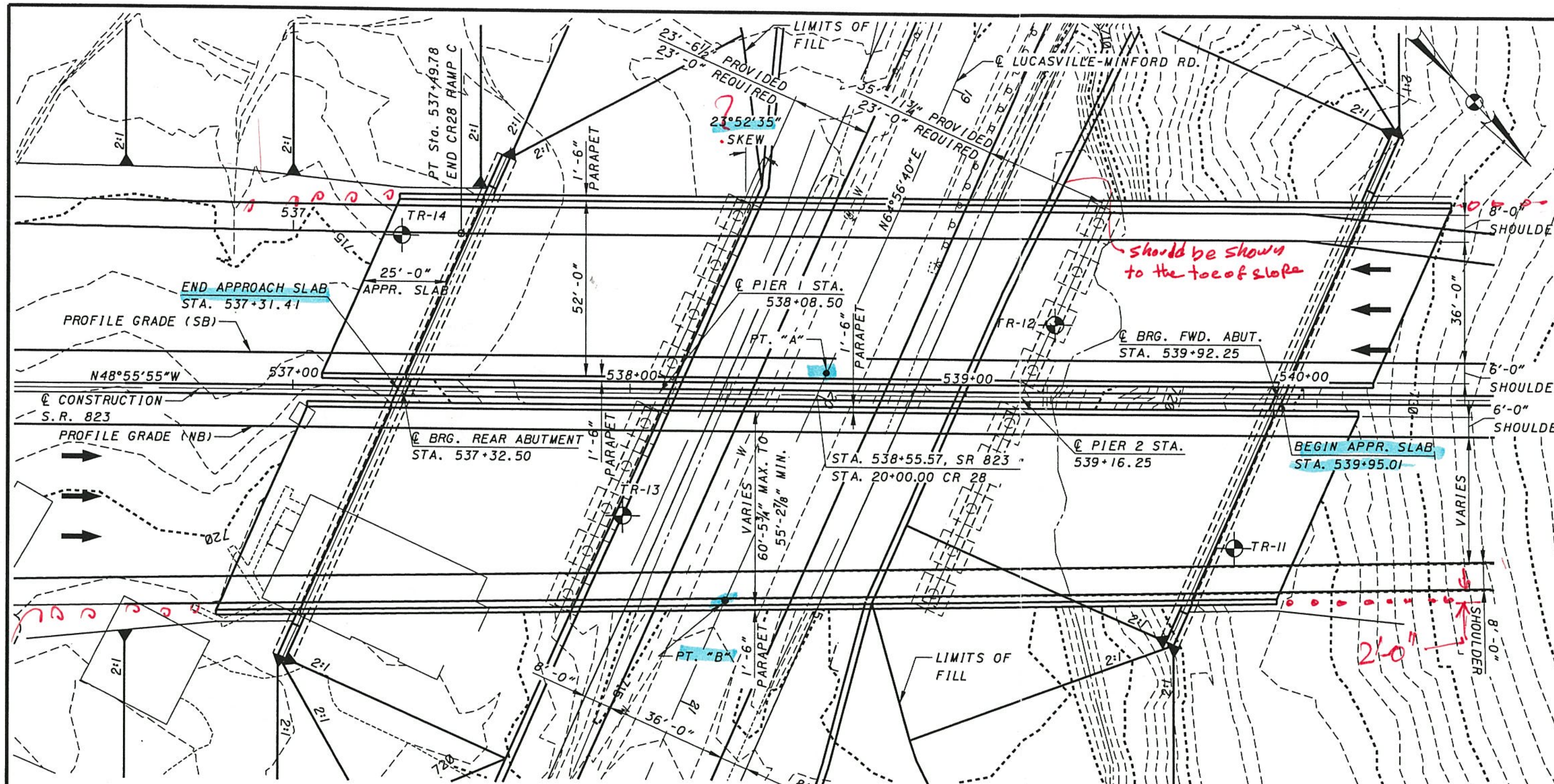
	Year 2004	Annual Escalation	Year 2008
Pavement Planing, Asphalt Concrete, per sq. yd. (Item 254)	$0.98	3.5%	$1.12
Asphalt Concrete Surface Course, per cu. yd.	$72.00	3.5%	$82.62

Asphalt Resurfacing Costs:

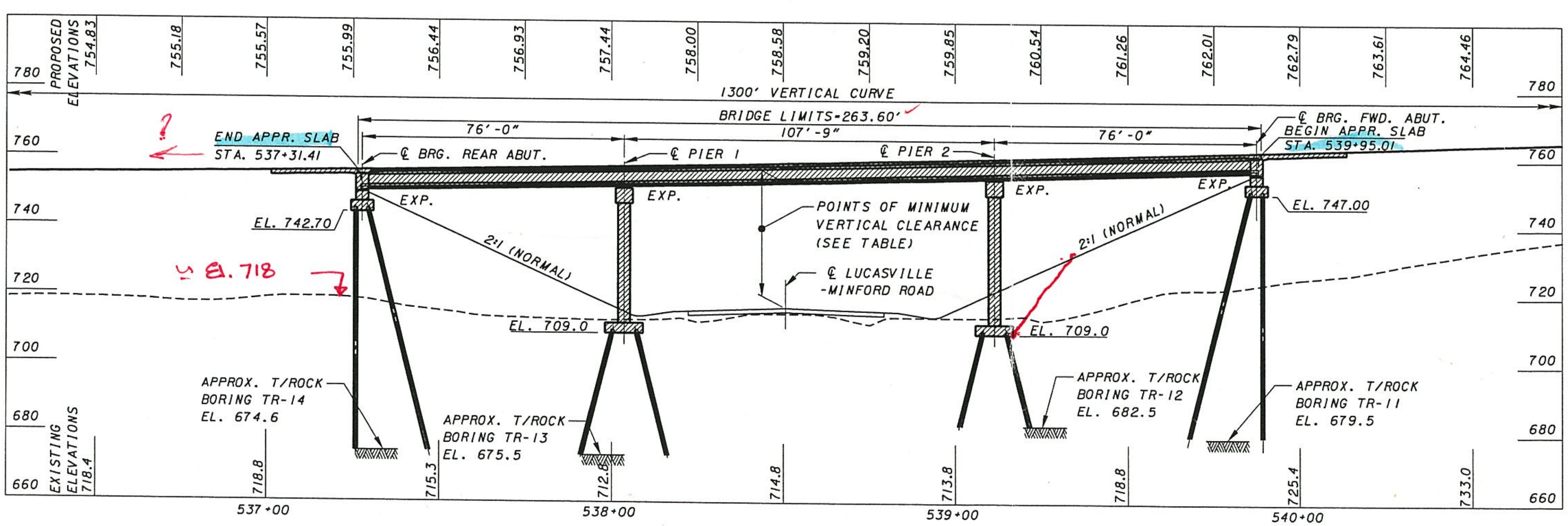
	Approach Roadway Length (ft.) (4)	Approach Roadway Width (ft.)	Resurfacing Area (sq. yd.)	Wearing Course Thickness (in.)	Wearing Course Volume (cu. yd.)
Alt. 1		38.0	0	1.50	0.0
Alt. 2		38.0	0	1.50	0.0

APPENDIX B

Preferred Alternative Site Plan and Details



PLAN



ELEVATION ALONG PROFILE GRADE LINE S.R. 823 RIGHT BRIDGE

BENCHMARK 1	BENCHMARK 2
(TO BE PROVIDED LATER)	(TO BE PROVIDED LATER)

TRAFFIC DATA

(SR 823)

CURRENT YEAR ADT (2010) - 19,800
CURRENT YEAR ADTT (2010) - 4752
DESIGN YEAR ADT (2030) - 26,000
DESIGN YEAR ADTT (2030) - 6240

TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	36.29'	34.03'
REQUIRED	15.00'	15.00'

FIRST GUARDRAIL POST OFF BRIDGE LOCATIONS

LOCATION	STATION	SIDE
REAR ABUT.	x	RT.
REAR ABUT.	x	LT.
FWD. ABUT.	x	RT.
FWD. ABUT.	x	LT.

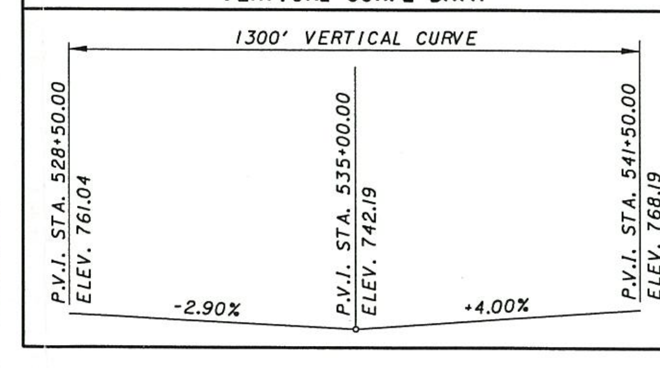
NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14x73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

VERTICAL CURVE DATA



PROPOSED STRUCTURE

TYPE: THREE SPAN, 60" MODIFIED AASTHO TYPE 4 PRESTRESSED CONCRETE I-BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY SEMI-INTEGRAL ABUTMENTS AND CAP AND COLUMN PIERS

SPANS: 76'-0", 107'-9", 76'-0" C/C SUBSTRUCTURES

ROADWAY: VARIES, 60'-5¾" TO 55'-2⅞" T/T OF BARRIER

LOADING: HS-25, ALTERNATE MILITARY LOADING AND FWS - 60psf

SKEW: 25°52'35" LF 23°52'35" ?

CROWN: 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (25' LONG)

LATITUDE:

LONGITUDE:

DESIGN AGENCY: TranSystems, 5747 PERIMETER DRIVE, SUITE 240, DUBLIN, OHIO 43017

DESIGNED PJP	CHECKED MSL	DRAWN PJP	REVISED	REVIEWED JFC	STRUCTURE FILE NUMBER	DATE 11/30/06

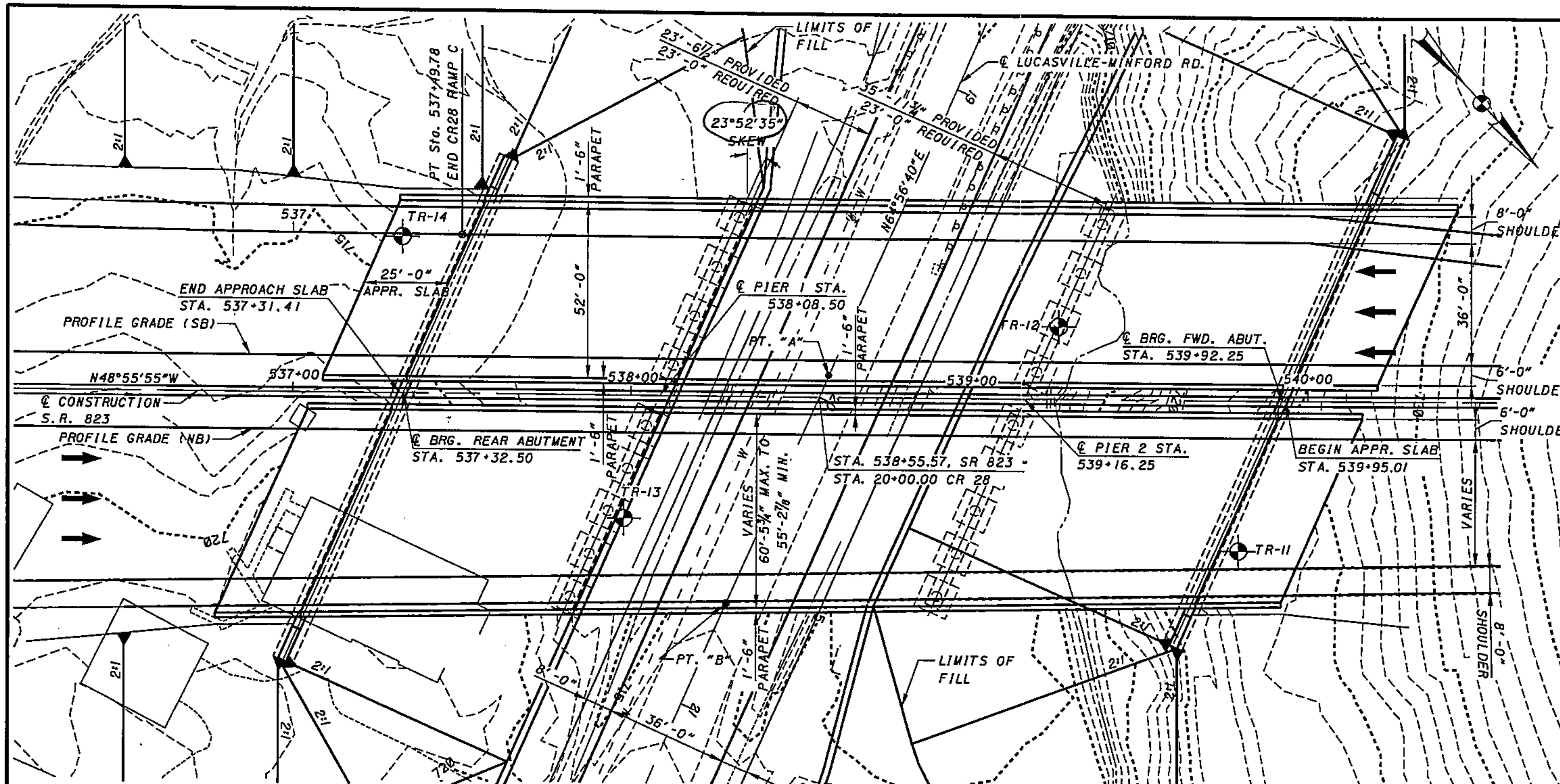
SCIOTO COUNTY
STA. 537+31.41
STA. 539+95.01

PRELIMINARY SITE PLAN - ALTERNATIVE 1
BRIDGE NO. SCI-823-1018 R
SR 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

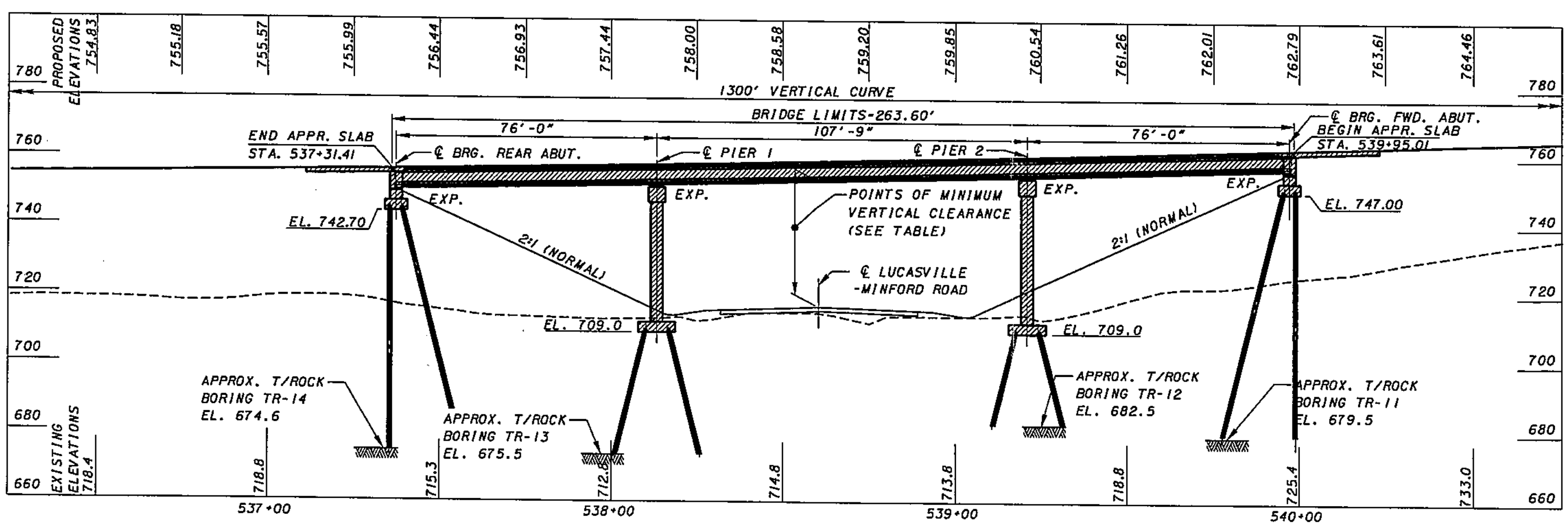
SCI-823-10.31
PID 79977

1 / 4

DATE: 8/30/2006 FILE: .....



PLAN



ELEVATION ALONG PROFILE GRADE LINE S.R. 823 LEFT BRIDGE

BENCHMARK 1	BENCHMARK 2
(TO BE PROVIDED LATER)	(TO BE PROVIDED LATER)

TRAFFIC DATA

(SR 823)
CURRENT YEAR ADT (2010) = 19,800
CURRENT YEAR ADTT (2010) = 4752
DESIGN YEAR ADT (2030) = 26,000
DESIGN YEAR ADTT (2030) = 6240

TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	36.29'	34.03'
REQUIRED	15.00'	15.00'

FIRST GUARDRAIL POST OFF BRIDGE LOCATIONS

LOCATION	STATION	SIDE
REAR ABUT.	x	RT.
REAR ABUT.	x	LT.
FWD. ABUT.	x	RT.
FWD. ABUT.	x	LT.

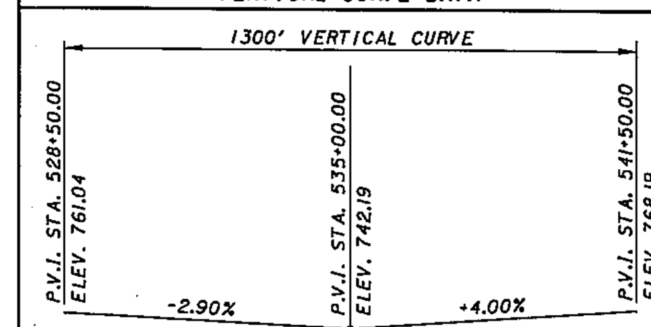
NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14x73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

VERTICAL CURVE DATA



PROPOSED STRUCTURE

TYPE: THREE SPAN, 60" MODIFIED AASTHO TYPE 4 PRESTRESSED CONCRETE I-BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY SEMI-INTEGRAL ABUTMENTS AND CAP AND COLUMN PIERS

SPANS: 76'-0", 107'-9", 76'-0" C/C SUBSTRUCTURES

ROADWAY: 52'-0" T/T OF BARRIER

LOADING: HS-25, ALTERNATE MILITARY LOADING AND FWS = 60psf

SKEW: 25°52'35" LF

CROWN: 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (25' LONG)

LATITUDE:

LONGITUDE:

DESIGN AGENCY: TranSystems, 5747 PERIMETER DRIVE, SUITE 240, DUBLIN, OHIO 43017

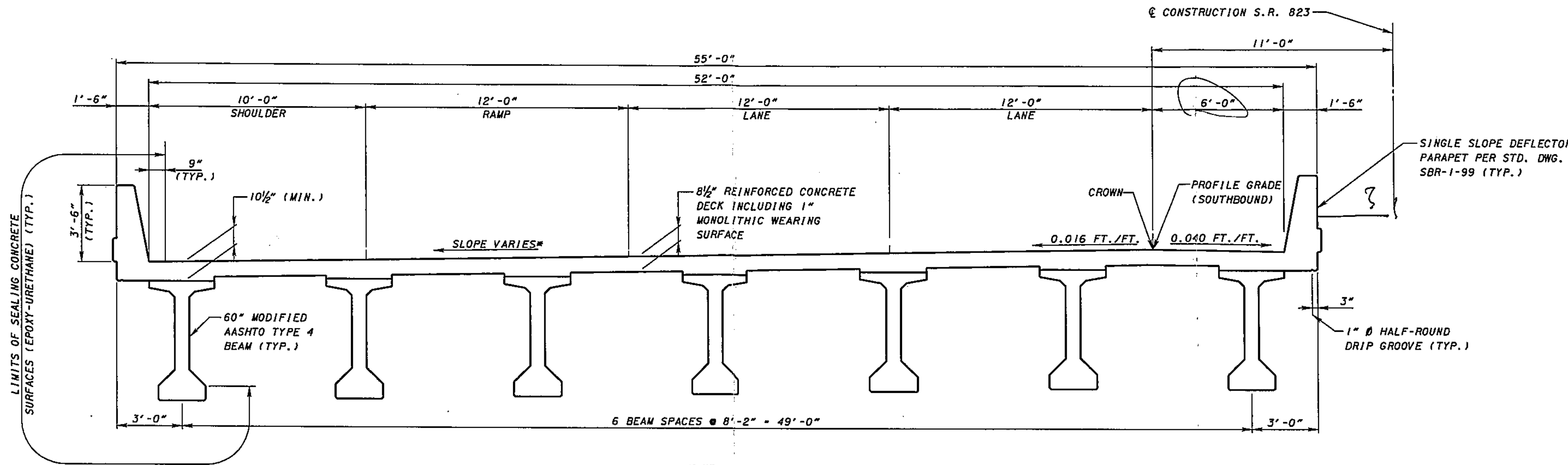
DESIGNED PJP | CHECKED MSL | DRAWN PJP | REVISED | REVIEWED JRC | DATE 11/30/06 | STRUCTURE FILE NUMBER

SCIOTO COUNTY
STA. 537+31.41
STA. 539+95.01

PRELIMINARY SITE PLAN - ALTERNATIVE 1
BRIDGE NO. SCI-823-1018 L
SR 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

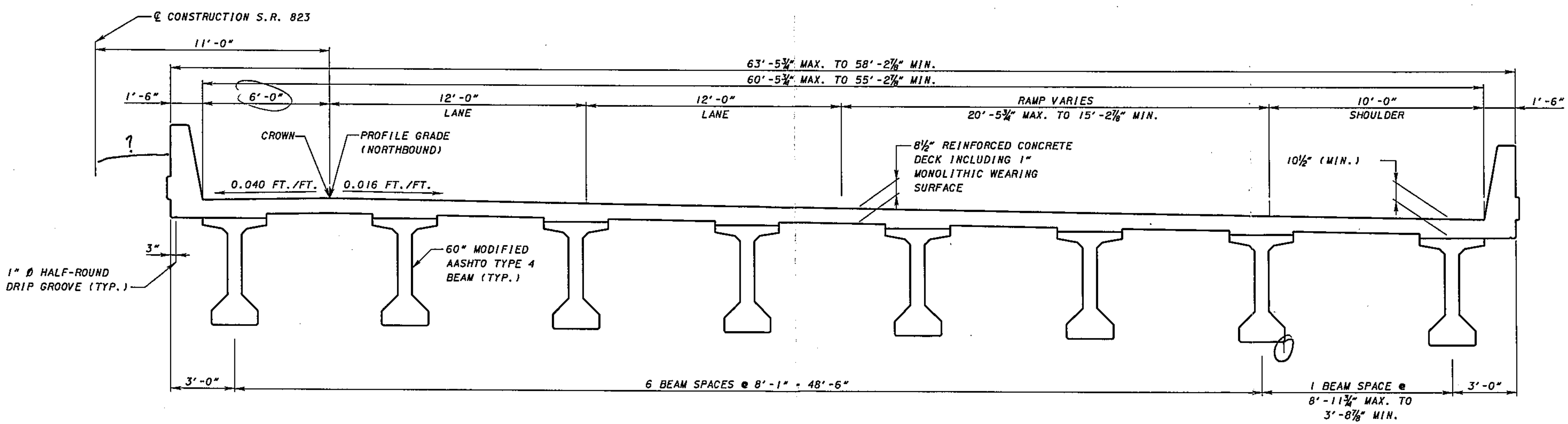
SCI-823-10.31
PID 79977

DATE: 1/30/2006 FILE:



LEFT BRIDGE

* RAMP CROSS SLOPE VARIES
STA. 537+39.79 (RAMP C) = 0.027 FT/FT
TO STA. 537+69.79 (SR 823) = 0.016 FT/FT



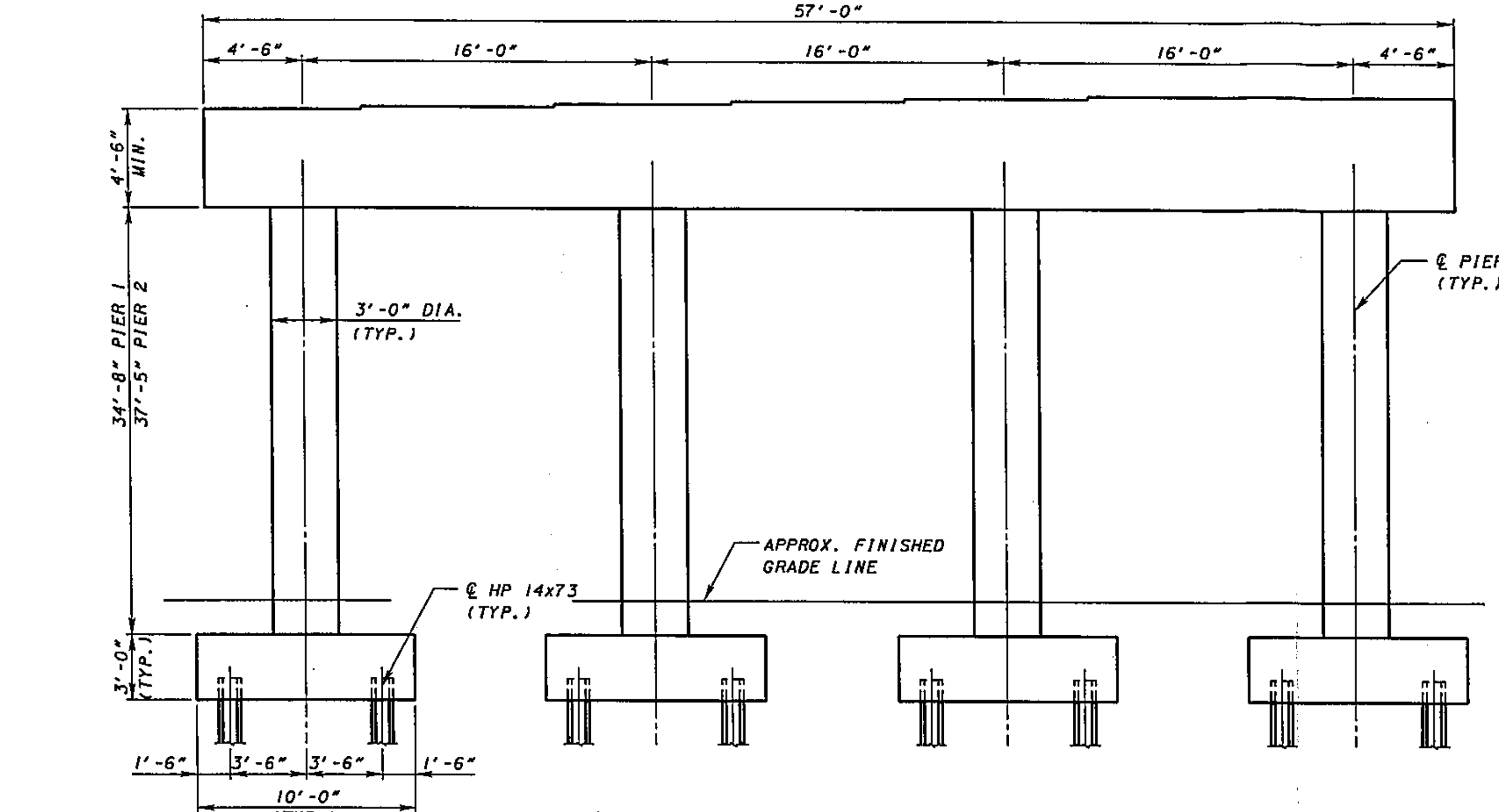
RIGHT BRIDGE

DESIGN AGENCY: TranSystems

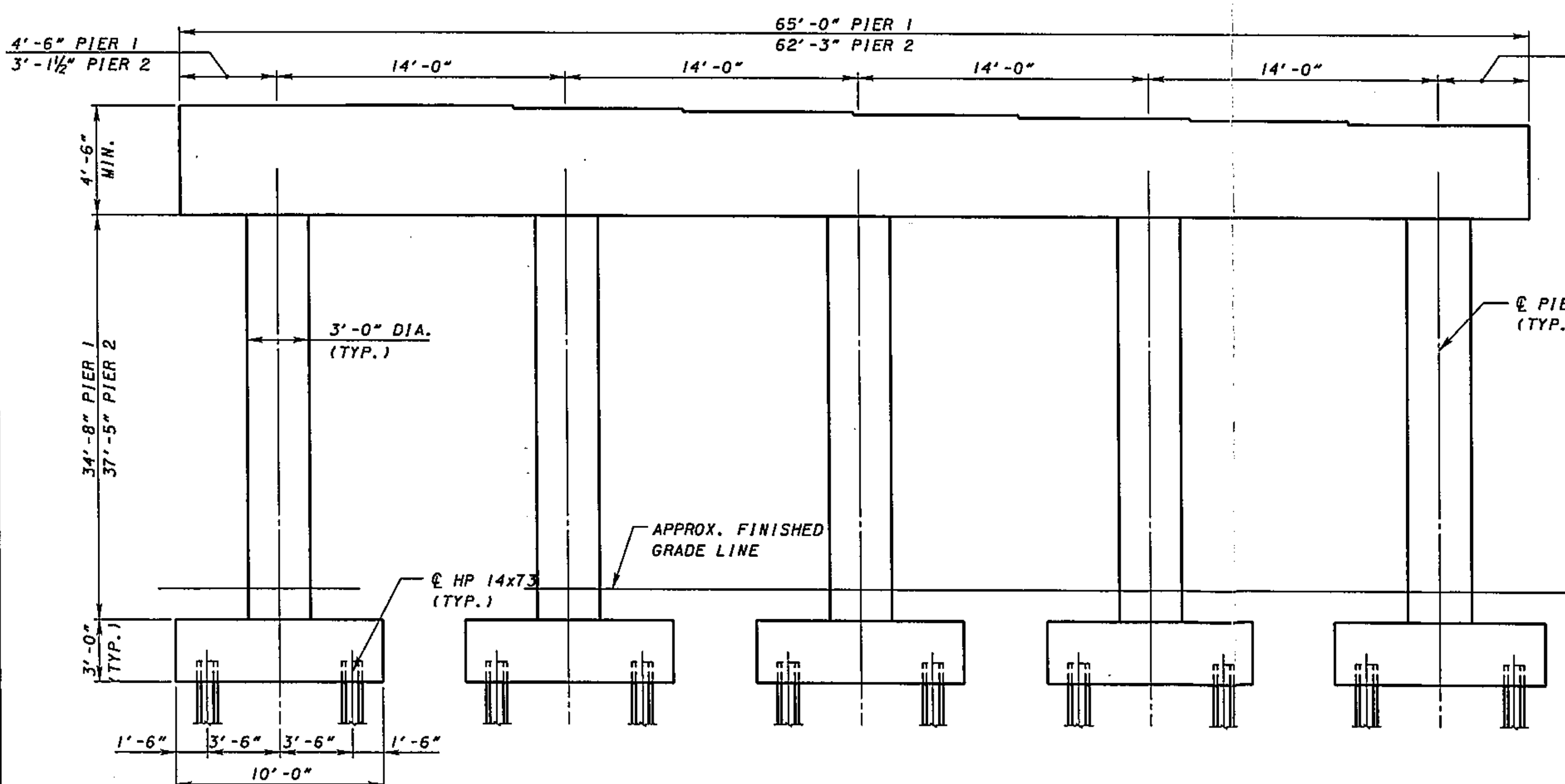
DESIGNED	DRAWN	REVIEWED	DATE
PJP	MEB	JRC	11/30/06
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MSL			

TRANVERSE SECTION-ALTERNATIVE I
BRIDGE NO. SCI-823-1018 L&R
S.R. 823 OVER LUCASVILLE-MINFORD ROAD CR-28

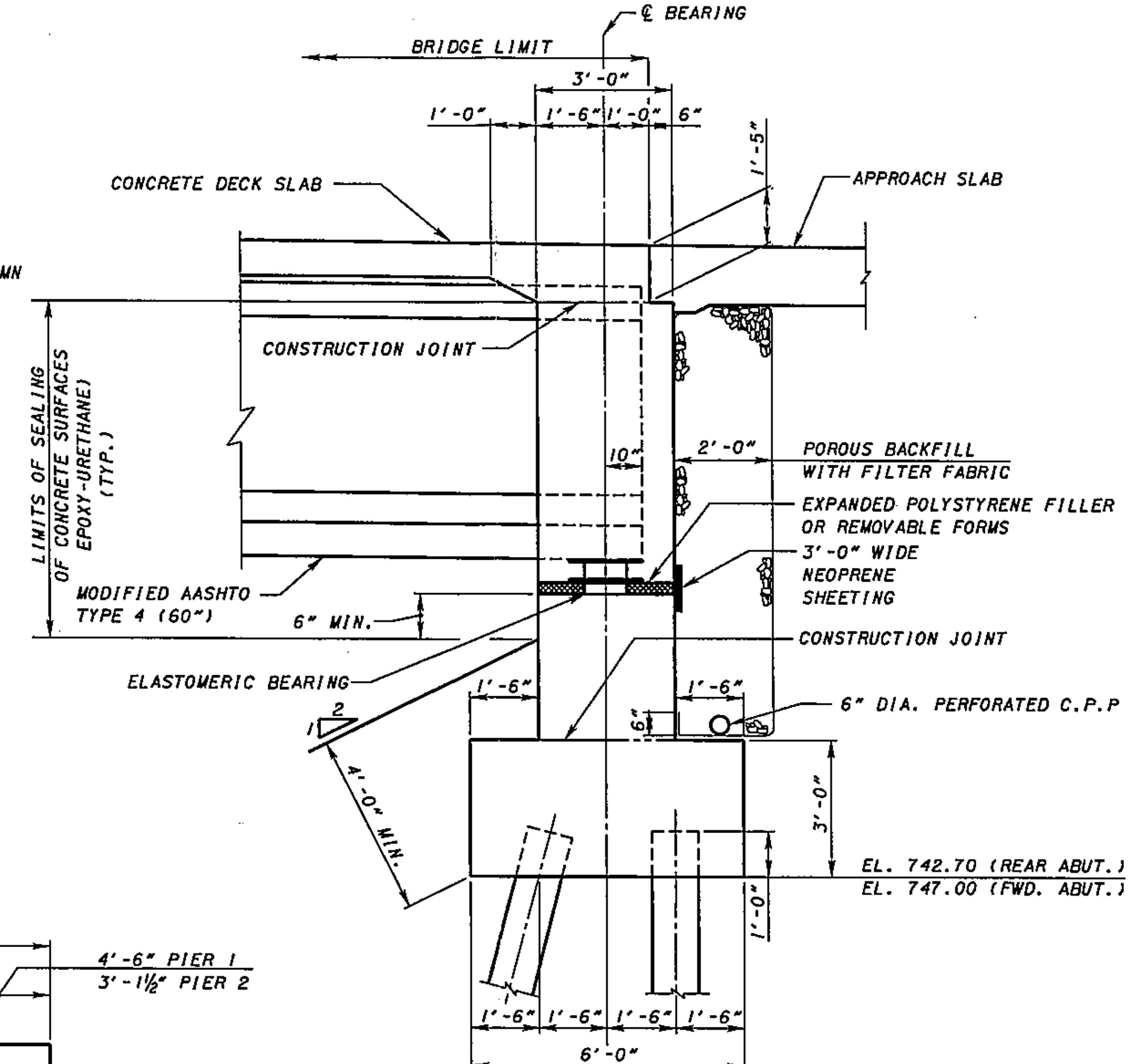
SCI-823-10.31
PID 79977



LEFT BRIDGE - PIER 1 & PIER 2



RIGHT BRIDGE - PIER 1 & PIER 2



ABUTMENT SECTION

SUPERSTRUCTURE DEPTH	
ITEM	60" MODIFIED AASHTO TYPE 4 BEAM
SLAB (INCLUDING WEARING SURFACE)	8½"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
GIRDER DEPTH	60"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (INCH)	70.50"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (FEET)	5.875'

DESIGN AGENCY TranSystems

DESIGNED PJP | CHECKED MSL | DRAWN PJP | REVISED | REVIEWED JRC | DATE 11/30/06 | STRUCTURE FILE NUMBER

PIER & ABUTMENT SECTION - ALTERNATIVE 1

BRIDGE NO. SCI-823-1018 L&R

SR823 OVER LUCASVILLE MINFORD ROAD (CR 503)

SCI-823-10.31

PID 79977

4/4

Ohio Prestressers Association
51 Mallard Point Hebron Ohio 43025-9688 Phone: 614-456-3012 Email: mekllc@columbus.rr.com

April 18, 2006

Patrick Plews, EI
TranSystems Corporation
720 E. Pete Rose Way
Suite 360
Cincinnati Ohio 45202

Re: Portsmouth Bypass, AASHTO Modified Type 4 I-beams 72"

Dear Patrick:

Thank you for the opportunity to provide input for your prestressed concrete bridge design.

Pursuant to Email correspondence, and review of the information you sent to Prestress Services Industries, LLC, and United Precast, Inc., on behalf of those member producers, I offer the following:

1. Producing 72" AASHTO Modified Type 4 Prestressed Concrete I-Beams is no problem for either member producer at lengths of 150'-0".
2. Release strength of 6,000 psi and final strength of 8,000 psi is not a problem for either producer and will not add additional cost to the beams.
3. It is highly recommended that a 4' top flange is used to add stability for shipping.
4. The producers do not anticipate any unusual problems shipping beams to the site. PSI scouted the route and can deliver, but only from the East side taking US23 to 728 East which becomes Lucasville/Minford Rd. They will continue east to CR 46/High Street (Minford) south to project area.
5. Budget pricing for your beams ranges from $258/lf to $300/lf furnished and erected. Budget pricing is developed from actual historical bridges sold by ODOT over the past 2 years.

Both Ohio Prestressers Association members are looking forward to competing on this project when it comes to sale. If you need any additional information, please call.

Sincerely,
Ohio Prestressers Association

Mary Ellen Kimberlin
Executive Director

APPENDIX C

Vertical Clearance Calculations

TranSystems

TranSystems

Made By	MTN	**Date**	11/17/06	**Job No.**	P403030064
Checked By	PJP	**Date**	11/17/06	**Sheet No.**	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**

Description S.R. 823 Lucasville Minford **PID #** 77366

Alternative 1 - 60" AASHTO TYPE 4 CONCRETE I-BEAMS ***Point Location: A***

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)		
Profile grade line to critical pt.:	-0.04	x	4.5		-0.18
			Total Adjustment	=	-0.18

Superstructure Depth

Comment	Depth (in)	Depth (ft)		
Deck Thickness:	8.5	0.71		
Haunch:	2	0.17		
Girder or Beam Depth:	60	5		
	70.5	5.88		
	Total Superstructure Depth (ft)		=	5.88

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+58.45**
Offset Location @ Critical Point	=	**6.50 Lt.**
Profile Grade Elevation at Critical Point	=	758.79
Adjustment for Cross Slopes to Beam CL	=	-0.18
Top of Deck Elevation @ Critical Point	=	**758.61**
Total Superstructure Depth	=	-5.88
Bottom of Beam Elevation @ Critical Point	=	**752.73**
Top of Pavement @ Critical Point Sta. 19+92.89	=	**716.44**
Actual Vertical Clearance	=	***36.29***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06	Job No.	P403030064
Checked By	PJP	Date	11/17/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 Structure

Description S.R. 823 Lucasville Minford PID # 77366

Alternative 1 - 60" AASHTO TYPE 4 CONCRETE I-BEAMS — ***Point Location:*** ***B***

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.016	x	50.47	-0.80752
			Total Adjustment =	**-0.81**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	60	5
	70.5	5.88

Total Superstructure Depth (ft) = **5.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+28.32**
Offset Location @ Critical Point	=	**61.47' Rt.**
Profile Grade Elevation at Critical Point	=	758.07
Adjustment for Cross Slopes to Beam CL	=	-0.81
Top of Deck Elevation @ Critical Point	=	**757.26**
Total Superstructure Depth	=	-5.88
Bottom of Beam Elevation @ Critical Point	=	**751.38**
Top of Pavement @ Critical Point Sta. 20+67.25	=	**717.35**
Actual Vertical Clearance	=	***34.03***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06	Job No.	P403030064
Checked By	PJP	Date	11/17/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name	SCI-823-0.00	Structure	
Description	S.R. 823 Lucasville Minford	PID #	77366

Alternative 1 - 60" AASHTO TYPE 4 CONCRETE I-BEAMS — ***Point Location:*** *C*

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)		
Profile grade line to critical pt.:	-0.04	x	4.5		-0.18
			Total Adjustment	=	**-0.18**

Superstructure Depth

Comment	Depth (in)	Depth (ft)		
Deck Thickness:	8.5	0.71		
Haunch:	2	0.17		
Girder or Beam Depth:	60	5		
	70.5	5.88		
	Total Superstructure Depth (ft)		=	**5.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+30.02**
Offset Location @ Critical Point	=	**6.50' Lt.**
Profile Grade Elevation at Critical Point	=	758.11
Adjustment for Cross Slopes to Beam CL	=	-0.18
Top of Deck Elevation @ Critical Point	=	**757.93**
Total Superstructure Depth	=	-5.88
Bottom of Beam Elevation @ Critical Point	=	**752.05**
Top of Pavement @ Critical Point Sta. 20+04.40, Off. 26.00 Lt.	=	**715.71**
Actual Vertical Clearance	=	***36.34***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06	Job No.	P403030064
Checked By	PJP	Date	11/17/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**

Description S.R. 823 Lucasville Minford **PID #** 77366

Alternative 1 - 60" AASHTO TYPE 4 CONCRETE I-BEAMS — ***Point Location:*** **D**

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.016	x	51.05	-0.8168
			Total Adjustment =	**-0.82**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	60	5
	70.5	5.88

Total Superstructure Depth (ft) = **5.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**537+99.68**
Offset Location @ Critical Point	=	**62.05' Rt.**
Profile Grade Elevation at Critical Point	=	757.44
Adjustment for Cross Slopes to Beam CL	=	-0.82
Top of Deck Elevation @ Critical Point	=	**756.62**
Total Superstructure Depth	=	-5.88
Bottom of Beam Elevation @ Critical Point	=	**750.74**
Top of Pavement @ Critical Point Sta. 20+79.36, Off. 26.00 Lt.	=	**716.69**
Actual Vertical Clearance	=	***34.05***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06	Job No.	P403030064
Checked By	PJP	Date	11/17/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**

Description S.R. 823 Lucasville Minford **PID #** 77366

Alternative 2 - Rolled Steel W36x194 — ***Point Location:*** ***A***

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.04	x	4.5	-0.18
			Total Adjustment =	**-0.18**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36.5	3.04
	47	3.92

Total Superstructure Depth (ft) = **3.92**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+58.45**
Offset Location @ Critical Point	=	**6.50 Lt.**
Profile Grade Elevation at Critical Point	=	758.79
Adjustment for Cross Slopes to Beam CL	=	-0.18
Top of Deck Elevation @ Critical Point	=	**758.61**
Total Superstructure Depth	=	-3.92
Bottom of Beam Elevation @ Critical Point	=	**754.69**
Top of Pavement @ Critical Point Sta. 19+92.89	=	**716.44**
Actual Vertical Clearance	=	***38.25***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By MTN Date 11/17/06 Job No. P403030064

Checked By PJP Date 11/17/06 Sheet No.

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 Structure

Description S.R. 823 Lucasville Minford PID # 77366

Alternative 2 - Rolled Steel W36x194 **Point Location: B**

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.016	x	50.47	-0.80752
			Total Adjustment =	**-0.81**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36.5	3.04
	47	3.92

Total Superstructure Depth (ft) = **3.92**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+28.32**
Offset Location @ Critical Point	=	**61.47' Rt.**
Profile Grade Elevation at Critical Point	=	758.07
Adjustment for Cross Slopes to Beam CL	=	-0.81
Top of Deck Elevation @ Critical Point	=	**757.26**
Total Superstructure Depth	=	-3.92
Bottom of Beam Elevation @ Critical Point	=	**753.34**
Top of Pavement @ Critical Point Sta. 20+67.25	=	**717.35**
Actual Vertical Clearance	=	***35.99***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06
Checked By	PJP	Date	11/17/06

Job No. P403030064

Sheet No.

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00

Structure

Description S.R. 823 Lucasville Minford

PID # 77366

Alternative 2 - Rolled Steel W36x260

Point Location: C

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.04	x	4.5	-0.18
			Total Adjustment =	**-0.18**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36.3	3.03
	46.8	3.91

Total Superstructure Depth (ft) = **3.91**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+30.02**
Offset Location @ Critical Point	=	**6.50' Lt.**
Profile Grade Elevation at Critical Point	=	758.11
Adjustment for Cross Slopes to Beam CL	=	-0.18
Top of Deck Elevation @ Critical Point	=	**757.93**
Total Superstructure Depth	=	-3.91
Bottom of Beam Elevation @ Critical Point	=	**754.02**
Top of Pavement @ Critical Point Sta. 20+04.40, Off. 26.00 Lt.	=	**715.71**
Actual Vertical Clearance	=	***38.31***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

TranSystems

Made By	MTN	Date	11/17/06	Job No.	P403030064
Checked By	PJP	Date	11/17/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**

Description S.R. 823 Lucasville Minford **PID #** 77366

Alternative 2 - Rolled Steel W36x260 ***Point Location: D***

Adjstment for Cross Slope

Comment	Grade		Offset (from PGL)	
Profile grade line to critical pt.:	-0.016	x	51.05	-0.8168
			Total Adjustment =	**-0.82**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36.3	3.03
	46.8	3.91

Total Superstructure Depth (ft) = **3.91**

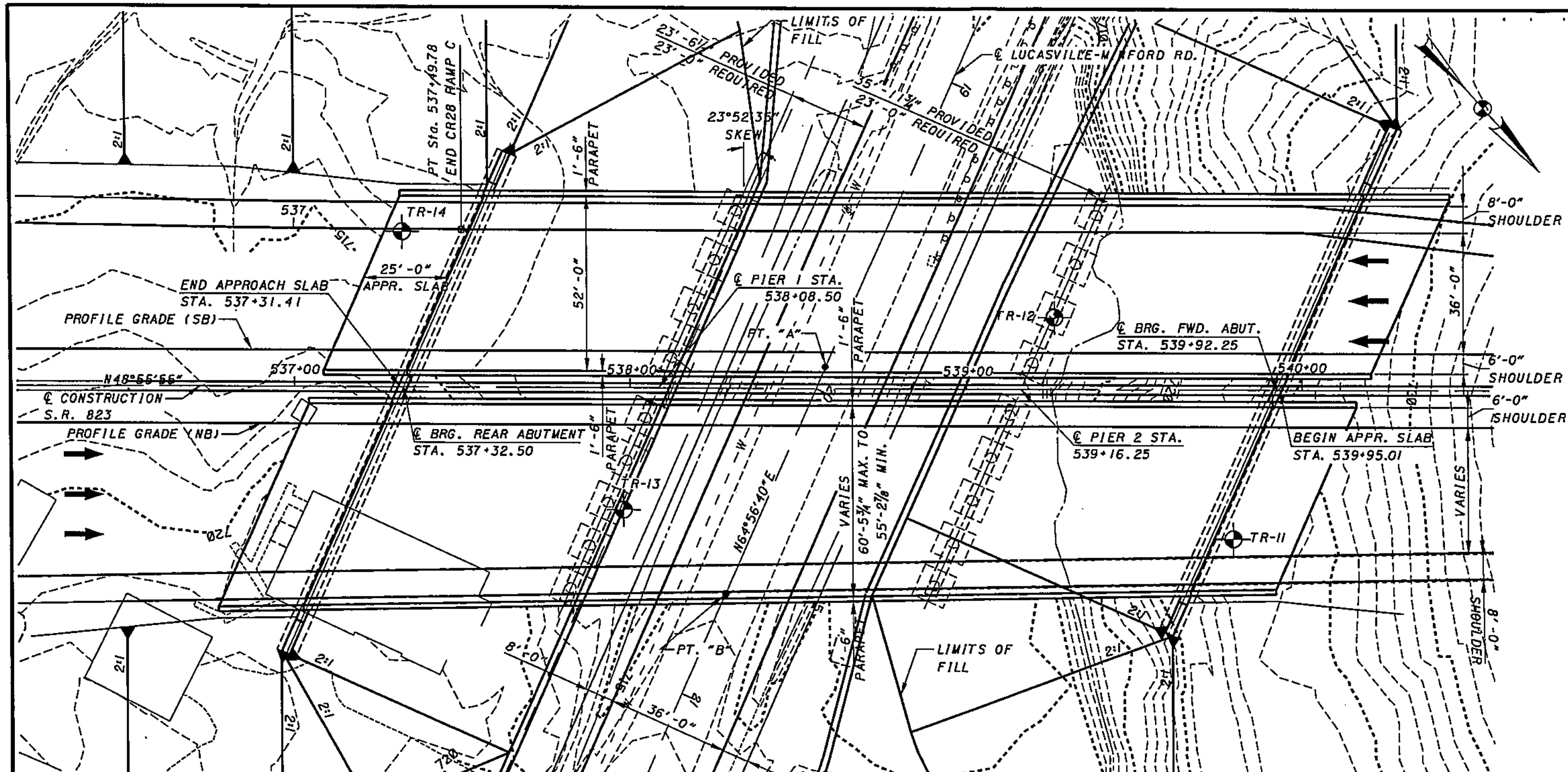
Vertical Clearance at Critical Point

Station @ Critical Point	=	**537+99.68**
Offset Location @ Critical Point	=	**62.05' Rt.**
Profile Grade Elevation at Critical Point	=	757.44
Adjustment for Cross Slopes to Beam CL	=	-0.82
Top of Deck Elevation @ Critical Point	=	**756.62**
Total Superstructure Depth	=	-3.91
Bottom of Beam Elevation @ Critical Point	=	**752.71**
Top of Pavement @ Critical Point Sta. 20+79.36, Off. 26.00 Lt.	=	**716.69**
Actual Vertical Clearance	=	***36.02***
Preferred Vertical Clearance	=	*17.0*
Required Vertical Clearance	=	*16.5*

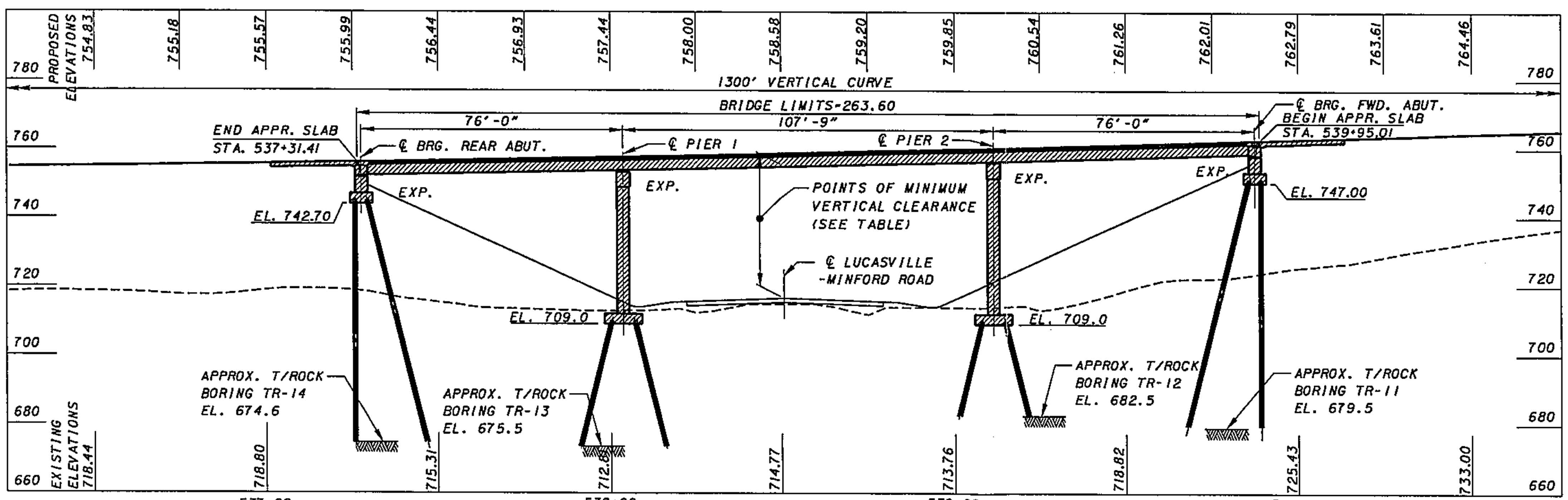
APPENDIX D

Preliminary Site Plan

TranSystems



PLAN



ELEVATION ALONG PROFILE GRADE LINE S.R. 823 RIGHT BRIDGE

SUPERSTRUCTURE DATA

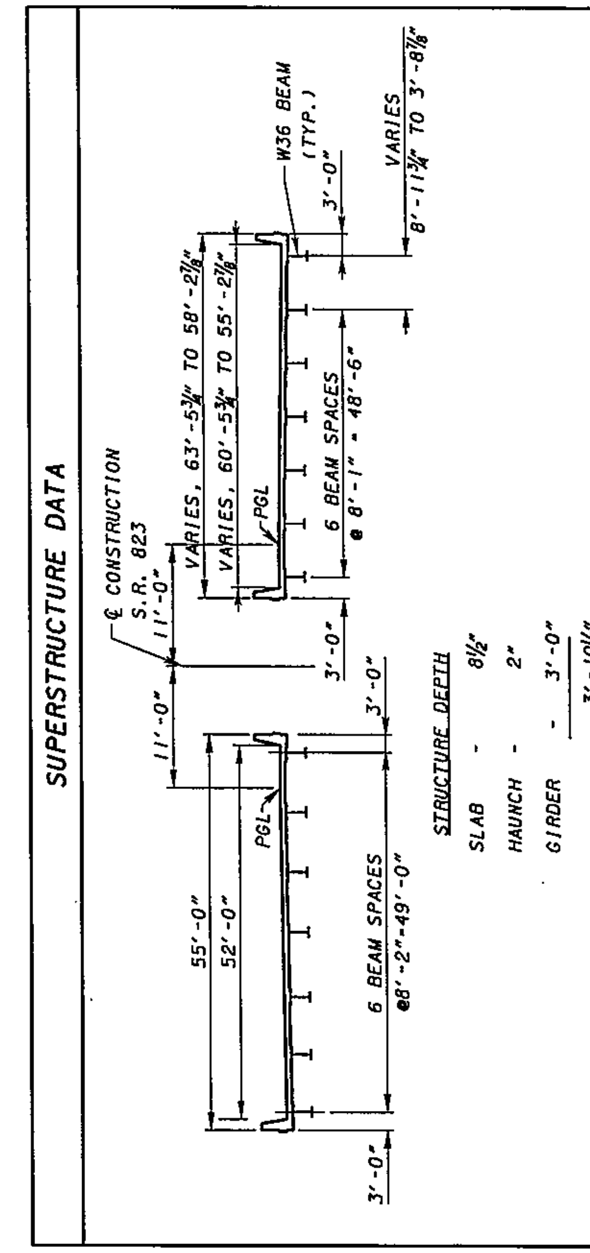


TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	38.25'	35.99
REQUIRED	15.00'	15.00'

PROPOSED STRUCTURE

TYPE: THREE SPAN, CONTINUOUS STEEL ROLLED BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY SEMI-INTEGRAL ABUTMENTS AND CAP AND COLUMN PIERS

SPANS: 76'-0", 107'-9", 76'-0" C/C SUBSTRUCTURES

ROADWAY: VARIES

LOADING: HS-25 AND ALTERNATE MILITARY LOADING

SKEW: 25°52'35" LF

CROWN: 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (25' LONG)

LATITUDE:

LONGITUDE:

DESIGN AGENCY: TranSystems, 5747 Perimeter Drive, Suite 240, Dublin, Ohio 43017

DESIGNED	DRAWN	REVIEWED	DATE
PJP	PJP	JRC	11/30/06
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MSL			

SCIOTO COUNTY
STA. 537+31.41
STA. 539+95.01

PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-1018 L&R
SR 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

SCI-823-10.31
PID 79977

DATE: 11/30/2006 FILE: ****

APPENDIX E

Preliminary Foundation Recommendations
Preliminary MSE Wall Evaluations

TranSystems

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

March 31, 2005

Mr. Greg Parsons, P.E.
Project Manager
TranSystems Corporation
5747 Perimeter Dr., Suite 240.
Dublin, OH 43017

Re: **SCI-823-0.00 over Lucasville-Minford Rd (SR-728)**
Preliminary Structural Foundation Recommendations
Project SCI-823-0.00
DLZ Job No.: 0121-3070.03

Dear Mr. Parsons:

This letter reports the findings of the subsurface exploration and preliminary foundation recommendations for the proposed structure SCI-823-0.00 over Lucasville-Minford Rd (SR 728). It is anticipated that the proposed structure will be a three-span, elevated bridge with embankment fills at both abutments. The existing grade at the proposed new bridge location is relatively flat with an elevation between 712 and 722. It is anticipated that the SCI-823-0.00 mainline will require an embankment height of approximately 45 feet. The existing area is located within a broad valley with the overburden primarily composed of glacial lake deposits.

The findings and recommendations presented in this report should be considered preliminary. It is understood that the final number and locations of substructure units have not been determined yet. After the substructure unit locations have been established, the results of the borings should be reviewed to determine if additional exploration is needed to finalize the foundation recommendations for the new structure.

Field Exploration

A total of four borings, TR-11 through TR-14, were drilled at the proposed structure. Borings TR-13 and TR-14 were drilled between June 4 and 8, 2004, and TR-11 and TR-12 were drilled between March 16 and 17, 2005. The borings were drilled to depths between 50 and 57 feet. The borings were extended into bedrock, which was verified by rock coring. Boring Logs and information concerning the drilling procedures are attached.

The boring locations were selected by TranSystems Corporation. Ground surface elevations at the boring locations were estimated from the established topographic mapping for the project and are presented on the attached Boring Logs.

Findings

The following text presents generalized subsurface conditions encountered by the borings. For more detailed information, please refer to the attached Boring Logs.

At the ground surface, topsoil was encountered to depths of 3 to 6 inches. Beneath the topsoil, generally cohesive soils were encountered to the top of bedrock. The cohesive soils encountered ranged from sandy silt (A-4a) to clay (A-7-6), and were generally soft to very stiff. The material was generally highly plastic with relatively high moisture contents.

Bedrock was encountered between 38 and 43 feet below the ground surface, which was generally a medium hard shale that was slightly broken to intact. Recovery of the core samples ranged from 50 to 100%, and RQD values ranged from 25 to 92% with an average RQD of 71%.

Seepage was detected in all of the borings ranging in depth from 23.5 to 38.5 feet below the ground surface. Water levels recorded at completion of drilling ranged from 8.9 to 28.6 feet. However, the final water levels include drilling water and may not be representative of the actual groundwater conditions. Groundwater levels may vary seasonally.

Conclusions and Recommendations

It appears that driven H-piles to rock or drilled shafts to rock will be the best-suited foundation types for the support of the proposed structure. Due to the size of the structure, if H-piles are used it is anticipated that HP 14X73 H-pile sections, with a 95-ton capacity, will be used. If high lateral or uplift loads are anticipated drilled shafts or socketed H-piles into bedrock may be needed. The actual lengths of the rock sockets will need to be designed based upon actual loading conditions. The following table summarizes the site conditions and preliminary foundation recommendations.

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

Foundation Recommendations

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Top of Rock Elevation* (Feet)	Estimated H-pile Tip Elevation* (HP 14X73 95 Ton capacity)	Estimated Drilled Shaft Tip Elevation*	Allowable Bearing Capacity for Drilled Shafts (TSF)
TR-11	Forward Abutment	722	679	675	673	15
TR-12	Pier 2	712	674	672	669	15
TR-13	Pier 1	718	679	677	672	15
TR-14	Rear Abutment	715	672	671	668	15

*Existing ground surface elevation was estimated from the established topographic mapping.

Additionally, since the SCI-823-0.00 mainline will be located on a relatively large embankment through the valley area, and could be potentially underlain by compressible soils, the abutment locations may need special construction procedures, and/or an additional load added to the design loads to account for negative skin friction associated with the embankment settlement.

It should be noted that if driven H-piles are selected, special pile-driving techniques may be required. Wet silts and fine sands, such as those encountered within this area, tend to produce exaggerated blow counts during pile driving, due to increased pore pressures during driving, which do not reflect the actual load carrying ability of the strata. Piles should be driven to the design capacity, allowed to sit at least 24 hours to allow pore pressures to dissipate, then re-driven to ensure that the design capacity has been achieved. If the design capacity has not been achieved, the pile should be re-driven until the design capacity has been achieved with confirmation after 24 hours.

Because of the many geotechnical factors across the anticipated structure location, such as, large potential lateral loads, large embankment heights, depths of relatively compressible soils, and potential for differential settlement, a detailed evaluation of all geotechnical parameters will need to be considered for the final design. It is strongly recommended that we discuss the proposed foundation design after TranSystems has had a chance to review these recommendations.

ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

No grain-size analyses were performed for scour analysis since the proposed structure location is not located along a stream.

Closing

If you have any questions please contact our office.

Sincerely,

DLZ OHIO, INC.

P. Paul Painter

P. Paul Painter
Engineering Geologist

Dorothy A. Adams for

Arthur (Pete) Nix, P.E.
Geotechnical Division Manager

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Boring Location Plan
Boring Logs TR-11, TR-12, TR-13, TR-14

cc: File

M:\proj\0121\3070.03\Structures\Lucasville-Minford SR 728\lucas-minford lt.doc

GENERAL INFORMATION
DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.

2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.

3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.

   50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.

4. The length of the sampler drive is indicated graphically by horizontal lines across the "Standard Penetration" and "Recovery" columns.

5. Sample recovery from each drive is indicated numerically in the column headed "Recovery".

6. The drive sample location is designated by the heavy vertical bar in the "Sample No., Drive" column.

7. The length of hydraulically pressed "Undisturbed" samples is indicated graphically by horizontal lines across the "Press" column.

8. Sample numbers are designated consecutively, increasing in depth.

9. Soil Description

   a. The following terms are used to describe the relative compactness and consistency of soils:

   Granular Soils – Compactness

Term	Blows/Foot Standard Penetration
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	over 50

   Cohesive Soils – Consistency

Term	Unconfined Compression tons/sq.ft.	Blows/Foot Standard Penetration	Hand Manipulation
Very Soft	less than 0.25	below 2	Easily penetrated by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated by thumb
Medium Stiff	0.50 – 1.0	4 – 8	Penetrated by thumb with moderate pressure
Stiff	1.0 – 2.0	8 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	15 – 30	Readily indented by thumb nail
Hard	over 4.0	over 30	Indented with difficulty by thumb nail

   b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled".

   c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

Description	Size	Description	Size
Boulders	Larger than 8"	Sand – Coarse	2.0 mm to 0.42 mm
Cobbles	8" to 3"	– Fine	0.42 mm to 0.074 mm
Gravel – Coarse	3" to ¾"	Silt	0.074 mm to 0.005 mm
– Fine	¾" to 2.0 mm	Clay	smaller than 0.005 mm

d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

trace	0 to 10%
little	10 to 20%
some	20 to 35%
"and"	35 to 50%

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

Term	Relative Moisture or Appearance
Dry	No moisture present
Damp	Internal moisture, but none to little surface moisture
Moist	Free water on surface
Wet	Voids filled with free water

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

Term	Relative Moisture or Appearance
Dry	Powdery
Damp	Moisture content slightly below plastic limit
Moist	Moisture content above plastic limit but below liquid limit
Wet	Moisture content above liquid limit

10. Rock Hardness and Rock Quality Designation

a. The following terms are used to describe the relative hardness of the **bedrock.**

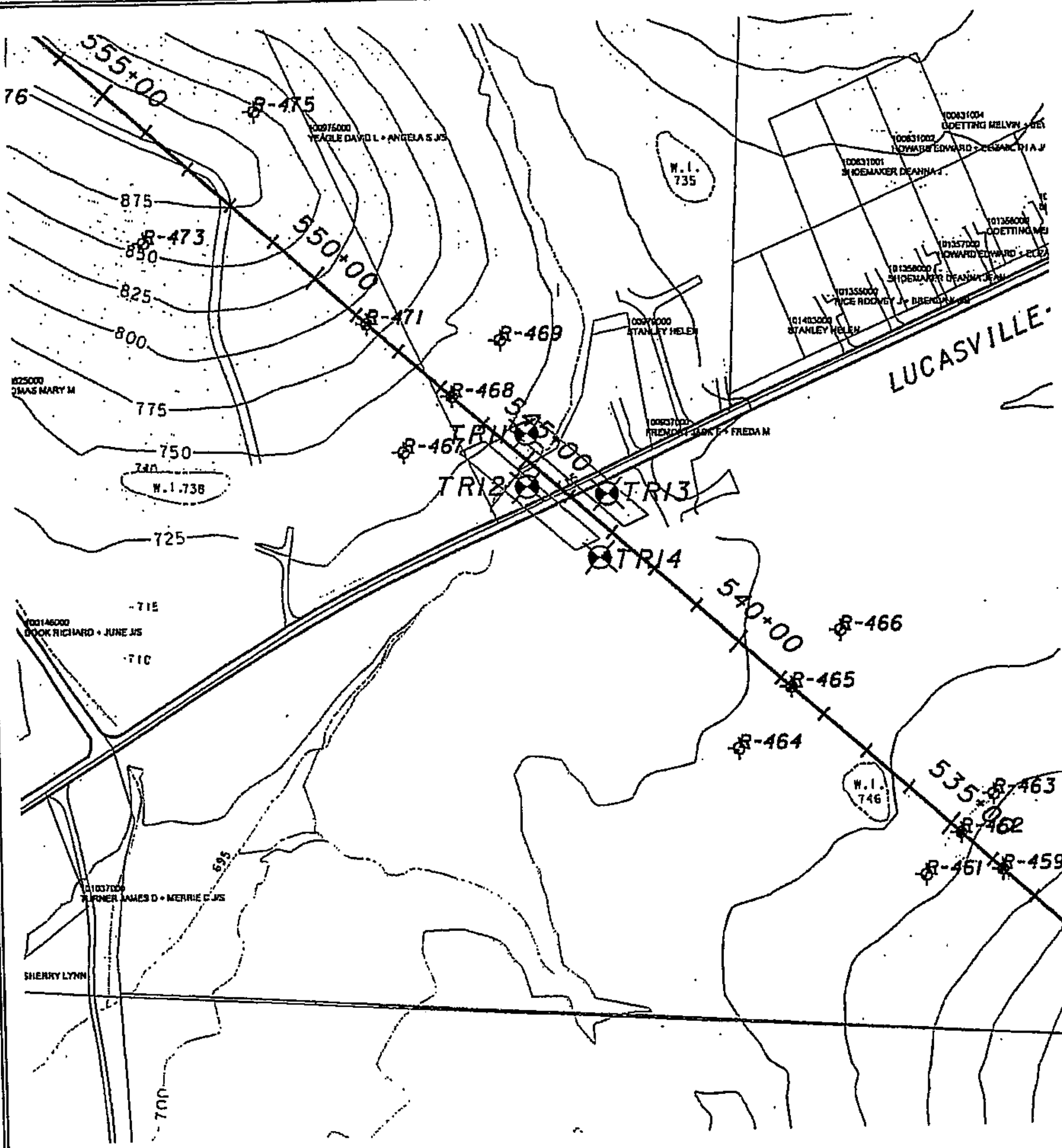
Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed hammer)
Medium Hard	Resists pencil point, but can be scratched with a knife blade. (Breaks easily under single hammer blow, but with crumbly edges.)
Hard	Can be deformed or broken by light to moderate hammer blows. (Breaks under one or two strong hammer blow, but with resistant sharp edges.)
Very Hard	Can be broken only by heavy and in some rocks repeated hammer blows.

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated graphically.

13. The standard penetration (N) value in blows per foot is indicated graphically.



Source: Topographic Mapping provided by TranSystems Corporation, Dated 2004

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SITE PLAN

Lucasvill-Minford Road

SCI-823 over SR 728

SCI-823-0.00

FIGURE 1.

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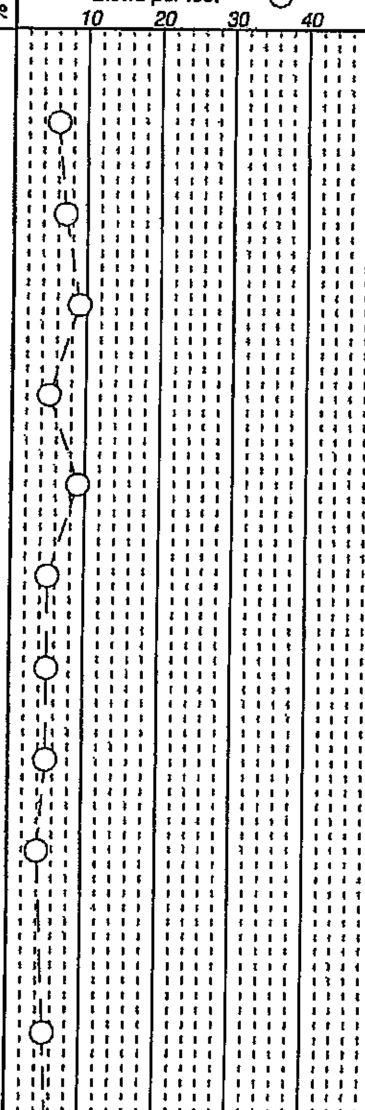
Client: TranSystems, Inc. **Project:** SCI-823-0.00 **Job No.** 0121-3070.03

LOG OF: Boring [redacted] **Location:** Forward Abutment SCI-823 over SR 728 **Date Drilled:** 3-16-05 to 3-17-05

WATER OBSERVATIONS:
Water seepage at: 23.5'
Water level at completion: Dry (Prior to coring)
21.9' (Includes drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0							Stiff to very stiff light brown CLAY (A-7-6), trace silt; damp.						
		1 3 3	18	1		2.5							
5		2 3 4	18	2		2.5							
		3 4 5	18	3		1.5	@ 6.0', 45° fractures.						
10		2 2 3	18	4		2.0							
		4 4 5	18	5		2.5	@ 11.0', gray.						
13.0							Soft to medium stiff gray CLAY (A-7-6); moist.						
15		2 2 3	18	6		0.75							
		2 2 3	18	7		0.75							
20		WOH 2 3	18	8		0.5							
		1 2 2	18	9		0.5							
25		WOH WOH 3	18	10		0.5							
		1 2 3	18	11		0.5							
30		WOH WOH 3	18	12		0.75	@ 28.5', contains sandstone fragments.						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○



FILE: 0121-3070-03 [3/31/2005 9:35 AM]

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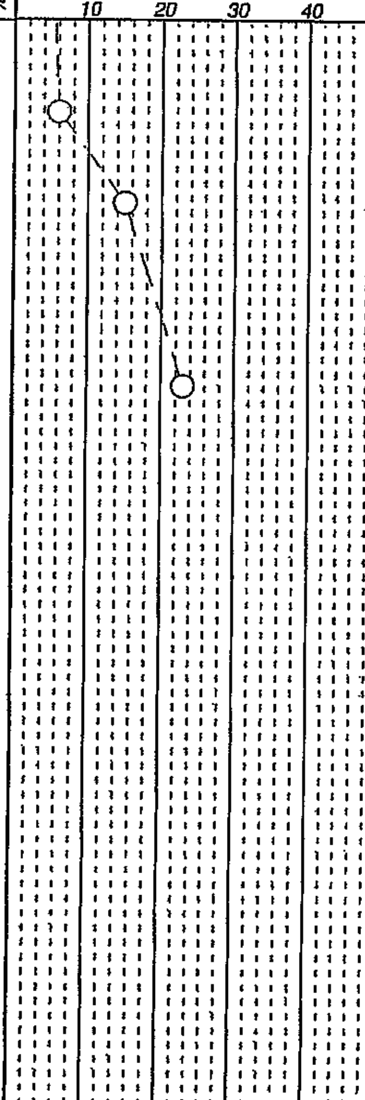
Client: TranSystems, Inc. **Project:** SCI-823-0.00 **Job No.** 0121-3070.03

LOG OF: Boring TR-11 **Location:** Forward Abutment SCI-823 over SR 728 **Date Drilled:** 3-16-05 to 3-17-05

WATER OBSERVATIONS:
Water seepage at: 23.5'
Water level at completion: Dry (Prior to coring)
21.9' (Includes drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30		1 2 4	18	13		0.5	Soft to medium stiff light brown CLAY (A-7-6); moist.						
33.0		8 6 9	18	14		0.75	Very stiff gray SILTY CLAY (A-6b), trace fine sand; damp to moist.						
35 / 40		7 8 15	18	15		2.5							
43.0 / 45		50/5	5	16		—	Soft to medium hard gray SHALE; moderately to highly weathered.						
47.0 / 50 / 55		Core 120"	Rec 120"	RQD 91%	R1		Medium hard gray SHALE; slightly to moderately weathered, micaceous, thinly laminated to very thinly bedded, slightly fractured.						
57.0 / 60							Bottom of Boring - 57.0'						

STANDARD PENETRATION (N)



FILE: 0121-3070-03 (3/31/2005 9:35 AM)

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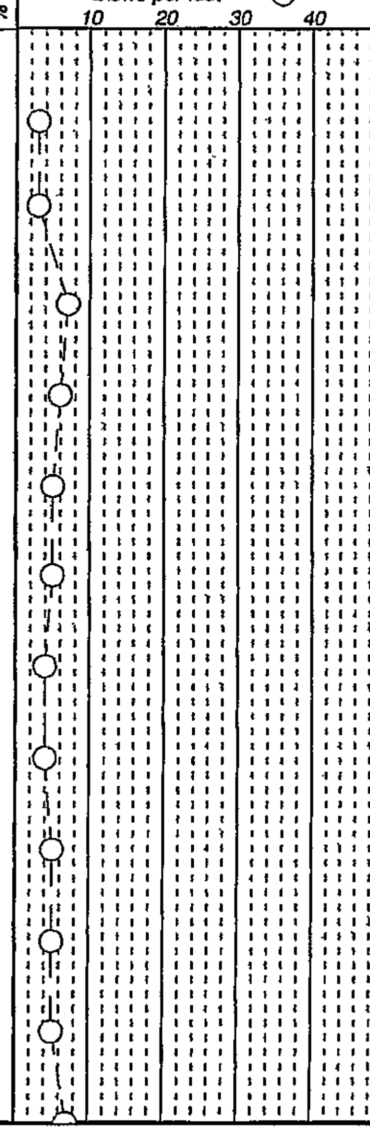
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-12 | Location: Pier #2 SCI-823 over SR 728 | Date Drilled: 3/17/05

WATER OBSERVATIONS: Water seepage at: 10.5'-30.5'
Water level at completion: 10.1' (including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0		1 1 2	18	1		0.75-1.25	POSSIBLE FILL: Medium stiff to stiff brown GRAVEL WITH SAND AND SILT (A-2-4), some fine to coarse sand, trace gravel; moist to wet.						
		WOH 1 2	16	2		'---							
5 - 5.5		3 3 4	18	3		2.5	Very stiff brown and gray CLAY (A-7-6); varved; moist.						
		1 2 4	18	4		2.25							
10 - 10.5		WOH 2 3	18	5		0.75	Medium stiff brownish gray CLAY (A-7-6); varved; moist to wet.						
		WOH 2 3	18	6		0.75							
15		WOH 2 2	18	7		0.5							
		WOH 2 2	18	8		0.5							
20		WOH 2 3	18	9		0.5							
		1 2 3	18	10		0.75							
25		1 2 3	18	11		0.5							
30		3 3 4	18	12		0.5							

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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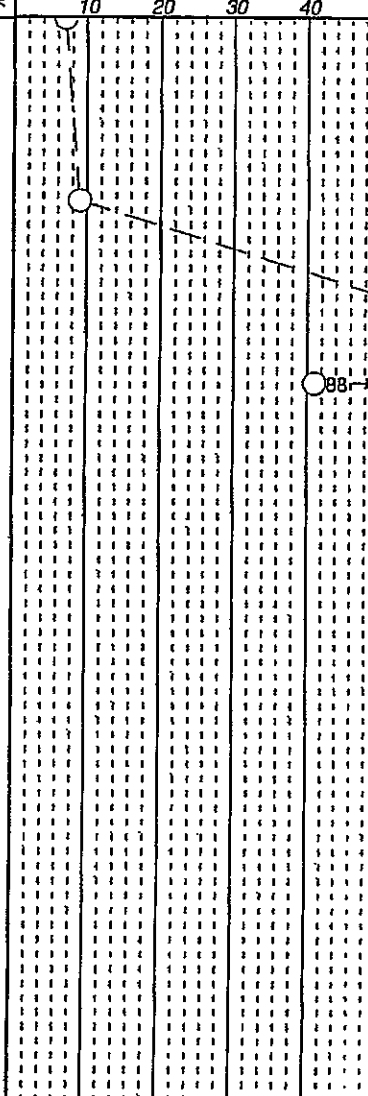
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-12 | Location: Pier #2 SCI-823 over SR 728 | Date Drilled: 3/17/05

WATER OBSERVATIONS: Water seepage at: 10.5'-30.5'
Water level at completion: 10.1' (Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30 – 30.5													
30.5 – 38.5		2 3 6	18	13		1.5	Stiff gray and brown SANDY SILT (A-4a), little gravel; varved; damp.						
38.5 – 40.0		12 38 50/4	16	14		4.5+	Soft gray SHALE; highly weathered to decomposed.						
40.0 – 50.0		Core 120"	Rec 120"	RQD 92%	R1		Medium hard gray SHALE; slightly weathered. @ 45.9'-48.2', light brown siltstone layer.						
50.0							Bottom of Boring - 50.0'						

Depth scale: 30, 35, 45, 55, 60



FILE: 0121-3070-03 (3/31/2005 9:35 AM)

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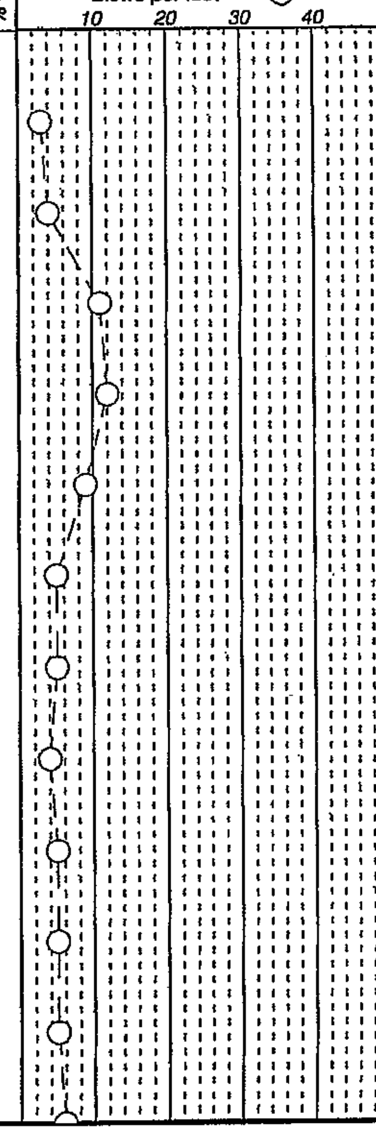
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-13 | *Location:* Pier #1 SCI-823 over SR 728 | *Date Drilled:* 6/8/04

WATER OBSERVATIONS: Water seepage at: 33.5'-35.0'
Water level at completion: Dry (Prior to coring)
28.6'(Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0 – 0.6							Topsoil - 6"						
0.6		1 1 2	10	1		1.75	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, trace to little gravel; moist.						
5		1 2 2	16	2		1.25							
		2 4 7	18	3		3.5	@6.0' - 7.5', gray, contains rust stains.						
8.5		3 5 7	18	4		3.25	Stiff to very stiff mottled brown and gray CLAY (A-7-6), little fine to coarse sand; moist.						
10		2 3 6	18	5		2.25							
		1 2 3	18	6		1.25							
15		1 2 3	18	7		2.0							
		1 2 2	18	8		1.5							
20		1 2 3	18	9		0.75	@21.0' - 22.5', medium stiff, gray.						
		1 2 3	18	10		1.0							
25 – 25.5		WOH 2 3	18	11		1.5	Stiff grayish brown SILT AND CLAY (A-6a), little fine sand; moist.						
28.0 – 30		2 2 4	18	12		1.5	Stiff grayish brown CLAY (A-7-6), little fine sand; moist.						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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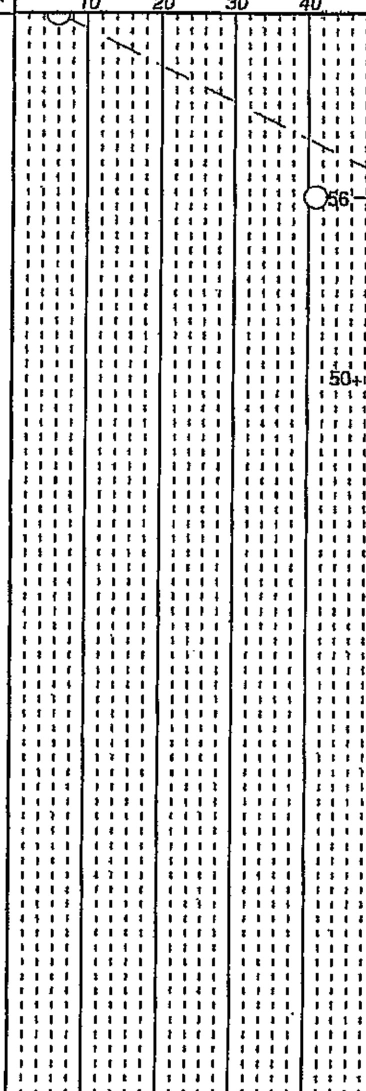
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-13 | *Location:* Pier #1 SCI-823 over SR 728 | *Date Drilled:* 6/8/04

WATER OBSERVATIONS:
Water seepage at: 33.5'-35.0'
Water level at completion: Dry (Prior to coring)
28.6'(Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0 – 40.0		8 24 32	18	13		3.0	Very stiff to hard brown and gray SANDY SILT (A-4a), little gravel; contains rock fragments; damp to moist. (SEVERELY WEATHERED AND DECOMPOSED SHALE)						
		27 49 50/2	16	14		4.5+							
40.0 – 50.0		Core 120"	Rec 61"	RQD 25%	R-1		Medium hard gray SILTSTONE; fissile. @40.0' - 44.9', core loss. @46.6' - 46.8', clay seam. @47.8' - 50.0', broken to highly fractured with occasional clay seams.						
50.0							Bottom of Boring - 50.0'						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ *LL*
Blows per foot - ○
10 20 30 40



FILE: 0121-3070-03 [3/31/2005 9:35 AM]

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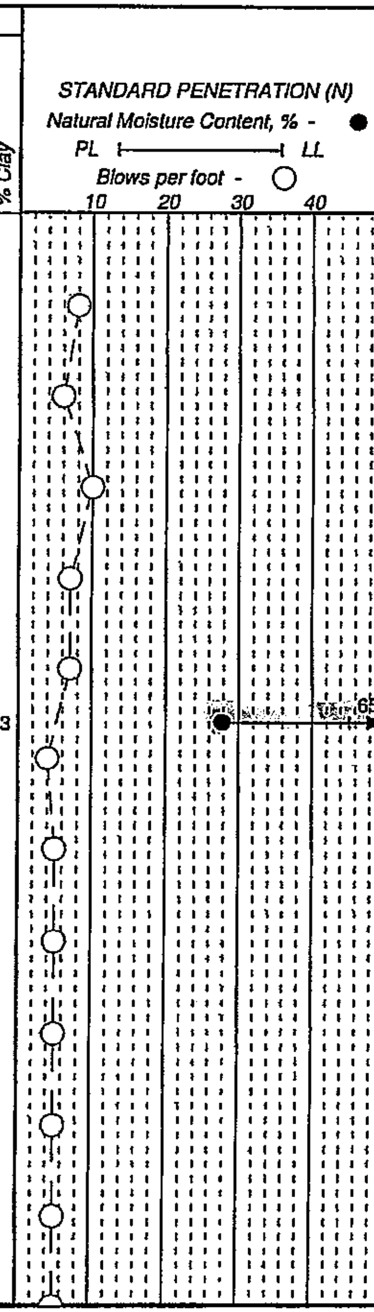
Client: TranSystems, Inc. | **Project:** SCI-823-0.00 | **Job No.** 0121-3070.03

LOG OF: Boring TR-14 | **Location:** Rear Abutment SCI-823 over SR 728 | **Date Drilled:** 6/4/04 to 6/7/04

WATER OBSERVATIONS:
Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0							Very stiff brown and gray SILTY CLAY (A-6b), little fine to coarse sand; moist.						
		2 3 5	18	1		2.25							
5		2 2 4	18	2		3.75							
		2 4 6	18	3		2.75	@6.0' - 7.5', gray.						
8.5							Stiff to very stiff brown CLAY (A-7-6), trace to little fine to coarse sand; damp to moist.						
10		2 3 4	18	4		2.75							
		2 3 4	18	5		2.25							
15		WOH 2 2	18	6	ST-1	1.0	@13.5', becomes gray.	0	0	--	0	7	93
		WOH 2 3	18	7		1.5							
20		1 2 3	18	8		1.25							
		1 2 3	18	9		1.25							
25		1 2 3	18	10		1.5							
		2 2 3	18	11		1.25							
30		2 2 3	18	12		2.0							



FILE: 0121-3070-03 (3/31/2005 9:35 AM)

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Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-14 | Location: Rear Abutment SCI-823 over SR 728 | Date Drilled: 6/4/04 to 6/7/04

WATER OBSERVATIONS: Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Blows per foot
30.0							Very dense brown SANDY SILT (A-4a), some gravel; contains rock fragments; moist.							
35		14 28 40	18	13										68
40		40 50/4	12	14										50+
43.5		50/4	4	15			Severely weathered gray SILTSTONE.							
44.0 / 45		Core 60"	Rec 54"	RQD 72%	R-1		Medium hard gray SILTSTONE; fissile. @45.7', 46.4', 49.3', 50.7',53.0'; clay seams @46.1' - 46.7', 49.0' - 49.3'; broken to highly fractured.							
50		Core 60"	Rec 56"	RQD 77%	R-2		@53.5' - 53.7', vertical fracture.							
54.0 / 55 / 60							Bottom of Boring - 54.0'							

STANDARD PENETRATION (N): Natural Moisture Content, % - ●; PL ├──┤ LL; Blows per foot - ○; 10 20 30 40

FILE: 0121-3070-03 [3/31/2005 9:35 AM]

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July 24, 2006

Michael D. Weeks, P.E., P.S.
TranSystems Corporation
5747 Perimeter Drive, Suite 240
Dublin, OH 43017

Re: **Preliminary MSE Wall Evaluations**
SCI-823 over Lucasville-Minford Road
SCI-823-0.00 Portsmouth Bypass
DLZ Job No.: 0121-3070.03
Document # 0013

Dear Mr. Weeks:

This letter includes the findings of preliminary evaluations of mechanically stabilized earth (MSE) retaining walls on the above-referenced project. The findings included in this letter pertain to the MSE walls at the crossing of proposed SR 823 and Lucasville-Minford Road. The findings of other preliminary MSE wall evaluations will be submitted in separate documents.

It should be noted that the results of these evaluations are based upon the findings of four preliminary structural borings and one roadway boring. After the bridge design is finalized, it may be necessary to drill additional borings in the area of the proposed MSE walls in accordance with ODOT's Specifications for Subsurface Investigations in order to finalize the MSE wall evaluations. Boring logs for borings TR-11 through TR-14 and B-1223 are attached.

An MSE retaining wall essentially consists of good quality backfill material with layers of metal or plastic reinforcing that are attached to concrete facing panels. The MSE wall and associated backfill should be constructed in accordance with the specifications of the manufacturer of the MSE wall.

At the time this letter was prepared, it was understood that the plan location of the bridge structure for proposed SR 823 over Lucasville-Minford Road as shown on the plan and profile drawings dated July 10, 2005 is still current. See attached plan and profile drawings. Using this configuration, MSE walls will be placed at approximate stations 538+00 and 539+00 to contain the abutments and hold back the roadway embankment for proposed SR 823. Furthermore, it is understood that the full height of the MSE wall at station 539+00 (Rear Abutment) will be approximately 44 feet. Similarly, the maximum height of the MSE wall at station 539+00 (Forward Abutment) is also understood to be approximately 46 feet high.

A preliminary global stability analysis and preliminary bearing capacity analysis were performed for the MSE walls at this bridge location in accordance with ODOT and AASHTO guidelines.

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At the time this letter was prepared, it was not known what foundation type was to be used at this site to support the bridge abutments. However, given the soil conditions, the site seems to be best suited for deep foundations. Consequently, the use of deep foundations to support the structure is assumed for the purposes of these analyses. Once a foundation type has been selected, DLZ should be informed so that the analyses may be revised as necessary.

Preliminary calculations for bearing capacity, as well as the results of the global stability analyses are attached. Other external and internal stability analyses are required for the design of an MSE wall, but are considered outside the scope of this report. The parameters required to perform the stability analyses are presented below.

In accordance with ODOT guidelines, a unit weight of 120 pcf and a friction angle of 34 degrees were selected for the backfill material in the reinforced zone. Similarly, the fill material used to construct the roadway embankments is assumed to have a unit weight of 120 pcf and a friction angle of 30 degrees. If the embankment fill material or backfill material for the reinforcing zone has properties significantly different from these values, DLZ should be informed so that the analyses may be revised as necessary.

The forward abutment location was analyzed at this structure location. The proposed embankment is slightly higher at the forward abutment location than at the rear abutment. The results of the analyses pertain to both the rear and forward abutment locations. It should be noted, variations may be found in borings drilled for the final design that may change the results of these analyses.

MSE Wall Evaluation Stations 538+00 and 539+00
Rear and Forward Abutments, SR 823 Over Lucasville-Minford Road

In the area of the proposed MSE wall at the rear abutment location, boring TR-13 generally encountered 6 inches of topsoil at the surface. Below the topsoil layer, primarily stiff sandy silt (A-4a) was encountered to a depth of 3.0 feet below the ground surface. Below 3.0 feet, primarily stiff to very stiff silt and clay (A-6a) was encountered to a depth of 8.5 feet below the ground surface. Below 8.5 feet, primarily medium stiff clay (A-7-6) was encountered to a depth of 30.0 feet. Below 30.0 feet, primarily very stiff sandy silt (A-4a) was encountered to a depth of 40.0 feet, at the top of bedrock. Underlying the soil, this boring encountered medium hard siltstone to the bottom of the boring at 50.0 feet.

Similarly, in the area of the proposed MSE wall at the forward abutment location, boring TR-11 generally encountered 4 inches of topsoil at the surface. Below the topsoil layer, primarily stiff to very stiff clay (A-7-6) was encountered to a depth of 13.0 feet. Below 13.0 feet, primarily soft to medium stiff clay (A-7-6) was encountered to a depth of 30.5 feet. Below 30.5 feet, medium stiff silty clay (A-6b) was encountered to a depth of 43.0 feet. Underlying the soil, this boring encountered severely weathered gray shale to a depth of 47.0 feet. Below 47.0 feet, medium hard sandstone was encountered to the bottom of the boring at 57.0 feet.

The MSE wall at the rear abutment is assumed to have a maximum height of approximately 44 feet. Similarly, the MSE wall at the forward abutment is understood to have a maximum height of approximately 46 feet.

Initial analyses for the MSE walls bearing on the native soils at this location yielded factors of safety below the minimum recommended values for undrained and drained global stability. As a result, a global stability analysis was performed assuming a five-foot undercut and replacement with compacted granular fill. This analysis also yielded inadequate factors of safety. Consequently, the use of MSE walls at this location is not recommended.

In lieu of MSE walls at this location, spill through slopes were analyzed. It is understood that the maximum embankment height will be approximately 46 feet at the forward abutment location. Assuming 2H:1V slopes, stability analyses have yielded factors of safety for the drained and drained-seismic conditions of 1.38 and 1.27 respectively. These factors of safety are marginally acceptable. However, the undrained strength of the foundation soils is not adequate. As a result, additional analyses were performed to determine the maximum embankment height that is permissible using staged construction. These analyses indicate that a maximum construction stage of 30 feet may be used while maintaining undrained stability. Consequently, it is recommended that 2H:1V or flatter slopes built with a maximum stage of 30 feet be used to construct the spill-through slopes at the rear and forward abutment locations. A significant settlement period will be necessary between the construction stages. The embankments in this area will most likely require vertical drains to expedite the consolidation process. Additionally, the magnitude of settlement for a 46-foot, continuous embankment in this area has been estimated to be approximately 28 inches. The recommendations for wick drains and time-rate of consolidation calculations will be included in the embankment recommendations portion of the SR 823 / Lucasville-Minford Road Interchange report.

It should be noted that the factors of safety for drained (long-term) global stability is marginal using 2H:1V slopes. As per FHWA guidelines, assuming the structure is supported on deep foundations, the minimum factor of safety for global stability used is 1.3. Additional borings

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may be required in accordance with ODOT's Specifications for Subsurface Investigations for the final bridge configurations. If these borings encounter poorer soil conditions than what is presently known, the analyses may have to be revised, thus potentially rendering 2H:1V slopes unacceptable at this location.

Calculations for bearing capacity and drawings showing the results of the global stability analyses for the MSE wall are attached. A settlement analysis, considering a 46-foot high continuous embankment is also attached in addition to the results of strength and consolidation testing.

We appreciate having the opportunity to be of service to you on this project. Please do not hesitate to call if you have any questions concerning our preliminary findings.

Respectfully submitted,

DLZ OHIO, INC.

Steven J. Riedy
Geotechnical Engineer

Dorothy A. Adams

Dorothy A. Adams, MSCE, P.E.
Senior Geotechnical Engineer

Encl: As noted

cc: file

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GENERAL INFORMATION
DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.

2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.

3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.

   50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.

4. The length of the sampler drive is indicated graphically by horizontal lines across the "Standard Penetration" and "Recovery" columns.

5. Sample recovery from each drive is indicated numerically in the column headed "Recovery".

6. The drive sample location is designated by the heavy vertical bar in the "Sample No., Drive" column.

7. The length of hydraulically pressed "Undisturbed" samples is indicated graphically by horizontal lines across the "Press" column.

8. Sample numbers are designated consecutively, increasing in depth.

9. Soil Description

   a. The following terms are used to describe the relative compactness and consistency of soils:

   Granular Soils – Compactness

Term	Blows/Foot Standard Penetration
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	over 50

   Cohesive Soils – Consistency

Term	Unconfined Compression tons/sq.ft.	Blows/Foot Standard Penetration	Hand Manipulation
Very Soft	less than 0.25	below 2	Easily penetrated by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated by thumb
Medium Stiff	0.50 – 1.0	4 – 8	Penetrated by thumb with moderate pressure
Stiff	1.0 – 2.0	8 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	15 – 30	Readily indented by thumb nail
Hard	over 4.0	over 30	Indented with difficulty by thumb nail

   b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled".

   c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

Description	Size	Description	Size
Boulders	Larger than 8"	Sand – Coarse	2.0 mm to 0.42 mm
Cobbles	8" to 3"	– Fine	0.42 mm to 0.074 mm
Gravel – Coarse	3" to ¾"	Silt	0.074 mm to 0.005 mm
– Fine	¾" to 2.0 mm	Clay	smaller than 0.005 mm

d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

trace	0 to 10%
little	10 to 20%
some	20 to 35%
"and"	35 to 50%

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

Term	Relative Moisture or Appearance
Dry	No moisture present
Damp	Internal moisture, but none to little surface moisture
Moist	Free water on surface
Wet	Voids filled with free water

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

Term	Relative Moisture or Appearance
Dry	Powdery
Damp	Moisture content slightly below plastic limit
Moist	Moisture content above plastic limit but below liquid limit
Wet	Moisture content above liquid limit

10. Rock Hardness and Rock Quality Designation

a. The following terms are used to describe the relative hardness of the **bedrock.**

Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed hammer)
Medium Hard	Resists pencil point, but can be scratched with a knife blade. (Breaks easily under single hammer blow, but with crumbly edges.)
Hard	Can be deformed or broken by light to moderate hammer blows. (Breaks under one or two strong hammer blow, but with resistant sharp edges.)
Very Hard	Can be broken only by heavy and in some rocks repeated hammer blows.

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated graphically.

13. The standard penetration (N) value in blows per foot is indicated graphically.

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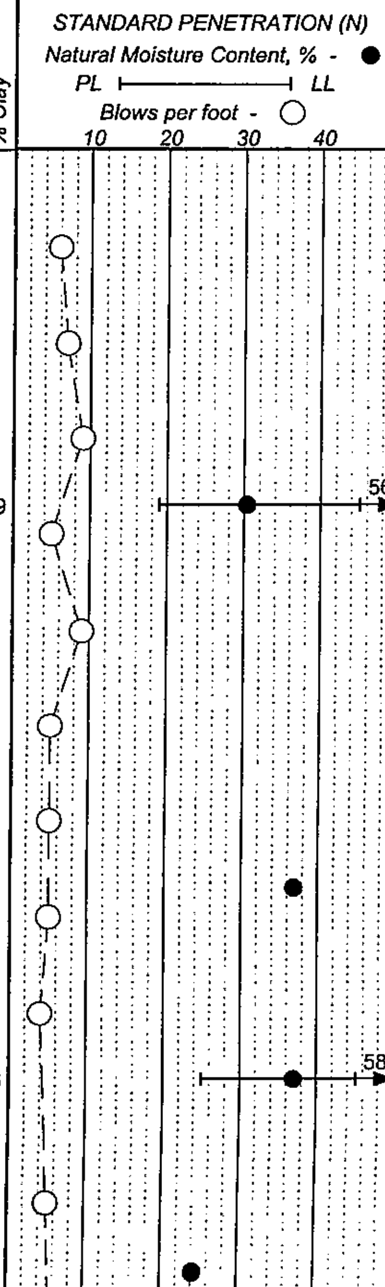
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-11 | *Location:* Forward Abutment SCI-823 over SR 728 | *Date Drilled:* 3-16-05 to 3-17-05

WATER OBSERVATIONS: Water seepage at: 23.5'
Water level at completion: None (Prior to coring)
21.9' (Includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press/Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	722.5												
0.3	722.2						Topsoil - 4"						
		1 3 3	18	1		2.5	Stiff to very stiff light brown CLAY (A-7-6), some silt, trace fine sand; damp.						
5		2 3 4	18	2		2.5							
		3 4 5	18	3		1.5	@ 6.0', 45° fractures.						
10		2 2 3	18	4		2.0		0	0	--	1	20	79
		4 4 5	18	5		2.5	@ 11.0', gray.						
13.0	709.5												
15		2 2 3	18	6		0.75	Soft to medium stiff brown CLAY (A-7-6); moist.						
		2 2 3	18	7		0.75	@ 16.0', gray.						
20		WOH 2 3	18	8		0.5							
		1 2 2	18	9		0.5							
25		WOH WOH 3	18	10		0.5		0	0	--	0	14	86
		1 2 3	18	11		0.5							
30		WOH WOH 3	18	12		0.5	@ 28.5', contains sandstone fragments.						



FILE: 0121-3070-03 [7/24/2006 9:11 AM]

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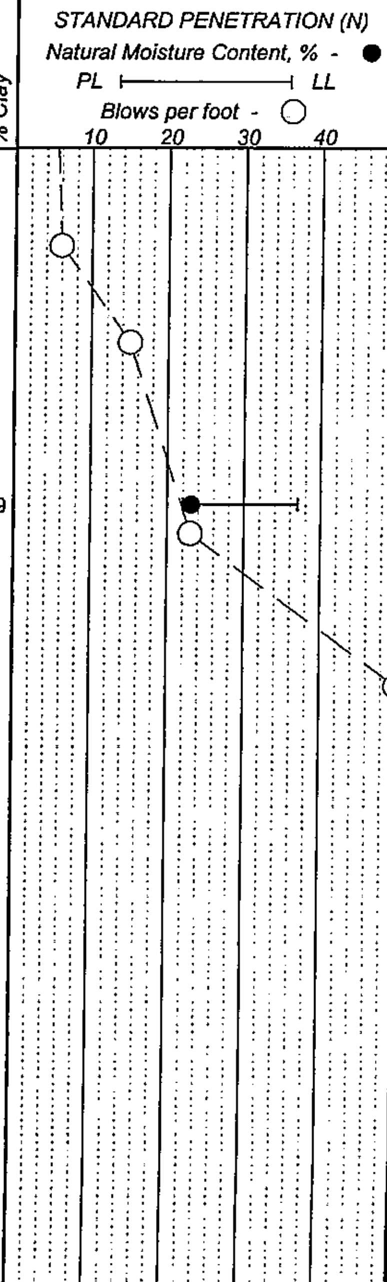
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-11 | *Location:* Forward Abutment SCI-823 over SR 728 | *Date Drilled:* 3-16-05 to 3-17-05

WATER OBSERVATIONS: Water seepage at: 23.5'
Water level at completion: None (Prior to coring)
21.9' (Includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	692.5												
30.5	692.0						Medium stiff gray and light brown SILTY CLAY (A-6b), trace fine sand; moist.						
		1 2 4	18	13		0.5							
		8 6 9	18	14		0.75							
35													
		7 8 15	18	15		2.5	@ 38.5', Very stiff.	0	0	–	1	50	49
40													
43.0	679.5						Severely weathered gray SHALE.						
		50/5	5	16									
45													
47.0	675.5						Medium hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly laminated to very thinly bedded, slightly fractured, contains abundant argillaceous laminations.						
50													
		Core 120"	Rec 120"	RQD 91%	R1								
55													
57.0	665.5						Bottom of Boring - 57.0'						
60													



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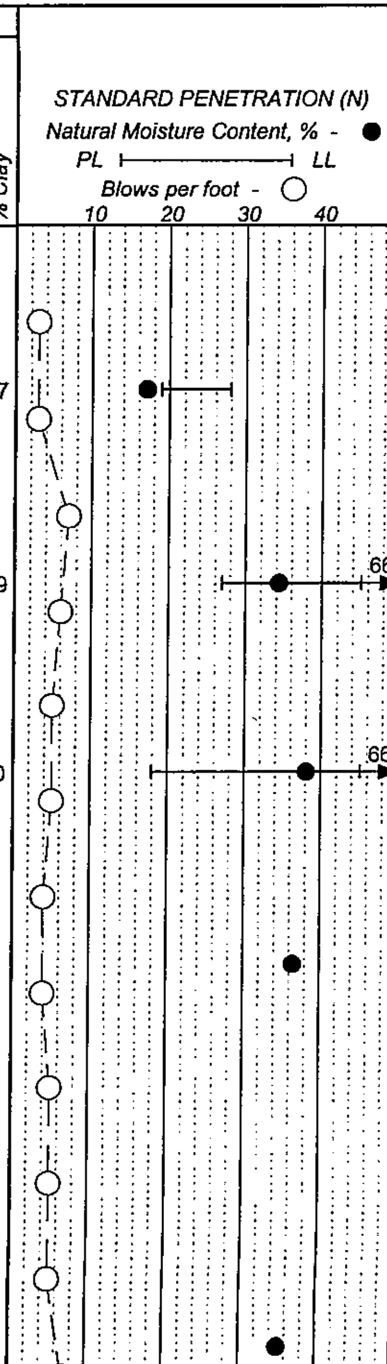
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-12 | Location: Pier #2 SCI-823 over SR 728 | Date Drilled: 3/17/05

WATER OBSERVATIONS: Water seepage at: 10.5'-30.5'
Water level at completion: None (prior to coring)
10.1' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	722.5												
0.4	722.1						Topsoil - 5"						
		1 1 2	18	1		0.75	POSSIBLE FILL: Medium stiff to stiff brown SANDY SILT (A-4a), some gravel, little clay; moist to wet.						
		WOH 1 2	16	2		--		30	15	--	11	27	17
5.5	717.0						Very stiff brown and gray CLAY (A-7-6); varved; moist to wet.						
		3 3 4	18	3		2.5							
		1 2 4	18	4		2.25		0	0	--	0	11	89
		WOH 2 3	18	5		0.75	@ 11.0', Medium stiff, brownish gray.						
		WOH 2 3	18	6		0.75		0	0	--	0	10	90
		WOH 2 2	18	7		0.5							
		WOH 2 2	18	8		0.5							
		WOH 2 3	18	9		0.5							
		1 2 3	18	10		0.75							
		1 2 3	18	11		0.5							
30		3 3 4	18	12		0.5							



FILE: 0121-3070-03 [7/24/2006 9:11 AM]

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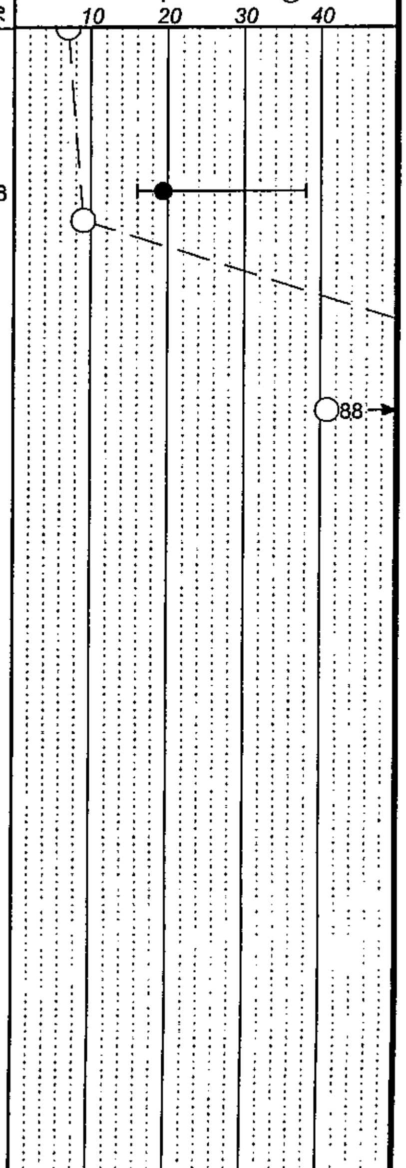
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-12 | Location: Pier #2 SCI-823 over SR 728 | Date Drilled: 3/17/05

WATER OBSERVATIONS: Water seepage at: 10.5'-30.5'
Water level at completion: None (prior to coring)
10.1' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0	692.5						Stiff gray and brown SILTY CLAY (A-6b), little fine to coarse sand, trace gravel; varved; damp.						
35		2 3 6	18	13		1.5		1	5	–	8	58	28
37.0	685.5						Severly weathered gray SHALE.						
		12 38 50/4	16	14		4.5+							
40.0	682.5						Medium hard gray SANDSTONE; very fine grained, highly weathered to decomposed, argillaceous, micaceous, slightly fractured, contains ferric bands and abundant argillaceous laminations, fissile after desiccation.						
45		Core 120"	Rec 120"	RQD 92%	R1		@ 45.9' to 48.2', light brown siltstone layer.						
50.0	672.5						Bottom of Boring - 50.0'						
55													
60													

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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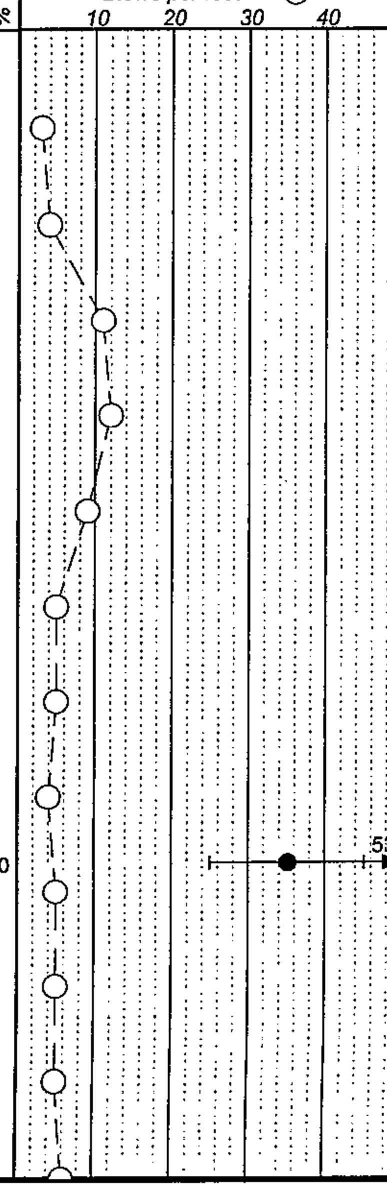
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-13 | Location: Pier #1 SCI-823 over SR 728 | Date Drilled: 6/8/04

WATER OBSERVATIONS: Water seepage at: 33.5'-35.0'
Water level at completion: None (prior to coring)
28.6' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	713.5												
0.6	712.9						Topsoil - 6"						
		1 1 2	10	1		1.75	Stiff gray SANDY SILT (A-4a), some clay, trace gravel; organic odor; moist.						
3.0	710.5	1 2 2	16	2		1.25	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, trace to little gravel; moist.						
5		2 4 7	18	3		3.5	@ 6.0'-7.5', moltted brown and gray.						
8.5	705.0	3 5 7	18	4		3.25	Stiff to very stiff mottled brown and gray CLAY (A-7-6), little fine to coarse sand; moist.						
10		2 3 6	18	5		2.25							
		1 2 3	18	6		1.25							
15		1 2 3	18	7		2.0	@ 16.0'-27.5', gray.						
		1 2 2	18	8		1.5							
20		1 2 3	18	9		0.75	@ 21.0'-22.5', medium stiff.	0	0	–	1	19	80
		1 2 3	18	10		1.0							
25		WOH 2 3	18	11		1.5	@ 26.0', contains sand seams.						
30		2 2 4	18	12		1.5							

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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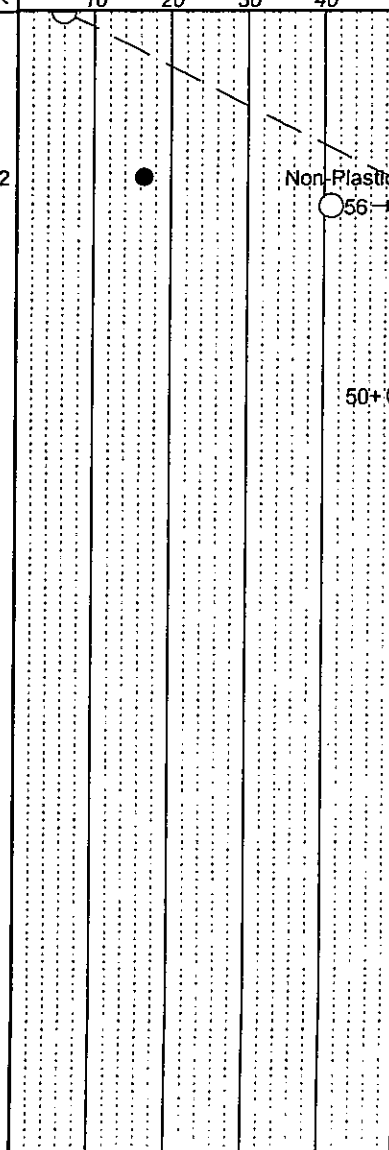
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-13 | *Location:* Pier #1 SCI-823 over SR 728 | *Date Drilled:* 6/8/04

WATER OBSERVATIONS: Water seepage at: 33.5'-35.0'
Water level at completion: None (prior to coring)
28.6' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0	683.5						Very stiff to hard gray and brown SANDY SILT (A-4a), little clay, trace gravel; contains sandstone fragments; damp to moist.						
35		8 24 32	18	13		3.0		5	10	–	25	48	12
		27 49 50/2	16	14		4.5+							
40.0	673.5						Medium hard gray SILTSTONE; fissile. @40.0' - 44.9', core loss.						
45		Core 120"	Rec 61"	RQD 25%	R-1		@46.6' - 46.8', clay seam. @47.8' - 50.0', broken to highly fractured with occasional clay seams.						
50.0	663.5						Bottom of Boring - 50.0'						
55													
60													

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○
10 20 30 40



FILE: 0121-3070-03 [7/24/2006 9:11 AM]

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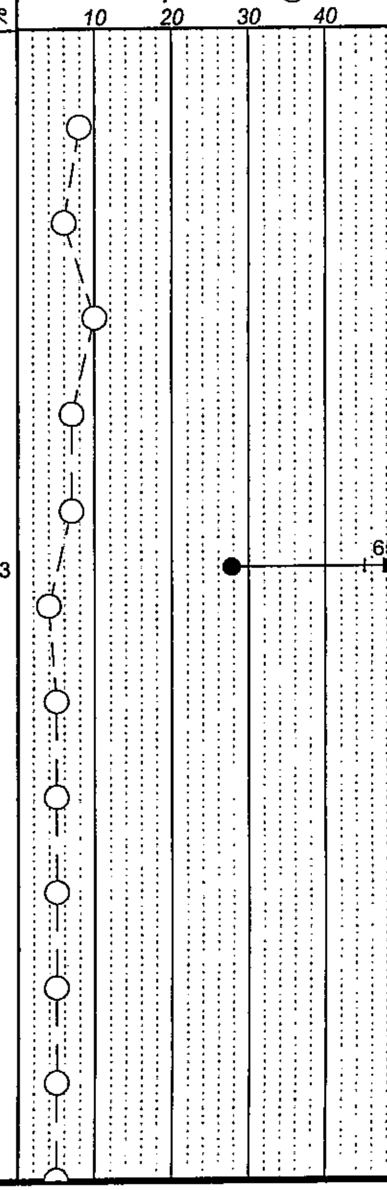
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-14 | Location: Rear Abutment SCI-823 over SR 728 | Date Drilled: 6/4/04 to 6/7/04

WATER OBSERVATIONS: Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	713.6												
0.3	713.3						Topsoil - 4"						
		2 3 5	18	1		2.25	Very stiff brown and gray SILTY CLAY (A-6b), little fine to coarse sand; moist.						
5		2 2 4	18	2		3.75							
		2 4 6	18	3		2.75	@6.0' - 7.5', gray.						
8.5	705.1	2 3 4	18	4		2.75	Stiff to very stiff brown CLAY (A-7-6), trace to little fine to coarse sand; varved; damp to moist.						
10		2 3 4	18	5		2.25							
15		WOH 2 2	18	6	ST-1	1.0	@13.5', gray.	0	0	--	0	7	93
		WOH 2 3	18	7		1.5							
20		1 2 3	18	8		1.25							
		1 2 3	18	9		1.25							
25		1 2 3	18	10		1.5	@ 23.5', gray and brown.						
		2 2 3	18	11		1.25							
30		2 2 3	18	12		2.0	@ 28.5', contains sand seams.						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-14 | Location: Rear Abutment SCI-823 over SR 728 | Date Drilled: 6/4/04 to 6/7/04

WATER OBSERVATIONS: Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Blows per foot
30	683.6						Stiff to very stiff gray and brown CLAY (A-7-6), trace to little fine to coarse sand; varved; contains sand seams; damp to moist.							
33.5	680.1	14 28 40	18	13			Severely weathered gray SILTSTONE.							68
		40 50/4	12	14										50+
44.0	669.6	50/4	4	15			Medium hard gray SILTSTONE; fissile.							
		Core 60"	Rec 54"	RQD 72%	R-1		@45.7', 46.4', 49.3', 50.7',53.0'; clay seams @46.1' - 46.7', 49.0' - 49.3'; broken to highly fractured.							
		Core 60"	Rec 56"	RQD 77%	R-2		@53.5' - 53.7', vertical fracture.							
54.0	659.6						Bottom of Boring - 54.0'							

STANDARD PENETRATION (N): Natural Moisture Content, % - ●; PL ⊢—⊣ LL; Blows per foot - ○; 10 20 30 40

FILE: 0121-3070-03 (7/24/2006 9:11 AM)

DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

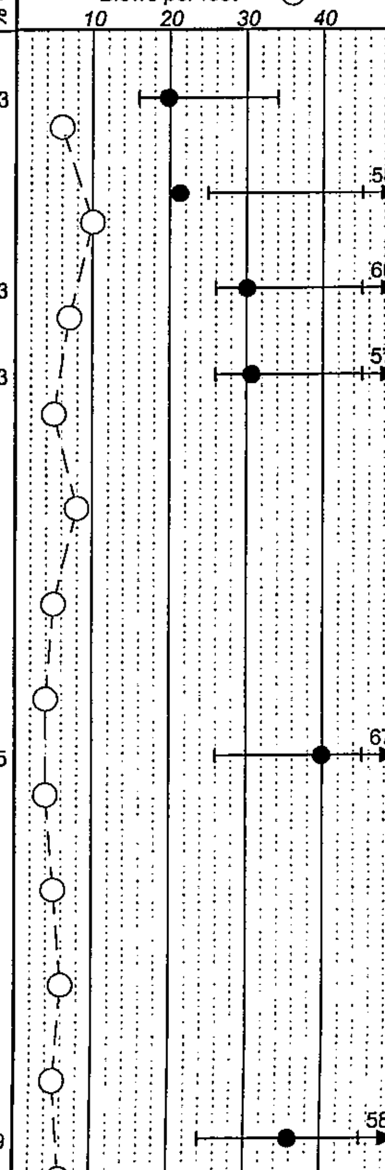
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring B-1223 | *Location:* As per plan | *Date Drilled:* 8/03/05

WATER OBSERVATIONS: Water seepage at: 39.0'
Water level at completion: 44.0' (inside hollowstem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press/Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	717.4												
0.5	716.9						Topsoil - 6"						
		2 2 4	8	1		2.75	Very stiff brown SILTY CLAY (A-6b), little fine to coarse sand; moist.	0	1	–	10	46	43
3.5	713.9	1 4 6	8	2		4.5+	Hard brown CLAY (A-7-6), trace fine to coarse sand; contains roots; damp.	0	3	–	4	93	
6.0	711.4	2 3 4	18	3		2.75	Stiff to very stiff brown and gray CLAY (A-7-6), trace to little silt; moist.	0	0	–	0	7	93
		2 2 3	18	4	P1	2.5		0	0	–	0	17	83
		2 4 4	18	5		2.0	@ 11.0'-12.5', contains few silt seams.						
		1 2 3	18	6		1.5	@ 13.5', becomes gray.						
		1 2 2	18	7		0.75	@ 16.0'-17.5', medium stiff.						
		1 2 2	18	8	P2	1.25		0	0	–	0	5	95
		1 2 3	18	9		1.0	@ 21.0'-22.5', 28.5'-30.0, contains few silt seams.						
		1 3 3	18	10		1.25							
		2 2 3	18	11		1.0							
		2 2 4	18	12	P3	1.5		0	0	–	0	21	79

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○



FILE: 0121-3070-03 [7/24/2006 9:11 AM]

DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring B-1223 | Location: As per plan | Date Drilled: 8/03/05

WATER OBSERVATIONS: Water seepage at: 39.0'
Water level at completion: 44.0' (inside hollowstem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	Standard Penetration (N)
30	687.4						Medium stiff gray CLAY (A-7-6) , trace fine to coarse sand; moist.							
35		1 3 9	18	13		0.5	@ 34.9'-35.0', silt seam.							
38.5	678.9	9 14 13	17	14		2.0	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, little gravel; damp.							
43.5	673.9	8 20 50/4	12	15			Decomposed gray SILTSTONE, arenaceous.							50+
48.8	668.6	50/3	3	16			Bottom of Boring - 48.8'							50+

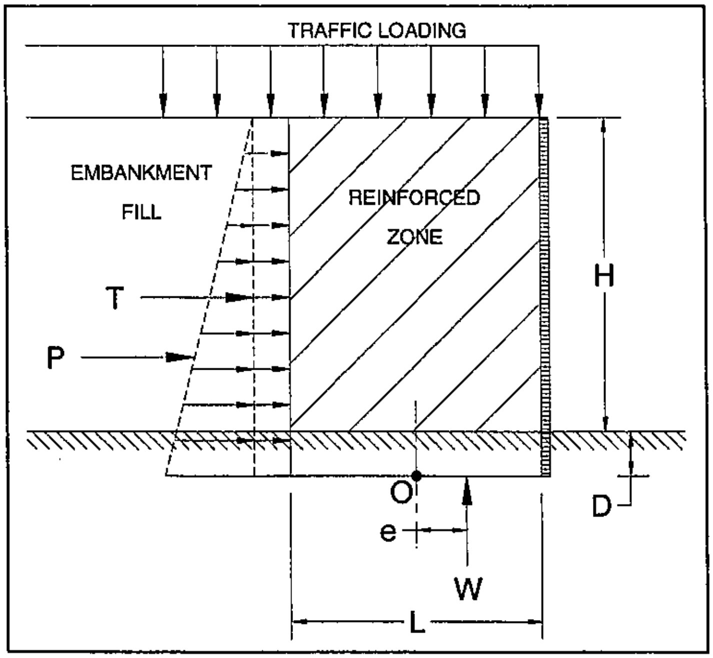
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○
10 20 30 40

FILE: 0121-3070-03 [7/24/2006 9:11 AM]

SUBJECT		JOB NUMBER	0121-3070.03
Client	TranSystems	SHEET NO.	OF
Project	SCI 823-0.00	COMP. BY	SJR DATE 7/19/06
Item	Bearing Capacity	CHECKED BY	DATE
Lucasville-Minford Road Based on TR-11			

BEARING CAPACITY OF A MSE WALL

Ref: {AASHTO; STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 17th Edition, 2002}



Soil Properties

γ_{EMB}	=	120	pcf	Unit weight	Embankment fill
ϕ'_{EMB}	=	30	deg.	Friction ang.	Embankment fill
γ_{FDN}	=	120	pcf	Unit weight	Foundation soil
c	=	2500	psf	Cohesion	Foundation soil
ϕ	=	0	deg.	Friction ang.	Foundation soil
c'	=	0	psf	Cohesion	Foundation soil
ϕ'	=	30	deg.	Friction ang.	Foundation soil

Loads and Parameters

ω_t	=	240	psf	Traffic loading
L=B	=	36.8	ft	Length of MSE reinforcement
L factor	=	0.8		Length factor-range (0.7 - 1.0)
D	=	0	ft	Embedment depth
Dw	=	5	ft	Groundwater depth
H+D	=	46	ft	
H	=	46	ft	Height of wall
Ka	=	0.33		
Γ Pa	=	15.333	ft	Moment arm
Γ Wt	=	23	ft	Moment arm
B'	=	29.94	ft	
γ'	=	57.6	pcf	
W_t		8,832	lb/ft of wall	Weight from traffic
W_{mse}	=	203,136	lb/ft of wall	Weight from MSE wall

Effective Bearing Pressure

$$\sigma_v = \frac{W_t + W_{MSE}}{L - 2e}$$

σ_v = 7,080 psf

Ultimate undrained bearing capacity, q_{ult}

$$q_{ULT} = cN_c + \sigma'_D N_q + \frac{1}{2}\gamma B N_\gamma$$

q_{ULT} = 12,850 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 5,140 psf

* Does Not Consider Multiple Layers

Factor of Safety = **1.81** **No Good**

Ultimate drained bearing capacity, q_{ult}

$$q_{ULT} = c'N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 19,315 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 7,726 psf

Factor of Safety = **2.73** **OK**

Bearing Capacity Factors for Equations

Undrained		Drained	
N_c	5.14	N_c	30.14
N_q	1.00	N_q	18.40
N_γ	0.00	N_γ	22.40

Eccentricity of Resultant Force

e = 3.43 ft

Kern

e < L/6 = 6.13 ft

DLZ

CLIENT	TranSystems Corp	JOB NUMBER	0121-3070.03		
PROJECT	SCI-823 Portsmouth Bypass	SHEET NO.	1	of	1
SUBJECT	Multiple Layer Bearing Capacity	COMP. BY	SJR	Date	7/19/2006
Lucasville-Minford Road. Based on TR-11		CHECKED BY		Date	

Bearing Capacity *MSE Wall Analysis*
Stiff Over Soft Clay

EM1110-1-1908
Method as per Meyerhof and Brown (1969)

Upper Layer	Stiff Clay	c=	2500	psf	Cohesion of Upper Layer	
Lower Layer	Soft Clay	c=	540	psf	Cohesion of Lower Layer	
		H_t=	13	ft	Depth below footing to lower layer	
		D=	0	ft	Depth of Footing	
		B=	36.8	ft	Width of Footing	0.8Hw
		γ=	120	pcf	Unit Weight of Upper Soil	

$$N_{CW,0} = 1.5\left(\frac{H_t}{B}\right) + 5.14\left(\frac{c_{u,lower}}{c_{u,upper}}\right) \le 5.14$$

$N_{cw,0}$ = 1.64 $\le$ 5.14 Use $N_{cw,0}$= 1.64

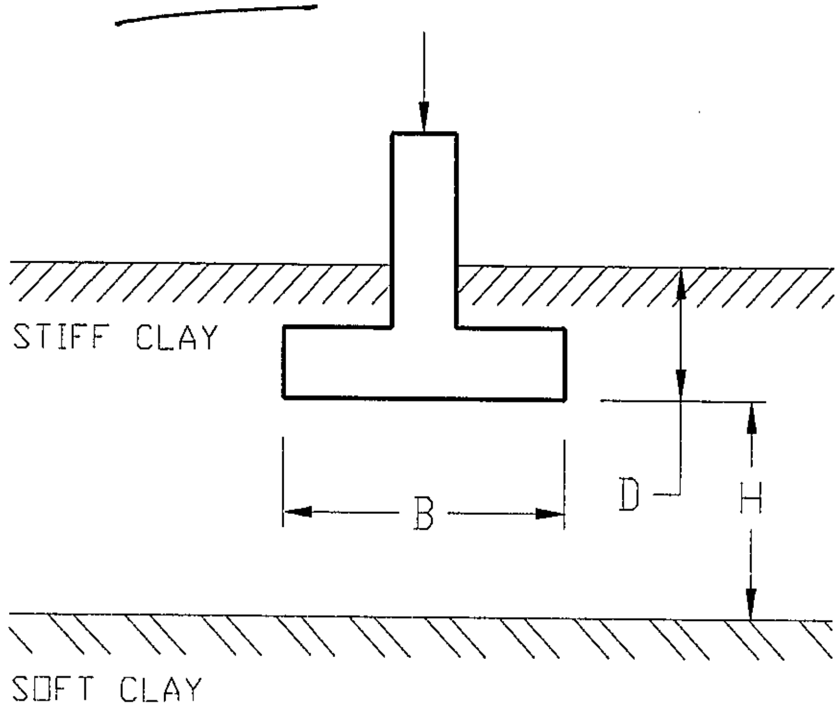
D/B = 0

$N_{cw,D}$ = 1.64 *See Table 4-7, EM1110-1-1905*

q_u = 4,100 psf $q_u = C_{u,1} * N_{cw,D} + \gamma D$ *Eqn: 4-12a*

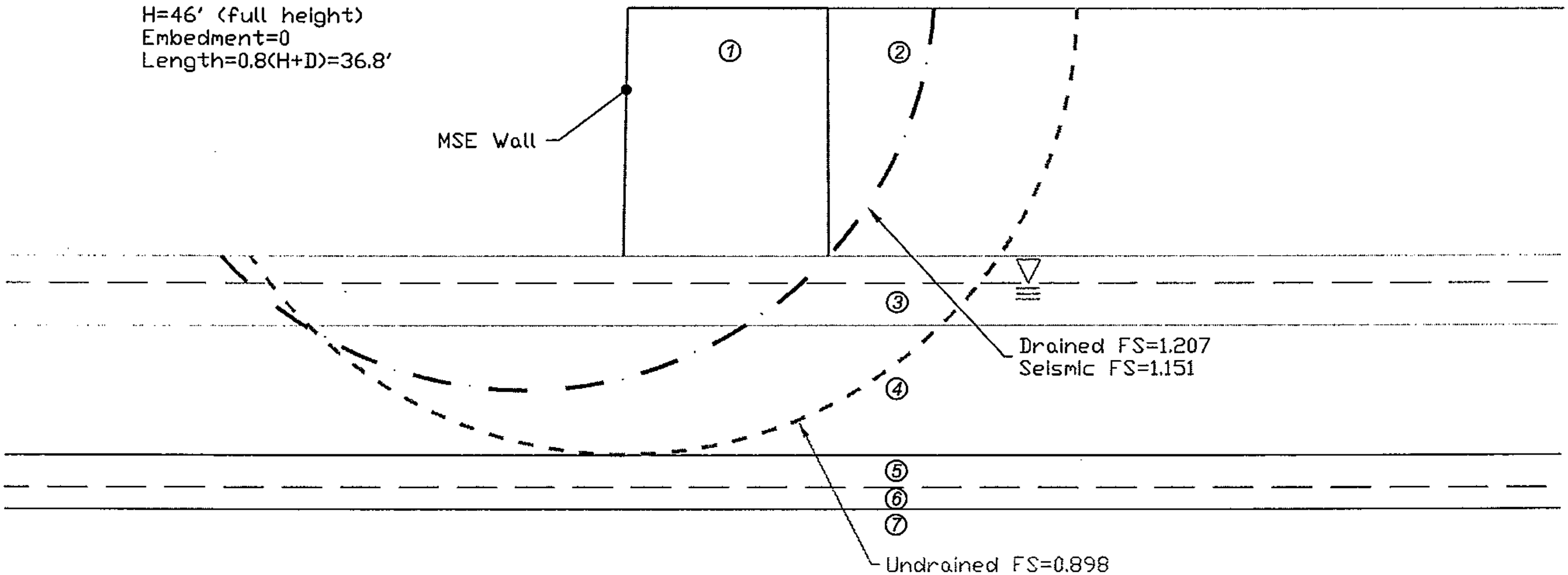
q_{allow} = **1,640 psf** FS=2.5

Undrained



MSE Wall Stability
823 Over Lucasville-Minford Road
Forward Abutment Sta. 539+00
Based on TR-11
Composite Strengths from TR-11
and B-1223
H=46' (full height)
Embedment=0
Length=0.8(H+D)=36.8'

Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ (deg)	Drained C' (psf)	Drained Φ' (deg)	γ (pcf)
Material 1	Compacted	MSE Fill	0	34	0	34	120
Material 2	Compacted	Emb. Fill	0	30	0	30	120
Material 3	V. Stiff	Clay	2500	0	0	32	122
Material 4	M. Stiff	Clay	540	0	0	17	117
Material 5	V. Stiff	Silty Clay	2000	0	0	32	120
Material 6		W. Bedrock	5000	34	5000	34	130
Material 7		Bedrock	10000	45	10000	45	145



LUCASVILLE - MINFORD ROAD
FORWARD ABUTMENT STA: 539+00

MSE WALL STABILITY ANALYSIS

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 07/19/06

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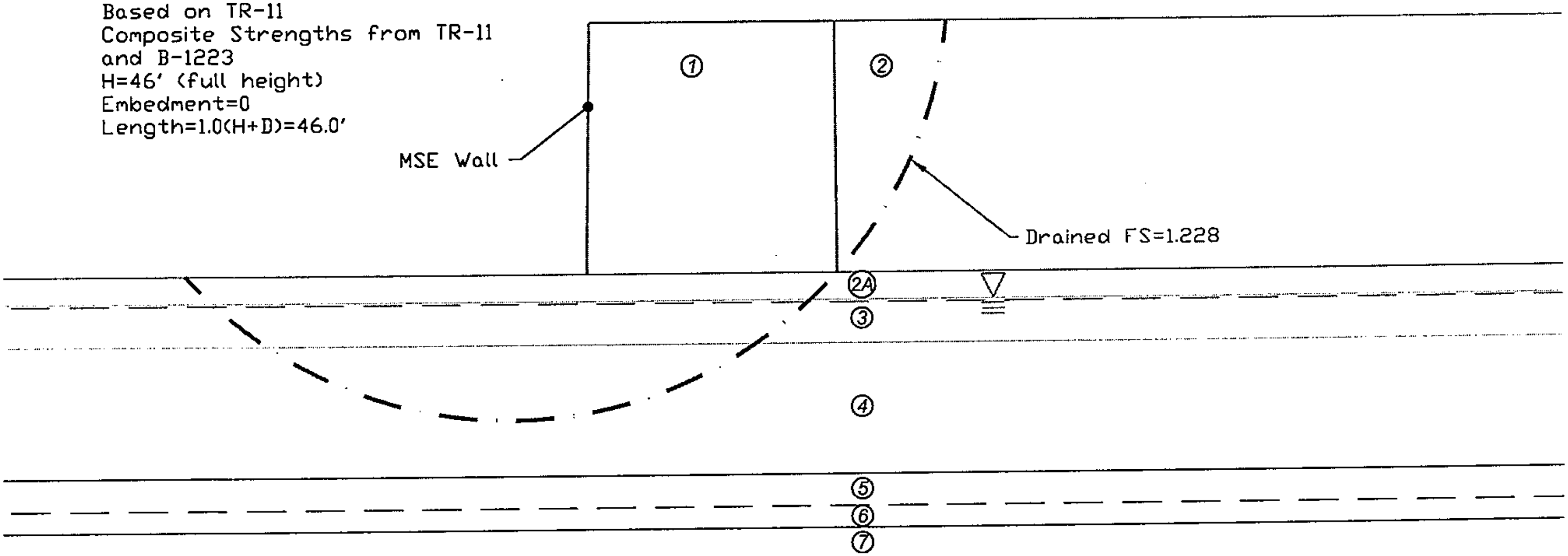
MSE Wall Stability
With 5' Undercut and Replace with
Compacted Granular Fill
823 Over Lucasville-Minford Road
Forward Abutment Sta. 539+00
Based on TR-11
Composite Strengths from TR-11
and B-1223
H=46' (full height)
Embedment=0
Length=1.0(H+D)=46.0'

Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ (deg)	Drained C' (psf)	Drained Φ' (deg)	γ (pcf)
Material 1	Compacted	MSE Fill	0	34	0	34	120
Material 2	Compacted	Emb. Fill	0	30	0	30	120
Material 2A	Compacted	Gran. Fill	0	34	0	34	120
Material 3	V. Stiff	Clay	2500	0	0	32	122
Material 4	M. Stiff	Clay	540	0	0	17	117
Material 5	V. Stiff	Silty Clay	2000	0	0	32	120
Material 6		W. Bedrock	5000	34	5000	34	130
Material 7		Bedrock	10000	45	10000	45	145

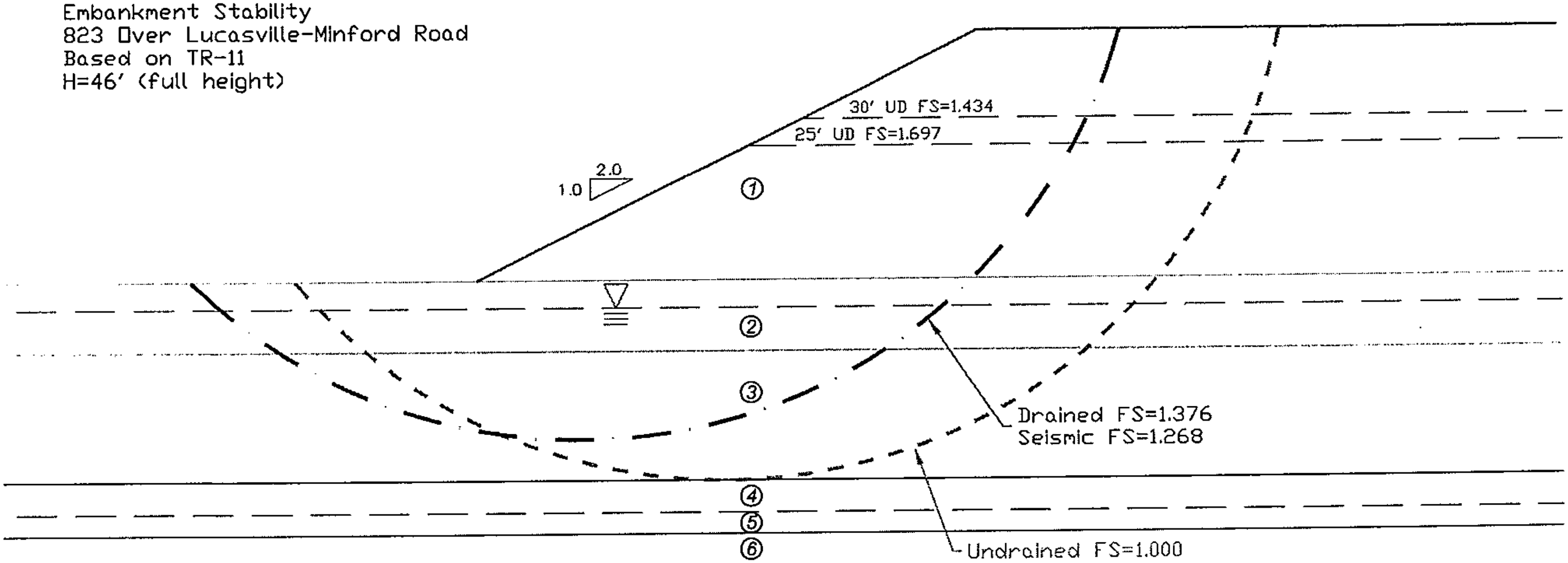


LUCASVILLE - MINFORD ROAD
FORWARD ABUTMENT STA: 539+00
INCLUDES 5-FOOT UNDERCUT
MSE WALL STABILITY ANALYSIS
SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 07/19/06

Material	Consistency	Soil Type	Undrained C (psf)	Undrained φ (deg)	Drained C′ (psf)	Drained φ′ (deg)	γ (pcf)
Material 1	Compacted	MSE Fill	0	34	0	34	120
Material 2	Compacted	Emb. Fill	0	30	0	30	120
Material 3	V. Stiff	Clay	2500	0	0	32	122
Material 4	M. Stiff	Clay	540	0	0	17	117
Material 5	V. Stiff	Silty Clay	2000	0	0	32	120
Material 6		W. Bedrock	5000	34	5000	34	130
Material 7		Bedrock	10000	45	10000	45	145

Embankment Stability
823 Over Lucasville-Minford Road
Based on TR-11
H=46′ (full height)



823 OVER LUCASVILLE-MINFORD ROAD
FORWARD ABUTMENT
2:1 SLOPES

EMBANKMENT STABILITY ANALYSIS

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 07/19/06

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DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

CLIENT TranSystems
PROJECT SCI-823 Portsmouth Bypass
SUBJECT Embankment Consolidation Parameters - Testing and Estimates

PROJECT NO. 0121-3070.03
SHEET NO. 1 OF 1
COMP. BY SJR DATE 7-19-0(
CHECKED BY ____ DATE ____

46' High Embankment - Assume Continuous Soil Profile from TR-11

Layer 1 0'-10' Taken from B-1223 P-1 (See Plan & Profile Drawings) (See Consolidation Test)

$C_c = 0.27$ $e_o = 0.790$
$C_r = 0.10$ $P_c = 1780$ psf $\gamma_N = 122$ pcf

Layer 2 10'-15' Taken from TR-14 ST-1 (See Plan & Profile Drawings) (See Consolidation Tests)

$C_c = 0.25$ $e_o = 1.061$
$C_r = 0.08$ $P_c = 1780$ psf $\gamma_N = 117$ pcf

Layer 3 Ⓐ 15'-25' Ⓑ 25'-30.5' Taken from B-1223 P-2 (See Plan & Profile Drawings) (See Consolidation Tests)

$C_c = 0.37$ $e_o = 1.124$
$C_r = 0.16$ $P_c = 10,800$ psf $\gamma_N = 116$ pcf

Layer 4 30.5'-43.0' Taken from FHWA NHI-00-045 ✓
*Boring TR-11

1) Check if Preconsolidated: $I_L = \frac{\omega - PL}{LL - PL} = \frac{23-22}{37-22} = 0.07 < 0.7$

↳ We may assume that the soil is overconsolidated $\sigma_c > \sigma_f$

2) Estimate e_o: $e_o = \frac{\omega \cdot G_s}{100} = \frac{23(2.75)}{100} = 0.633$

3) Estimate C_c & C_r:

$$C_c = \frac{\omega}{100} = \frac{23}{100} = 0.23$$

$$C_r = \frac{\omega}{1000} = \frac{23}{1000} = 0.023$$

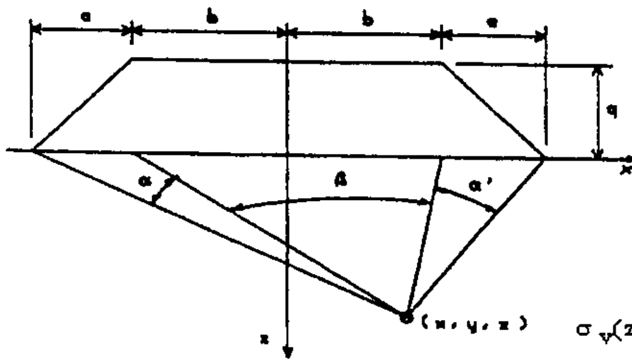
$C_v \approx 0.30$ ft²/day Estimated from Figure 9-5 (FHWA HI-97-021)

DLZ SUBJECT

Client TranSystems Inc.	JOB NUMBER	0121-3070-03	
Project SCI-823 Portsmouth Bypass	SHEET NO.	1 OF 1	
Item Settlement Analysis Forward Abutment	COMP. BY	SJR	DATE 07/20/06
Lucasville-Minford Road	CHECKED BY		DATE

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table:	D=	5.0	ft	
Embankment Height:	H =	46	ft	
Fill Unit Weight:	γ_{emb} =	120	pcf	q = 5,520 psf
Width of Slope:	a =	92		
Top half-width of Emb:	b =	50		
Distance from CL:	x =	0		
Output Range:	z =	0	to 43	ft

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

								Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye	Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0 ft	Clay	122	1,780	610	5,520	6,130	0.0	0.10	0.27	0.790
2	15.0 ft	Clay	117	1,780	1,045	5,512	6,556	0.0	0.08	0.25	1.061
3	25.0 ft	Clay	116	10,800	1,449	5,489	6,938	0.0	0.16	0.37	1.124
4	30.5 ft	Clay	116	10,800	1,864	5,443	7,307	0.0	0.16	0.37	1.124
5	43.0 ft	Clay	116	7,800	2,347	5,359	7,706	0.0	0.02	0.00	0.633
6	0.0		0	0							
7	0.0		0	0							
8	0.0		0	0							
9	0.0		0	0							
10	0.0		0	0							

No.	Settlement:	Total Settlement
1	1.070 ft	
2	0.388 ft	2.307 ft
3	0.512 ft	
4	0.246 ft	
5	0.091 ft	27.7 in
6		
7		
8		
9		
0		

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0 < \sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0 < \sigma'_c < \sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

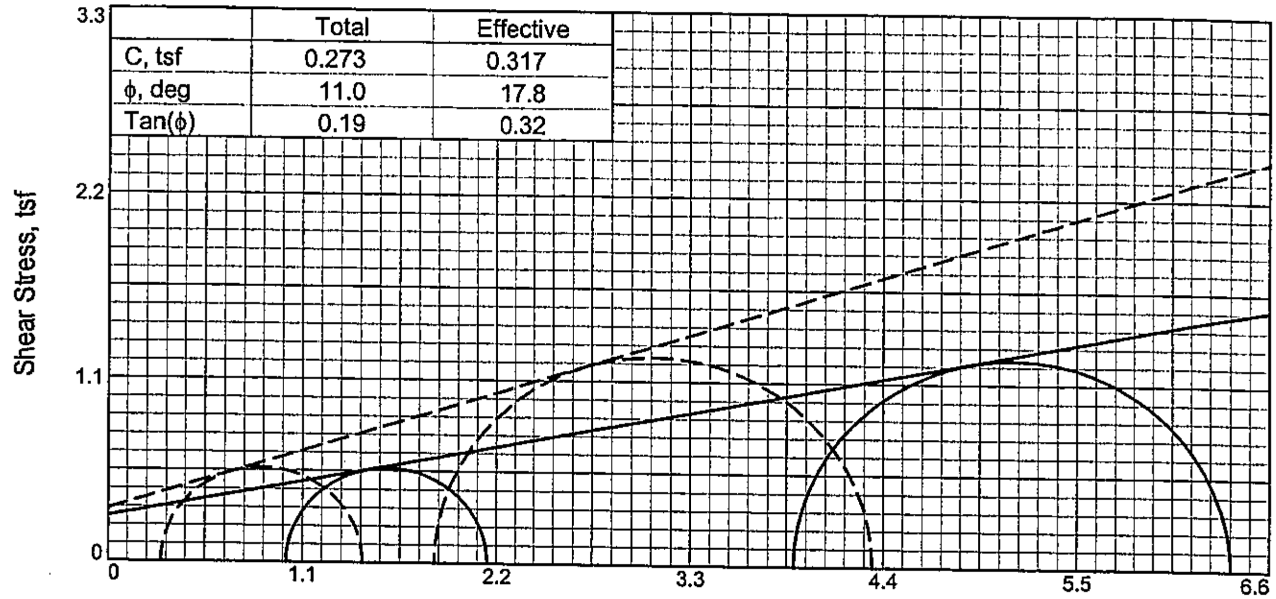
Normally Consolidated Soils ($\sigma'_0 = \sigma'_c$) Eqn: 11.23

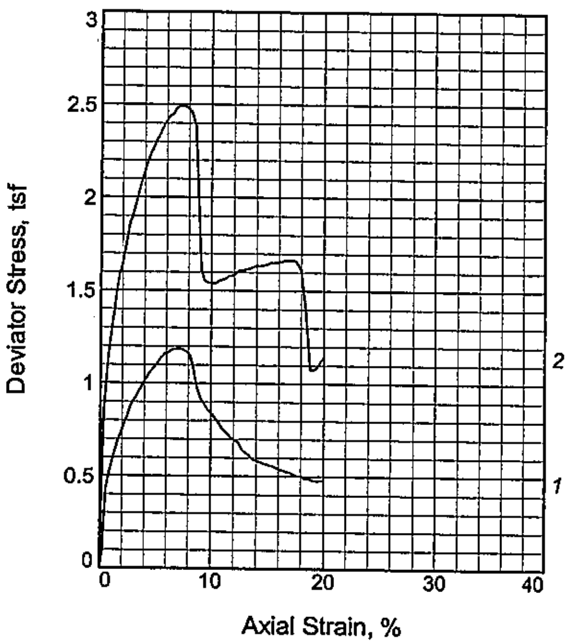
$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Cohesionless Soils ($\sigma'_0 = \sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

	Total	Effective
C, tsf	0.273	0.317
ϕ, deg	11.0	17.8
Tan(ϕ)	0.19	0.32





Sample No.		1	2
Initial	Water Content,	39.9	39.9
	Dry Density, pcf	82.7	82.7
	Saturation,	100.6	100.6
	Void Ratio	1.1057	1.1063
	Diameter, in.	2.81	2.84
	Height, in.	5.55	5.58
At Test	Water Content,	48.3	38.3
	Dry Density, pcf	74.2	84.2
	Saturation,	100.0	100.0
	Void Ratio	1.3464	1.0690
	Diameter, in.	2.97	2.82
	Height, in.	5.55	5.58
Strain rate, in./min.		0.01	0.01
Back Pressure, tsf		4.03	4.03
Cell Pressure, tsf		5.04	7.92
Fail. Stress, tsf		1.14	2.49
Total Pore Pr., tsf		4.74	6.08
Ult. Stress, tsf		1.14	2.49
Total Pore Pr., tsf		4.74	6.08
$\bar{\sigma}_1$ Failure, tsf		1.44	4.34
$\bar{\sigma}_3$ Failure, tsf		0.30	1.84

Type of Test:
CU with Pore Pressures

Sample Type: Press Tube

Description: Fat clay

LL= 67 **PL=** 26 **PI=** 41

Assumed Specific Gravity= 2.79

Remarks:

Client: TranSystems, Inc.

Project: SCI-823-0.00

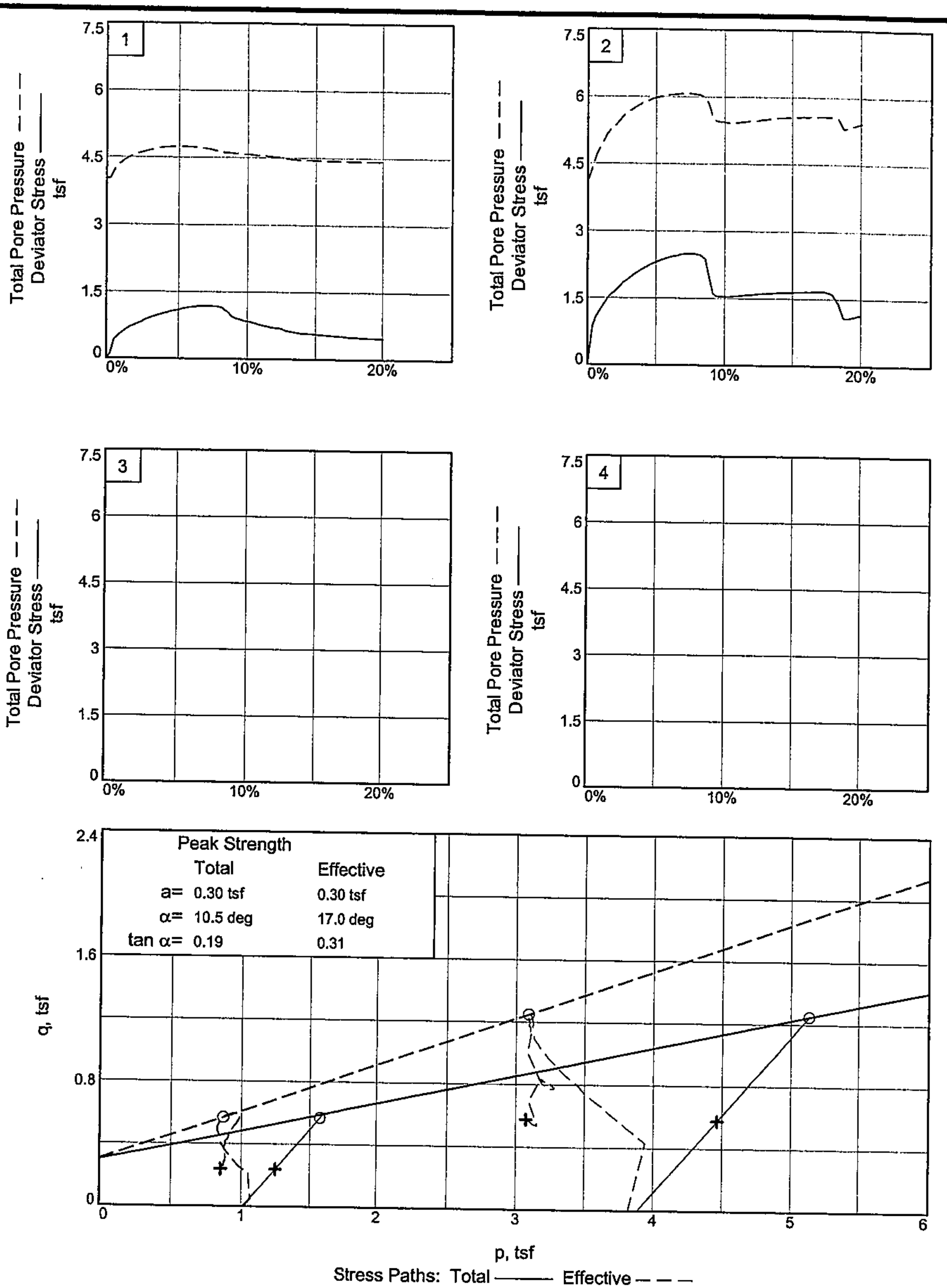
Source of Sample: B-1223 **Depth:** 18.0

Sample Number: P2

Proj. No.: 0121-3070.03 **Date:** 9/27/05

DLZ

Figure ________



Client: TranSystems, Inc.

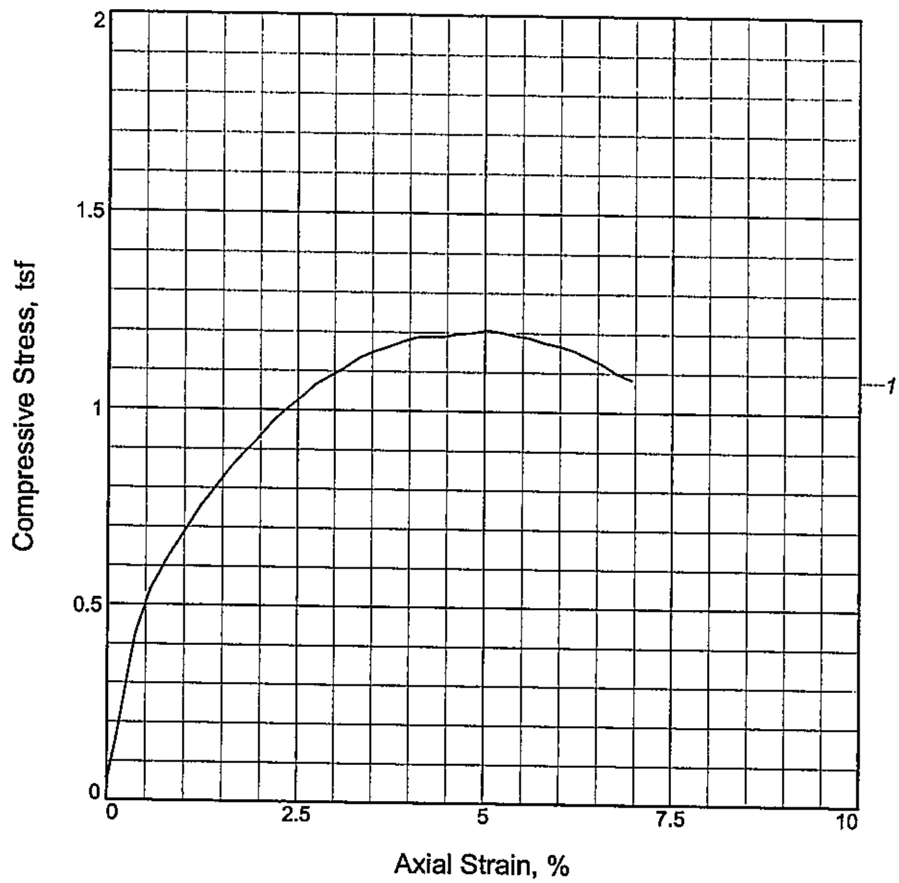
Project: SCI-823-0.00

Source of Sample: B-1223 **Depth:** 18.0 **Sample Number:** P2

Project No.: 0121-3070.03 **Figure** ______

DLZ, INC.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	1.206			
Undrained shear strength, tsf	0.603			
Failure strain,	5.0			
Strain rate, in./min.	0.10			
Water content, %	29.8			
Wet density, pcf	122.2			
Dry density, pcf	94.1			
Saturation, %	99.6			
Void ratio	0.8238			
Specimen diameter, in.	2.81			
Specimen height, in.	5.54			
Height/diameter ratio	1.97			

Description: Fat clay

LL = 57	PL = 26	PI = 31	GS= 2.75	Type: Press Tube

Project No.: 0121-3070.03

Date: 9/20/05

Remarks:

Client: TranSystems, Inc.

Project: SCI-823-0.00

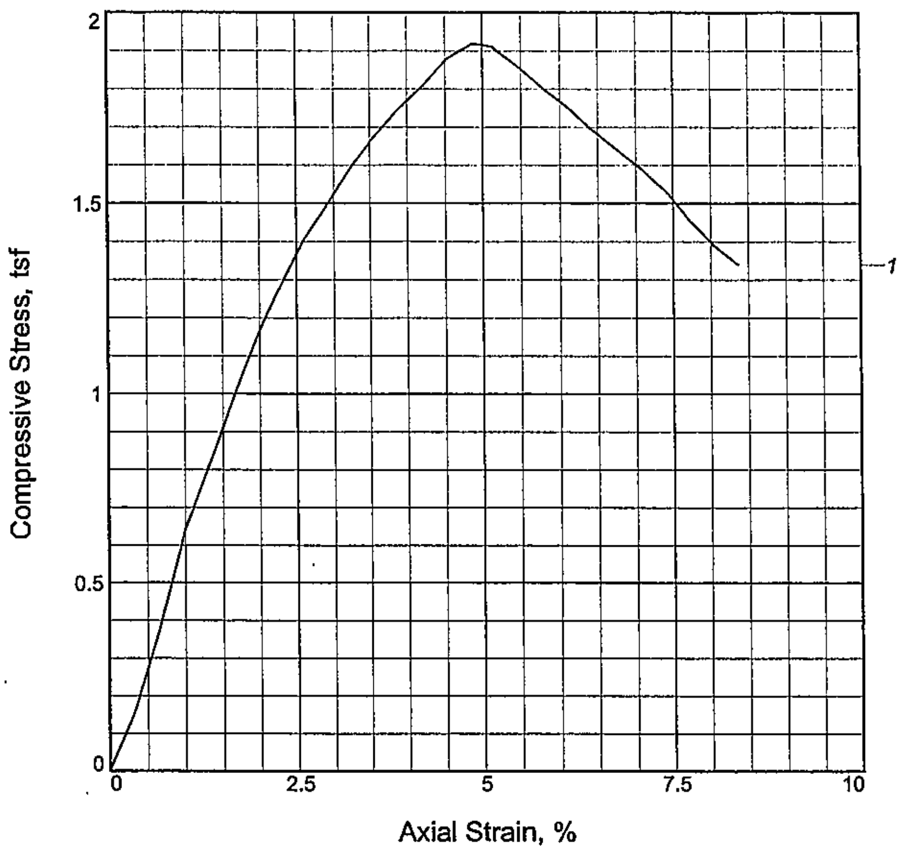
Source of Sample: B-1223 **Depth:** 8.0

Sample Number: P1

DLZ

Figure ________

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	1.911			
Undrained shear strength, tsf	0.955			
Failure strain,	5.1			
Strain rate, in./min.	0.06			
Water content, %	38.5			
Wet density, pcf	116.9			
Dry density, pcf	84.4			
Saturation, %	100.0			
Void ratio	1.0865			
Specimen diameter, in.	2.85			
Specimen height, in.	6.26			
Height/diameter ratio	2.20			

Description: Fat clay

LL = 65	**PL** = 28	**PI** = 37	**Assumed GS**= 2.82	**Type:** 2.8" press tube

Project No.: 0121-3070.03

Date: 7/26/04

Remarks:

Figure ________

Client: TranSystems, Inc.

Project: SCI-823-0.00

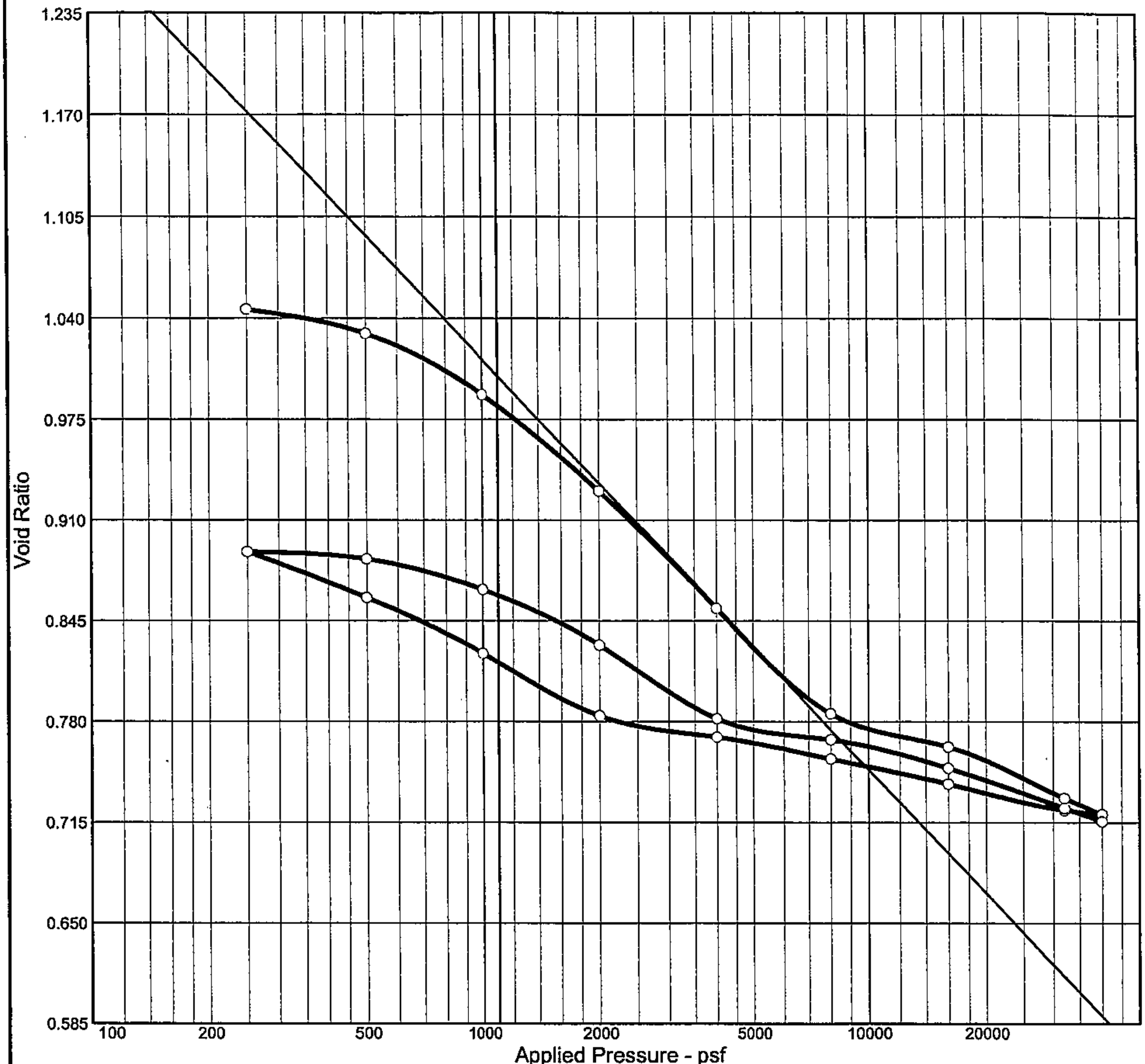
Source of Sample: TR-14 **Depth:** 13.0

Sample Number: ST-1

DLZ

Tested By: Gary Bowen

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
98.3 %	37.0 %	85.4	65	37	2.82	CH	A-7-6(44	1.061

MATERIAL DESCRIPTION

Fat clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-14 **Sample No.:** ST-1 **Elev./Depth:** 13.0

DLZ

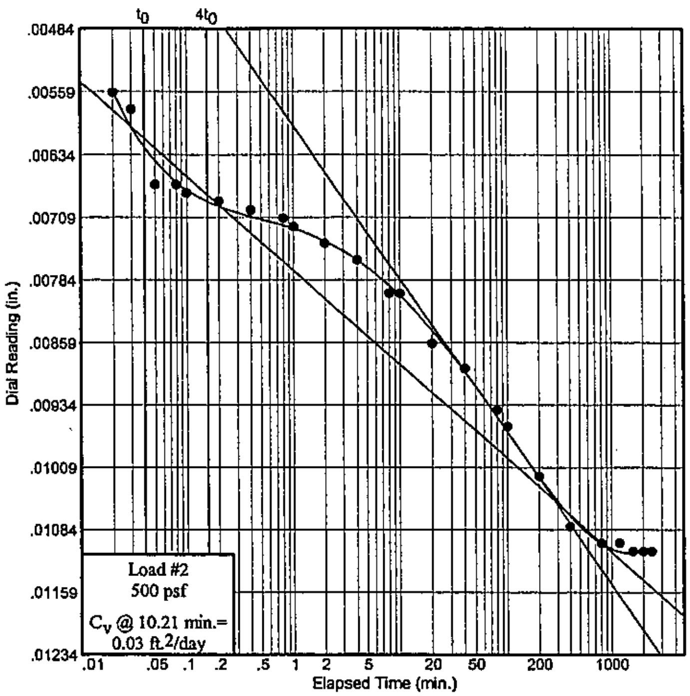
Remarks:

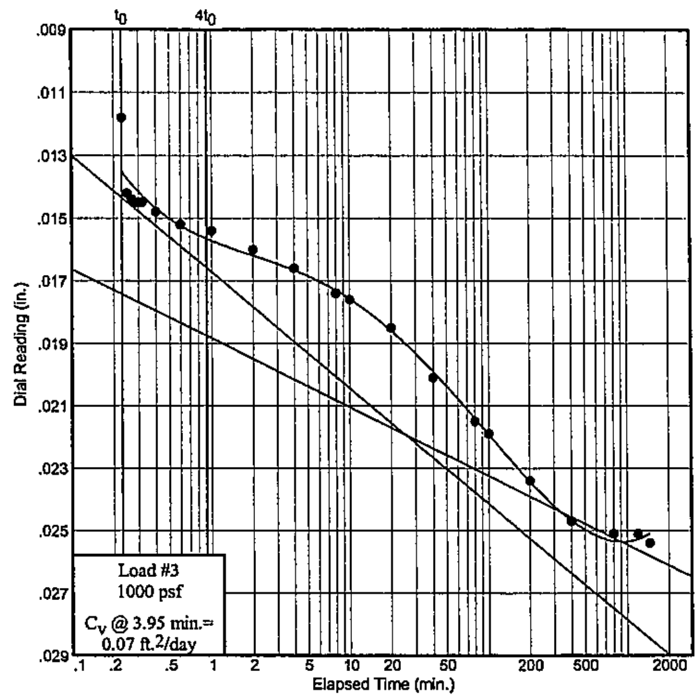
Figure

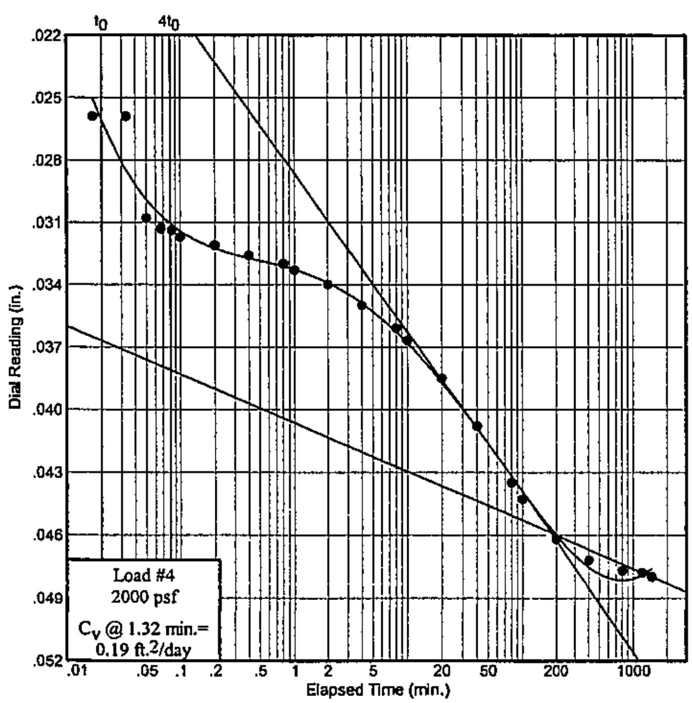
Dial Reading vs. Time

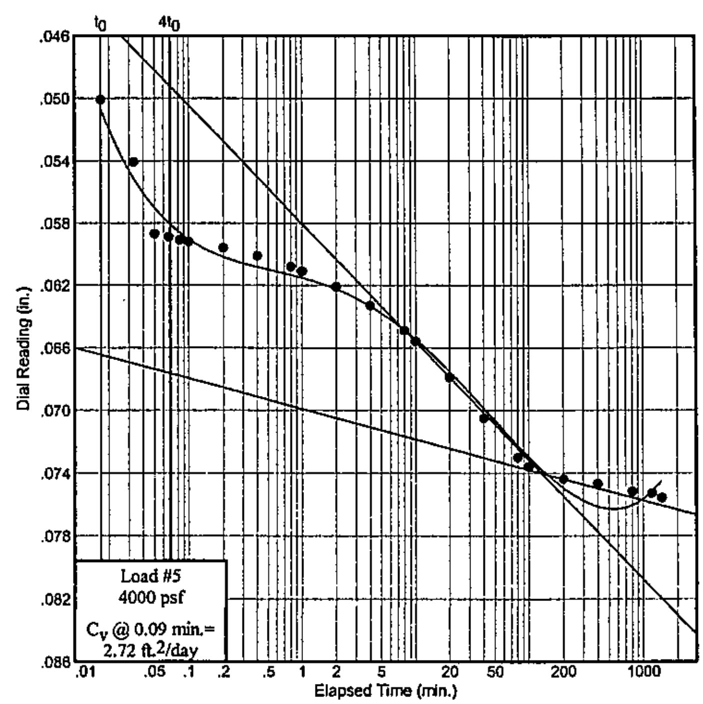
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-14 Sample No.: ST-1 Elev./Depth: 13.0









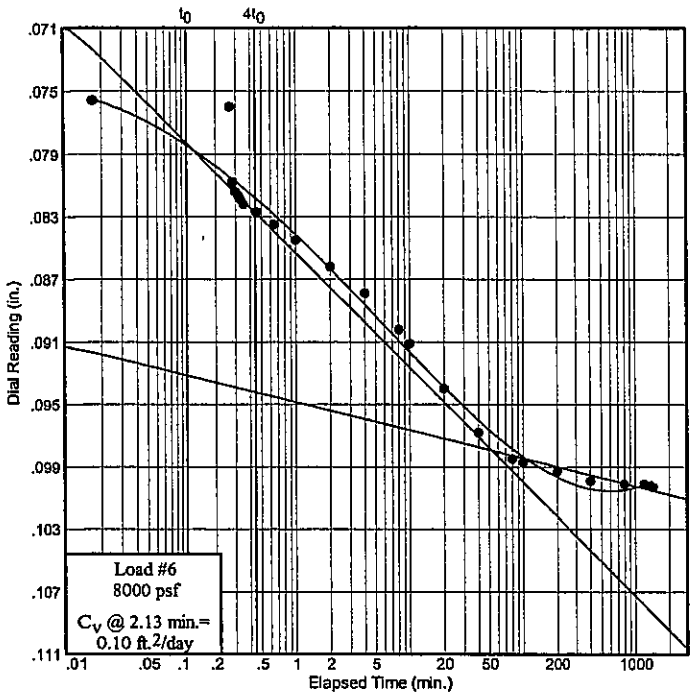
DLZ

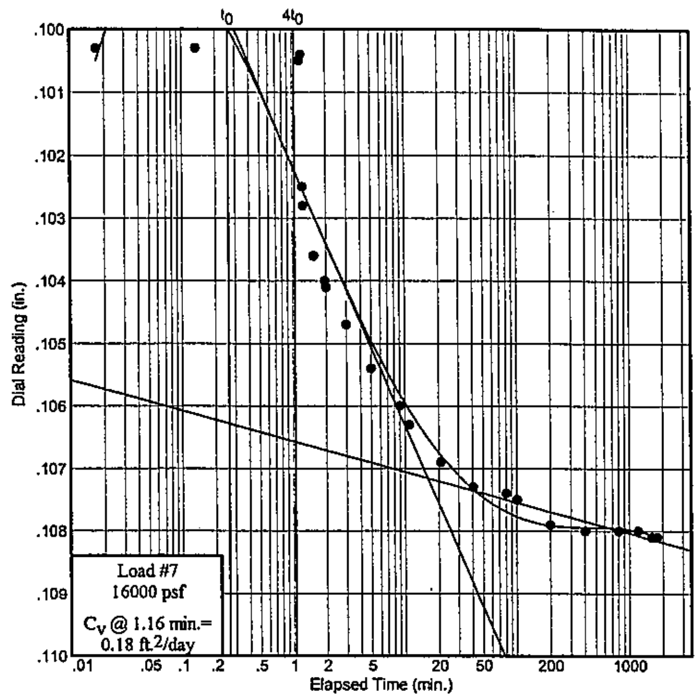
Figure

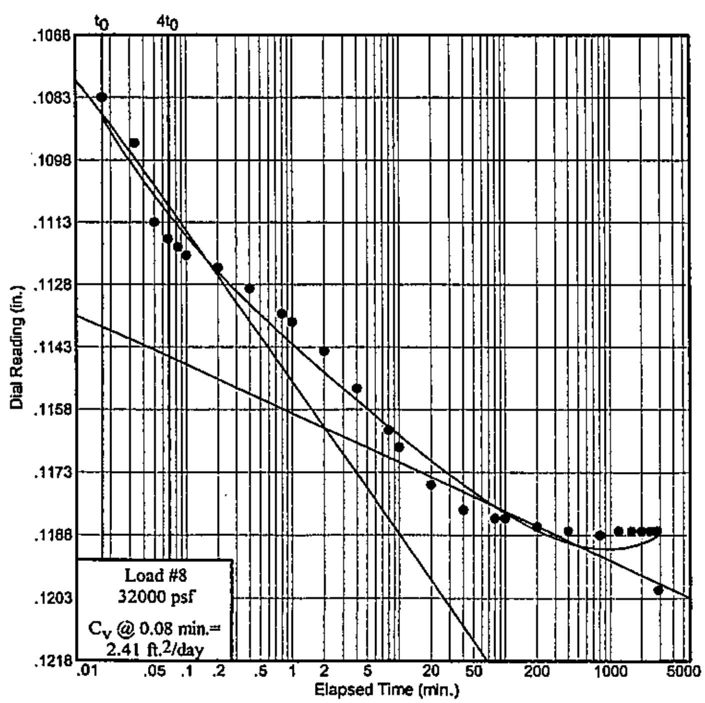
Dial Reading vs. Time

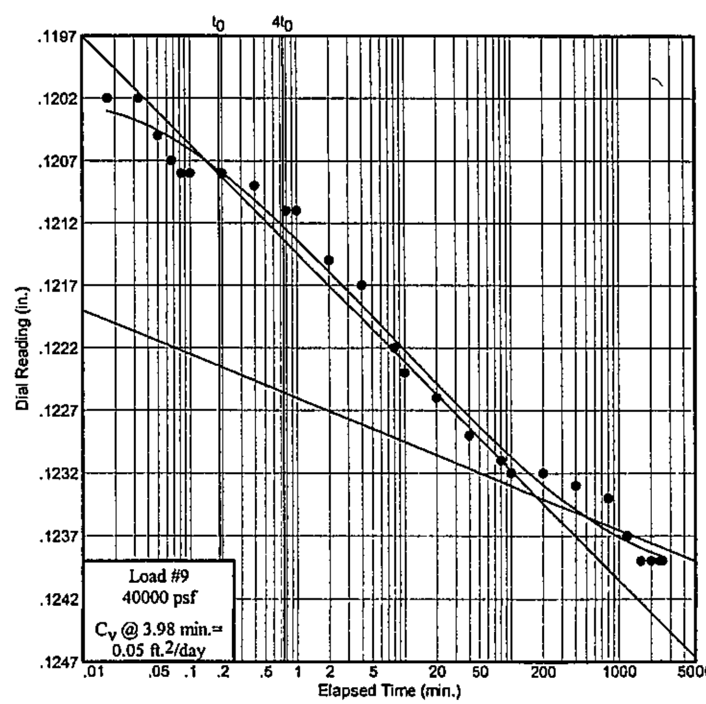
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-14   Sample No.: ST-1   Elev./Depth: 13.0









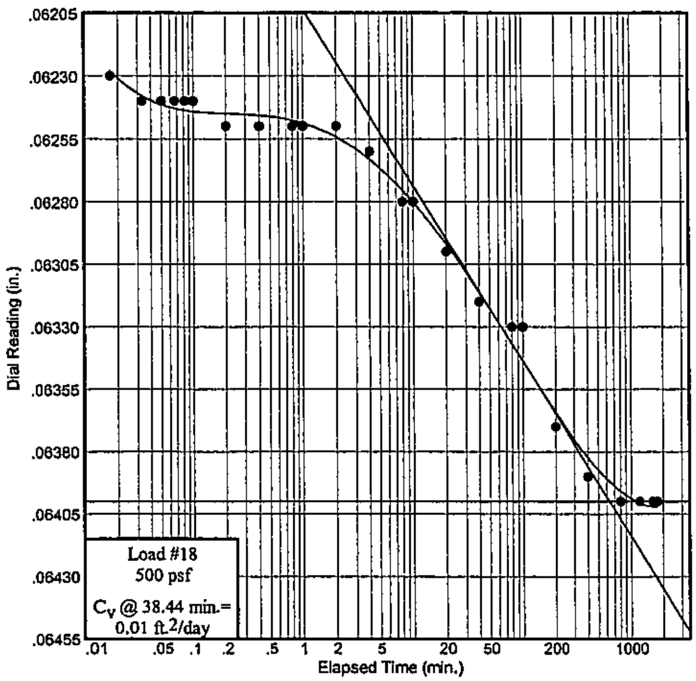
DLZ

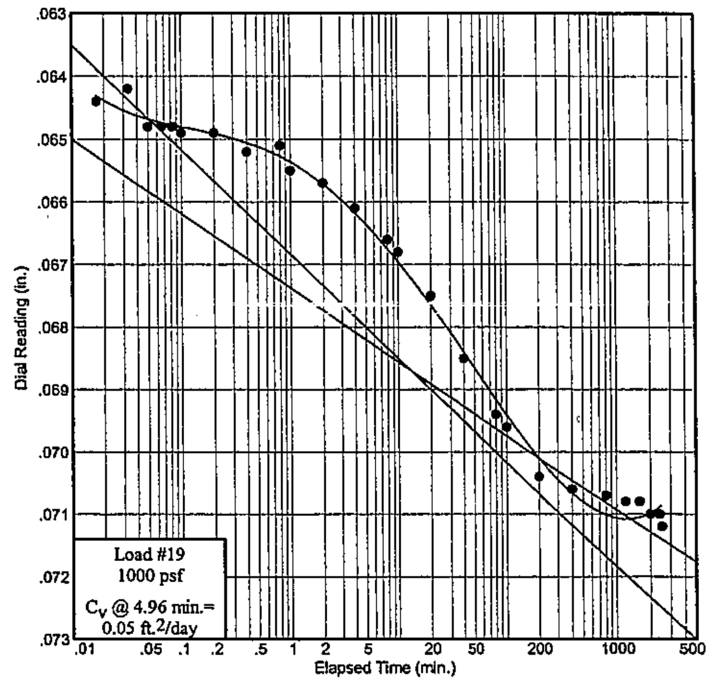
Figure

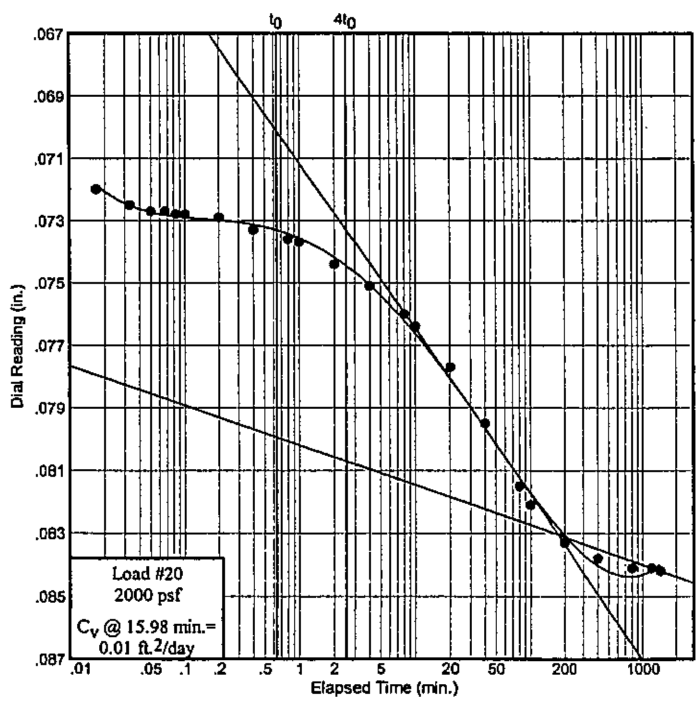
Dial Reading vs. Time

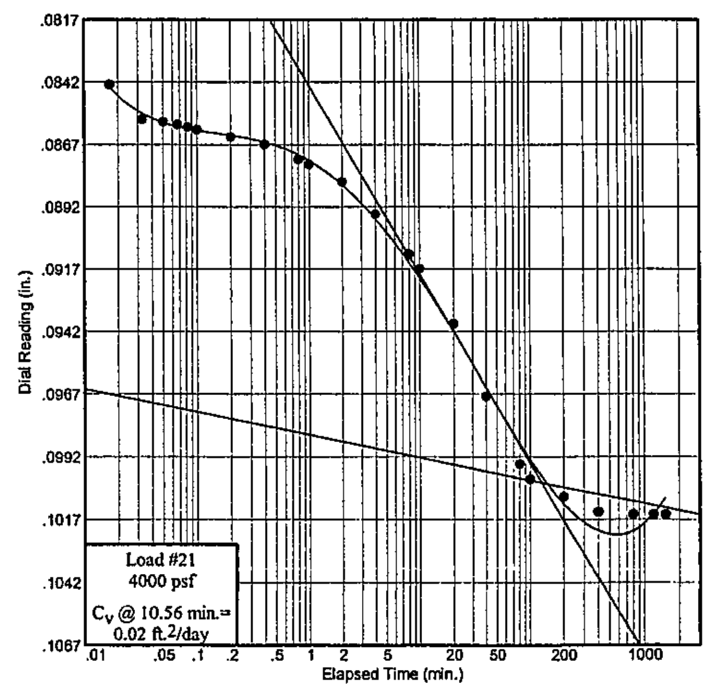
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-14 | Sample No.: ST-1 | Elev./Depth: 13.0









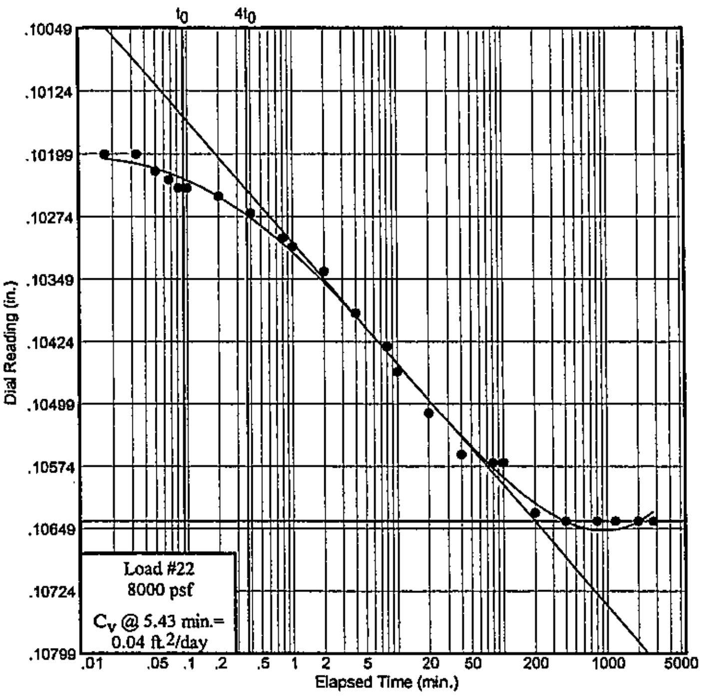
DLZ

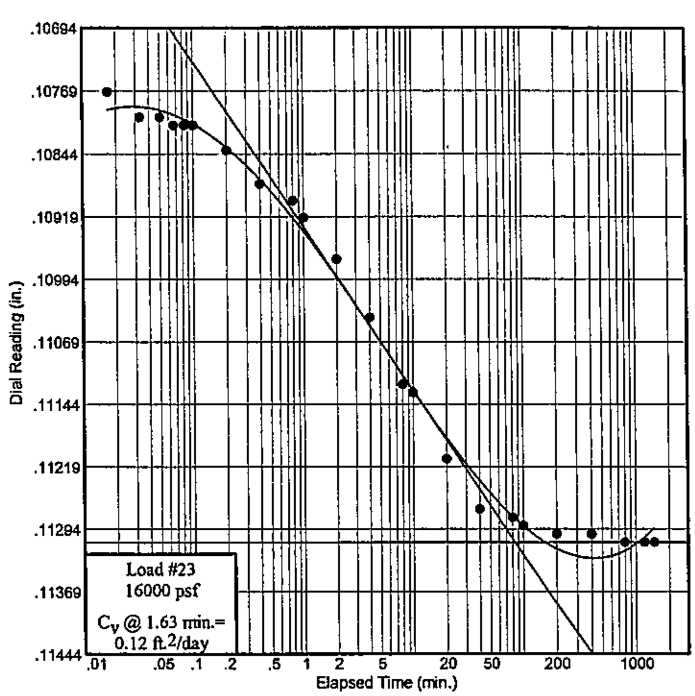
Figure

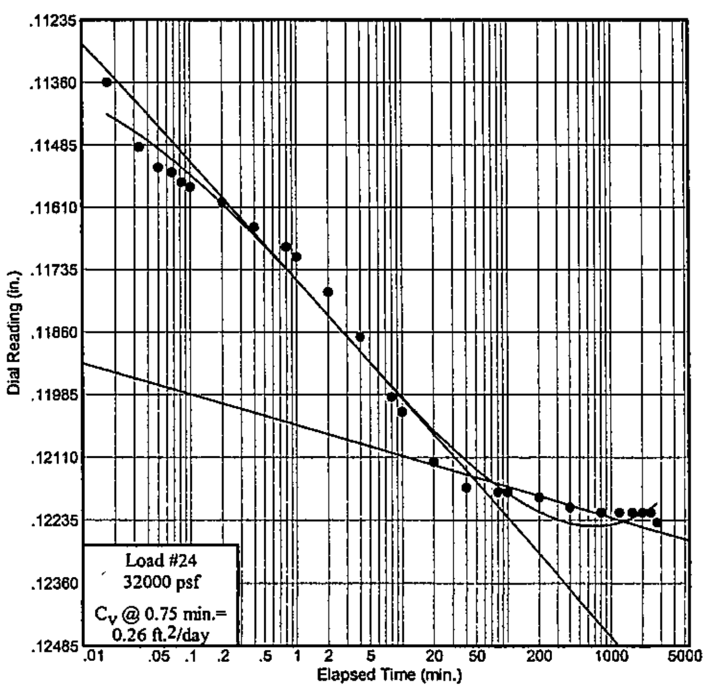
Dial Reading vs. Time

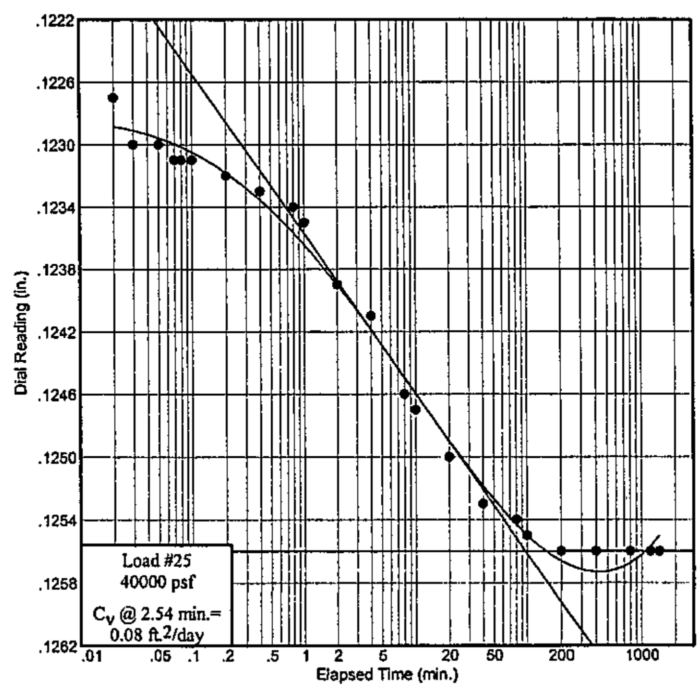
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-14 | Sample No.: ST-1 | Elev./Depth: 13.0





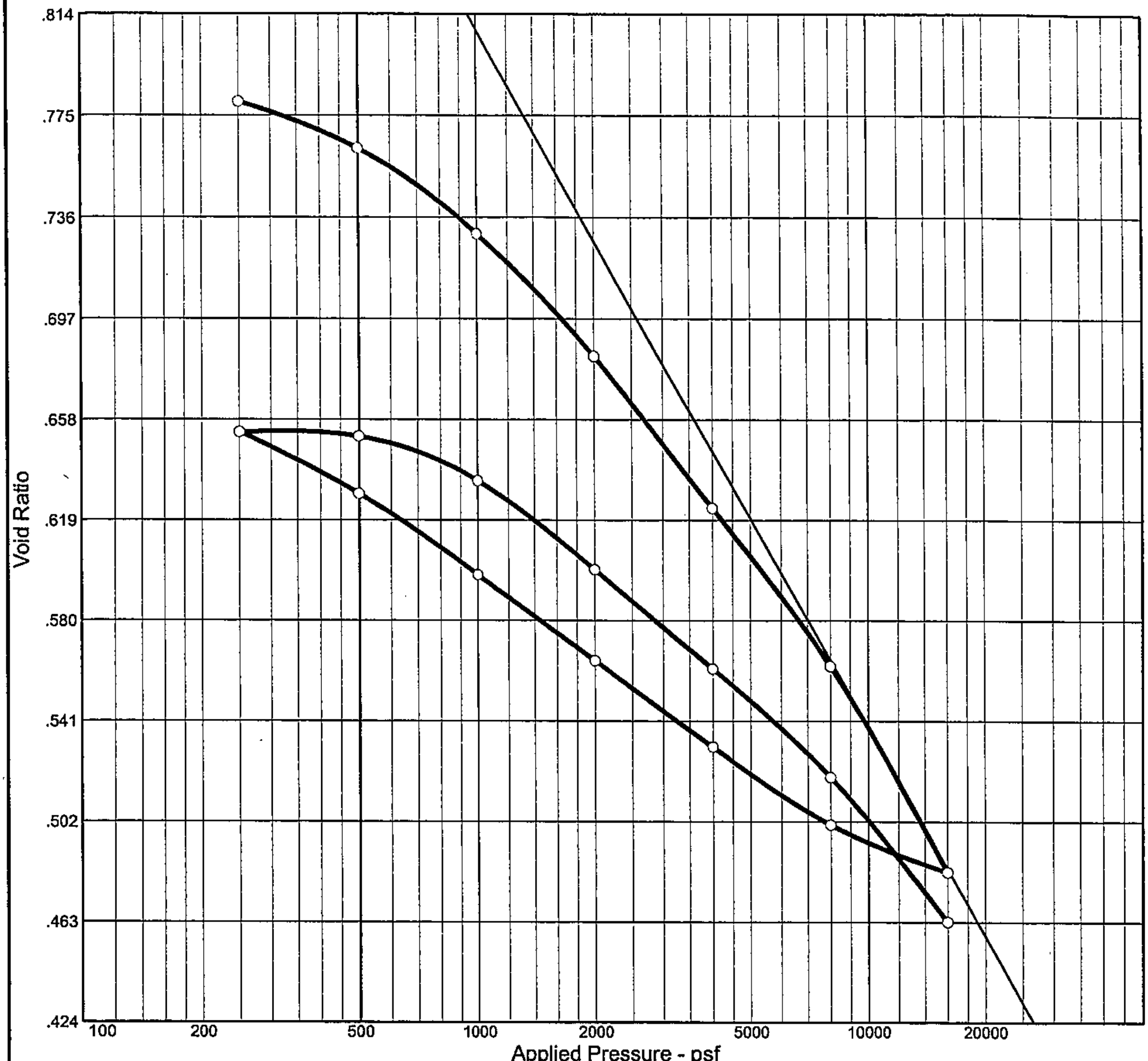




DLZ

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	28.7 %	95.9	57	31	2.75	CH	A-7-6(36	0.790

MATERIAL DESCRIPTION
Fat clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: B-1223 **Sample No.:** P1 **Elev./Depth:** 8.0

DLZ

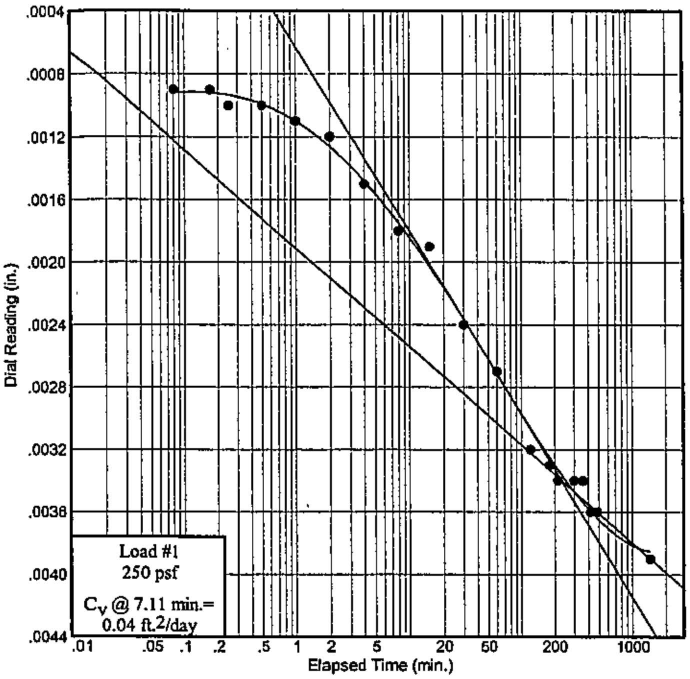
Remarks:

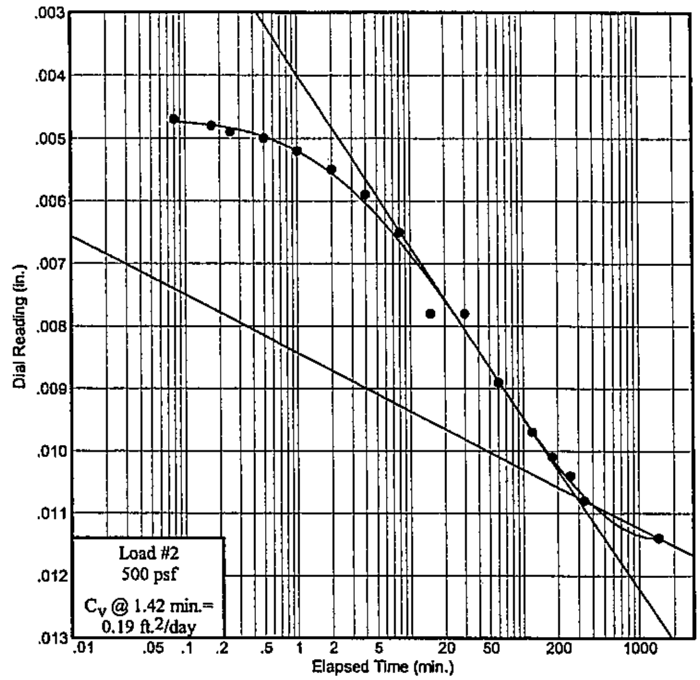
Figure

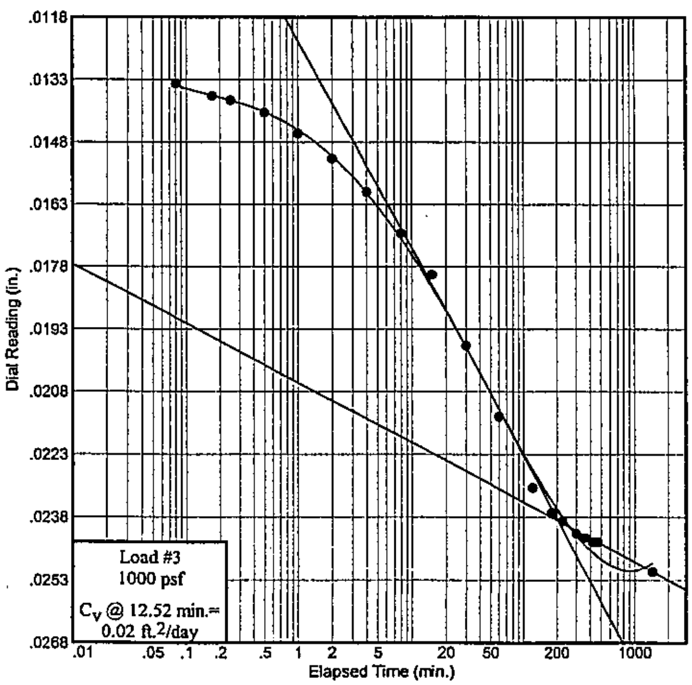
Dial Reading vs. Time

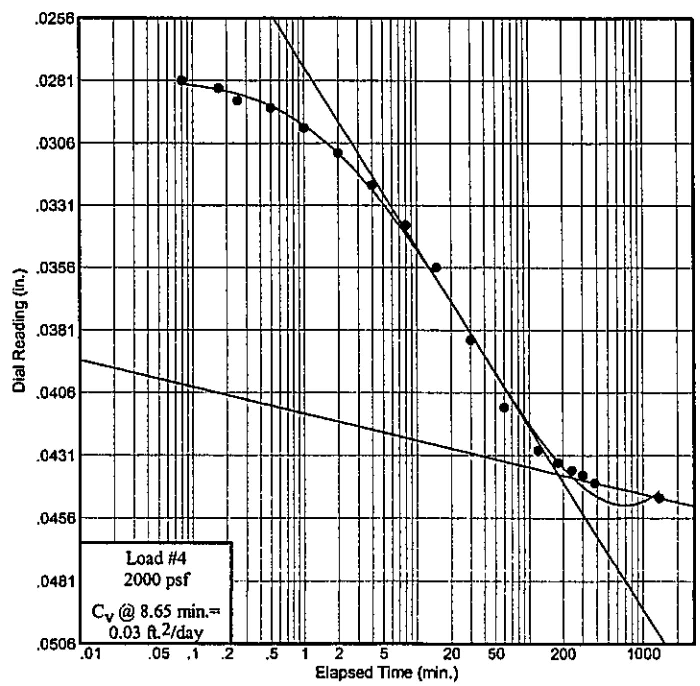
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 | Sample No.: P1 | Elev./Depth: 8.0









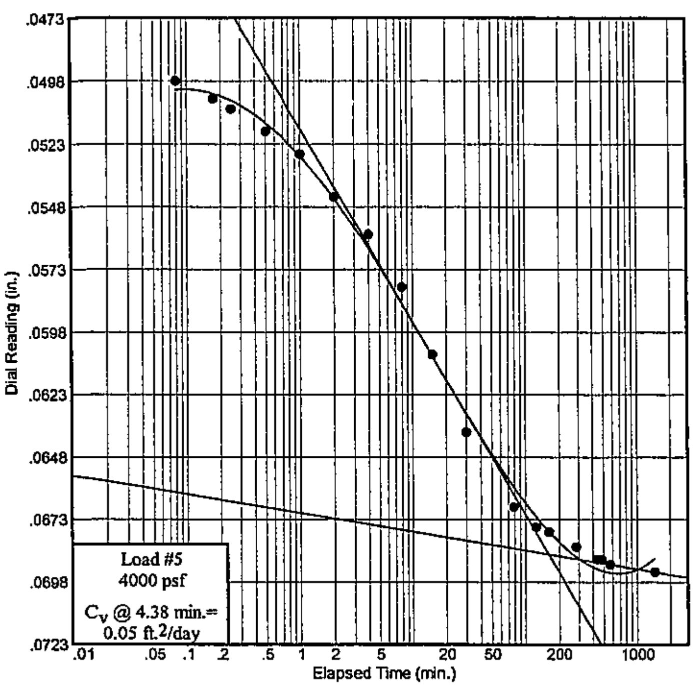
DLZ

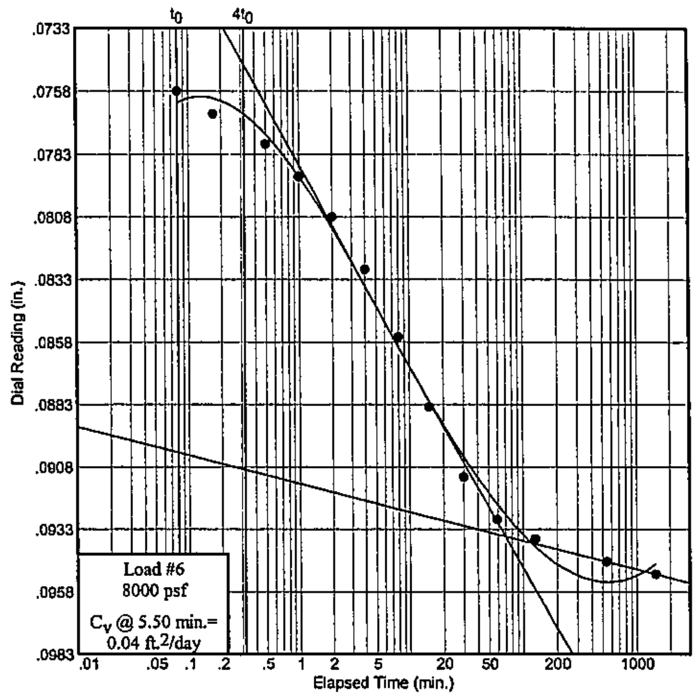
Figure

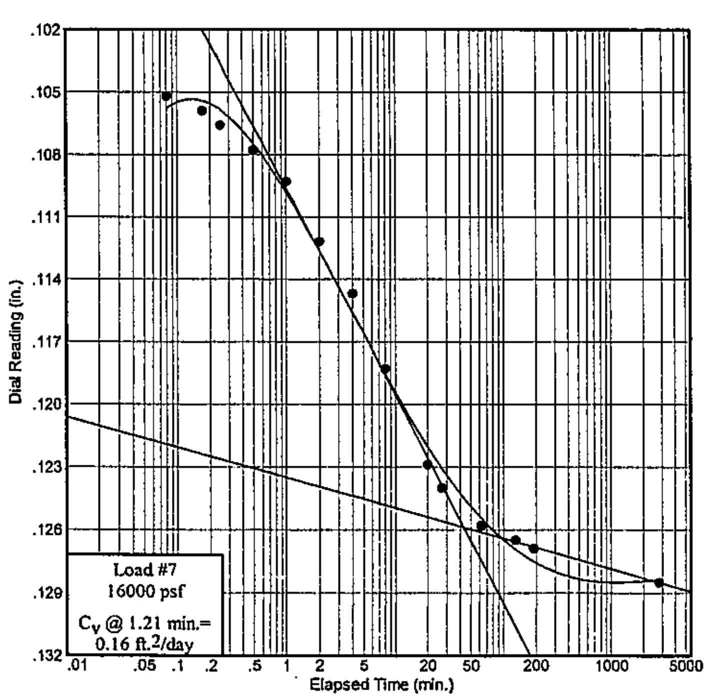
Dial Reading vs. Time

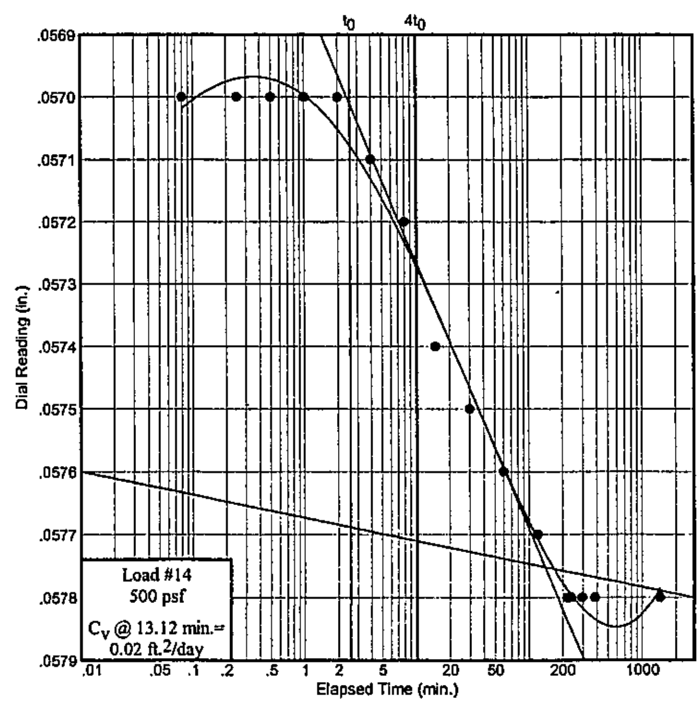
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 | Sample No.: P1 | Elev./Depth: 8.0









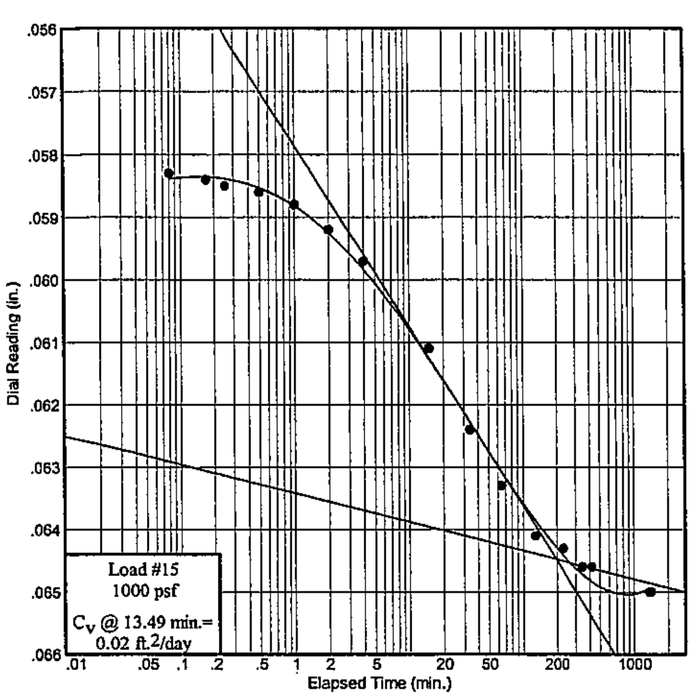
DLZ

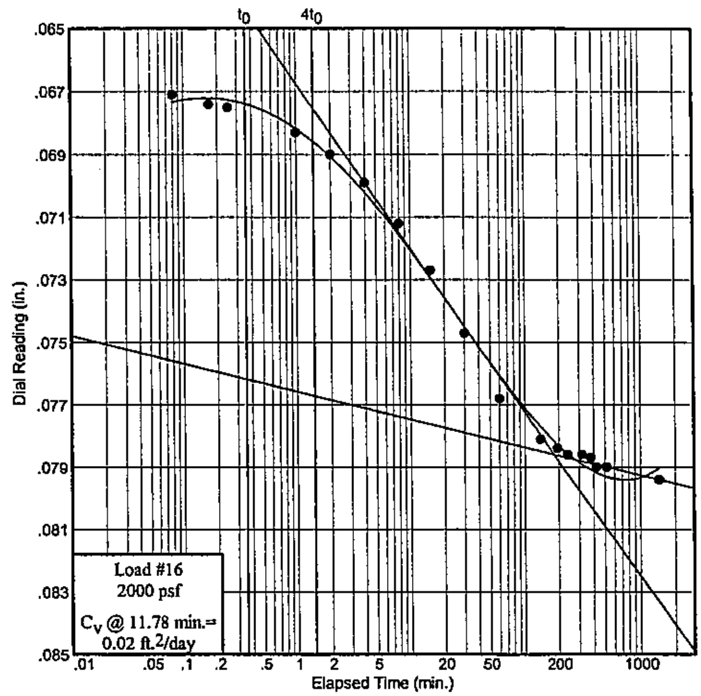
Figure

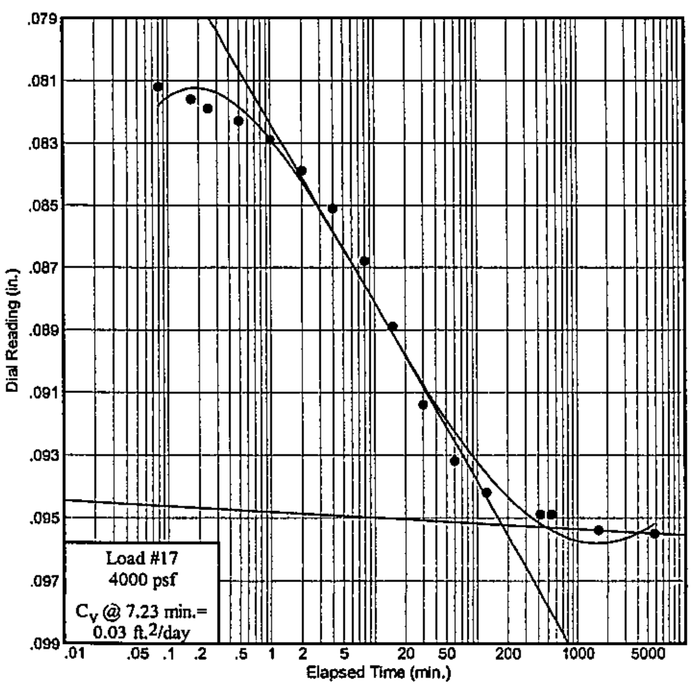
Dial Reading vs. Time

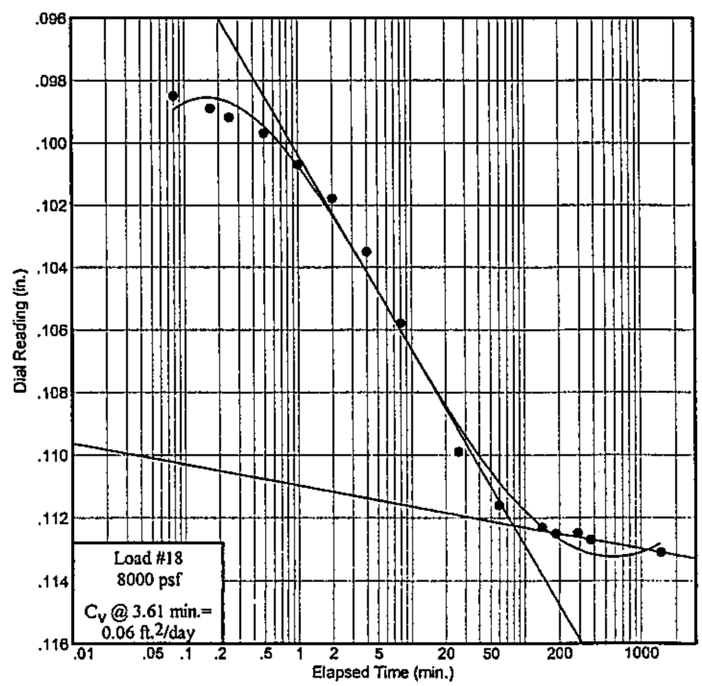
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 | Sample No.: P1 | Elev./Depth: 8.0









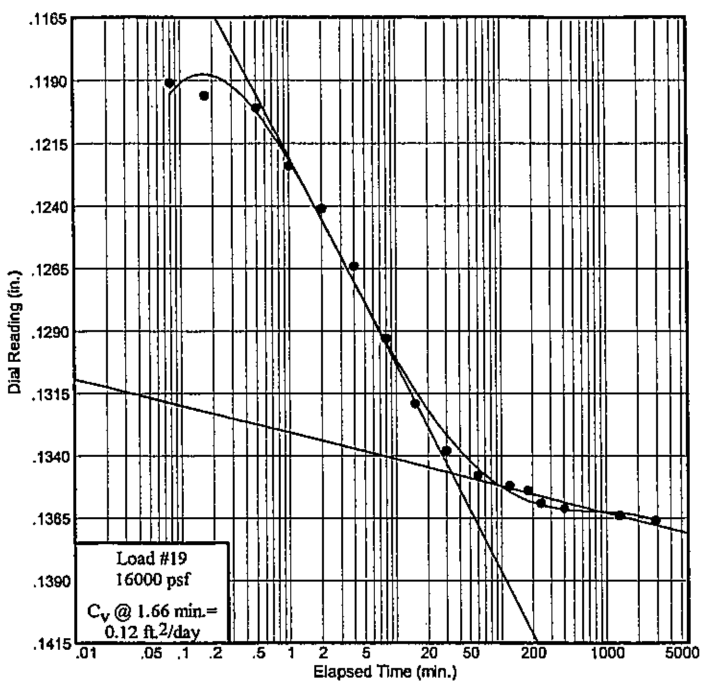
DLZ

Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

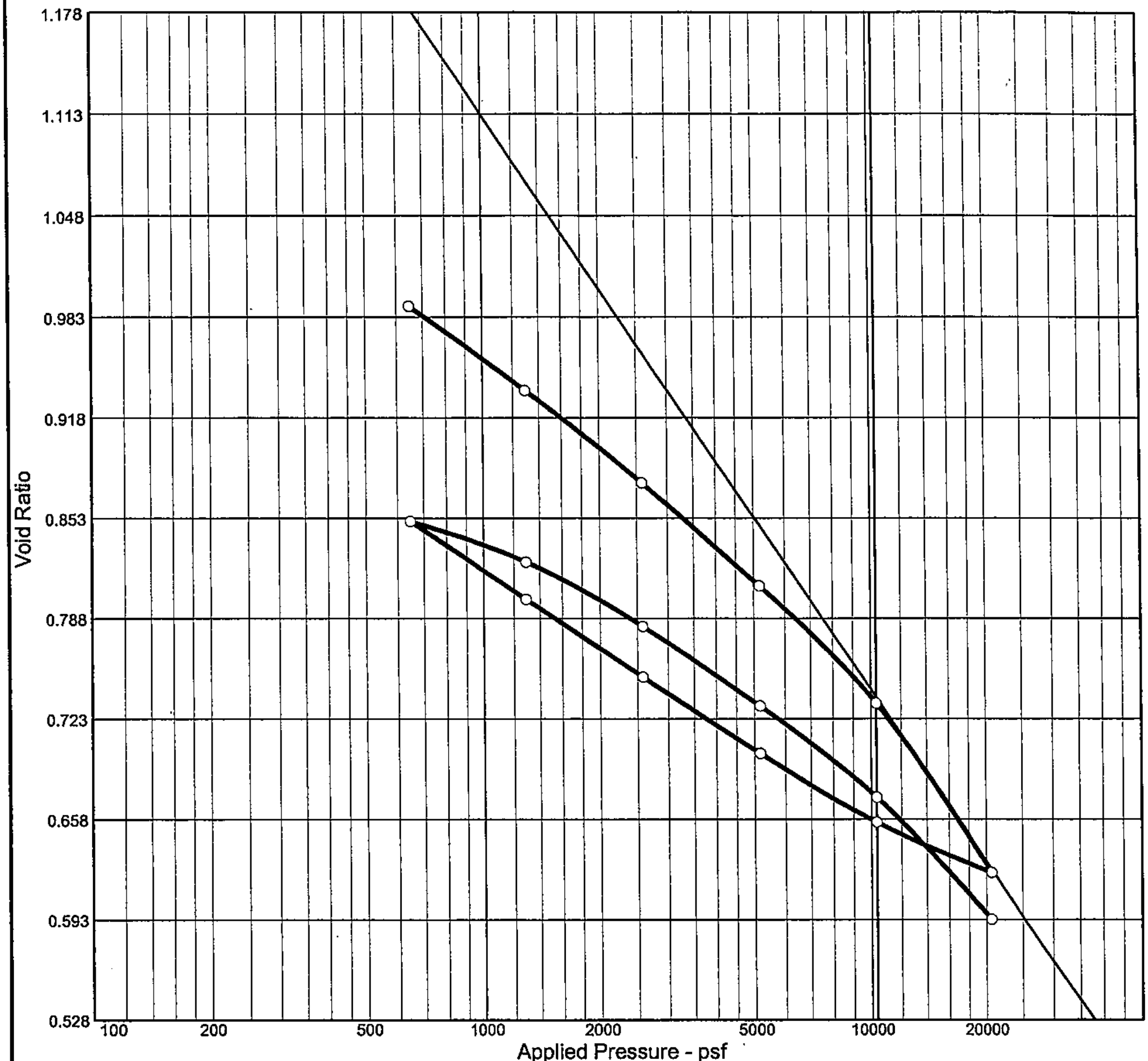
Source: B-1223 | Sample No.: P1 | Elev./Depth: 8.0



DLZ

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.3 %	40.4 %	82.0	67	41	2.79	CH	A-7-6(48	1.124

MATERIAL DESCRIPTION

Fat clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: B-1223 **Sample No.:** P2 **Elev./Depth:** 18.0

DLZ

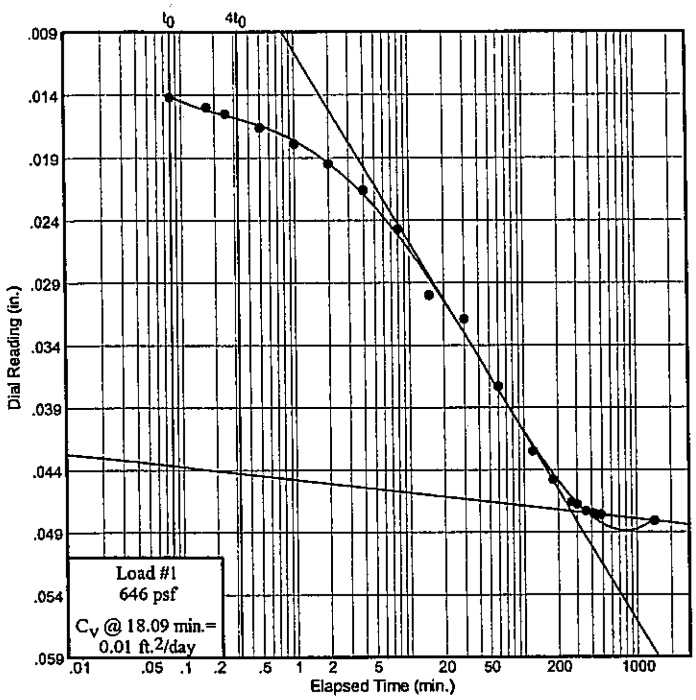
Remarks:

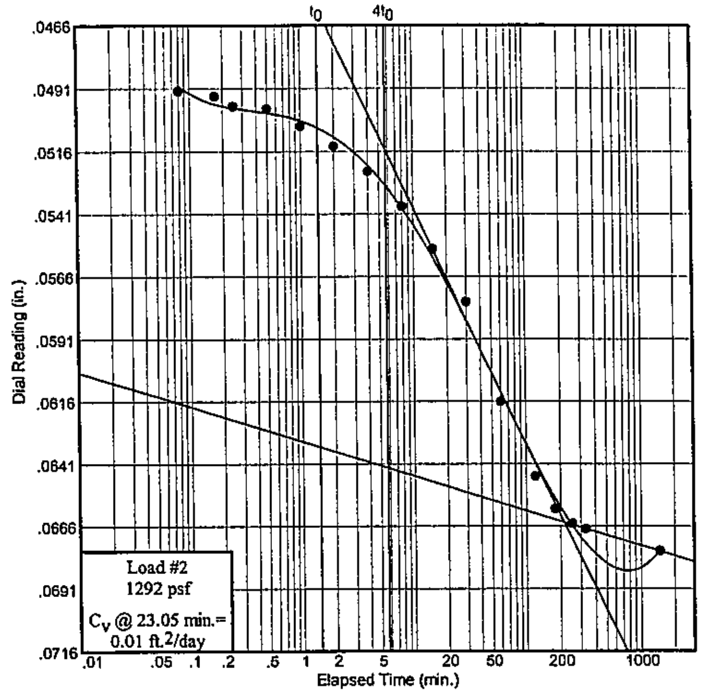
Figure

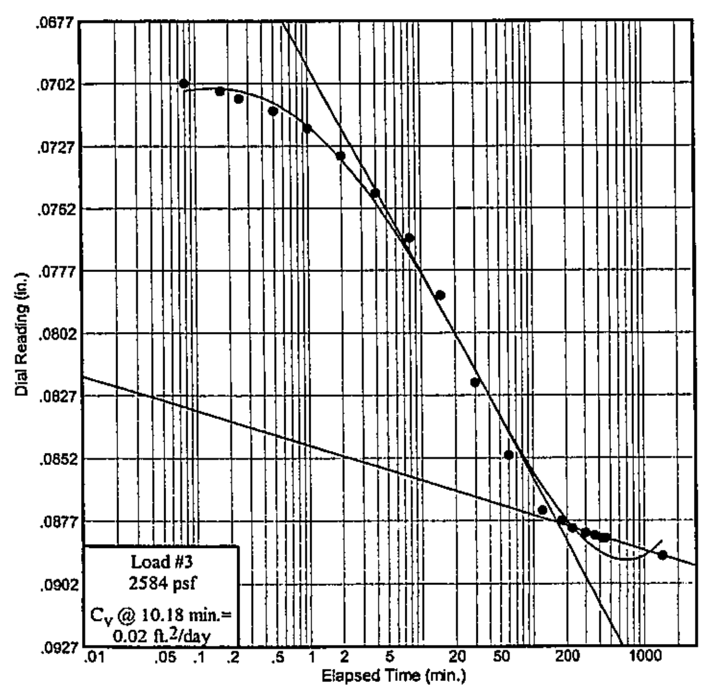
Dial Reading vs. Time

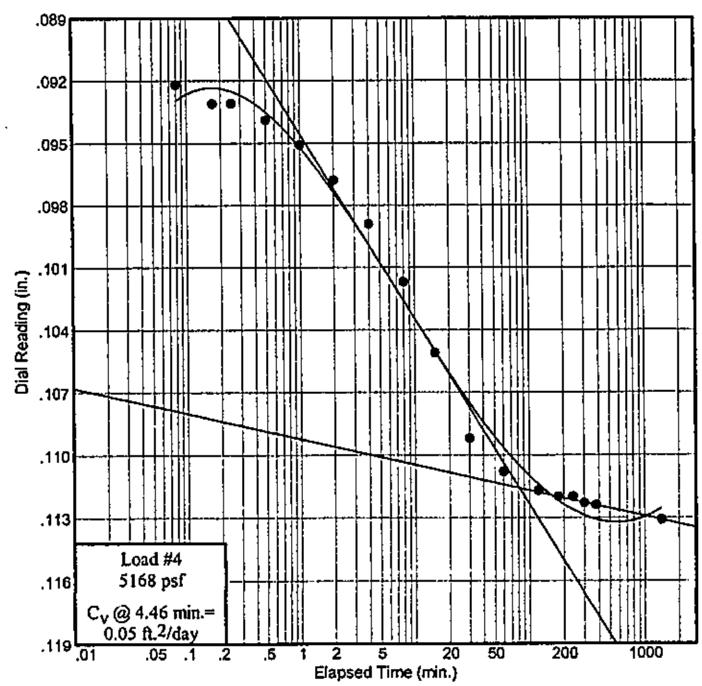
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 Sample No.: P2 Elev./Depth: 18.0









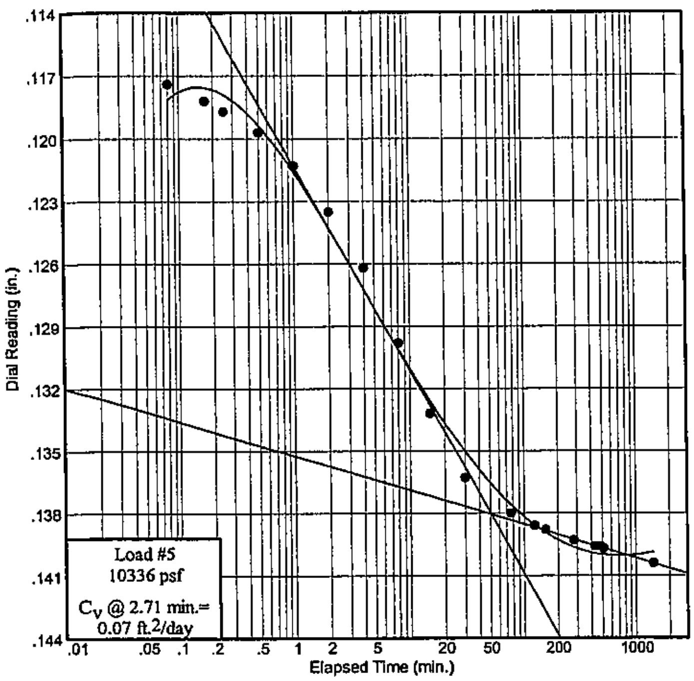
DLZ

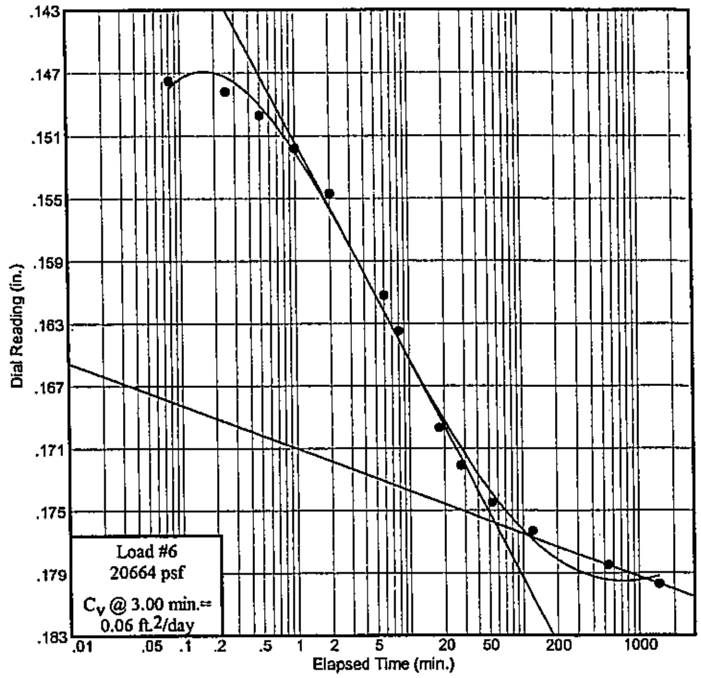
Figure

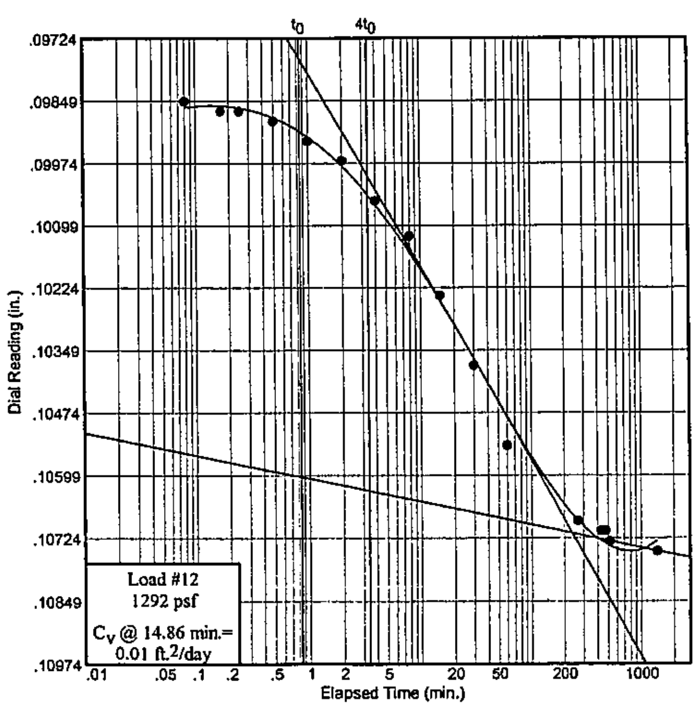
Dial Reading vs. Time

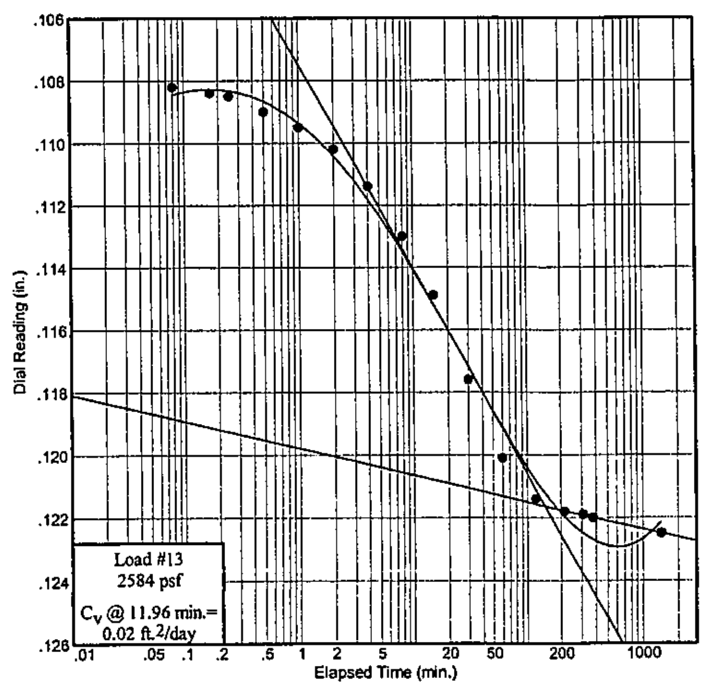
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 | Sample No.: P2 | Elev./Depth: 18.0









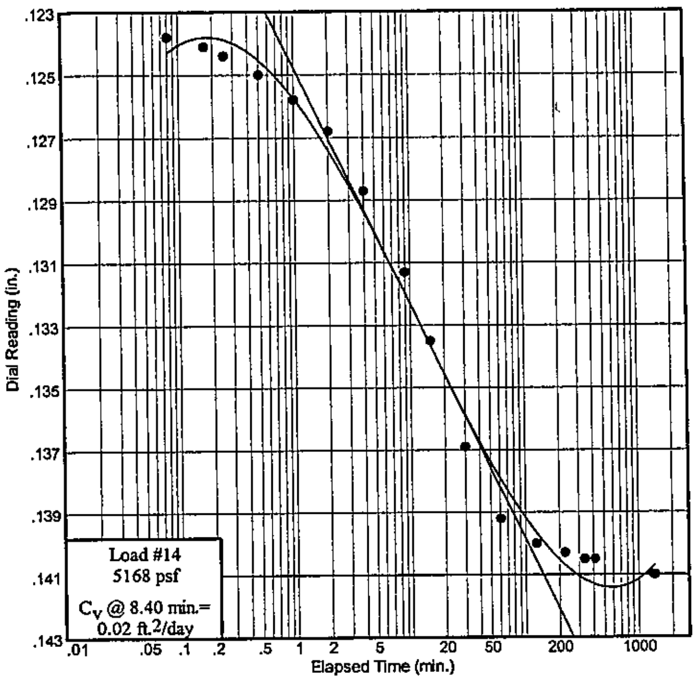
DLZ

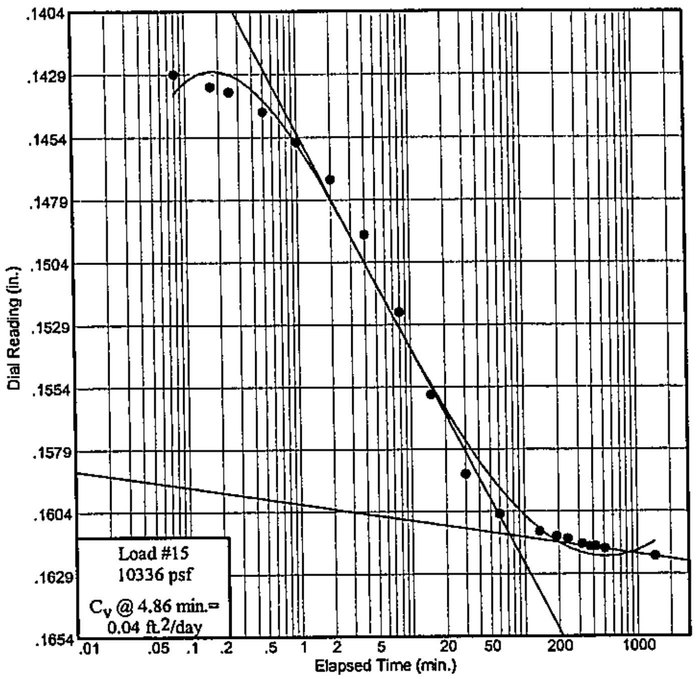
Figure

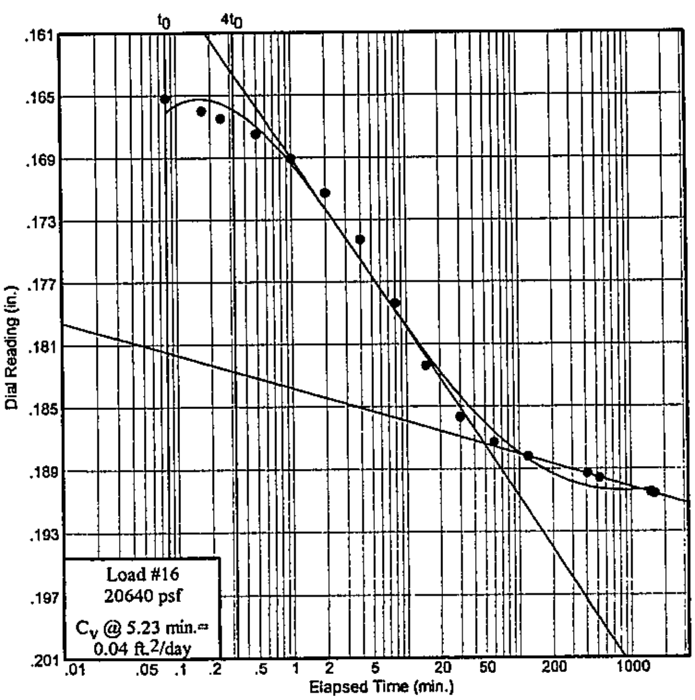
Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-1223 Sample No.: P2 Elev./Depth: 18.0

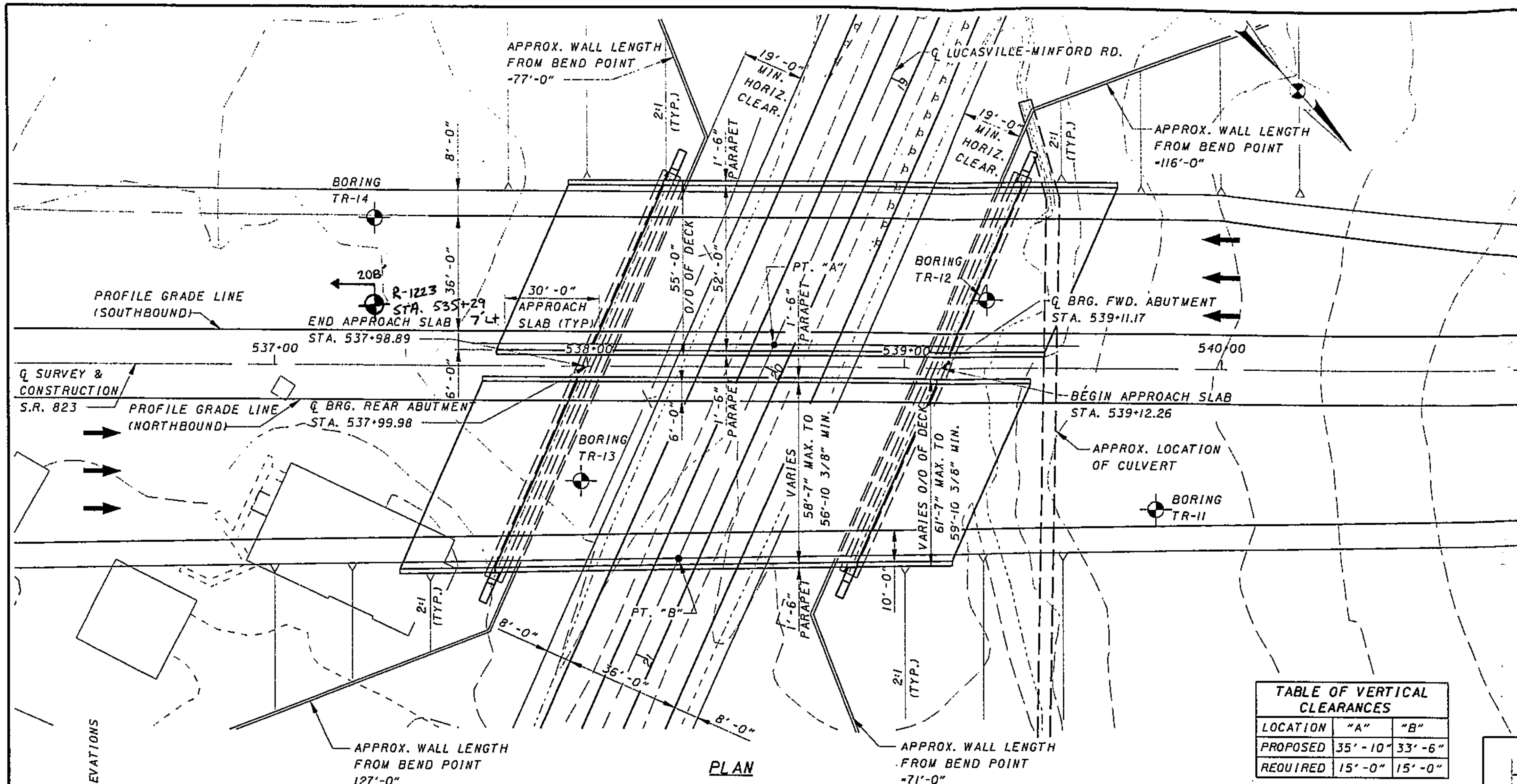






DLZ

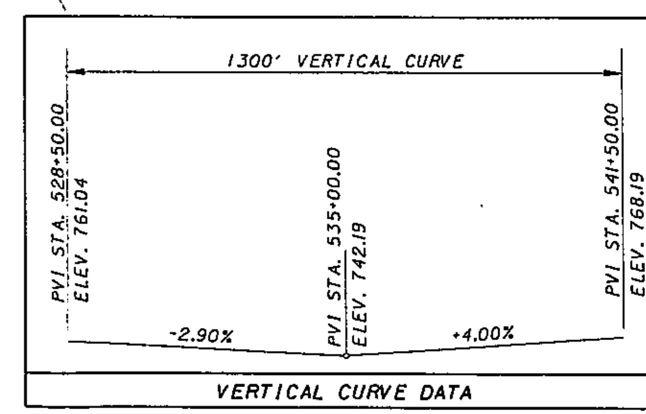
Figure



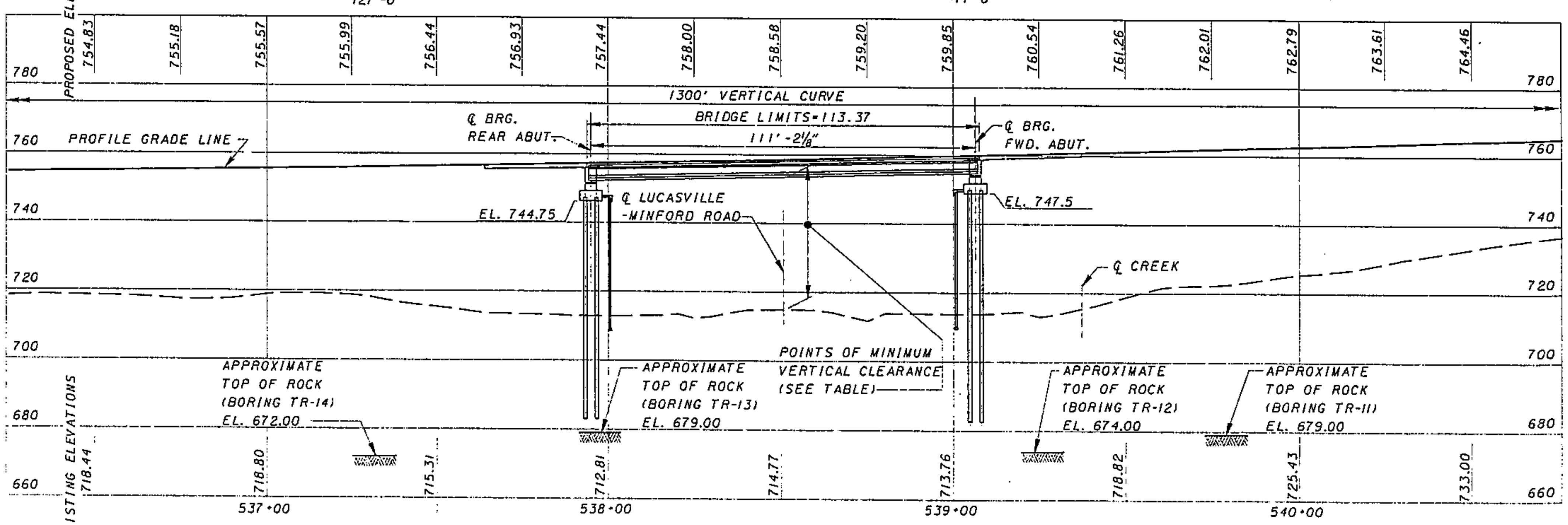
PLAN

TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	35'-10"	33'-6"
REQUIRED	15'-0"	15'-0"



VERTICAL CURVE DATA



ELEVATION ALONG PROFILE GRADE LINE S.R. 823 RIGHT BRIDGE

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
3. THE PROPOSED PROFILE GRADE IS WITHIN BRIDGE LIMITS. SEE ROADWAY PLANS FOR PAVEMENT ELEVATIONS BEYOND BRIDGE LIMITS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14x73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

DESIGN AGENCY: TRANSYSTEMS CORPORATION, 55 PUBLIC SQUARE, SUITE 1900, CLEVELAND, OHIO 44113-1901

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MEB	NFF	7/10/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
GHD			

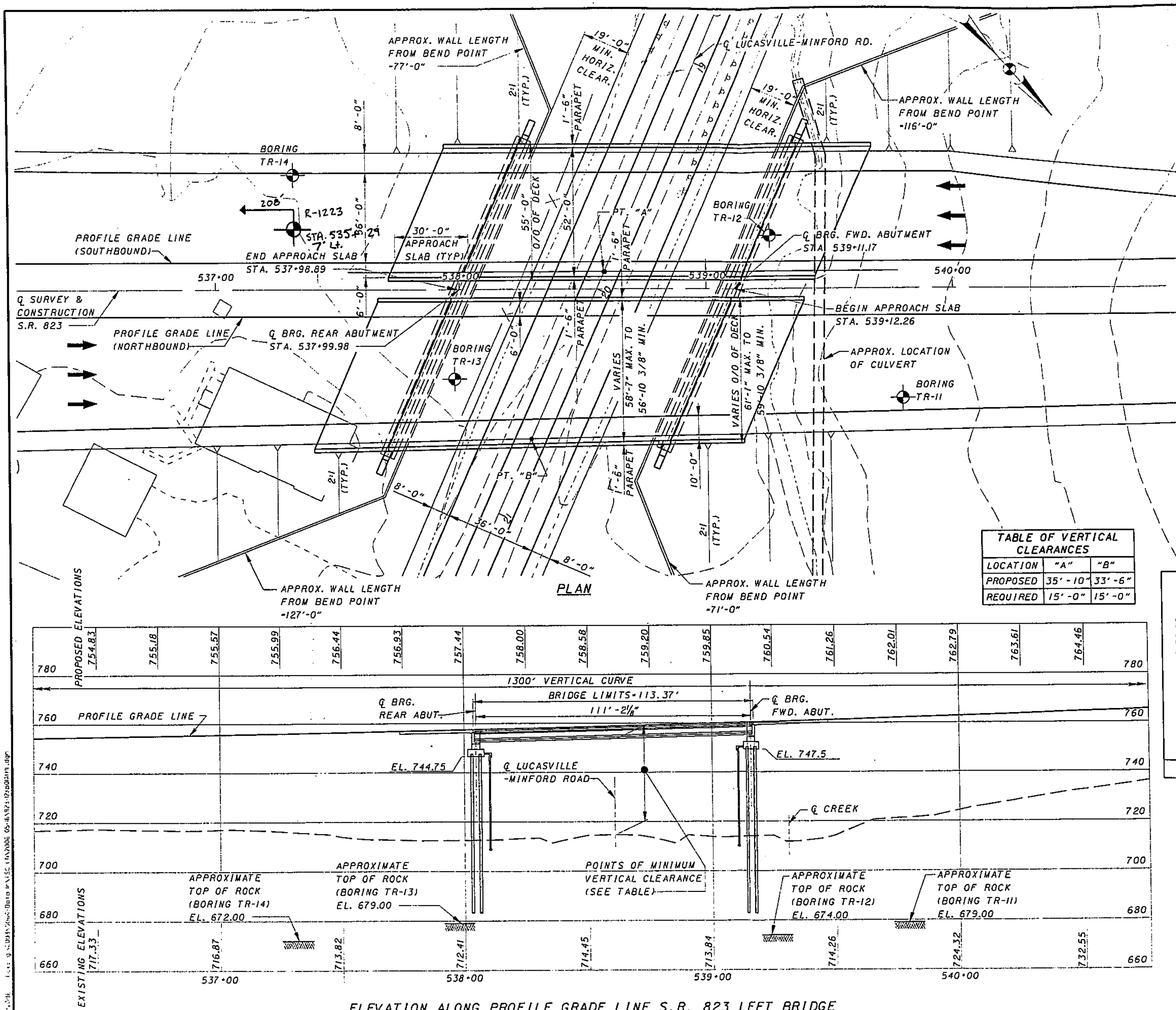
SCIOTO COUNTY
STA. 537+27.33
STA. 540+48.40

PRELIMINARY SITE PLAN - ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD

SCI-823-0.00
PID 19415

1 / 1

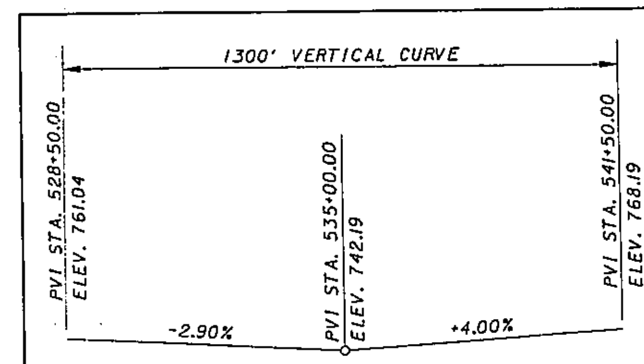
XXX
YYY



ELEVATION ALONG PROFILE GRADE LINE S.R. 823 LEFT BRIDGE

TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	35'-10"	33'-6"
REQUIRED	15'-0"	15'-0"



VERTICAL CURVE DATA

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
3. THE PROPOSED PROFILE GRADE IS WITHIN BRIDGE LIMITS. SEE ROADWAY PLANS FOR PAVEMENT ELEVATIONS BEYOND BRIDGE LIMITS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14x73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

DESIGN AGENCY: TRANSYSTEMS CORPORATION, 55 PUBLIC SQUARE, SUITE 1900, CLEVELAND, OHIO 44113

DESIGNED JDH | DRAWN MEB | REVIEWED NFF | DATE 7/10/05 | CHECKED | REVISED | STRUCTURE FILE NUMBER

SCIOTO COUNTY STA. 537+27.33 STA. 540+48.40

PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD

SCI-823-0.00
PID 19415

1 / 1