ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SUBSURFACE INVESTIGATION

STATE JOB NO. 110635

FEDERAL AID PROJECT NO. STATE JOB

AHP DIST. 5 MULTI-PURPOSE FACILITY (WEST MEMPHIS) (S)

STATE HIGHWAY 191 **SECTION** 1

IN CRITTENDEN **COUNTY**

LETTING OF DECEMBER 7, 2016

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

March 17, 2016

TO: Mr. Joe Sartini, State Maintenance Engineer

SUBJECT: Job No. 110635
Arkansas Highway Police Headquarters/Training Center (West Memphis)
Route 191, Section 1, L.M. 1.42
Crittenden County

Transmitted herewith are summaries of the site geology and subsurface conditions, design recommendations, percent material passing #200 sieve, undisturbed Shelby tube test results (including unconsolidated-undrained triaxial shear, Atterberg Limits, gradation, and moisture content), consolidation test results, and the logs of the borings conducted for the structure of the above referenced project.

If you have any questions concerning these recommendations, please contact the Geotechnical Section.

Michael C. Benson
Materials Engineer

MCB:rpt:mlg
Attachment

cc: Facilities Management
G.C. File

GEOTECHNICAL REPORT FOR JOB NO. 110635
ARKANSAS HIGHWAY POLICE HEADQUARTERS/TRAINING CENTER

INTRODUCTION

The Arkansas State Highway and Transportation Department (AHTD) is planning on constructing a new Arkansas Highway Police Headquarters near West Memphis, Arkansas. The new Highway Police Headquarters is to be located on the north side of Interstate 40 about 1 mile east of the Interstate 40 / Interstate 55 Interchange.

The primary purpose of this study is to obtain subsurface data at the site and to provide geotechnical recommendations for earthwork, foundations, and pavement design. The structure planned for the site is a one-story building. The sample locations and preliminary site layout of the structure, parking areas, and access roads are included in Appendix A. This location has been investigated and the findings and subsequent recommendations are presented in this report.

FIELD INVESTIGATION AND LABORATORY PROCEDURES

Two borings were completed at the locations requested by the State Maintenance Engineer. One boring was completed at the northeast and southwest corner of the proposed location of the structure. Approximately 53 total feet of borings were drilled and 14 Standard Penetration tests were performed. In addition, 11 Shelby Tube samples were taken to obtain triaxial shear test and consolidation test specimens. Preliminary descriptions of the materials encountered were recorded in the field and all recovered samples were brought to the laboratory and visually classified by experienced lab personnel to verify field identifications.

Atterberg limits, in situ moisture contents, UU Triaxial tests, and consolidation tests were performed on representative soil samples to verify field classifications, evaluate shrink-swell and settlement potential, and measure the shear strength of the subsurface soils. All laboratory testing was performed in accordance with AASHTO standards.

SITE AND SUBSURFACE CONDITIONS

General Site Conditions

The Arkansas Highway Police Headquarters/Training Center is to be located just north of I-40 and west of Highway 191 in Crittenden County. There is a recently constructed Arkansas Welcome Center and a Shell gas station located to the east of the proposed job site. There is a foundation of an old on/off ramp connecting the I-40 Frontage Road to Highway 191 and this bounds the jobsite to the north and west. In general, there is very little elevation relief across the proposed project site, which could very likely be subject to flooding following heavy or prolonged periods of rain. The area to the north and west of the site is currently utilized as agricultural land. Buried telecommunication lines parallel both the I-40 Frontage Road and Highway 191 to the southeast of the proposed job site. No other major utilities were observed.

Site Geology

The project site is located over deposits mapped as alluvial (channel meander) deposits (map symbol, Qcm). These deposits are recent channel meanders and current flood plain deposits of significant streams and meandering river systems. The partition of this unit from other Holocene alluvial deposits was based more on geomorphic considerations than lithology or age. Oxbow lakes and old channel scars are common in this unit and fossils are rare. The lower contact is unconformable and of variable thickness. A map further delineating the Quaternary deposits of eastern Arkansas designate these as backswamp (flood basin) deposits (map symbol, Hb). The backswamp deposits typically consist of gray to black clays and silty clays. The backswamp deposits overlie Late Wisconsin Stage Valley Train deposits. A valley train is a gently sloping plain underlain by coarse-grained glacial outwash and confined by valley walls.

Seismic Considerations

This project is located in the New Madrid Seismic Zone (NMSZ), which is the source for most of the seismic activity in the area. The NMSZ faults are buried below the surface from 0 to about 3,000 feet in depth by thick alluvial sediments of the Mississippi and other rivers in the area. The NMSZ has the potential to produce very large earthquakes, and when combined with the unconsolidated sediments of the area; ground motion, ground failure, and liquefaction may be a concern.

The AASHTO Bridge Design Guide gives a horizontal ground acceleration coefficient of approximately 0.405 for this location. According to the AASHTO Bridge Design Guide, this site is best characterized at Site Class E. The soils encountered in the top ten feet of the borings have a low liquefaction potential due to their clayey nature. The wet, very loose to loose, gray and brown, silt, silty sand, sand with silt, and silty clay encountered occasionally in the borings from approximately 10 feet below the existing ground surface to a depth of 20 feet, have a high liquefaction potential. However, it is not considered economically feasible to design a small one story structure to withstand liquefaction of deep subsurface soils.

Description of Subsurface Stratigraphy

The materials comprising the foundation strata for the proposed structure and pavement areas, as determined by the geotechnical exploration, are shown on the Boring Logs in Appendix B. In general, the surface of the site is underlain by moist to wet, soft to very stiff, gray, high plasticity clay to an approximate depth of 10 feet. Loose to very loose brown and gray silty sand and sand with silt and clay were encountered at depths from approximately 19 to 20 feet deep grading back into clay to total depths of the borings. Occasional calcareous nodules, gypsum, and organic matter were present in several samples within the clay.

Laboratory Test Results

Laboratory test results including Unconsolidated-Undrained Triaxial shear strength tests and Consolidation tests are summarized in Appendix C. Atterberg limit laboratory tests performed on representative samples found plastic limits ranging from 21 to 37, liquid limits from 31 to 76, and plasticity indices (PI's) ranging from 10 to 48. Unconsolidated-Undrained (UU) Triaxial tests performed on representative "undisturbed" Shelby tube samples resulted in estimated shear strengths of 403 to 1426 psf.

RECOMMENDATIONS

Foundations

Due to the high plasticity of the soils at the site, a conventional spread footing foundation and slab-on-grade construction will result in excessive differential movements in the structure. Given that the proposed structure is a one-story building, it is believed that the most economical means of dealing with the expansive soil at this location is removal of a portion of the

problematic clay by undercutting followed by the placement of an above-natural-grade select fill material building pad.

This alternative will require the removal of a minimum of 3 feet of material below the building footprint and extending 10 feet beyond the building perimeter on all sides. The material removed should be replaced with a minimum of 3 feet of selected material meeting the minimum requirements of Class SM-4 (Section 302, AHTD Standard Specifications for Highway Construction, 2014 edition). Select fill should be placed in continuous, horizontal lifts of eight inches maximum thickness and should be compacted to at least 95 percent of the maximum dry density determined by the Standard Proctor compaction test (AASHTO T-99) at a moisture content within 2 percent of the optimum value. The backfilling of the excavation should be performed in a timely manner allowing no more wetting or drying of the underlying soils than is necessary. Once the undercut area is brought back up to natural grade with the selected material, an additional 6 feet of Class SM-4 selected material should be placed and compacted as previously specified to bring the top of the selected fill to a minimum of 6 feet above the immediately surrounding natural grade. The select material building pad may be sloped back to the natural grade in the manner best suited to accommodate the final site grading plan, but limited to no steeper than 2H:1V. Clay plating should be placed over the backfill area that falls outside the building slab to prevent water from entering the backfill material from above. The clay plating should consist of a minimum of 18 inches of lean clay with a PI between 6 and 25. It should be ensured that sufficient grading is provided to prevent water from ponding in the vicinity of the structure. The additional bearing pressure resulting from the placement of the 6 feet of fill is anticipated to result in significant settlement at the structure location; however, the selected fill is expected to provide sufficient bridging effect to limit differential movements to tolerable limits.

A footing with a minimum width of 2 feet founded a minimum of 2 feet below the surface of the selected fill material building pad may be designed based on a factored bearing capacity of 1500 psf.

Pavement Design

It is recommended that the native clay subgrade for all paved areas including parking lots and driveways be undercut a minimum of 2 feet to remove the soft, disturbed material and backfilled with approximately 2.5 feet of Class SM-4. Fill material should meet the material requirements of Section 302 in the Standard Specifications for Highway Construction, 2014 Edition for Selected Material (SM-4).

CONSTRUCTION RECOMMENDATIONS

The foundation bearing area should be level and free of loose soil, ponded water, and debris prior to placement of concrete. Should the materials at bearing level become excessively dry or saturated, it is recommend that the affected materials be removed prior to placing concrete. Concrete should be placed as soon as possible after excavating the footing so that excessive drying of bearing materials does not occur.

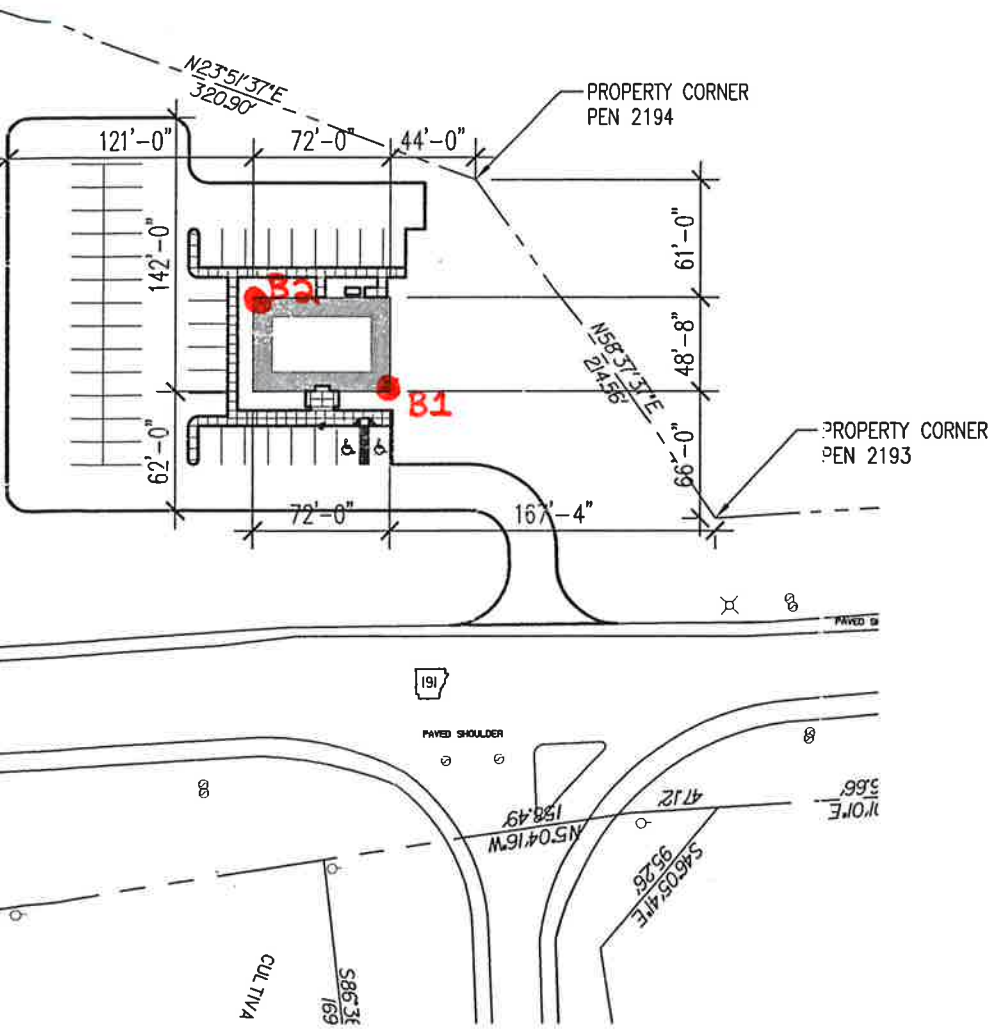
Before filling operations begin, representative samples of each proposed fill material should be collected. The samples should be tested to determine the maximum dry density, optimum moisture content, natural moisture content, gradation, and plasticity of the soil. These tests are needed for quality control during compaction and also to determine if the fill material meets the selected material requirements.

The fill surface must be adequately maintained during construction in order to achieve an acceptable compacted fill. It is recommended that the fill surface be sloped to achieve sufficient drainage and to prevent water from ponding on the fill. If the surface soils become excessively wet or frozen, fill operations should be halted and the Resident Engineer should be consulted for guidance.

It is recommended that at least one field density test be performed for every 2,500 square feet of fill in each fill layer.

Appendix A

Site Layout



ARKANSAS HIGHWAY POLICE HEADQUARTERS

West Memphis, Arkansas
Crittenden County

DATE: JUNE 8, 2015
JOB NO: ?????????
DRAWN BY: KB
REVISIONS:

C1.1

Appendix B

Boring Logs

LEGEND

SOIL TYPES

(SHOWN IN SYMBOL COLUMN)

(PREDOMINANT TYPE SHOWN HEAVY)

GRAVEL | SAND | SILT | CLAY | ORGANIC MATTER

ROCK TYPES

(SHOWN IN SYMBOL COLUMN)

SANDSTONE | SHALE or SILTSTONE | LIMESTONE or DOLOMITE | ALTERNATING LAYERS of SHALE and SANDSTONE | OTHER

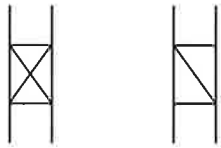
SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE

UNDISTURBED SAMPLE RECOVERY | DISTURBED SAMPLE RECOVERY | NO RECOVERY

SPLIT SPOON



SAMPLE RECOVERY | NO RECOVERY

ROCK CORING

% RECOVERY INDICATED ON LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
"N" Value	Density	"N" Value	Consistency	"N" Value	Consistency	"N" Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium Stiff	Over 60	
31-50	Dense	9-15	Stiff	9-15	Stiff	More than 2"	
Over 50	Very Dense	16-30	Very Stiff	16-30	Very Stiff	Penetration	
		31-60	Hard	31-60	Hard	in 60 Blows:	Medium Hard
		Over 60	Very Hard	Over 60	Very Hard	Less than 2"	
						Penetration	
						in 60 Blows:	Hard

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6 inches of penetration on the drill log. The field "N" Value (N_f) can be obtained by adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9=17 blows/ft$. The "N" Value corrected to 60% efficiency (N_{60}) can be obtained by multiplying N_f by the hammer correction factor published on the boring log.

ARKANSAS HWY. & TRANS. DEPARTMENT
MATERIALS DIVISION - GEOTECHNICAL SEC.

BORING NO. 1
PAGE 1 OF 1

JOB NO. 110635
JOB NAME: Arkansas Highway Police Headquarters/Training Center (West Memphis)
STATION: Northeast Corner
LOCATION: 35.166830, -90.176355
LOGGED BY: Steve Faulkner

DATE: December 21, 2015
TYPE OF DRILLING: Hollow Stem Auger
EQUIPMENT: CME 45B
HAMMER CORRECTION FACTOR: N/A

COMPLETION DEPTH: 20.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	DRY WEIGHT LBS PER CU.FT.	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
			SURFACE ELEVATION: 215.48								
			Moist, Stiff, Brown Clay								
			Moist, Loose, Brown Silt	MH	37	42	74	77.3			
			Moist, Stiff, Brown Clay with Some Organic Matter	-					3 4-6		
5			Moist, Stiff, Brown Clay	CH	30	33	74	85.0			
			Moist, Stiff, Brown Clay with Some Organic Matter and Trace Gypsum	-					3 4-5		
10			Moist, Medium Stiff, Brown Clay with Trace Nodules	CL	22	23	35	98.1			
			Wet, Loose, Brown and Gray Silty Sand*	-					2 3-3		
			Wet, Very Loose, Brown Silt with Trace Nodules	ML	NP	29		NT			
15									2 1-2		
			Wet, Soft, Gray Silty Clay	-					2 1-2		
20			Wet, Soft, Gray Clay						0 2-1		
			Boring Terminated								
25											
30											
35											

REMARKS: * Encountered Water At 11.0'

ARKANSAS HWY. & TRANS. DEPARTMENT
MATERIALS DIVISION - GEOTECHNICAL SEC.

BORING NO. 2
PAGE 1 OF 1

JOB NO. 110635
JOB NAME: Arkansas Highway Police Headquarters/Training Center (West Memphis)
STATION: Southwest Corner
LOCATION: 35.166635, -90.176526
LOGGED BY: Steve Faulkner

DATE: December 22, 2015
TYPE OF DRILLING: Hollow Stem Auger
EQUIPMENT: CME 45B
HAMMER CORRECTION FACTOR: NA

COMPLETION DEPTH: 32.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 214.93	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	DRY WEIGHT LBS PER CU.FT.	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
			Moist, Stiff, Brown Clay with Organic Matter	*					3 4-5		
			Moist, Brown Elastic Silt	MH	34	46	70	73.4			
5			Moist, Soft, Brown Clay with Trace Organic Matter	*					1 1-2		
			Moist, Brown Clay	CH	28	31	76	87.6			
			Moist, Stiff, Brown and Gray Clay	*					3 4-6		
10			Moist, Brown Clay	CL	21	28	31				
			Wet, Loose, Gray Silt *	*					2 3-2		
15			Wet, Gray Silt with Sand	ML	NP	31		NT			
			Wet, Loose, Gray Silt						2 3-2		
20			Wet, Loose, Gray Silt with Trace Nodules								
			Wet, Soft, Gray Clay	*					0 2-1		
25			Wet, Medium Stiff, Gray Clay						2 2-3		
			Wet, Gray Clay	CL	23	38	46	87.3			
30			Wet, Gray Clay	CH	23	35	52	87.6			
			Wet, Very Loose, Gray Silt	*					0 1-2		
			Boring Terminated								
35											

REMARKS: * Water encountered at 12.0 feet below ground level.

Appendix C

Test Results

Shelby Tube Sample Test Summary

Project: 110635

Station	Location	Depth (ft)	Plastic Limit	Liquid Limit	Plasticity Index	% Passing No. 200	Moist Unit Wt. (pcf)	Moisture Content (%)	Dry Unit Wt.	Estimated Cohesion (psf)	Description
Boring 1	NE Corner	0.5	37	74	37	98	110.2	42.5	77.3	994	Elastic Silt (A-7-5 (46))
Boring 1	NE Corner	5.0	30	74	44	97	112.8	32.7	85.0	1368	Fat Clay (A-7-5 (51))
Boring 1	NE Corner	9.0	22	35	13	86	120.7	23.1	98.1	950	Lean Clay (A-6 (11))
Boring 1	NE Corner	13.0	NP			96		29.3		NT	Silt (A-4 (0))
Boring 2	SW Corner	2.0	34	70	36	99	106.9	45.6	73.4	403	Elastic Silt (A-7-5(44))
Boring 2	SW Corner	6.0	28	76	48	98	115.0	31.2	87.6	1426	Fat Clay (A-7-6 (55))
Boring 2	SW Corner	10.0	21	31	10	90		28		NT	Lean Clay (A-4 (9))
Boring 2	SW Corner	14.0	NP			82		30.6		NT	Silt w/ Sand (A-4(0))
Boring 2	SW Corner	27.0	23	46	23	89	120.8	38.3	87.3	893	Lean Clay (A-1-6 (22))
Boring 2	SW Corner	29.0	23	52	29	95	118.1	34.9	87.6	1368	Fat Clay (A-1-6(31))

Consolidation Test Results
Summary

Project: Arkansas Highway Police Headquarters
Location: B-2
Job Number: 110635

Project Number: 110635

Sample Number: 1
Boring Number: 2
Depth: 6.0-8.0
Sample Type: Undisturbed

Sample Description: Brown and Gray Clay
Remarks:

Test Number:
Test Date: 01/21/2016

Index	Load Sequence (tsf)	Cummulative Change in Height (in)	Specimen Height (in)	Height of Void (in)	Vertical Strain (%)	Void Ratio	t90 Fitting Time (min)	t50 Fitting Time (min)	t90 Cv (ft2/year)	t50 Cv (ft2/year)
0	0.000	0.0000	0.7500	0.3827	0.00	1.0420	0.000	0.000	0.000	0.000
1	0.250	0.0010	0.7490	0.3817	0.13	1.0393	4.335	* 2.4085	100.132	41.871
2	0.500	0.0038	0.7462	0.3789	0.51	1.0317	0.816	* 0.4534	527.932	220.764
3	1.000	0.0121	0.7379	0.3706	1.61	1.0091	1.393	* 0.7741	302.384	126.444
4	2.000	0.0267	0.7233	0.3560	3.56	0.9693	1.427	* 0.7930	283.607	118.594
5	4.000	0.0455	0.7045	0.3372	6.07	0.9181	0.948	* 0.5264	405.311	169.490
6	8.000	0.0728	0.6772	0.3099	9.71	0.8438	6.590	* 3.6613	53.845	22.516
7	16.000	0.0403	0.7097	0.3424	5.37	0.9323	8.522	* 4.7345	45.733	19.124
8	8.000	0.0991	0.6509	0.2836	13.21	0.7722	0.000	0.000	0.000	0.000
9	4.000	0.0890	0.6610	0.2937	11.87	0.7997	0.000	0.000	0.000	0.000
10	1.000	0.0734	0.6766	0.3093	9.79	0.8422	0.000	0.000	0.000	0.000
11	0.250	0.0565	0.6935	0.3262	7.53	0.8882	0.000	0.000	0.000	0.000
12	0.050	0.0389	0.7111	0.3438	5.19	0.9361	0.000	0.000	0.000	0.000

Predicted value indicated with *

Tested By:

Checked By:

Consolidation Test Results
Summary

Project: Arkansas Highway Police Headquarters
Location: B-2
Job Number: 110635

Project Number: 110635

Sample Number: 2
Boring Number: 2
Depth: 10.0-12.0
Sample Type: Undisturbed

Sample Description: Silt w/ Sand
Remarks:

Test Number:
Test Date: 01/21/2016

Index	Load Sequence (tsf)	Cummulative Change in Height (in)	Specimen Height (in)	Height of Void (in)	Vertical Strain (%)	Void Ratio	t90 Fitting Time (min)	t50 Fitting Time (min)	t90 Cv (ft2/year)	t50 Cv (ft2/year)
0	0.000	0.0000	0.7500	0.3370	0.00	0.8160	0.000	0.000	0.000	0.000
1	0.050	0.0021	0.7479	0.3349	0.28	0.8110	0.000	0.000	0.000	0.000
2	0.125	0.0070	0.7430	0.3300	0.93	0.7991	3.614	* 2.0078	118.199	49.426
3	0.250	0.0112	0.7388	0.3258	1.49	0.7889	0.549	* 0.3048	769.723	321.913
4	0.500	0.0189	0.7311	0.3181	2.52	0.7703	1.441	* 0.8006	286.997	120.015
5	1.000	0.0285	0.7215	0.3085	3.80	0.7470	0.660	* 0.3668	610.040	255.119
6	2.000	0.0390	0.7110	0.2980	5.20	0.7216	0.717	* 0.3985	545.395	228.039
7	4.000	0.0537	0.6963	0.2833	7.16	0.6860	0.758	* 0.4212	494.856	206.921
8	8.000	0.0697	0.6803	0.2673	9.29	0.6473	2.851	* 1.5840	125.602	52.522
9	16.000	0.0250	0.7250	0.3120	3.33	0.7555	15.453	* 8.5851	26.320	11.006
10	8.000	0.0878	0.6622	0.2492	11.71	0.6034	0.000	0.000	0.000	0.000
11	4.000	0.0863	0.6637	0.2507	11.51	0.6071	0.000	0.000	0.000	0.000
12	1.000	0.0829	0.6671	0.2541	11.05	0.6153	0.000	0.000	0.000	0.000
13	0.250	0.0787	0.6713	0.2583	10.49	0.6255	0.000	0.000	0.000	0.000
14	0.050	0.0738	0.6762	0.2632	9.84	0.6373	0.000	0.000	0.000	0.000

Predicted value indicated with *

Tested By:

Checked By: