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TEXAS ACCELERATED PAVEMENT TESTING (TxAPT)
PLANS AND SPECIFICATIONS for EMBANKMENT CONSTRUCTION

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Product 5-1924-01-P3 (Received 2/26/04)
This product contains 3 parts:

- **Document titled "Texas Accelerated Pavement Testing (TxAPT) Plans and Specifications for Embankment Construction"**
- **Document titled "Specifications for Competitive Sealed Proposal for Construction of Pavement Test Area"**
- **Tube of plan drawings (shelved in RTI Library in tube storage area at top of rolling aisles)**

CENTER FOR TRANSPORTATION RESEARCH
BUREAU OF ENGINEERING RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

Revised: February 2004

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(TxAPT)

PLANS AND SPECIFICATIONS
for
EMBANKMENT CONSTRUCTION

REVISION

At the time of the original creation of this product in October 2002, the plans and specifications were not compiled. The Texas Accelerated Pavement Test Center was working with UT Physical Plant to obtain a contract to build the facility. The final plans and specifications were approved by UT Physical Plant and Smith-Western Engineering, and then submitted to TxDOT representatives for approval. After TxDOT approval, the project was announced to potential contractors through the UT bidding process. These construction plans and specifications were finalized on March 13, 2003, and several copies were provided to TxDOT at that time.

Appendix C is an attachment to this Product, and is in fact a separate document set containing actual plans and specifications used in the construction of the TxAPT facility. Project 0-9900 will produce a deliverable entitled "As Constructed Site Report; Layout of the Test Facility," which will contain the final drawings and depict full changes made to the construction site, including the construction drawings.

This document supports the original product submitted in 2002, and now contains Appendix C, the construction plans and specifications.

INTRODUCTION

The University of Texas at Austin, Center for Transportation Research (CTR) is under contract with the Texas Department of Transportation (TxDOT) to prepare an Accelerated Pavement Testing (APT) facility at the Pickle Research Campus (PRC) in Austin, Texas. Components of the facility include:

1. **Subgrade Embankment** – Construction and installation of the TxAPT embankment structure on which test pavements will be constructed.
2. **Site clearing** – Clean up and prepare site as needed for operational readiness.
3. **Parking/Access Road** – Permanent driveway and parking structures for driving access to the facility from Neils Thompson Drive.
4. **MLS Access** – temporary structure/earth work for ingress/egress of the MLS and related equipment to the TxAPT embankment and existing embankment. This access will be removed after the MLS is placed on the TxAPT embankment.
5. **Utilities** - including electric and water/wastewater.
6. **Construction Inspection** – Provide inspection and QA/QC services to insure contractor performs work in accordance with the plans and specifications.
7. **Test Pad Construction** – Construction and installation of aggregate base and asphalt pavement for the initial TxAPT pilot project.

The intent of this project is to construct an embankment with uniform characteristics to support the construction of pavement test sections and the operation of the TxAPT Center. This document contains the Plans and Specifications that describe the excavation and embankment work for the TxAPT Center at the Pickle Research Campus.

There will be a mandatory pre-bid conference that interested contractors must attend. The time and date for the pre-bid conference is to be determined.

SUBGRADE EMBANKMENT

Embankment Layout

The TxAPT embankment will be installed in a north-south orientation as shown in **Figures 1 and 2**. The embankment will be installed between the "NEES" building (to be constructed) and the existing pavement research embankment to the east. The eastern most edge of the embankment will be established by the engineer in the field regardless of the dimensions shown in **Figure 2**.

The site has an existing elevation change of approximately 7-feet (2% grade), sloping downward toward the south. The finished test pad embankment will have an elevation 1-foot higher than the insitu ground elevation at the north end of the embankment and 2 feet at the south end. The embankment will have a 1.5 percent longitudinal and transverse cross slope **(Figures 3a, b)**.

Design Parameters

The purpose of the embankment is to provide a uniform underlying subgrade with uniform strength characteristics on which the TxAPT will build pavement sections for testing. To accomplish this objective, the embankment will be constructed according to specifications and standards outlined in Texas' Standard Specifications of Highways, Streets and Bridges, Items 110 (excavation), and 132 (embankment) except as modified by the special provisions contained herein.

The embankment dimensions shall be 350' by 75' and shall be constructed with a 2 to 1 (2 horizontal versus 1 vertical) back slope.

Soil Testing

A geo-technical engineering study was performed to determine the characteristics of the insitu subgrade materials. Eleven boreholes were drilled onsite to measure soil strata thickness, soil classification and gradation. The location of the soil borings is shown in **Figure 4**. A copy of the boring logs and laboratory testing is provided in **Appendix A**.

The results of the investigation are summarized below:

1. There is no bedrock within 20 feet of the surface.
2. The underlying strata is composed of 3 layers in general
3. Groundwater was found at a depth of 13 feet in borehole number 1 (see **Figure 4**) on July 31, 2002.

MATERIAL	THICKNESS	LL	PI	CBR/Modulus**
Top soil	6 to 8 inches	------	------	------
Grey Clay	1 to 6 feet	55	35	5 to 7 ksi.
Tan Clay	20 + feet	25-35	11-22	35 to 180 ksi

** - Values calculated from Dynamic Cone Penetrometer (DCP) tests.

Soil Strata Profiles

Figure 5 shows how the three different soil layers vary in thickness and depth over the length and width of the TxAPT site. This diagram, in combination with the boring logs and a 1-foot topographical map was used to produce **Figure 6**, which displays the insitu elevations of the soil layers under the proposed embankment site a specific distances (cross-sections AA through HH) along the 350 ft. embankment (**Figure 7**).

Excavation and fill quantities were estimated from this information using the average-end-area method and are shown in **Table 1**. These "compacted in-place quantities should be verified by proposing contractors based on the description of earthwork to be done and the information contained herein.

The "Borrow" amount listed under Fill Quantities in **Table 1** represents additional subgrade material to be supplied by the contractor to achieve the final desire embankment elevation. This material must be tested and accepted by CTR prior to its use in the embankment.

EXCAVATION (CUT) QUANTITIES

	0 to 28 ft.	28 to 78 ft.	78 to 128 ft.	128 to 200 ft.	200 to 265 ft.	265 to 315 ft.	315 to 350 ft.	**Totals Yd^3**
Section	AA to BB	BB to CC	CC to DD	DD to EE	EE to FF	FF to GG	GG to HH	**AA to HH**
TS	63	109	113	161	150	118	83	**797**
FC	406	483	285	294	218	146	91	**1923**
MIX	59	105	87.7	69	96	113	68	**598**
LC	0	0	0	91	420	399	402	**1312**

TS – Topsoil
FC - Fat clay
LC – Lean clay
Mix – Mixture of fat and lean clay

EMBANKMENT (FILL) QUANTITIES

TYPE	**TOTAL (CY)**
Top Soil	797
Gray Clay	1923
Borrow	2400
Mix Clay	598
Tan Clay	1312
TOTAL	**7030**

Table 1. Estimated embankment cut and fill quantities.

Special Provisions

Work consists of excavating materials from the site, stockpiling these materials, and relaying stockpiled material and contractor supplied subgrade (borrow) to construct an embankment as provided for in the Texas Standard Specification for Construction of Highways, Streets and Bridges and these Special Provisions.

For convenience, the relevant Items from the Standard Specifications (Item 110-Excavation and Item 132-Embankment) are provided in **Appendix B**, combined where appropriate with the following Special Provisions:

Item 110 - Excavation

110.1 Description – Refer to the soil-boring log in Appendix A for detailed information regarding the materials that underlie the proposed site.

100.2. Construction Methods. -- Excavation shall be performed as follows (see **Figure 7)** for a graphical representation of the soil profile):

1. Remove topsoil from the site until the second layer of material (gray clay) is exposed (**Figure 8**). This includes approximately 6-inches of topsoil (from boring logs) and enough underlying material (1 to3 inches) to completely expose the layer of gray clay. The clean topsoil shall be placed in stockpile #1. Any topsoil mixed with clay will be placed in the waste stockpile #4 (waste material) or immediately loaded in a truck for disposal off site. Disposal of this material shall be at the contractors expense
2. Remove underlying gray clay layer minimizing contamination by the tan clay (**Figure 9.0**) which lies below and place this material in stockpile #2. The thickness of this material is variable over the site from 1 to 2 feet at the northern extremity of the excavation to 5 feet at the southern extremity.
3. Remove an additional layer of material (4 to 12 inches) that contains a mixture of gray and tan clays obtained in the excavation to completely expose the tan clay. Put this mixed clay material in stockpile #3.
4. Excavate the tan clay (**Figure 9.1**) and re-lay (**Figure 9.2**) at the optimum moisture content in 8-inch lifts to produce a density as required in Texas' Standard Specifications. Work the material to produce a uniform surface of tan clay material.
5. Scarify to a depth of six inches, the cut section of tan clay and re-compact (**Figure 9.3).**
6. Work the surface of the tan clay to produce a uniform level surface with a 1.5% longitudinal and transverse slope (**Figure 10**).

Any deviation from the proposed method described above must be presented and pre-approved by the Engineer.

Item 132 – Embankment

Excavated materials (except waste) will be re-laid with pre-approved borrow as described in the following Special Provisions.

132.2. Material. – Additional clay material (borrow) will be furnished by the contractor meeting the requirements that follow:

Insitu CBR – 4 to 8
Mr – 5 to 10 ksi

Liquid Limit – 55 ± 10%
Plasticity Index – 35 ± 20%

It is expected that CTR will work closely with the contractor to find an acceptable source for borrow. The following table shows a sample gradation of the gray clay on site (see **Appendix A** the for additional gradation information on insitu materials).

Sieve #	% Passing
¾"	100.0
3/8"	95.2
No. 4	91.6
No. 10	89.6
No. 40	84.4
No. 200	77.3

The material source for the clay must be identified early in the construction process so that samples can be tested and approved. All borrowed clay must come from the same source unless the engineer approves an alternate source. Clay samples will be tested for swelling potential and those clays that exhibit excessive swelling potential will be rejected.

132.3 Construction Methods – The embankment will be constructed using material excavated as described herein and combined with contractor furnished borrow material. The embankment will be prepared as follows:

1. Relay the mixed clay material from stockpile #3 (mixture of excavated tan and gray clays) in 8-inch lifts maintaining the 1.5% transverse and longitudinal slopes as shown in **Figure 11** and compact as specified.
2. Relay the excavated gray clay from stockpile #2 in 8-inch lifts and compact as specified **(Figure 12)**.
3. Import sufficient clay material with properties as defined in the specifications and lay the material to finish the embankment **(Figure 13)** to the elevation as shown in the plans, with a 1.5% longitudinal grade and 1.5 % transverse slope (Figures 3a and #b). Material shall be compacted to the specified density.

4. All compaction shall be done in accordance with TxDOTs Standard Specifications Item 132.3(3b) Density Control and will be monitored by CTR in accordance with the appropriate test methods listed therein.
5. Use the stockpiled topsoil (stockpile #1) and cover the slopes of the embankment and any clay surfaces exposed as a result of embankment construction to a minimum depth of six-inches. The contractor shall properly dispose of unused topsoil.
6. The finished embankment shall have a back slope of 2 to 1.
7. The contractor is responsible for setting stakes and doing the surveying necessary to achieve the specified embankment elevations and slopes.
8. Spray the surface of the embankment (not the back slopes) with two coats of asphalt emulsion according to Texas' Standard Specifications, Item 314, at an application rate as directed by the engineer.
9. Remove all unused and waste soils from the site and dispose of properly.

Any deviation from the proposed method described above must be requested and pre-approved by the Engineer.

Seeding and Soil Retention

The embankment slopes and adjacent areas on which topsoil has been relayed shall be seeded for erosion control using a seed mixture suitable for winter/summer application as per Texas' Standard Specifications for Construction of Highways, Streets and Bridges, Item 164. The Contractor shall also install and secure a soil retention blanket over these areas according to Texas' Standard Specifications, Item 169.

Additional Requirements

It is anticipated that an unusual amount of testing will be carried out in conjunction with the construction of the embankment. Therefore the contractor is required to provide a standby cost (per hour) to be charged when the contractor is required by the Engineer to temporarily suspend embankment construction for testing or other purposes.

PRICE QUOTATION

Contractors will provide price quotes that break out the components of the work as follows:

Item	Description
1.	Mobilization of crew and/or machines (includes rental cost if required)
2.	Topsoil Excavation (CY)
3.	Clay Excavation (CY)
4.	On-site trucking (CY)
5.	Off-site trucking (CY)
6.	Clay Embankment (CY in place)
7.	Fine Grading (SY)
8.	Survey Crew For Stakes and Slope Verification (per hour)
9.	Cost of additional clay per the specifications (CY) delivered to the site
10.	Re-lay topsoil (CY)
11.	Disposal of waste (including trucking costs) and other unusable materials (CY)
12.	Seeding and soil retention blanket (SQ-FT)
13.	Emulsion seal coat (SQ-YD)
14.	Standby cost (per hour)
15.	Total Cost (less standby cost) for complete project as described

FIGURES

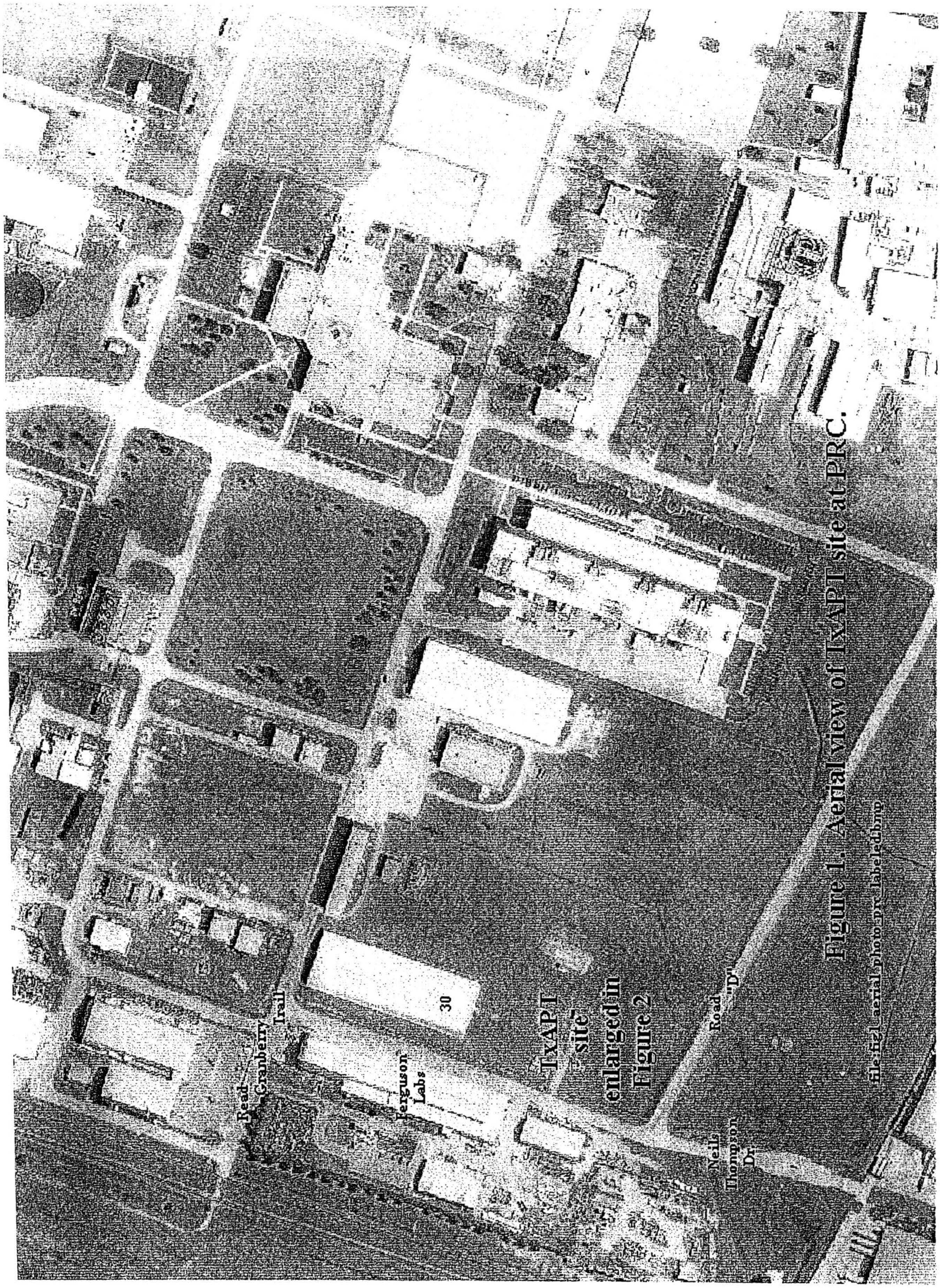


Figure 1. Aerial view of TxAPT site at PRC.

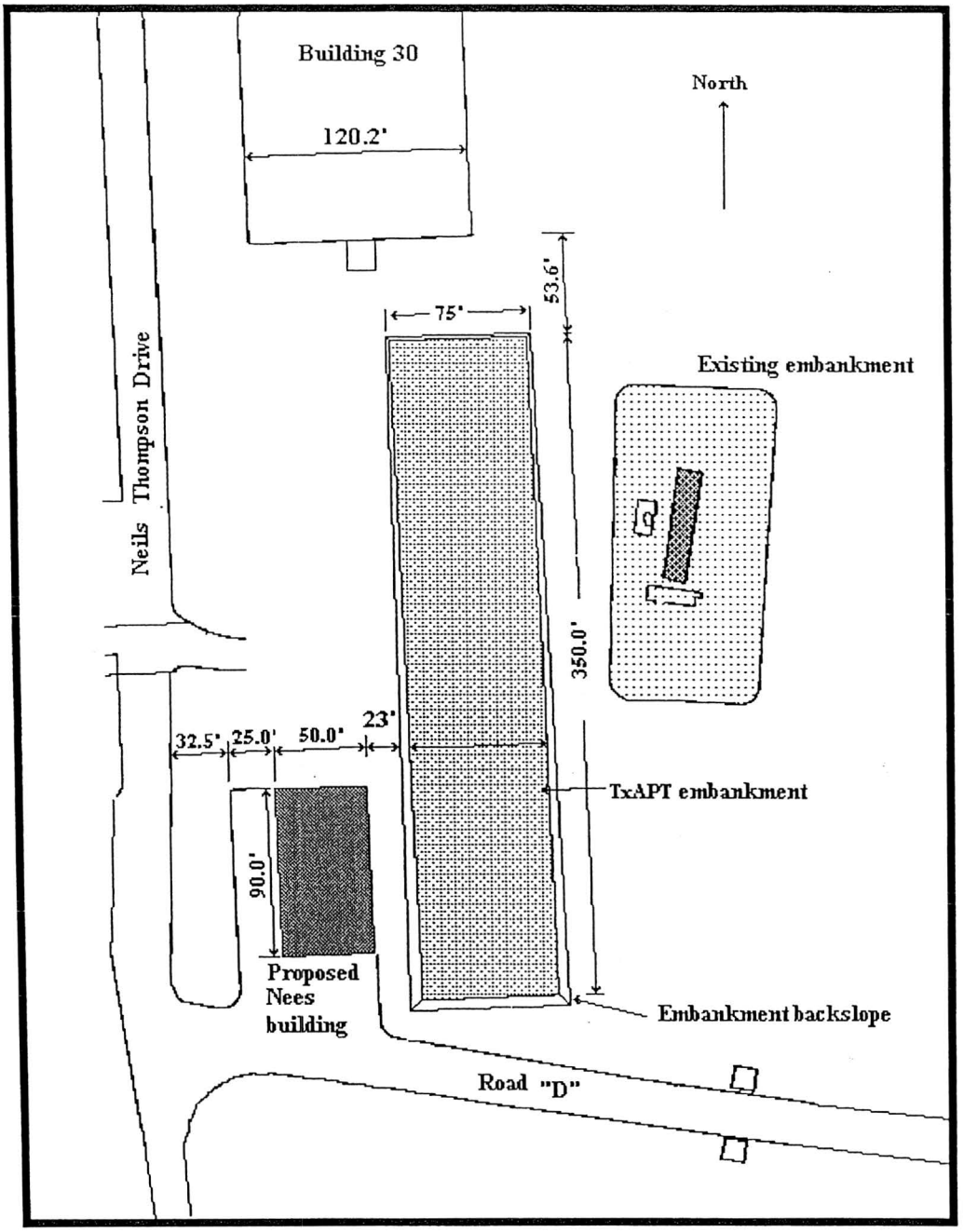


Figure 2. TxAPT PRC site layout.

file: fig2_perm_site_config.bmp

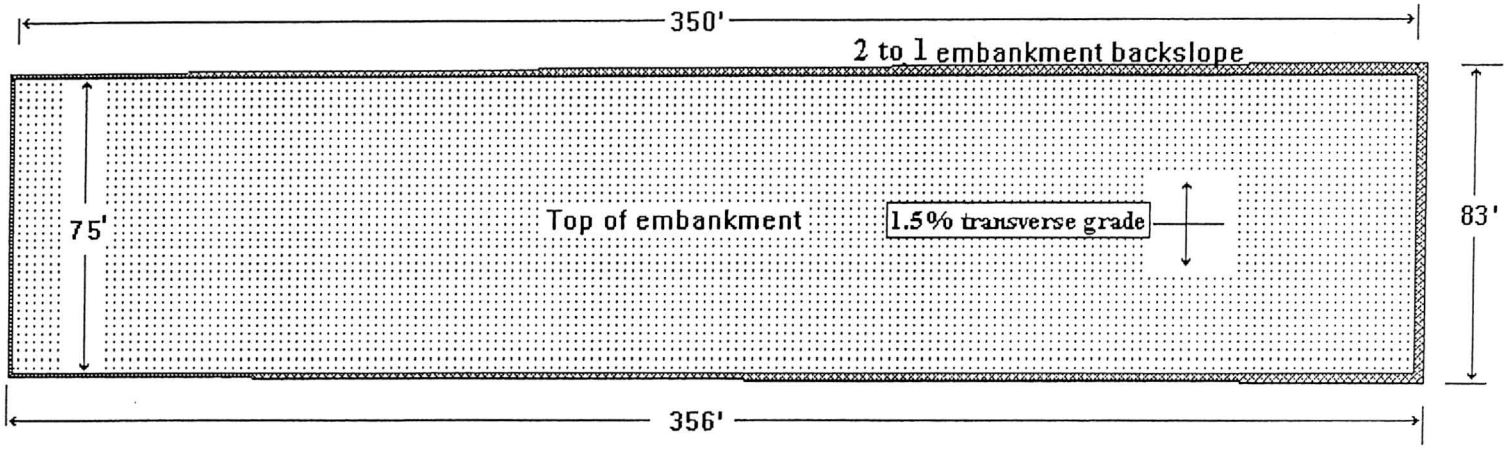


Figure 3a. Plan view of MLS embankment

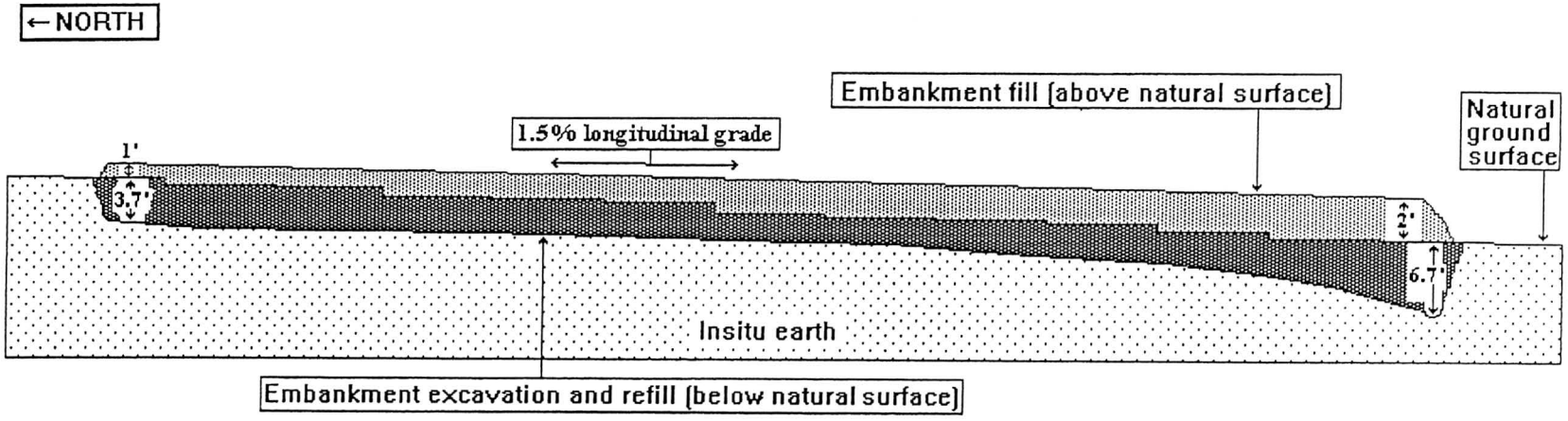
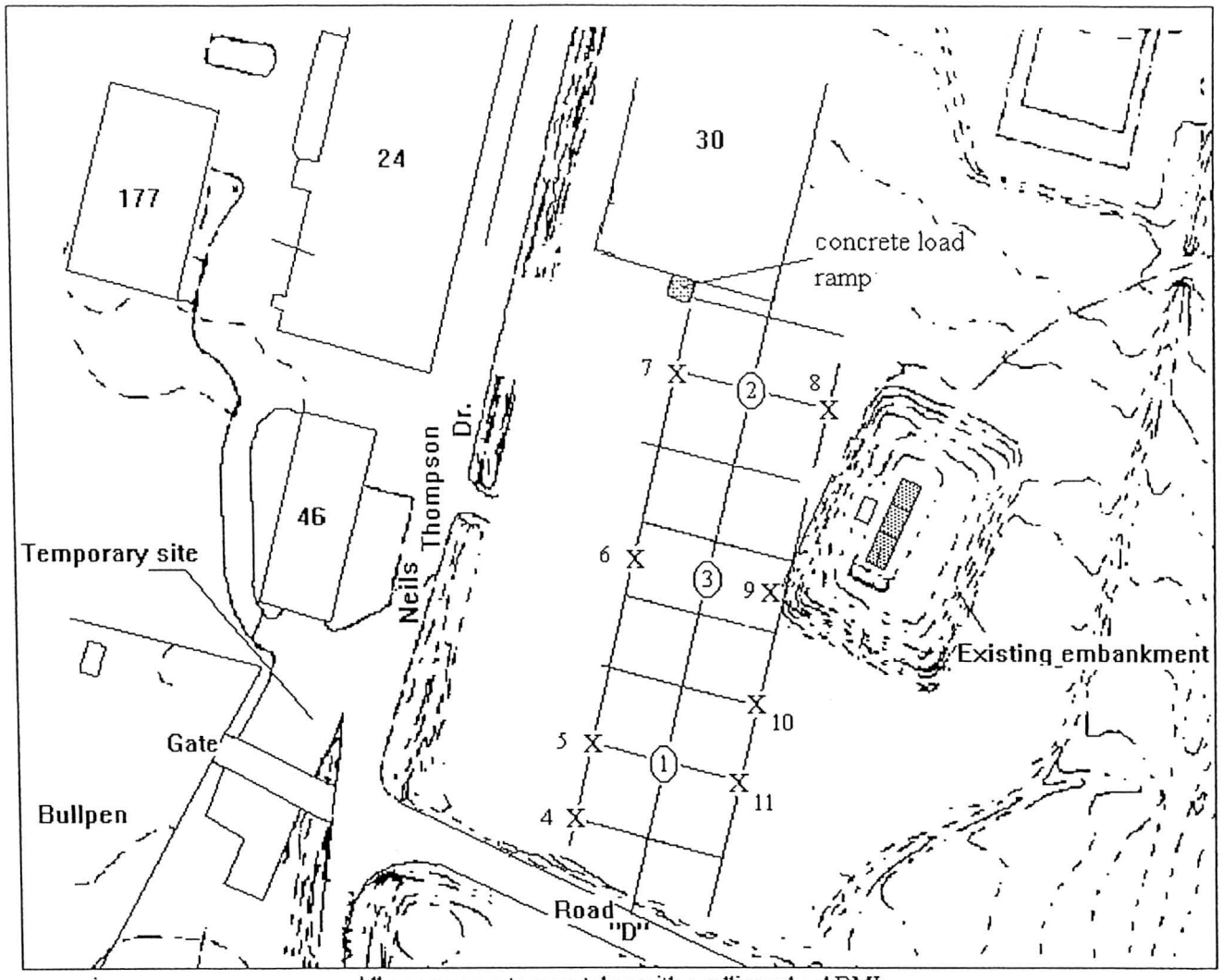


Figure 3b. Profile of MLS embankment showing cut and fill.

file: fig3_embank_plan_profile.bmp



All measurements were taken with a rolling wheel DMI.

X Borehole locations for clay depth (8 holes X 5ft. per).

⊗ Borehole locations to characterize underlying materials (3 holes X 20ft. per).

Grid shown is approximately 50 ft. X 50 ft.

Hole (1) is approximately 106 ft. from Rd.D EOP

Hole (2) is approximately 174 ft. from Neils Thompson Dr. EOP.

file: fig4_borehole_pattern_final.bmp

Figure 4. Soil testing and hole depth layout.

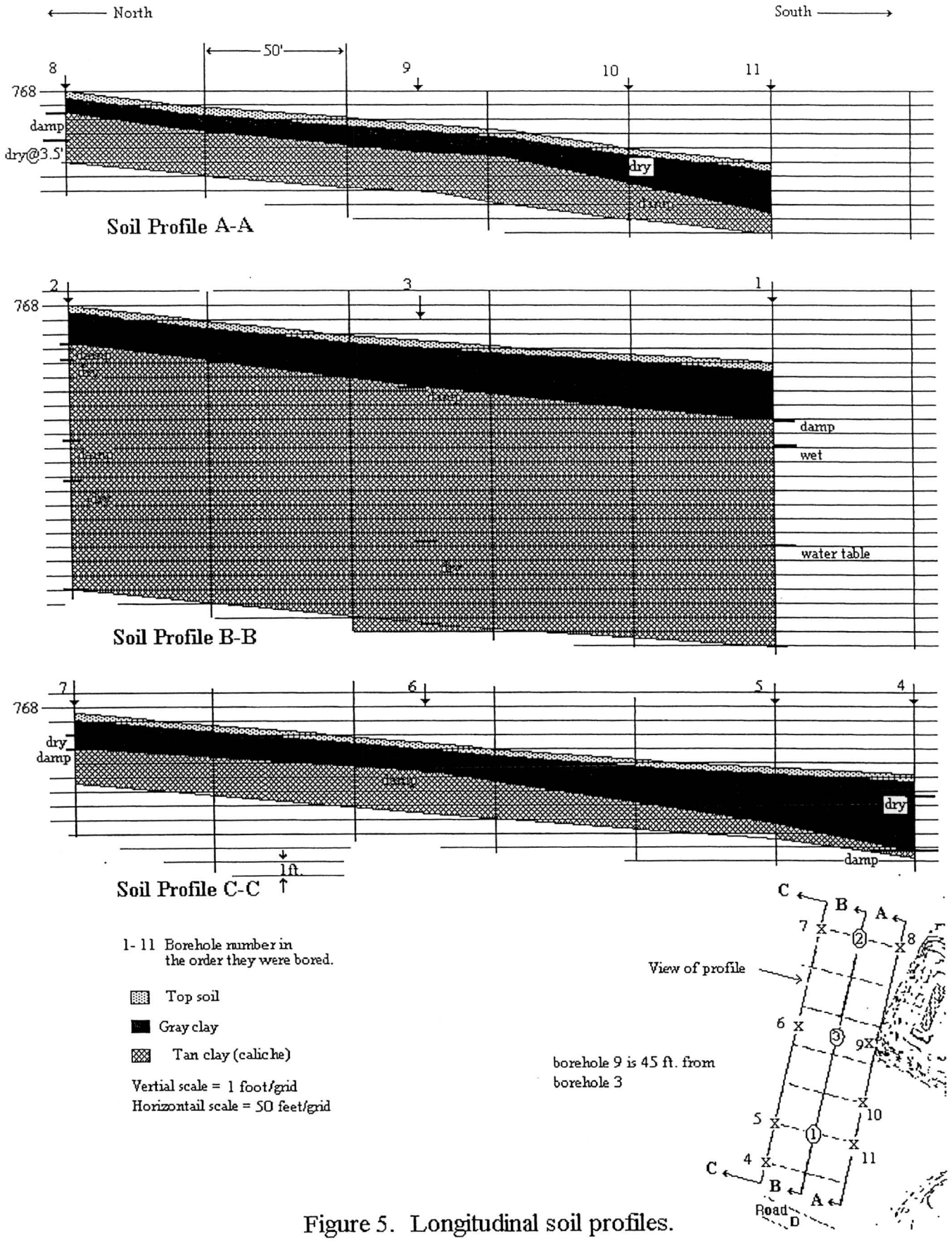
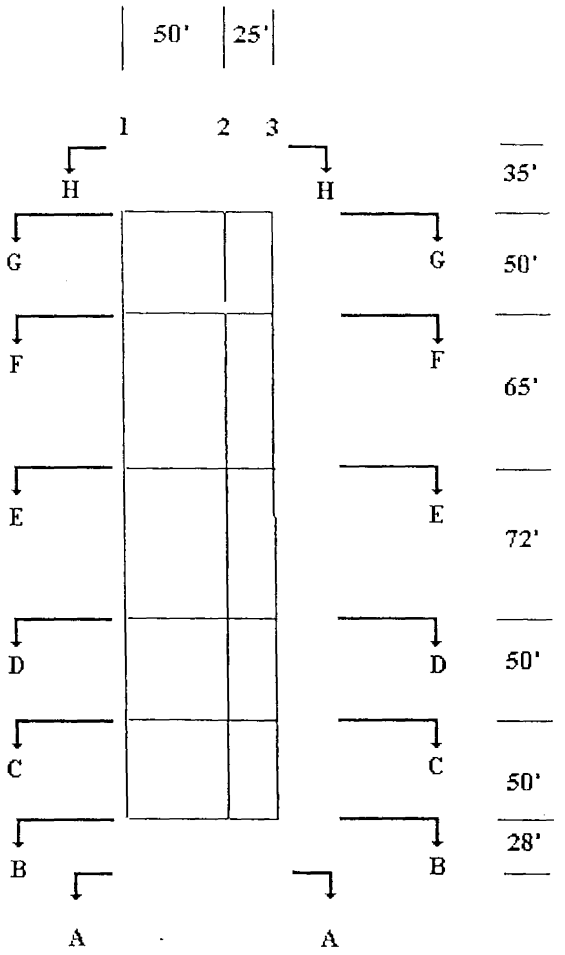


Figure 5. Longitudinal soil profiles.

file:fig5_soil_profile_e_b&w.bmp

Section		1	2	3
AA	Surface	762.0	761.3	761.3
	Fat Clay	761.3	760.6	760.6
	Mixed	755.3		
	Lean Clay	754.6		
BB	Surface	762.7	762.0	761.8
	FC	761.0	761.3	761.1
	Mix	757.2		
	LC	756.5		
CC	Surface	763.5	763.0	762.7
	FC	762.8	762.3	762.0
	Mix	760.0		
	LC	759.0		
DD	Surface	763.7	765.5	763.4
	FC	763.0	762.8	762.7
	Mix	761.2		
	LC	760.7		
EE	Surface	765.0	765.2	765.2
	FC	764.3	764.5	764.5
	Mix	763.2		
	LC	762.7		
FF	Surface	766.0	766.0	766.1
	FC	765.3	765.3	765.4
	Mix	764.3		
	LC	763.8		
GG	Surface	767.0	767.2	767.1
	FC	766.3	766.5	766.4
	Mix	765.5		
	LC	764.5		
HH	Surface	767.6	768.0	768.0
	FC	766.9	767.3	767.3
	Mix	766.4		
	LC	766.1		



Note: Underlined values are actual measured elevations taken from the boring logs. All other values are either calculated and/or extrapolated from measured elevations.

Figure 6. Insitu soil strata elevations from geo-technical boring log.

file: fig6_soil_elevations.bmp

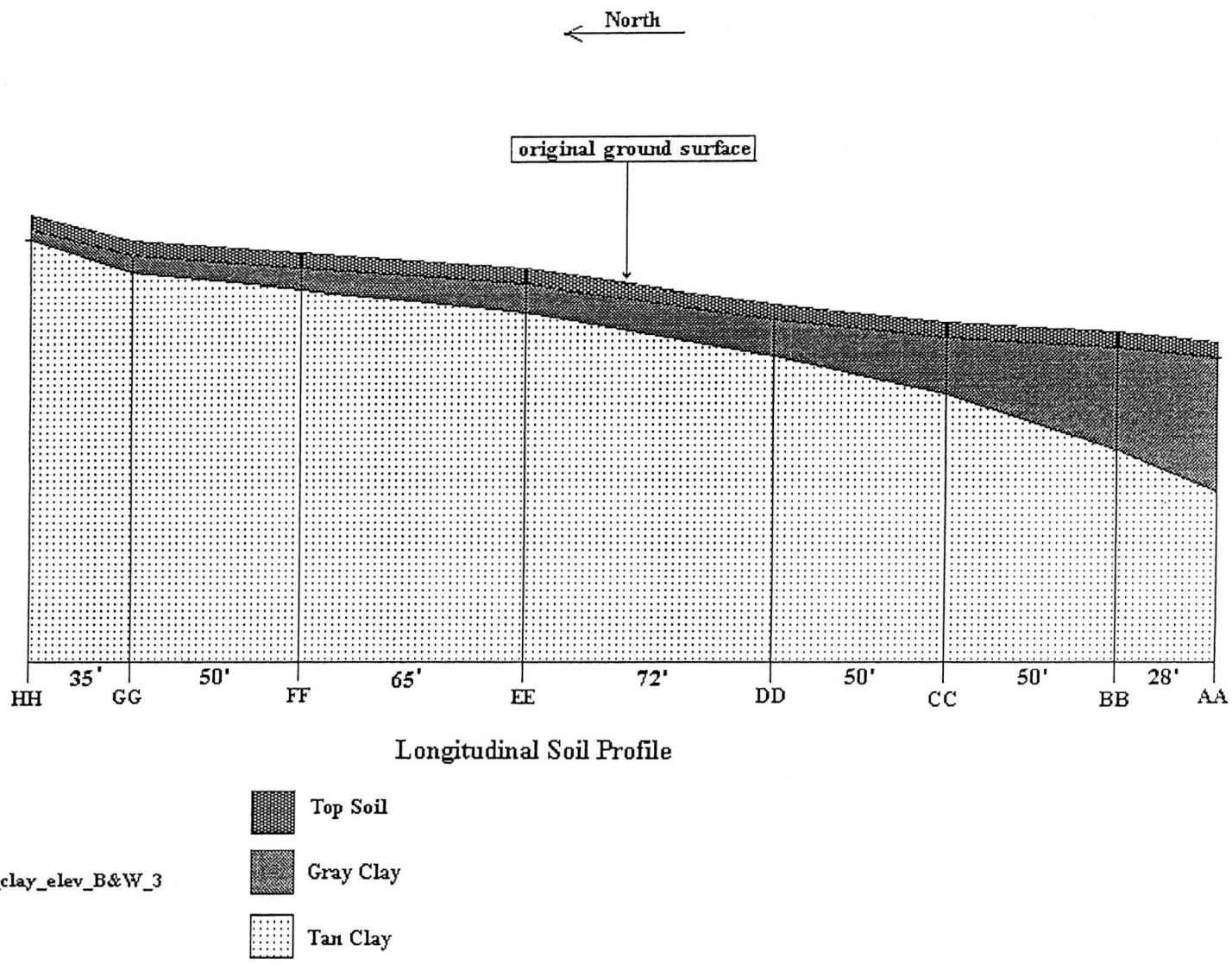
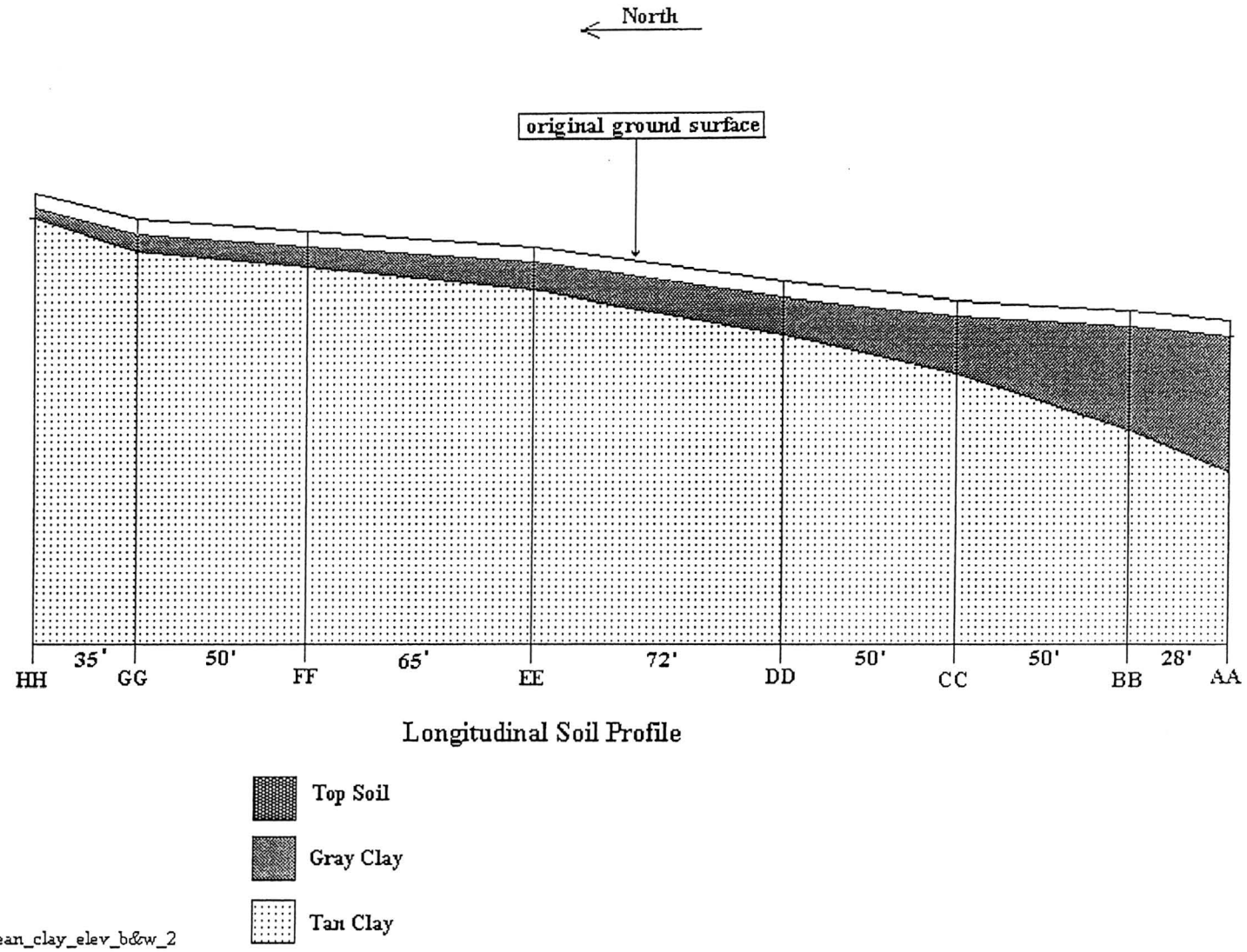
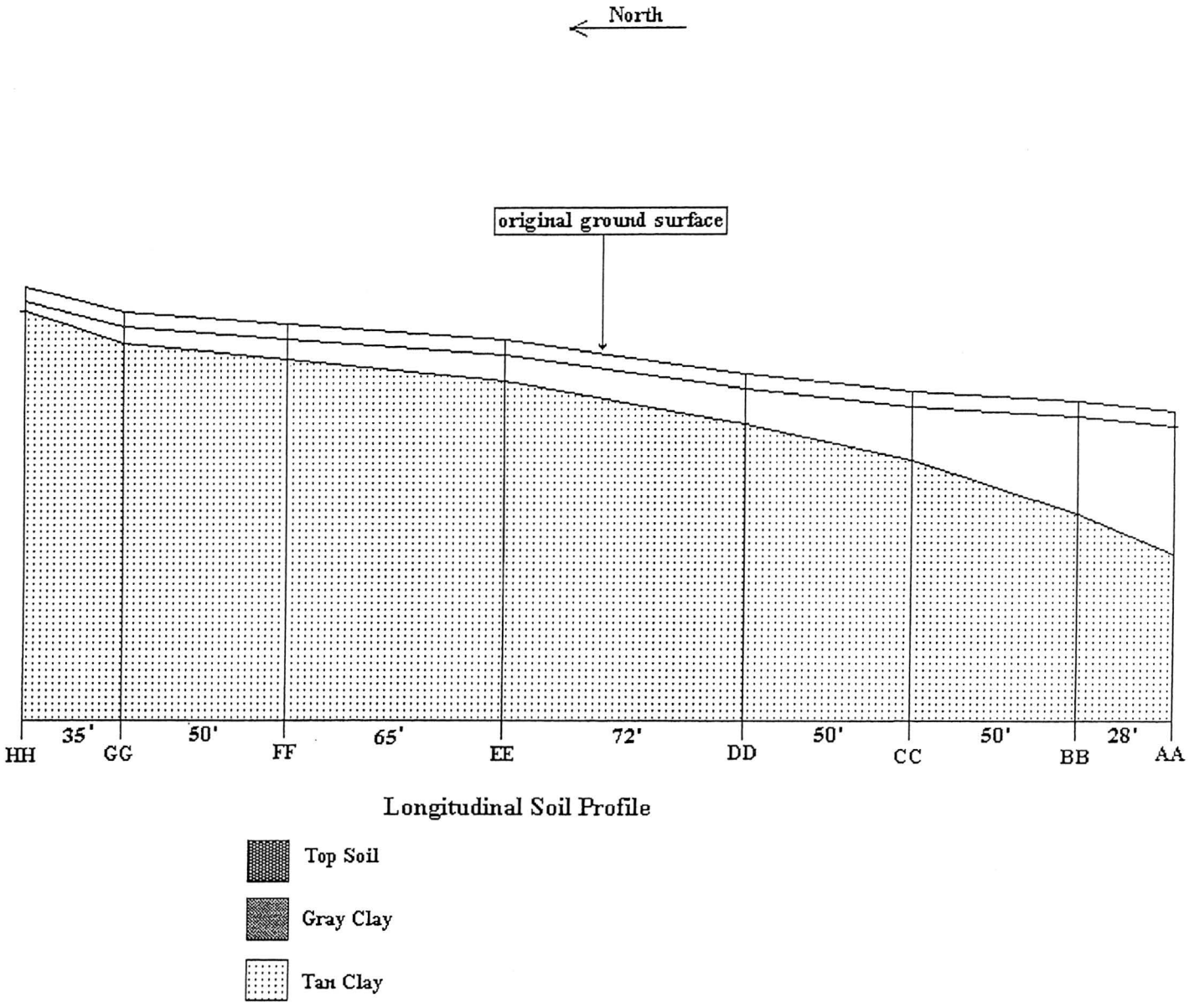


Figure 7. Longitudinal soil profiles.



file: fig8_embank_lean_clay_elev_b&w_2

Figure 8. Top soil excavated.



file: fig9.0_embank_lean_clay_elev_insitu

Figure 9.0. Gray clay excavation.

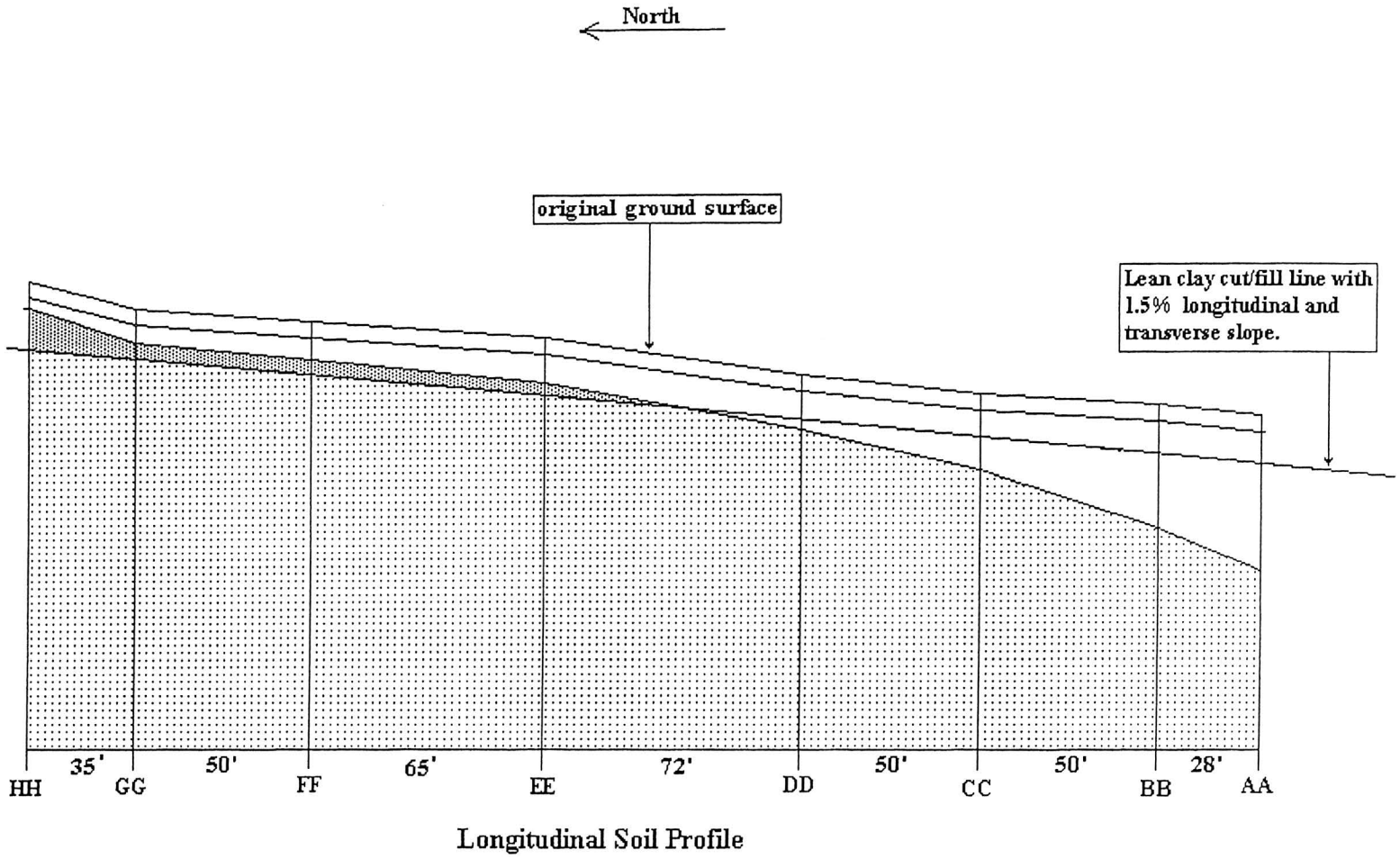
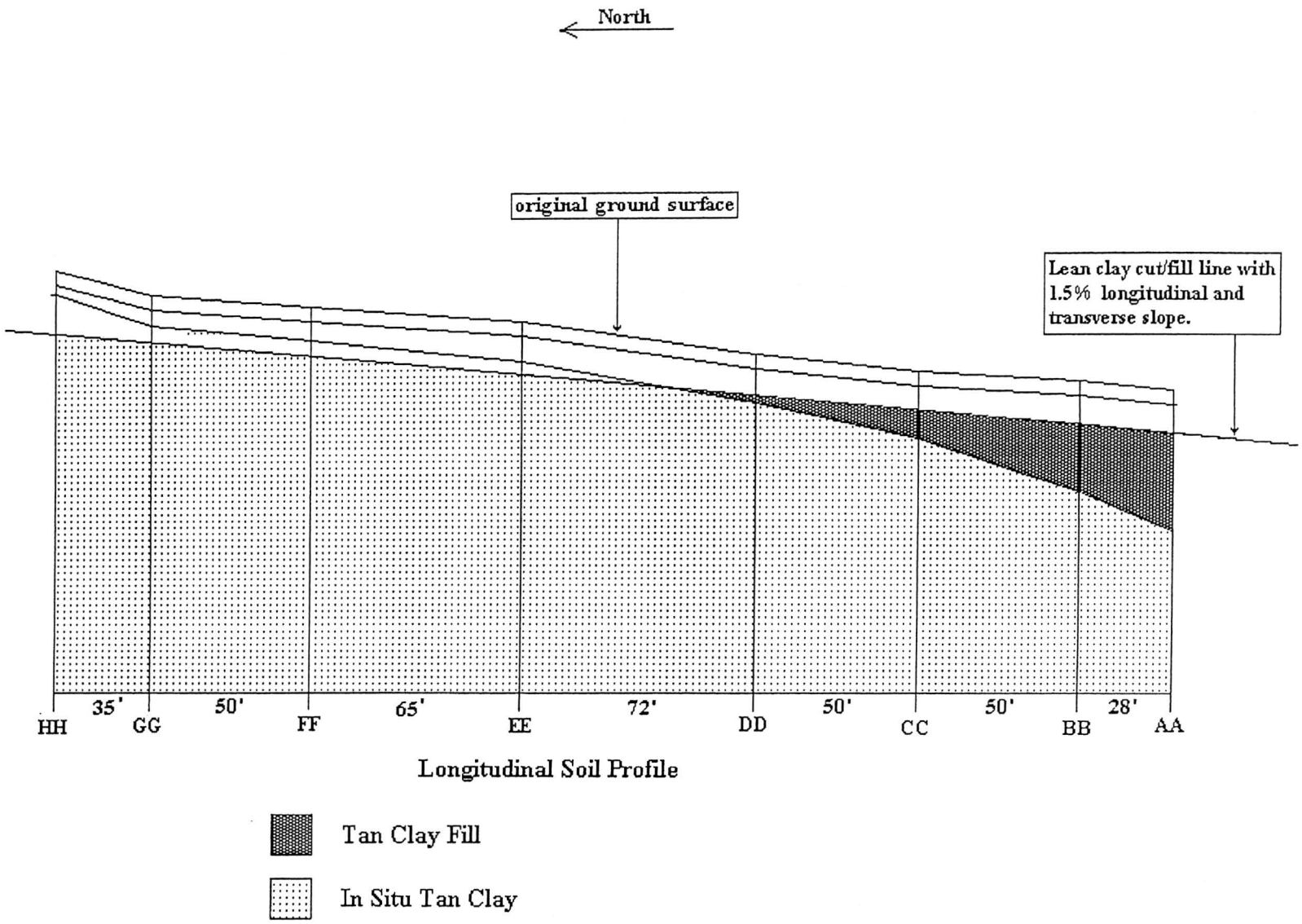
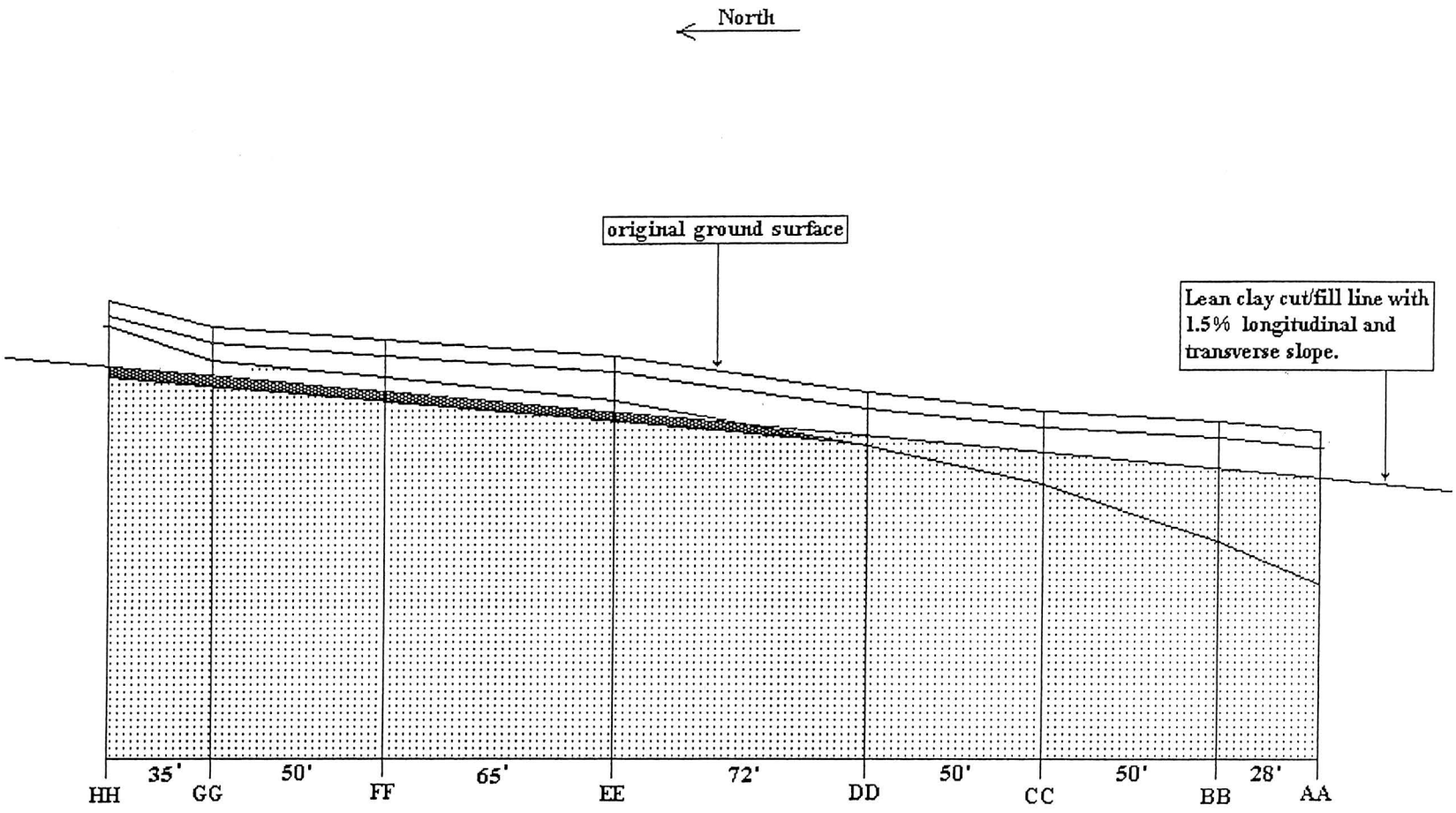


Figure 9.1. Tan clay cut.



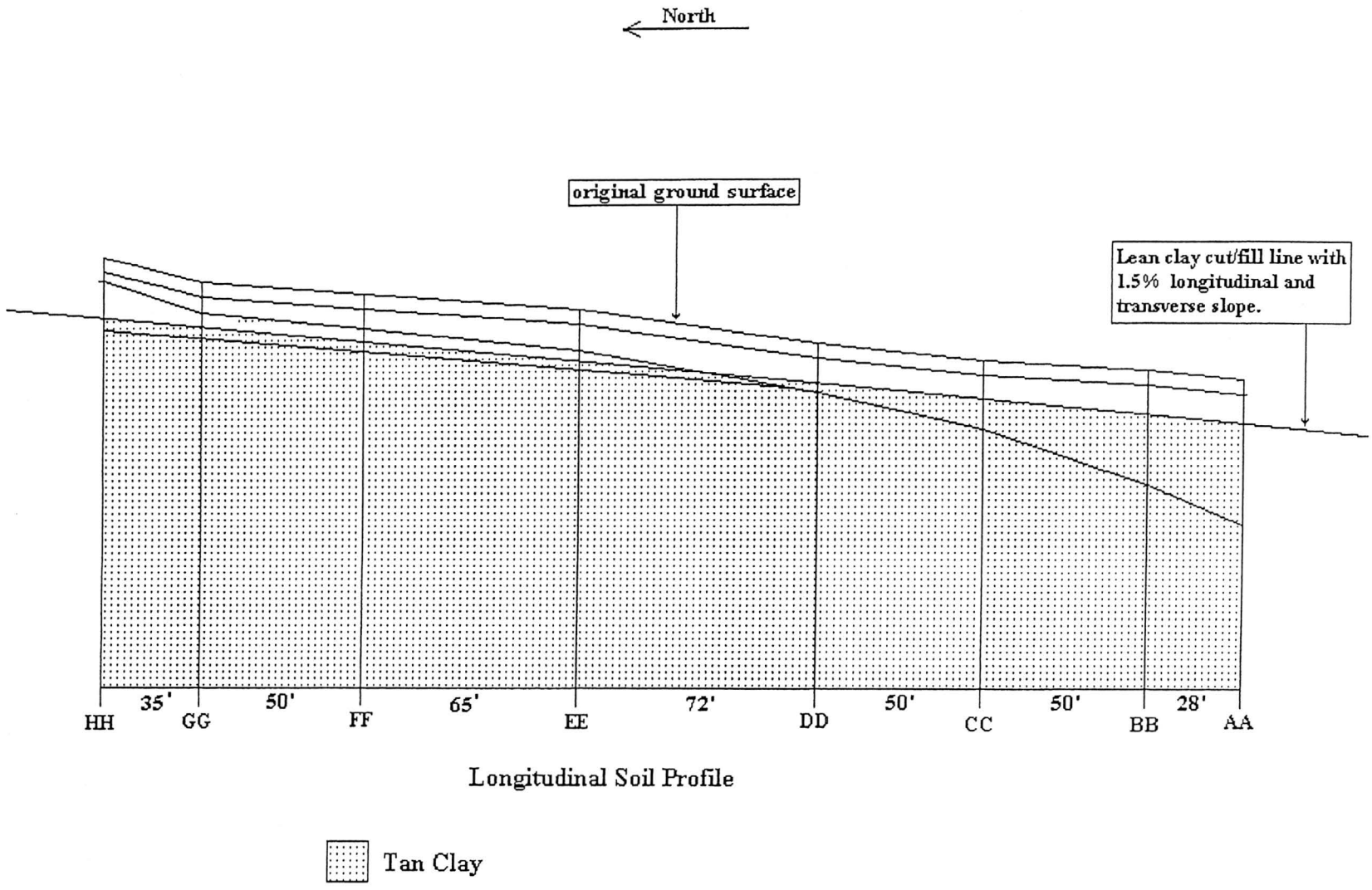
file: fig9.2_embank_lean_clay_fill_b&w1

Figure 9.2. Tan clay fill.



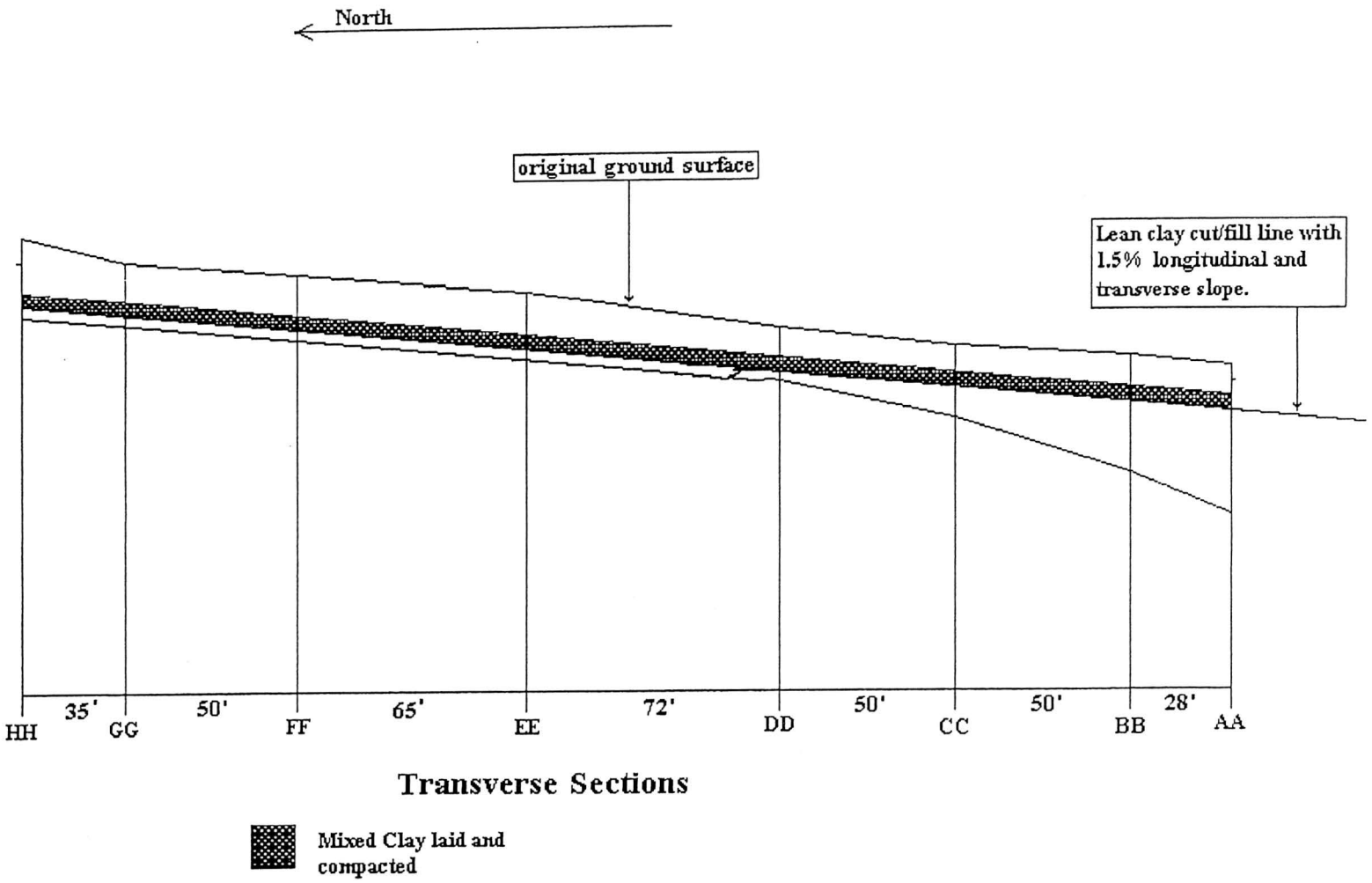
file: fig9.3_embank_lean_clay_elev_scarify

Figure 9.3. Scarify tan clay (6 inches) and recompact.



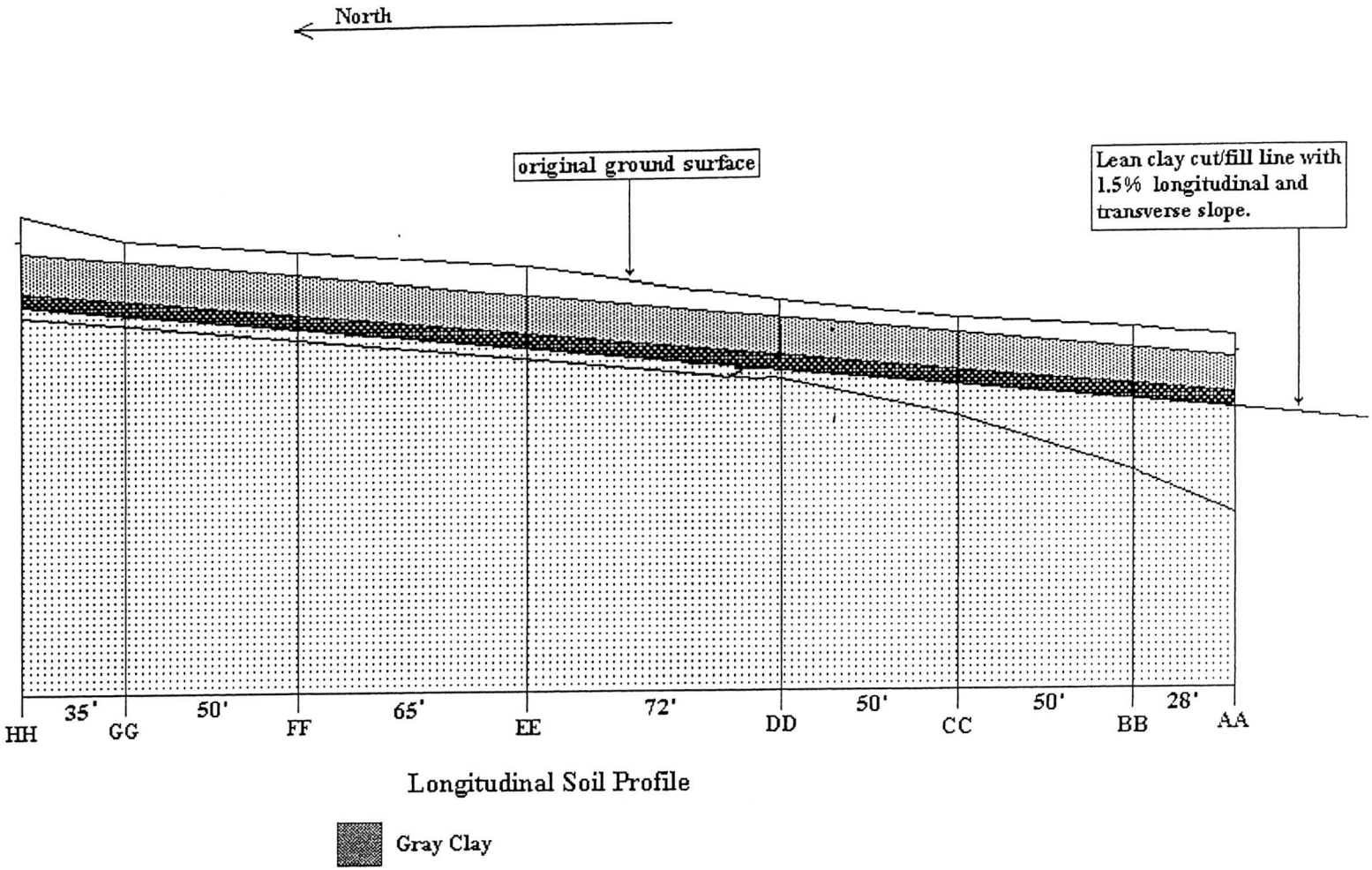
file: fig10_embank_lean_clay_elev_final

Figure 10. Final tan clay soil profile.



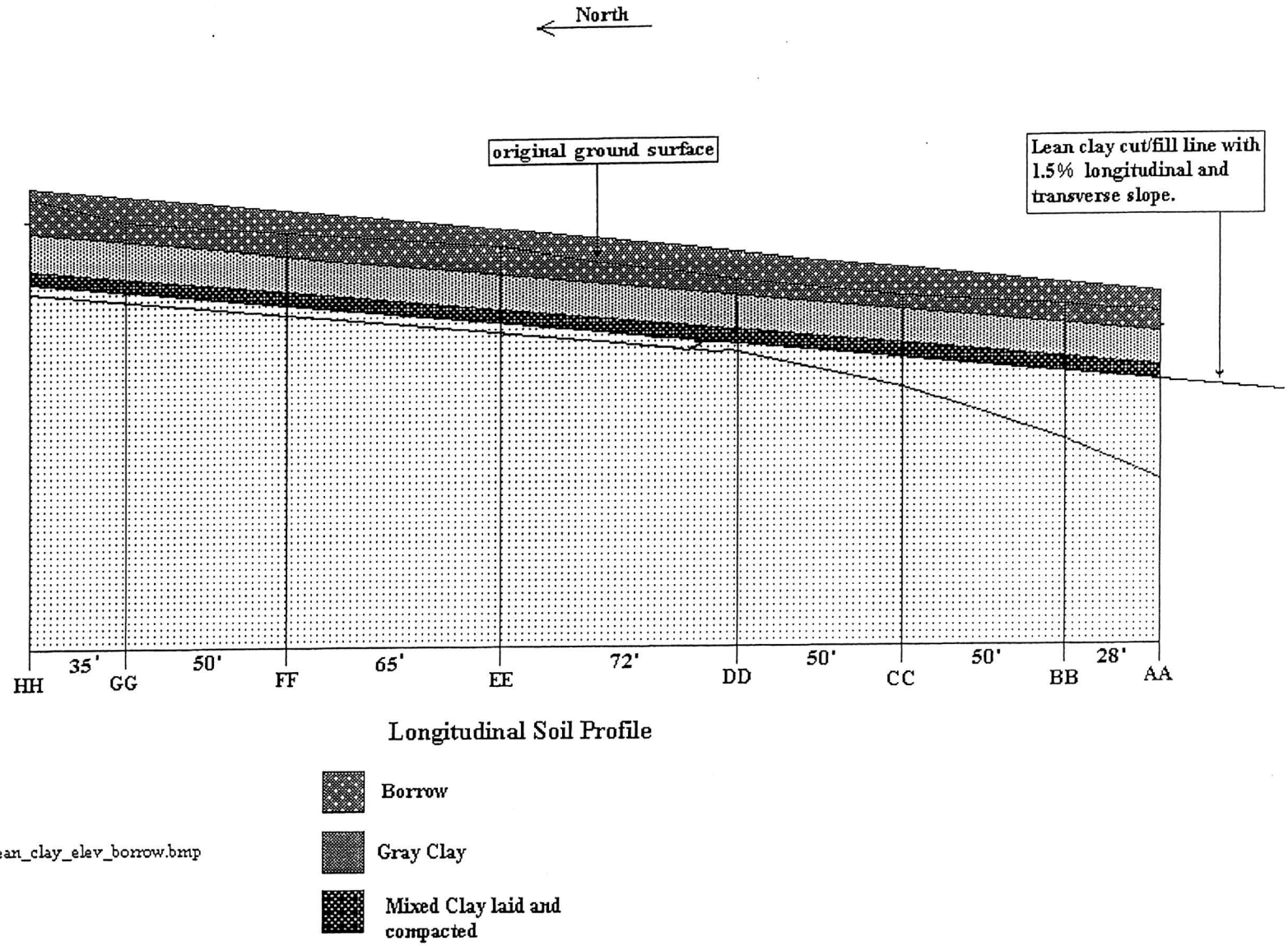
file: fig11_embank_lean_clay_elev_03

Figure 11. Relaid and compacted material from stockpile #3.



file: embankment_lean_clay_elev_b&w_03.bmp

Figure 12. Relaid and compacted material from stockpile #3.



file: fig14_embank_lean_clay_elev_borrow.bmp

Figure 13. Lay borrow clay to specified elevations and grades.

APPENDIX A

Boring Logs and Laboratory Testing

Geotechnical Investigation for
TX-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin,Texas
Bore Hole: 1

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 20 ft
Water Level: 13 ft.
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								
		1-1	Very Light Yellowish Brown, Sandy Lean CLAY. Group Symbol= CL	A			8.3	41	22		See NOTE # 1-1	
2.0		1-2	Dark Brown, Brown & Tannish Brown, Fat CLAY with Sand. Group Symbol= CH	A			16.5	53	36		Sieve # %Passing -3/4" 100.0 -3/8" 98.7 -No4 97.1 -No10 95.9 -No40 91.6 -No200 83.2	2.0
4.0												4.0
		1-3	Light Yellowish Brown, Lean CLAY with Sand. Caliche like material, damp. Group Symbol= CL	A			19.7	40	22		Sieve # %Passing -3/4" 100.0 -3/8" 99.2 -No4 98.7 -No10 97.2 -No40 90.5 -No200 76.9	
6.0												6.0
		1-4	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, wet. Group Symbol= CL	A			25.2	30	11		Sieve # %Passing -3/4" 100.0 -3/8" 99.8 -No4 99.0 -No10 97.3 -No40 91.1 -No200 78.5	
8.0												8.0
10.0			Consistency changes to harder at 9.5 ft.									10.0
12.0			Water Level at 13 ft.									12.0
		1-5	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, slurry sample. Group Symbol= CL	A			28.0	29	13		Sieve # %Passing -3/4" 100.0 -3/8" 99.0 -No4 95.1 -No10 91.3 -No40 86.6 -No200 78.6	
14.0												14.0
		1-6	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, slurry sample.	A			22.4	25	11		Sieve # %Passing -3/4" 100.0 -3/8" 98.8 -No4 95.9 -No10 92.5 -No40 88.3 -No200 82.9	
16.0												16.0
18.0												18.0
20.0			Boring Terminated at 20 ft. Water was encountered at 13 ft.									20.0

NOTE # 1-1

Sieve #	%Passing
-3/4"	100.0
-3/8"	95.9
-No4	85.1
-No10	76.4
-No40	66.4
-No200	55.8

Geotechnical Investigation for
TX-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin,Texas
Bore Hole: 2

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 20 ft.
Water Level: N/A
Drilling Method: A= Auger.

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								
		2-1	Dark Grayish Brown, Fat CLAY. Group Symbol= CH	A			12.8	54	36		See NOTE # 2-1	
2.0		2-2	Brown, Fat CLAY with Sand. Group Symbol= CH	A			11.1	55	37		See NOTE # 2-2	2.0
		2-3	Yellowish Brown, Lean CLAY with Sand, small calcareous gravel. 'Group Symbol= CL	A			15.0	47	27		See NOTE # 2-3	
		2-4	Light Yellowish Brown, Sandy Lean CLAY, damp. Group Symbol= CL	A			15.6	37	19		See NOTE # 2-4 Sieve # %Passing -3/4" 100.0 -3/8" 99.6 -No4 97.0 -No10 91.6 -No40 82.9 -No200 76.1	
4.0		2-5	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, dry. Group Symbol= CL	A			11.4	25	11		Sieve # %Passing -3/4" 100.0 -3/8" 98.7 -No4 95.9 -No10 91.1 -No40 84.0 -No200 78.4	4.0
6.0		2-6	Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, dry. Group Symbol= CL	A			12.2	25	11		Sieve # %Passing -3/8" 98.7 -No4 95.9 -No10 91.1 -No40 84.0 -No200 78.4	6.0
8.0		2-7	Yellowish Brown & Yellow, Lean CLAY w/ Sand, Caliche like material, dry. Group Symbol= CL	A			12.7	27	13		Sieve # %Passing -3/8" 98.7 -No4 95.9 -No10 91.1 -No40 84.0 -No200 78.4	8.0
10.0		2-8	Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, damp. Group Symbol= CL	A			14.3	33	18		Sieve # %Passing -3/4" 100.0 -3/8" 99.9 -No4 97..9 -No10 93.6 -No40 88.0 -No200 79.8	10.0
12.0		2-9	Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, dry. Group Symbol= CL	A			12.1	26	13		Sieve # %Passing -3/8" 100.0 -No4 99.5 -No10 97.4 -No40 92.8 -No200 89.4	12.0
14.0		2-10	Light Gray, Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			11.7	27	14		Sieve # %Passing -3/8" 100.0 -No4 99.6 -No10 97.8 -No40 94.3 -No200 90.7	14.0
16.0												16.0
18.0											Sieve # %Passing -3/8" 100.0 -No4 99.6 -No10 95.9 -No40 94.7 -No200 90.4	18.0
20.0		2-11	Yellowish Brown & Light Gray, Lean CLAY, dry. Caliche like material, dry. 'Group Symbol= CL	A			10.4	26	11			20.0

Boring Terminated at 20 ft.
No groundwater was encountered.

NOTE # 2-1

Sieve #	%Passing
-3/8"	100.0
-No4	99.2
-No10	98.1
-No40	92.1
-No200	85.9

NOTE # 2-2

Sieve #	%Passing
-3/4"	100.0
-3/8"	99.5
-No4	94.5
-No10	92.1
-No40	87.5
-No200	80.7

NOTE # 2-3

Sieve #	%Passing
-3/4"	100.0
-3/8"	99.6
-No4	97.5
-No10	94.3
-No40	85.8
-No200	75.1

NOTE # 2-4

Sieve #	%Passing
-3/4"	100.0
-3/8"	99.3
-No4	96.0
-No10	92.1
-No40	82.7
-No200	68.2

Geotechnical Investigation for
TX-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin,Texas
Bore Hole: 3

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 20 ft
Water Level: N/A
Drilling Method: A= Auger.

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								
		N / S	6" Very Light Yellowish Brown, Sandy Lean CLAY. (Same material as sample 1-1)	A							Sieve # %Passing -3/4" 100.0	
2.0		3-1	Brown & Tannish Brown, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			11.6	56	36		-3/8" 95.5 -No4 93.6 -No10 92.8 -No40 85.0 -No200 78.1	2.0
		3-2	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material. Group Symbol= CL	A			17.6	42	22		See NOTE # 3-2	
4.0		3-3	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, damp. Group Symbol= CL	A			12.7	31	16		Sieve # %Passing -3/4" 100.0 -3/8" 98.1 -No4 93.7 -No10 89.4 -No40 82.7 -No200 75.8	4.0
6.0												6.0
8.0		3-4	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, damp. Group Symbol= CL	A			14.3	24	10		Sieve # %Passing -3/4" 100.0 -3/8" 99.1 -No4 96.9 -No10 92.4 -No40 87.0 -No200 80.9	8.0
10.0		3-5	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, damp. Group Symbol= CL	A			11.5	26	12		Sieve # %Passing -3/4" 100.0 -3/8" 97.9 -No4 92.2 -No10 84.0 -No40 79.2 -No200 74.1	10.0
12.0												12.0
14.0												14.0
16.0		3-6	Light Gray & Light Yellowish Brown, Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			10.7	26	13		Sieve # %Passing -3/4" 100.0 -3/8" 99.1 -No4 96.8 -No10 92.6 -No40 88.3 -No200 85.5	16.0
18.0		3-7	Light Gray, Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			10.2	24	11		Sieve # %Passing -3/4" 100.0 -3/8" 99.1 -No4 97.7 -No10 95.2 -No40 90.9 -No200 87.5	18.0
20.0		3-8	Light Gray & Yellowish Brown, Lean CLAY, Group Symbol= CL	A			11.9	26	12		See NOTE # 3-8	20.0

Boring Terminated at 20 ft. No groundwater was encountered.

NOTE # 3-2

Sieve #	%Passing
-3/8"	100.0
-No4	99.8
-No10	99.3
-No40	93.1
-No200	84.5

NOTE # 3-8

Sieve #	%Passing
-3/8"	100.0
-No4	99.7
-No10	97.2
-No40	92.7
-No200	87.1

Geotechnical Investigation for
TX-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin,Texas
Bore Hole: 4

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 6 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								
		N / S	3" Very Light Yellowish Brown, Sandy Lean CLAY. (Same material as sample 1-1)	A								
1.0		4-1	Very Dark Gray, Fat CLAY w/ Sand. Group Symbol= CH	A			9.7	55	34		Sieve # %Passing -3/4" 100.0 -3/8" 95.2 -No4 91.6 -No10 89.6 -No40 84.4 -No200 77.3	1.0
2.0		4-2	Dark Brown, Yellow & Very Light Gray, Sandy Fat CLAY. Group Symbol= CH	A			14.3	51	30		Sieve # %Passing -3/4" 100.0 -3/8" 93.0 -No4 83.9 -No10 77.3 -No40 70.8 -No200 63.0	2.0
3.0		4-3	Very Dark Gray, Fat CLAY, small calcareous gravel, very thin layers of reddish brown mat. Group Symbol= CH	A			25.7	66	43		Sieve # %Passing -3/4" 100.0 -3/8" 99.7 -No4 99.6 -No10 99.2 -No40 96.0 -No200 87.0	3.0
4.0												4.0
5.0		4-4	Yellowish Brown, Fat CLAY, small calcareous gravel. Group Symbol= CH	A			14.8	51	30		Sieve # %Passing -3" 100.0 -3/4" 98.9 -3/8" 98.9 -No4 98.7 -No10 97.4 -No40 94.4 -No200 87.2	5.0
6.0		4-5	Very Light Yellowish Brown, Sandy Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			12.1	36	19		Sieve # %Passing -3/4" 100.0 -3/8" 95.4 -No4 88.6 -No10 77.3 -No40 68.1 -No200 60.0	6.0
7.0			Boring Terminated at 6 ft. No groundwater was encountered.									7.0
8.0												8.0
9.0												9.0
10.0												10.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 5

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
3.5		5-1	Very Dark Gray, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			16.9	56	23		Sieve # %Passing -3/4" 100.0 -3/8" 94.3 -No4 89.6 -No10 85.3 -No40 80.1 -No200 71.5	1.0 1.5 2.0 2.5 3.0 3.5
4.0		5-2	Brown, Lean CLAY w/ Sand, small calcareous gravel. Group Symbol= CL	A			23.1	46	24		Sieve # %Passing -3/8" 100.0 -No4 99.1 -No10 96.5 -No40 89.4 -No200 71.1	4.0
5.0		5-3	Very Light Yellowish Brown, Lean CLAY w/ Sand, Caliche like material, damp. Group Symbol= CL Boring Terminated at 5 ft. No groundwater was encountered.	A			21.9	34	13		Sieve # %Passing -3/4" 100.0 -3/8" 99.2 -No4 96.3 -No10 93.4 -No40 88.3 -No200 77.2	4.5 5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 6

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		6-1	Dark Brown, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			13.3	57	34		Sieve # %Passing -3/4" 100.0 -3/8" 96.6 -No4 95.4 -No10 94.3 -No40 85.7 -No200 77.8	1.0
1.5												1.5
2.0												2.0
2.5		6-2	Very Light Yellowish Brown, Sandy Lean CLAY, Caliche like material, damp. Group Symbol= CL	A			14.1	35	11		Sieve # %Passing -3/4" 100.0 -3/8" 98.6 -No4 94.8 -No10 88.5 -No40 79.8 -No200 69.4	2.5
3.0			very thin layers of dark yellow material									3.0
3.5												3.5
4.0												4.0
4.5												4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 7

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		7-1	Very Dark Gray, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			11.8	53	30		Sieve # %Passing -3/4" 100.0 -3/8" 94.0 -No4 90.4 -No10 87.6 -No40 80.5 -No200 70.5	1.0
1.5												1.5
2.0		7-2	Very Light Yellowish Brown, Sandy Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			10.7	48	20		Sieve # %Passing -3/4" 100.0 -3/8" 96.7 -No4 91.5 -No10 83.2 -No40 72.7 -No200 60.2	2.0
2.5												2.5
3.0		7-3	Very Light Yellowish Brown, Clayey SAND with Gravel, Caliche like material, damp. Group Symbol= SC	A			10.7	27	9		Sieve # %Passing -3/4" 100.0 -3/8" 92.0 -No4 83.8 -No10 72.5 -No40 58.6 -No200 48.6	3.0
3.5			Harder consistency after 3.5 ft.									3.5
4.0												4.0
4.5												4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 8

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		8-1	Brown & Dark Gray, Fat CLAY w/ Sand, Group Symbol= CH	A			17.3	54	32		Sieve # %Passing -3/4" 100.0 -3/8" 96.9 -No4 94.3 -No10 91.9 -No40 86.8 -No200 78.4	1.0
1.5												1.5
2.0		8-2	Very Light Tannish Brown, Lean CLAY. Group Symbol= CL	A			19.4	43	21		Sieve # %Passing -3/4" 100.0 -3/8" 99.1 -No4 98.1 -No10 96.6 -No40 93.3 -No200 88.3	2.0
2.5												2.5
3.0		8-3	Very Light Yellowish Brown, Sandy Lean CLAY, Caliche like material, damp. Group Symbol= CL	A			17.1	34	13		Sieve # %Passing -3/4" 100.0 -3/8" 93.3 -No4 85.5 -No10 80.1 -No40 76.3 -No200 68.3	3.0
3.5			Moisture changes to dry at 3.5 ft.									3.5
4.0												4.0
4.5												4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 9

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		9-1	Very Dark Gray & Brown, Sandy Fat CLAY, small calcareous gravel. Group Symbol= CH	A			10.7	52	30		Sieve # %Passing -3/4" 100.0 -3/8" 96.0 -No4 89.8 -No10 82.7 -No40 73.7 -No200 61.7	1.0
2.0		9-2	Brown, Sandy Fat CLAY, small calcareous gravel. Group Symbol= CH	A			12.1	51	29		Sieve # %Passing -3" 100.0 -3/4" 91.7 -3/8" 80.6 -No4 77.5 -No10 73.7 -No40 65.2 -No200 56.4	1.5 2.0
2.5 3.0 3.5 4.0 4.5		9-3	Yellowish Brown, Clayey SAND w/ Gravel. Group Symbol= SC	A			10.2	30	12		Sieve # %Passing -3/4" 100.0 -3/8" 90.7 -No4 79.7 -No10 68.5 -No40 56.3 -No200 46.6	2.5 3.0 3.5 4.0 4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 10

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		10-1	Very Light Yellowish Brown, Sandy Lean CLAY, Caliche like material, dry. Group Symbol= CL	A			9.3	41	20		Sieve # %Passing -3/4" 100.0 -3/8" 98.8 -No4 93.9 -No10 86.0 -No40 78.5 -No200 68.1	1.0
1.5												1.5
2.0		10-2	Very Light Yellowish Brown, Clayey SAND w/ Grav Caliche like material, damp. Group Symbol= SC	A			11.6	30	11		Sieve # %Passing -3/4" 100.0 -3/8" 94.3 -No4 82.7 -No10 68.9 -No40 54.4 -No200 44.6	2.0
2.5												2.5
3.0												3.0
3.5												3.5
4.0												4.0
4.5												4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

Geotechnical Investigation for
Tx-APT Mobile Load Simulator Project
UT - J.J. Pickle Research Campus
Austin, Texas
Bore Hole: 11

Station: N/A
Date Drilled: 7/31/02
Elevation: N/A

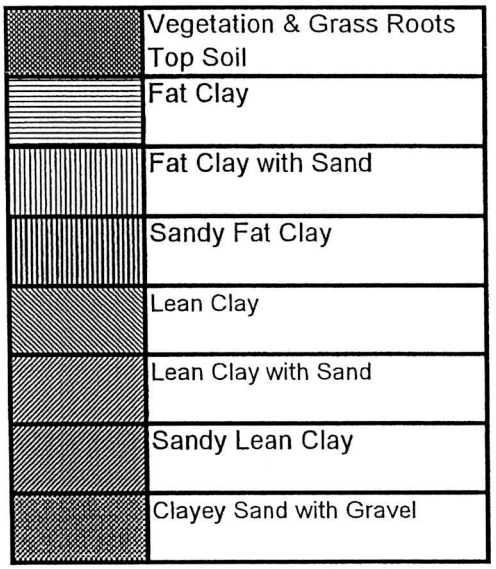
Boring Depth: 5 feet
Water Level: N/A
Drilling Method: A= Auger

Depth (feet)	Symbol	Sample	Material Field Description (Laboratory Classification)	Drilling Method	Blows/ Penetration	Pocket Pen (TSF)	Moisture (%)	Liquid Limit	P.I.	Linear Shrinkage (%)	Sieve Analysis	Depth (feet)
0.5		N / S	6" Very Dark Gray, Top Soil, grass, roots.	A								0.5
1.0		11-1	Dark Brown & Brown, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			21.7	69	37		Sieve # %Passing -3/8" 100.0 -No4 99.3 -No10 96.6 -No40 92.3 -No200 83.5	1.0
1.5												1.5
2.0												2.0
2.5												2.5
3.0		11-2	Light Yellowish Brown, Fat CLAY w/ Sand, small calcareous gravel. Group Symbol= CH	A			18.7	55	35		Sieve # %Passing -3/4" 100.0 -3/8" 98.2 -No4 96.9 -No10 93.3 -No40 87.9 -No200 74.7	3.0
3.5												3.5
4.0		11-3	Very Light Yellowish Brown, Lean CLAY w/ Sand, small calcareous gravel. Group Symbol= CL	A			22.4	34	13		Sieve # %Passing -3/4" 100.0 -3/8" 99.1 -No4 98.1 -No10 96.6 -No40 91.1 -No200 78.9	4.0
4.5												4.5
5.0			Boring Terminated at 5 ft. No groundwater was encountered.									5.0

LEGEND OF TERMINOLOGY

GRAVELS More than half of Coarse fraction is LARGER than No. 4 Sieve Size	Clean Gravels (little or no fines)	GW	Well-Graded, gravel-sand mixtures, mixtures, little or no fines
		GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
	Gravels w/ fines (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay Mixtures
SANDS More than half of Coarse fraction is SMALLER than No. 4 Sieve Size	Clean Sands (little or no fines)	SW	Well-Graded sands, gravely sands, little or no fines
		SP	Poorly-Graded sands, gravely sands little or no fines
	Sands w/ fines (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
SILTS AND CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, rock flour, silty or clayey fine sands or clayey silts w/slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays
		OL	Organic silts & organic silty clays of low plasticity
SILTS AND CLAYS Liquid Limit Greater Than 50		MH	Inorganic silts, micoceous or diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
Highly Organic Soils		PI	Peat & other highly organic soils

LEGEND OF SYMBOLS



APPENDIX B

Texas Standard Specifications Items 110 (Excavation)
and 132 (Embankment)

APPENDIX B

Texas Standard Specifications Items 110 (Excavation) and 132 (Embankment) are reproduced in the following text. Where applicable, Special Provisions are inserted in **underlined/bold text** to provide additional details regarding the TxAPT embankment project.

EXCAVATION

110.1 Description

This Item shall govern for the roadway, channel and/or special excavation of the required material in the areas shown on the plans and cross sections to the lines, grades and typical sections as specified. Excavation shall include all materials encountered regardless of their nature or of the manner in which they are removed.

110.1 Description – Refer to Appendix A for detailed information regarding the materials that underlie the proposed site.

110.2 Construction Methods

All excavation shall be performed as specified herein and the completed roadway and/or channels shall conform to the alignment, grades and typical sections as shown on the plans or project cross-sections or as established by the Engineer.

Unsuitable excavation and excavation in excess of that needed for construction shall be known as "Waste" by the Engineer, shall be replaced with material from the roadway excavation or with other suitable material as approved by the Engineer. This work shall be done in accordance with the provisions of the applicable bid items.

When excavated materials, including topsoil, are utilized in constructing the required roadway sections, payment for placement will be made under the pertinent placement specification.

During construction the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times. Ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. During construction, channels shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat and workmanlike manner.

All slopes shall be accurately shaped, and care shall be taken that no material is loosened below or outside the required slopes. Exceptions shall be those slopes in rock or other material where, in the judgment of the Engineer, some variation may be permitted. All breakage and slides shall be removed and disposed of in a manner acceptable to the Engineer.

1) **Rock Cuts.** The Contractor shall have the following options:

(a) Nonhomogeneous Rock.

(i) Excavate to finish subgrade elevation, manipulate and compact the subgrade in accordance with Section 132.2.(3).(a) without removal.
(ii) Excavate below grade (undercutting) and replace with embankment material approved by the Engineer. Compaction shall be in accordance with Section 132.2.(3).(a).

(b) Homogeneous Rock.
(i) Excavate to finish subgrade elevation.
(ii) Excavate to finish subgrade elevation, manipulate and compact the subgrade in accordance with Section 132.2.(3).(a) without removal.
(iii) Excavate below grade (undercutting) and replace with embankment material approved by the Engineer. Compaction shall be in accordance with Section 132.3.(3).(a).

2) **Earth Cuts**

When base and/or pavement structure is placed under this project, all earth cuts shall be scarified to a uniform depth of at least 6 inches below the required finished subgrade elevation for the entire roadbed width. The material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with Section 132.2.(3).(a) or as shown on the plans.

3) Subgrade Tolerances. Tolerances shall be as follows:

(a) Stage Construction. Any deviation in excess of 0.1 foot in cross section and 0.1 foot in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.
(b) Turn Key Construction. Any deviation in excess of ½ inch in cross section and ½ inch in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling, and rolling.

100.2. Construction Methods. – All excavation shall be performed as follows:

7. **Remove topsoil from the site until the second layer of material (fat clay) is exposed (Figure 7). This includes approximately 6-inches of topsoil (from boring logs) and enough underlying material (1 to3 inches) to completely expose the underlying layer of fat clay. Place the clean topsoil in stockpile #1. Any topsoil mixed with clay will be placed in the waste stockpile #4 (waste material).**
8. **Remove underlying clay layer (fat clay), minimizing contamination by material from the 3rd layer (Figure 8) and place this material in stockpile #2. The thickness**

of this material is variable over the site from 1 to 2 feet at the northern extremity of the excavation to 5 feet at the southern extremity.

9. **Remove an additional layer of material (4 to 12 inches) that contains a mixture of layer 2 and layer 3 clays to completely expose layer 3 (lean clay). Put this mixed clay material in stockpile #3.**
10. **Excavate the 3rd layer and re-lay as needed to produce a uniform elevation of lean clay material with a 1 percent slope as shown in Figure 9.**
11. **Scarify to a depth of one foot, the cut section of layer three and re-compact.**
12. **Work the surface of the third layer of material to produce a uniform level surface with a 1 percent longitudinal slope and 1 percent transverse slope as shown in the Figure 9.**

110.3. Measurement.
This Item will be measured by the cubic yard in its original position as computed by the method of average end areas.

This is a plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract plans, except as may be modified by Article 9.8. If no adjustment of quantities is required, additional measurements or calculations will not be required.

Excavation in backfill areas of retaining walls will not be measured for payment. Limits of measurement for excavation in retaining-wall areas will be as shown on Standard Details Sheet "Earthwork Measurement at Retaining Walls" (EMRW) in the plans.

Shrinkage or swellage factors will not be considered in determining the calculated quantities.

110.4 Payment.
The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Roadway)", "Excavation (Channel)", "Excavation (Special)" or "Excavation (Roadway and Channel)". This price shall be full compensation for all authorized excavation; for undercutting subgrade and reworking or replacing the undercut material; for all hauling; for all work required for disposal of material not used elsewhere on the project and for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work.

When a slide, not due to the Contractor's negligence or operation, occurs, payments for removal and disposal of the slide material will be in accordance with Article 9.3.

EMBANKMENT
132.1. Description. This Item shall govern for the placement and compaction of all materials necessary for the construction of roadway embankments, levees and dykes or any designated section of the roadway where additional material is required.

132.2. Material. Materials may be furnished from required excavation in the areas shown in the plans or from off right of way sources obtained by the Contractor and meeting the requirements herein. All embankments shall conform to one of the following types as shown on

the plans, except that material, which is in a retaining-wall-backfill area shall meet the requirements for backfill material of the pertinent retaining-wall item:

Type A. This material shall consist of suitable granular material, free from vegetation or other objectionable matter, and reasonably free from lumps of earth. This material shall be suitable for forming a stable embankment and, when tested in accordance with Test Methods Tex-104-E, Tex-105-E, Tex-106-E and Tex-107-E, Part II shall meet the following requirements:

The liquid limit shall not exceed 45
The plasticity index shall not exceed 15
The bar linear shrinkage shall not be less than 2

Type B. This material shall consist of suitable earth material such as rock, loam, clay, or other such materials as approved by the Engineer that will form a stable embankment.

Type C. This material shall be suitable and shall conform to the specification requirements shown on the plans.

Type D. This material shall be that obtained from required excavation areas shown on the plans and will be used in embankment.

132.2. Material. – Excavated materials (except waste) will be combined as needed with virgin material to construct the required embankment as described in the following Special Provisions. Additional clay material will be furnished by the contractor meeting the requirements that follow:

Insitu CBR – 4 to 8
Mr – 5 to 10 ksi

Liquid Limit – 50 +
Plasticity Index – 25 to 35

Gradation sample of fat clay on site:

Sieve #	% Passing
3/4"	100.0
3/8"	95.2
No. 4	91.6
No. 10	89.6
No. 40	84.4
No. 200	77.3

Swelling clay that swells excessively will not be acceptable. The material source used by the contractor must be identified for inspection by the engineer so that samples can be tested and approved.

132.3. Construction Methods.

1) General. When off right of way sources are involved, the contractor's attention is directed to Item 7, "Legal Relations and Responsibilities to the Public". Prior to placing any embankment, all work in accordance with Item 100, "Preparing Right of Way", shall have been completed on the areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly tamped by approved methods before commencing embankment construction. The surface of the methods before commencing embankment construction. The surface of the ground, including disk-loosened ground or any surface roughened by small washes or otherwise, shall be restored to approximately its original slope by blading or other methods. Where shown on the plans or required by the Engineer, the ground surface thus prepared shall be compacted by sprinkling and rolling.

The Engineer shall be notified sufficiently in advance of opening any material source to allow performance of any required testing.

Unless otherwise shown on the plans, the surfaces of unpaved areas (except rock) which are to receive embankment shall be loosened by scarifying to a depth of at least 6 inches. Hillsides shall be cut into steps before embankment materials are placed. Placement of embankment materials shall begin at the low side of hillsides and slopes. Materials which have been loosened shall be recompacted simultaneously with the new embankment materials placed upon it. The total depth of loosened and new materials shall not exceed the permissible depth of the layer to the compacted, as specified in Subarticle 132.3.(3).(a) and (b).

Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in embankment.

Unless otherwise shown on the plans, all embankments shall be constructed in layers approximately parallel to the finished grade of the roadbed.

Embankments shall be constructed to the grade and sections shown on the plans or as established by the Engineer. Each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

2) Constructing Embankments.

(a) Earth Embankments. Earth embankments shall be defined as those composed principally of material other than rock, and shall be constructed of acceptable material from approved sources.

Unless otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the sprinkling and compacting methods utilized.

Layers of embankment may be formed by utilizing equipment and methods which will evenly distribute the material.

A minor quantity of rock or broken concrete encountered in the construction of this project may be incorporated in the lower layers of the embankment if acceptable to the Engineer. Or, it may be placed in the deeper fills, in accordance with the requirements for the construction of rock embankments, provided such placement of rock is not immediately adjacent to structures or in areas where bridge foundations are to be constructed. Also, rock or broken concrete may be placed in the portions of embankments outside the limits of the completed roadbed width where the size of the rock or broken concrete prohibits its incorporation in the normal embankment layers. All exposed reinforced steel shall be cut and removed from the broken concrete.

Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be featheredged for at least 100 feet, or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking or similar methods until a uniform material of uniform density is achieved in each layer.

Sprinkling required to achieve the moisture content necessary for compaction shall meet the material requirements of Item 204, "Sprinkling". It shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary. In order to facilitate uniform wetting of the embankment material, the Contractor may apply water at the material source if the sequence and methods used do not cause an undue waste of water. Such procedures shall be subject to the approval of the Engineer.

132.3 Construction Methods – The embankment will be constructed using materials excavated as described herein and combined with contractor furnished virgin material as follows:

1. **Relay the mixed clay material from stockpile #3 (Figure 12 maintaining a 1.5 percent transverse and longitudinal slope and compact as specified.**
2. **Import virgin clay materials with properties as defined in the specifications and mix it with the fat clay material in stockpile #2 to form a homogeneous clay mixture. The mixing may take place either in the stockpile or on the embankment, prior to grading and compaction.**
3. **Lay the resulting material to finish the embankment to the elevation as shown in the specifications, with a 1.5 percent longitudinal grade and 1.5 percent transverse cross slope (Figure 13). Materials will be compacted to the specified density.**

4. **Use the material in stockpile #1 and cover the slopes of the embankment with topsoil to a uniform depth.**
5. **It is anticipated the finished embankment will have a slope of 1 over 2.**
6. **Cover the embankment with 6-mil plastic. Secure the plastic cover to the embankment so that a wind velocity of 40 MPH does not cause damage to the covering nor blow it off the embankment.**

(b) Rock Embankments. Rock embankments shall be defined as those composed principally of rock, and shall be constructed of acceptable material.

Unless otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual roadway cross-section and 18 inches or less in depth. When, in the opinion of the Engineer, the rock sizes necessitate a greater depth of layer, the layer depth may be increased as necessary, but in no case shall the depth of layer exceed 2-1/2 feet. Each layer shall be constructed in such a manner that the interstices between the larger stones are filled with smaller stones and spalls which have been created by this operation as well as from the placement of succeeding layers of material.

The maximum dimension of any rock used in embankment shall be less than the depth of the embankment layer, and in no case shall any rock over two (2) feet in its greatest dimension be placed in the embankment unless otherwise approved by the engineer. Unless otherwise shown on the plans, the upper or final layer of the embankment shall be composed of material so graded that the density and uniformity of the surface layer may be secured by the "Ordinary Compaction" or "Density Control" method. Exposed oversize material shall be reduced by sledging or other methods as approved by the Engineer.

When "Ordinary Compaction" is specified, each embankment layer shall be rolled and sprinkled when and to the extent directed by the Engineer. When "Density Control" is specified, each layer shall be compacted to the required density as outlined for "Earth Embankments", except that in those layers where rock will make density testing difficult, when shown on the plans, the Engineer may require the layer to be proof rolled to insure proper compaction.

(c) Embankment Adjacent to Culverts and Bridges. Embankments adjacent to culverts and bridges shall be compacted in the manner prescribed under Item 400, "Excavation and Backfill for Structures", or other appropriate bid items.

As a general practice, embankment material placed adjacent to any portion of any structure and in the first two layers above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of such gradation as to permit thorough compaction. When, in the opinion of the Engineer, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, in

which case no particle larger than 12 inches in greatest dimension and six (6) inches in least dimension may be used. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

3) **Compaction Methods.** Compaction of embankments shall be by "Ordinary Compaction" or "Density Control" as shown on the plans.

a) **Ordinary Compaction.** When "Ordinary Compaction" is shown on the plans, the following provisions shall govern:

Each layer shall not exceed eight (8) inches of loose depth, unless otherwise directed by the Engineer. Each layer shall be compacted in accordance with the provisions governing the Item or Items of "Rolling". Unless otherwise specified on the plans, the rolling equipment shall be as approved by the Engineer. Compaction shall continue until there is no evidence of further compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content directed by the Engineer, and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer. Should the subgrade, for any reason or cause, lose the required stability or finish, it shall be recompacted and refinished at the Contractor's expense.

b) **Density Control.** When "Density Control" is shown on the plans, the following provisions shall apply:

Each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction. The depth of layers, prior to compaction, shall depend upon the type of sprinkling, mixing and compacting equipment used. However, maximum depth (16 inches loose and 12 inches compacted) shall not be exceeded unless approved by the Engineer. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

Each layer shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise shown on the plans.

Description	**Density, Percent**	**Moisture**
Non-swelling soils with plasticity index less than 20	Not less than 98	
Swelling soils with plasticity index of 20 to 35	Not less than 98 nor more than 102	Not less than optimum
Swelling soils with plasticity index over 35	Not less than 95 nor more than 100	Not less than optimum

The density determination will be made in accordance with Test Method Tex-114-E. Field density determination will be made in accordance with Test Method Tex-115-E.

After each layer of earth embankment is complete, tests as necessary may be made by the Engineer. When the material fails to meet the density requirements or should the material lose the required stability, density, moisture or finish before the next course is placed or the project is accepted, the layer shall be reworked as necessary to obtain the specified compaction, and the compaction method shall be altered on subsequent work to obtain specified density. Such procedure shall be subject to the approval of the Engineer.

Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is four (4) percent less than the optimum.

The Contractor may be required to remove a small area of the layer in order to facilitate the taking of density tests. Replacement and compaction of the removed material in the mall area shall be at the Contractor's expense.

When shown on the plans and when directed by the Engineer, the Contractor shall proof roll in accordance with Item 216, "Rolling (Proof)". Soft spots shall be corrected as directed by the Engineer.

132.4 Tolerances. The tolerances shall be as follows:

1) **Grade Tolerances.**
   a. **Stage Construction.** Any deviation in excess of 0.1 foot in cross section and 0.1 foot in 16 feet measured longitudinally shall be corrected by loosening, adding, or removing the material, reshaping and recompacting by sprinkling and rolling.
   b. **Turnkey Construction.** Any deviation in excess of ½ inch in cross section and ½ inch in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.
2) **Gradation Tolerances.** The Engineer may accept the material, providing not more than one (1) out of the most recent five (5) gradation tests performed are outside the specified limit on any individual sieve by more than five (5)%.
3) **Density Tolerances.** The Engineer may accept the work providing not more than one (1) out of the most recent five (5) density tests performed is outside the specified density, provided the failing test is no more than three (3.0) pounds per cubic foot outside the specified density.
4) **Plasticity Tolerances.** The Engineer may accept the material providing not more than one (1) out of the most recent five (5) plasticity index samples tested are outside the specified limit by no more than two (2) points.

132.5. Measurement. This Item will be measured as follows:

1) **General.**
Retaining-wall-backfill areas which are also in embankment areas will be measured for payment as embankment except as shown on the plans; such material shall meet the requirements for backfill material of the pertinent retaining-wall item(s). Limits of measurement for embankment in retaining-wall areas will be as shown on Standard Detail Sheet "Earthwork Measurement at Retaining Walls" (EMRW) in the plans.
Shrinkage or swellage factors will not be considered in determining the calculated quantities.

2) **Class 1.** Embankment will be measured in its original, natural position, and the volume computed in cubic yards by the method of average end area.

3) **Class 2.** Embankment will be measured by the cubic yard in vehicles as delivered on the road.

4) **Class 3.** Embankment will be measured by the cubic yard in its final position as the volume of embankment computed in place between (1) the original ground surfaces or the surface upon which the embankment is to be constructed, and (2) the lines, grades and slopes of the accepted embankment, using the average end area method.

Class 3 is a plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract plans, except as may be modified by Article 9.8. If no adjustment of quantities is required, additional measurements or calculations will not be required.

132.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Embankment", of the compaction method, type and class specified. This price shall be full compensation for furnishing embankment; for hauling; for placing, compacting, finishing and reworking; and for all labor, royalty, tools, equipment and incidentals necessary to complete the work.

When proof rolling is shown on the plans and directed by the Engineer, it will be paid for in accordance with Item 216, "Rolling (Proof)".

When "Ordinary Compaction" is shown on the plans, all sprinkling and rolling, except proof rolling, will not be paid for directly, but will be considered subsidiary to this Item, unless otherwise shown on the plans.

When "Density Control" is shown on the plans, all sprinkling and rolling, except proof rolling, will not be paid for directly, but will be considered subsidiary to this Item.

When subgrade is constructed under this project, correction of soft spots in the subgrade will be at the Contractor's expense. When subgrade is not constructed under this project, correction of soft spots in the subgrade will be in accordance with Article 4.3.

APPENDIX C

Final Plans and Specifications
Separate Document