Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 1
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

CASING:
Hammer Weight (lb.): **Drop (in.):**
Type : **Size :**

SAMPLER:
Hammer Weight (lb.): 140 **Drop (in.):** 30
Type: Split Spoon Sampler **Size:** 1-3/8" I.D.

DATE: 11/1/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	4-4-5	9		***Clayey Silt*** Dark brown, yellow mottled clayey silt, few roots.	100		20		Ground water level was not found. –			
	SS	2	3-3-4	7			100		21					
						Clayey Silt Brown clayey silt, trace sand.								
	SS	3	5-5-6	11			100		22					
5	SS	4	5-9-15	24		***Silty Clay*** Brown, yellow mottled silty clay, trace subangular gravel fragments.	100		26					
	SS	5	20-20-60/3"	--			80		9					
10						***Sandy Silt*** Grayish brown and pinkish gray sandy silt, trace weathered rock fragments.								
	SS	6	65-3"	--			83		8					
15														
	SS	7	60/0.5"	--			--		--					
20						Note: Weathered Rock was broken by the sampling device into the above descibed constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 2
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

DATE: 10/5/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 15
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.): Drop (in.):
Type : Size :

SAMPLER:
Hammer Weight (lb.): 140 Drop (in.): 30
Type: Split Spoon Sampler Size: 1-3/8"

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	4-6-5	11		***Clayey Sandy Silt*** Brown, yellow mottled clayey sandy silt, few roots.	100		17		Ground water level was not found. –			
	SS	2	3-3-4	7		***Sandy Silt*** Brown sandy silt, some clay.	100		16			29.0	9.3	A-4 (2) / SC
	SS	3	15-28-38	66			68		17					
5	SS	4	85/4"	--		***Sandy Silt*** Light olive brown, yellow mottled sandy silt, some weathered rock fragments.	63		8					
	SS	5	100/3"	--			68		6					
10	SS	6	60/1"	--			--		--					
15						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
20														
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 3
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

DATE: 10/4/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.): Drop (in.):
Type : Size :

SAMPLER:
Hammer Weight (lb.): 140 Drop (in.): 30
Type: Split Spoon Sampler Size: 1-3/8" I.D.

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Ground water level was not found –			
0	SS	1	3-4-6	10		***Silty Clay*** Dark brown silty clay, trace sand, few roots.	100		38					
	SS	2	7-10-20	30		***Sandy Silt*** Olive brown, yellow mottled sandy silt, trace weathered rock fragments.	100		18					
5	SS	3	25-18-30	48			89		11					
	SS	4	42- 60/6"	--		***Sandy Silt*** Light olive brown sandy silt, some weathered rock fragments.	53		7					
10	SS	5	100/4"	--			75		4					
	SS	6	100/3"	--		***Sandy Silt*** Olive brown sandy silt and weathered rock fragments.	68		4					
15	SS	7	100/1"	--			--		--					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 4
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development **REFERENCE NO.: DA/11S3302**

DATE: 9/28/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

CASING: **SAMPLER:**

Hammer Weight (lb.): **Drop (in.):** **Hammer Weight (lb.): 140** **Drop (in.): 30**

Type : **Size :** **Type: Split Spoon Sampler** **Size: 1- 3/8" I.D.**

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0						***Silty Clay*** Brown to dark brown silty clay, trace sand, many roots.					Ground water level was not found			
	SS	1	2-4-6	10			100		29					
	SS	2	6-9-20	29			100		17			NP	NP	A-2-4 (0) / SC
						Sandy Silt Olive brown. yellow mottled sandy silt, trace weathered rock fragments.								
	SS	3	65/6"	--			83		8					
5						***Sandy Silt*** Light olive brown, yellow mottled sandy silt, some weathered rock fragments.								
	SS	4	85/6"	--			83		6					
	SS	5	92/6"	--			83		6					
10														
	SS	6	85/5"	--			80		4					
15						***Sandy Silt*** Light olive brown, yellow mottled sandy silt, some weathered rock fragments.								
	SS	7	100/5"	--			80		7					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 5
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

CASING:
Hammer Weight (lb.): Drop (in.):
Type : Size :

SAMPLER:
Hammer Weight (lb.): 140 Drop (in.): 30
Type: Split Spoon Sampler Size: 1-3/8" I.D.

DATE: 11/2/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 15
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Grond water level was not found.			
0	SS	1	4-4-6	10		***Silty Clay*** Dark brown silty clay, trace sand, few roots.	94		28					
	SS	2	7-8-12	20		***Silty Clay*** Brown, yellow mottled silty clay, trace sand.	89		81	3.7		48.2	25.7	A-7-6 (25) / CL
5	SS	3	12-32-60/3"	--		***Sandy Silt*** Brown, pinkish gray, yellow mottled sandy silt, some weathered rock fragments.	68		14					
	SS	4	100/4"	--			63		6					
10	SS	5	100/2.5"	--			80		9					
15	SS	6	60/0.5"	--			--		--					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

qu (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 6
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development **REFERENCE NO.: DA/11S3302**

CASING: **SAMPLER:**

Hammer Weight (lb.): **Drop (in.):** **Hammer Weight (lb.): 140** **Drop (in.): 30**

Type : **Size :** **Type: Split Spoon Sampler** **Size: 1-3/8" I.D.**

DATE: 9/28/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Ground water level was not found. –			
0	SS	1	2-4-4	8		***Sandy Clayey Silt*** Brown to dark brown sandy clayey silt, some subangular gravel fragments, few roots.	56		16					
	SS	2	2-3-4	7			67		11					
	SS	3	11-20-40	60		***Sandy Silt*** Olive brown, light olive brown, yellow mottled sandy silt, some weathered rock fragments.	89		19					
5	SS	4	36-60/6"	--			83		15			NP	NP	A-2-4 (0) / SC
	SS	5	50-48-60	108		***Sandy Silt*** Olive brown, light olive brown, yellow mottled sandy silt, some weathered rock fragments.	89		11					
10														
	SS	6	60/5"	--			80		12					
15														
	SS	7	70/4"	--			75		11					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 7
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

CASING:
Hammer Weight (lb.): **Drop (in.):**
Type : **Size :**

SAMPLER:
Hammer Weight (lb.): 140 **Drop (in.):** 30
Type: Split Spoon Sampler **Size:** 1-3/8" I.D.

DATE: 9/29/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 15
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Grond water level was not found. –			
0	SS	1	3-5-6	11		***Clayey Silt*** Brown to dark brown clayey silt, some subangular gravel fragments, few roots.	100		26					
	SS	2	6-8-32	40			89		18					
	SS	3	52/6"	--		***Sandy Silt*** Olive brown, light olive brown, yellow mottled sandy silt, some weathered rock fragments.	100		11					
5	SS	4	66/4"	--			76		4					
	SS	5	65/3"	--			83		2					
10	SS	6	100/2.5"	--		***Sandy Silt*** Gray sandy silt fines and rock fragments.	80		2					
15						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
20														
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 8
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development **REFERENCE NO.: DA/11S3302**

DATE: 11/7/2011
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: Mot. Cathead
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

CASING: **SAMPLER:**

Hammer Weight (lb.): **Drop (in.):** **Hammer Weight (lb.): 140** **Drop (in.): 30**

Type : **Size :** **Type: Split Spoon Sampler** **Size: 1-3/8" I.D.**

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Grond water level was not found. –			
0	SS	1	4-4-5	9		***Silty Clay*** Dark brown, brown, yellow motteld silty clay, few roots.	89		31					
	SS	2	4-5-5	10			94		23					
	SS	3	6-6-7	13			100		23	3.2				
5	SS	4	6-8-8	16			100		24	2.7				
	SS	5	60/2"	--			100		10					
10	SS	6	85/2"	--		***Sandy Silt*** Grayish brown sandy silt, some weathered rock fragments.	100		11					
15	SS	7	60/0.5"	--			--		--					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.

Soil / Geotechnical Engineering Laboratories

BORING NO.: 9
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

CASING:
Hammer Weight (lb.): **Drop (in.):**
Type : **Size :**

SAMPLER:
Hammer Weight (lb.): 140 **Drop (in.):** 30
Type: Split Spoon Sampler **Size:** 1-3/8" I.D.

DATE: 10/27/11
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: CME-45
DRILLER: R. Bruno
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	12-18-28	46		***Sandy Silt*** Light olive brown sandy silt, some weathered rock fragments, few roots.	89		6		Ground water level was not found. –			
	SS	2	32-56/6"	--		***Sandy Silt*** Light brownish gray sandy silt, some weathered rock fragments.	42		7					
	SS	3	60/6"	--			83		6					
5	SS	4	80/4"	--		***Sandy Silt (WC)*** Light brownish gray sandy silt, some weathered rock fragments.	75		6					
	SS	5	84/4"	--			63		5					
10						***Sandy Silt (WH)*** Light brownish gray sandy silt, some weathered rock fragments.								
15	SS	6	100/3"	--			68		6					
	SS	7	60/1/2"	--			--		-					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

Despiau Associates Corp.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 10
SHEET: 1 of 1
LOCATION: Coamo
NORTHING:
EASTING:

PROJECT: Monte Elvira Development
REFERENCE NO.: DA/11S3302

CASING:
Hammer Weight (lb.): Drop (in.):
Type : Size :

SAMPLER:
Hammer Weight (lb.): 140 Drop (in.): 30
Type: Split Spoon Sampler Size: 1-3/8" I.D.

DATE: 10/28/11
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20
DRILL MACHINE: CME-45
DRILLER: R. Bruno
DRILL METHOD: 5- 5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Ground water level was not found. –			
0	SS	1	4-8-12	20		***Silty Clay*** Dark brown, yellow mottled silty clay, trace sand, many roots.	100		25					
	SS	2	9-13-14	27			100		27			44.5	19.1	A-7-6 (16) / CL
						Silty Clay Dark brown, yellow mottled silty clay, trace sand.								
	SS	3	13-14-18	32			100		21					
5						***Sandy clayey silt*** Brown, yellow mottled sandy clayey silt.								
	SS	4	13-10-8	18			100		14					
	SS	5	8-10-14	24			100		15					
10						***Sandy Silt (WH)*** Light olive brown, yellow mottled sandy silt, trace weathered rock fragments.								
	SS	6	80/2.5"	--			80		10					
15														
	SS	7	50/1/2"	--			--		-					
20						Note: Weathered Rock was broken by the sampling device into the above described constituents.								
25														
30														
35														
40														

q_u (TSF) - Unconfined Compression Strength wh = Weight of Hammer to Drive Sampler

Wn = Natural Water Content in Percent of Dry Weight

Depth of Water Before Completion

Depth of Water After 24 Hours

ROUTINE LABORATORY TEST PROCEDURES

The subsurface exploration and testing program was directed toward the determination of problems, such as the presence of incompetent soils and a high groundwater table. In addition, the allowable bearing pressure of the soils and the foundation level is determined.

1. Classification

Visual-manual procedures, in accordance with ASTM D-2488, were employed to identify the subsoils at the site. Soils are described as one of the following: boulders, gravel, sand, silt, clay, organic soils and peat. Differentiation between the coarser soils is made by visual appreciation of predominant grain size. Fine grained soils (silt, clay, organic soils and peat) are partly identified using plasticity or dilatancy characteristics and the dry strength of the soil instead of the grain size.

2. Moisture Contents

The moisture content was determined for all samples obtained, and it is expressed in percentage of the given ratio of the weight of water and a given soil mass to the dry solid particles in it. The procedure used were in accordance to ASTM Designation D-2216.

3. Atterberg Limits

Designations: D-423 an D-424 establish respectively the standards for the determination of the liquid and plastic limits of the collected clayey samples. They are expressed as water contents and define the boundaries of three states in terms of "limits" as follows: (a) "liquid limit", the boundary between the liquid and the plastic states, and (b) "plastic limit", the boundary between the plastic and semi-solid states.

4. Volume Changes

Swelling characteristics are obtained in order to permit the expeditious identification of foundation soils which could be potentially troublesome due to excessive volume changes as shrinkage and swelling. The ratio of sample volume to its dry volume is recorded while immerse in distilled water for a period of 24 hours.

5. Unconfined Compressive Strengths (q-u)

A measure of shear strength was obtained for all cohesive soils sampled, where possible. The shear strength was determined either using a calibrated penetrometer, the unconfined compressive strength tester or the spring.

DESCRIPTIVE TERMINOLOGY CONSISTENCY OF COHESIVE SOILS AND RELATIVE DENSITY OF GRANULAR SOILS

To approximate the consistency of fine grained soils (soft, medium, stiff, very stiff, hard), a simple test is performed with the hand: a hard fine grain soil is difficult to indent with the thumbnail, a very stiff soil can be indented by the thumbnail, stiff soils are readily indented with the thumb, medium soils can be penetrated by moderate thumb pressure, soft soils are easily penetrated with the thumb, and soft soils run between the fingers when squeezed.

The consistency of cohesive soils has also been correlated to the results of the Standard Penetration Test, as shown below. The correlation, however, is greatly affected by the clay structures and factors as sensitivity.

TABLE 1 - DESCRIPTION OF SOIL DENSITY AND CONSISTENCY

COARSE GRAINED SOILS

Range of Standard Penetration Resistance (BPF)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
over 50	Very Dense

FINE GRAINED SOIL

Range of Standard Penetration Resistance (BPF)	Unconfined Compressive Strength (TSF)	Consistency
0 - 2	0 - 0.25	very soft
2 - 4	0.25 - 0.50	soft
4 - 8	0.50 - 1.00	medium
8 - 15	1.00 - 2.00	stiff
15 - 30	2.00 - 4.00	very stiff
over 30	over 4.00	hard

These are very approximate correlations which vary with, among other factors, overburden pressure, depth to water and grain size. These correlations are meaningless in soils with a significant amount of gravel or cobbles.

APPENDIX (2)

Earthwork Specifications

SPECIFICATIONS FOR PREPARATION EXCAVATION, FILLING AND GRADING

1. CLEARING AND GRUBBING

All trees and brush, including large roots, within the contract limit lines shall be cleared by the Contractor and suitably disposed.

2. STRIPPING

Topsoil shall be stripped from the site in all areas of excavation or fill. Topsoil shall be removed to its entire depth, and stockpiled in areas designated, or removed from the site.

3. COMPACTION OF SUBGRADE

Following stripping, the sub grade in all fill areas the exposed grade shall be compacted sufficiently to develop to a depth of at least twelve (12) inches at least 90% of modified Proctor maximum density as determined in the laboratory in conformance with ASTM designation D-1557.

4. MATERIAL FOR FILL

Material for fill shall be approved by the Soils Engineer. The criteria for acceptance shall be based on tests made for liquid and plastic limits, sieve analysis, maximum density at optimum moisture, shearing strength, and expansive qualities. Potential volume change tests shall accompany field density test results as required by field conditions. The fill material shall be AASHTO Classification A-2-4 or better for general earthwork construction. It shall be free of stone or rock fragments larger than 4-inch in their greatest dimension. All fill material shall be of an inorganic and non-swelling nature.

5. PLACEMENT AND COMPACTION OF FILL MATERIAL

Prior to placing fill, the sub grade shall be graded to provide adequate drainage, and shall be compacted as outlined in section 3.

(a) Placement of Fill:

The fill shall be spread evenly, in approximately horizontal layers of six (6) to twelve (12) inches loose thickness to be determined in the field by the Engineer.

(b) Moisture Control:

At the time of compaction, the material in each layer of fill shall have moisture content within 2% of optimum moisture content for compaction, as determined by ASTM D-1557 for determining the moisture-density relationship of the fill material.

(c) Drainage of the Site:

At all times the Contractor shall maintain and operate proper and adequate surface and subsurface drainage methods to the satisfaction of the Engineer in order to keep the construction site dry.

(d) Compaction Equipment:

It is the responsibility of the Contractor to select, furnish and properly maintain equipment which will compact the fill uniformly to the required density, however, the Contractor's selection of equipment is subject to approval by the Engineer. No fill shall be placed until approved compaction equipment is on the site and working condition.

(e) Compaction of Fill:

Each lift within load-bearing areas shall be uniformly compacted to at least 95% of Modified Proctor Maximum density as determined in the laboratory by the Engineer in accordance with ASTM designation D-1557. For sectors within non-load-bearing areas shall be uniformly compacted to at least 90% of the modified Proctor Maximum Density for each lift, unless otherwise required in the geotechnical report. Any lift, or portion there of, which is not compacted in accordance with the specifications, shall be compacted or removed and replaced to the satisfaction of the Engineer. The degree of compaction of each lift shall be checked by the Engineer and each successive lift shall not be placed or compacted until the previous lift is inspected, tested and approved by the Engineer.

(f) Ground Slopes:

Existing ground slope surfaces, to be covered by the fill, steeper than 5.1 (horizontal: vertical) shall be scarified into steps or benches and the fill progresses in order to provide a bond and avoid any shear failure along the fill/natural ground interface. Refer to Appendix 2-A (Excavation and Earthwork Benching) contained herein.

(g) Slopes on Fill:

Slopes shall not be steeper than 2.0 to 1.0 (Horizontal to Vertical units). Drainage other than storm water falling directly to slope shall not be permitted to cut across slope areas. Protection of slopes by planting of grass and shrubs on the same shall be performed immediately upon their completion. Special sloping requirement may be established in the geotechnical report.

(h) Erosion Protection:

Embankment fills with slopes steeper than 1.5:1 (H: V) shall be protected from runoff and erosion by an appropriate type of vegetation cover. This may be performed by hydro mulching in such a way as to cover the soil as fast as possible until evidence of "catch" or uniform stand to prevent erosion is achieved, at which time final acceptance will be given. The Contractor shall properly water, mow, and otherwise maintain all treated areas until final acceptance.

6. SLOPE CONTROL PLANTING

This item shall consist of the preparation of slopes for planting, fertilizing the soils, sowing the soil-fixing grasses, and permitting adequate growth of planted seeds.

(a) PREPARATION OF GROUND:

The top soil surface shall be uniformly trimmed and raked to true lines until it is free from unsightly variations such as humps, ridges, or depressions. All objectionable materials which might interfere with sowing of seeds, growth of grasses or subsequent maintenance of grass-covered areas, shall be removed or cleared.

Storm water run-off shall not be carried over the slopes. In cut sections, adequate protection must be provided by means of paved diversion ditches.

(b) FERTILIZERS:

Accepted fertilizers shall be thoroughly dissolved into the soil to a depth of at least three (3) inches, in order to promote rapid growth of the grass.

(c) SOIL FIXING GRASSES:

The following types of grasses are recommended in their order of preference; however, any other type of local grass acceptable to the engineer may also be used; (a) Bermuda grass and (b) St. Augustine grass.

(d) MAINTENANCE:

The contractor shall mow, water and otherwise maintain all seeded areas until the building is occupied. Any area shall fail to catch will have to be re seeded. Surfaces where erosion gullies develop or otherwise become damage due to over saturation shall be repaired

7. BENCHING

When embankment is to be placed and compacted on hillsides or when new embankment is to be compacted against an existing embankment, or when an embankment is built one-half (1/2) width at a time, the slopes that are steeper than four to one (4:1) when measured at right angles to the roadway shall be continuously benched over these areas as the work is brought up in layers. Benching shall be of sufficient width to permit operation if placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Refer to Appendix 2-A (Excavation and Earthwork Benching) contained herein.

BD/sc
DA-09 revision

APPENDIX (2-A)

Specifications for Excavation and Earthwork Benching

SPECIFICATIONS FOR EXCAVATION AND EARTHWORK BENCHING

Benching

Benching is required for all embankments placed on or against a slope steeper than 8:1. The existing slope has to be scalped first. This applies on all embankment areas whether the existing embankment cross slope is in the transverse or the longitudinal direction.

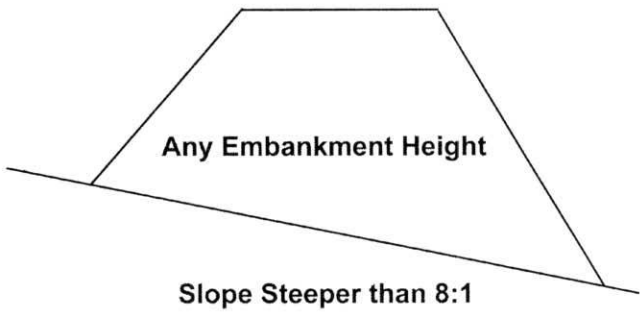


Figure 1 - Benching Required

Figure 2 details the bench into the existing embankment. For side hill fills, the existing embankment is physically notched out and connected to the new embankment. Benching requires horizontal cuts in the existing slope.

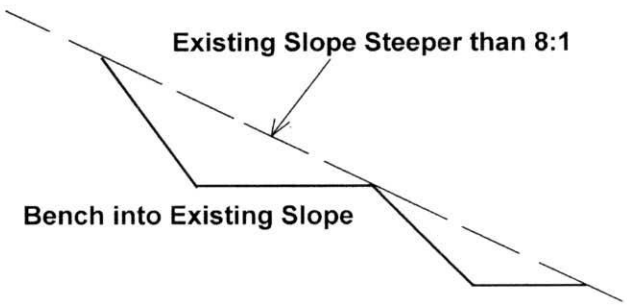


Figure 2 - Benching

The bench is wide enough to blend the new embankment with the existing embankment. In Figure 3, the total width between point A and B must be the width of the dozer blade and the compaction equipment.

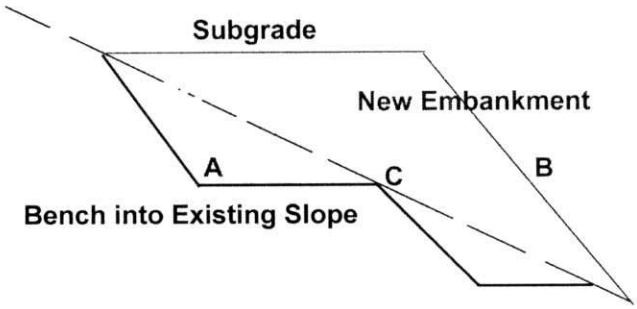


Figure 3 - Benching in New Embankment

If the plan calls for a new embankment, or the distance between C and B is less than a blade width or about 8 feet, then the existing embankment must be benched in the difference or distance A and C.

In Figure 4 the horizontal distance between points D and E is about 4 feet (1.3m). Therefore, the existing embankment must be benched into for about 4 more feet (1.3m) to complete the bench.

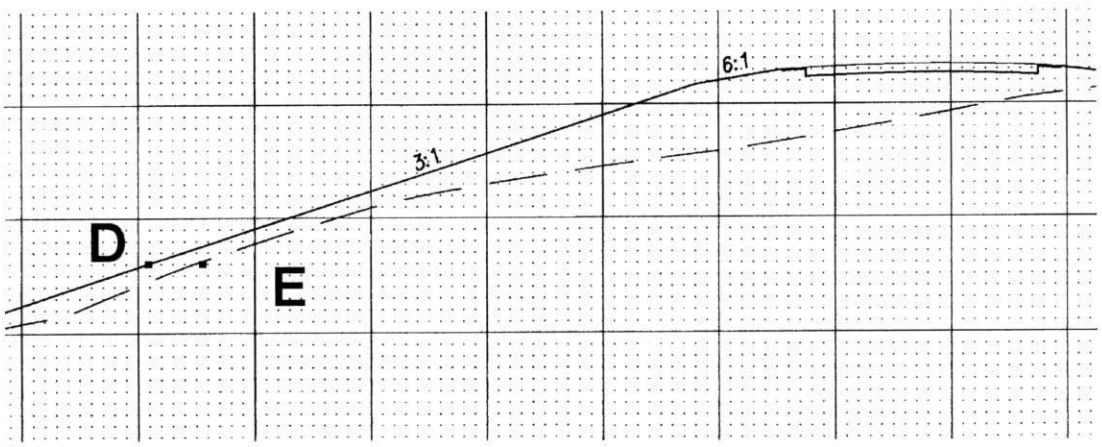


Figure 4 - Sliver Fills

Bench into the slope as the embankment is placed, and compact into layers. Begin each bench at the intersection of the existing slope and the vertical cut of the previous bench. The re-compaction of the cut materials is required.

Benching is nothing more than a side hill foundation. Benching knits two embankments together to ensure that a failure plane does not occur. Figure 5 details the typical benching seen on some plans.

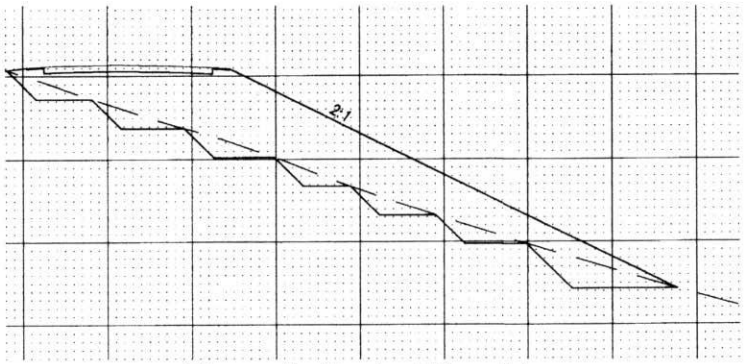


Figure 5 - Typical Benching

When the designer anticipates that there was a stability problem or weak soils in the existing embankment (or both). This is called special benching. Side hill embankments present unique problems in that they may be stable when originally constructed yet become unstable later. The result is usually a landslide.

If the bench is not benched into the existing embankment far enough then a weak plane can develop as shown in Figure 6. A failure may occur along this weak plane and the bench material will move laterally. The project should evaluate the existing soil conditions and determine if more benching is required than shown on the plans or required by the specifications.

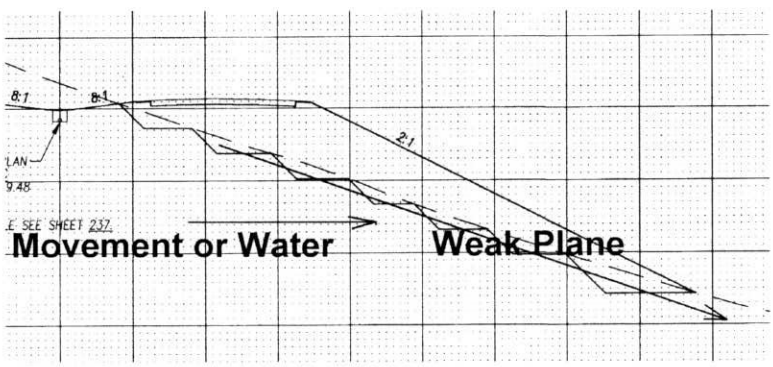


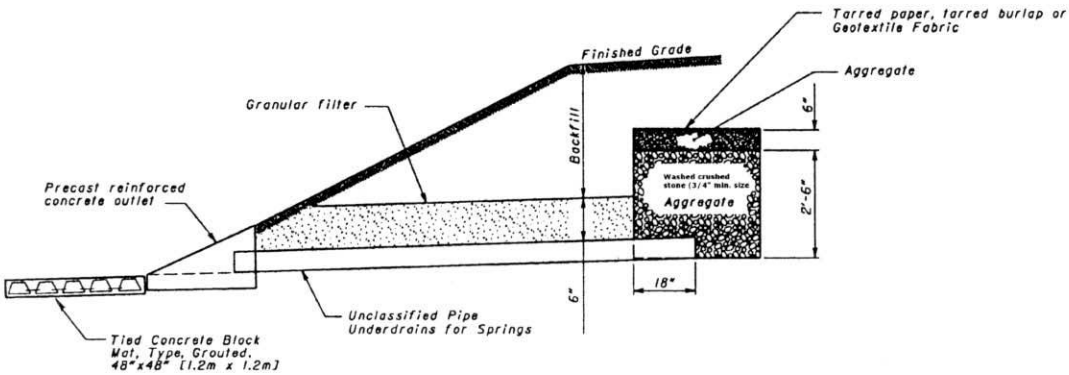
Figure 6 - Benching Problems

In most cases, the main cause of embankment benching failure is by water seeping into the embankment from the side hill or foundation. Notice in Figure 6 how water can move into the bench material and weaken the bench material.

Special attention must be given to side hill embankments. Consult the plans and soil profile to see where special benching, if any, is required; to see whether or not spring drains are provided, and to see if any potential spring or wet zones are mentioned. The areas should be inspected in detail for possible springs. In dry seasons, green or lush vegetation are often indicative of a semi-dormant spring that may become active during prolonged periods

of precipitation. If spring zones are encountered and no spring drains are provided in the plans, then drains should be added to the work.

Spring drains are detailed on the plans by plan notes, when they have been ascertained during the design phase. The standard drawing for spring drainage is partially shown in figure 7. Use non-perforated pipe.



SECTION A-A

SPRING DRAIN DETAIL

Figure 7 - Spring Drains

See Figure 8 when more severe water problems are encountered. If the water is coming in at all elevations, then a filter fabric and coarse aggregate can be placed to take the water flows. The fabric is used to stop the migration of fines into the coarse aggregate.

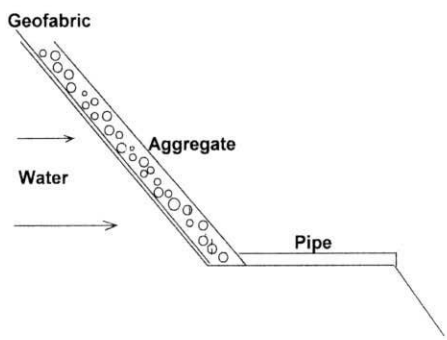


Figure 8 - Severe Water Problems in a Bench

APPENDIX (3)

Special Laboratory Tests

SPECIAL LABORATORY TESTS

I. Laboratory Testing Procedures:

As may be required for the geotechnical evaluations, a series of non-routine or special tests could be performed to assist in the engineering analyses. The special tests performed are contained in separate sheets included in this Appendix. The special tests performed for the present project are included in the following list of laboratory tests, among other usually performed.

1. Vane Shear Test
2. Mechanical Analysis of Soils
3. Liquid & Plastic Limit Tests
4. Unit Weight Determination of Soils
5. Unconfined Compressive Strength Tests (Stress-Strain)
6. Compaction Tests
7. Free Swell Tests

A brief description of the tests procedures which are used in the above list of special tests is as follows:

1. Vane Shear Test

A pocket vane shear test device was used to perform various vane shear tests on samples (i.e. SPT and Undisturbed Shelby Tubes). The results of the vane shear tests are given in tons per sq.-ft.

2. Mechanical Analysis of Soils

The process of separating the soil into particle-size groups, including both the sieve analysis of the coarser and fine grains was performed. Standard U.S. sieves were used to establish the Percent Finer by Weight of the samples. The percentage of fines was used to classify the samples in both the standard AASHTO and Unified Classification Systems.

3. Liquid & Plastic Limit Tests

The moisture content above which a soil readily becomes a liquid upon stirring is called the **liquid limit**. The standard Arthur Casagrande Device was use for such determination, following ASTM Specifications D423.

The **plastic limit** is defined as the minimum moisture content at which the soil mixture acts as a plastic solid. The standard ASTM specification D424 was followed in performing the tests.

From the above test results the **plasticity index** can be determined. It is defined as the numerical difference between the liquid limit and the plastic limit of the soil. In the data

sheets the tests results given in the corresponding column are the Liquid Limit (LL) and the Plasticity Index (P.I.).

4. Unit Weight Determination of Soils

The **wet** unit weight of the samples was obtained by mass per unit volume from the sample, as secured from the field. Dry unit weight determinations were obtained and are specifically mentioned in some of the tables and graphs submitted.

5. Unconfined Compressive Strength Tests (Stress-Strain)

Basically the **unconfined** compressive strength test is performed by axially loading a cylinder without lateral confinement. In wet fine grained soils the tests are performed quickly. Different from the routine Qu tests, in the special unconfined compressive tests, which are performed in the triaxial compression chamber, the stress-strain at predetermined intervals are recorded. In the routine tests on SPT samples, the unconfined compression tests are performed by the spring tester. Sometimes, the pocket penetrometer device is used to determine the unconfined compressive strength. The test type is indicated in the corresponding column of test results.

6. Modified Proctor Compaction Tests

The **laboratory** compaction test consists of determining the maximum dry density and optimum moisture content of representative samples of potential borrow fill sources.

The Modified Proctor Density Tests are performed in accordance to the ASTM Designation D 1557, Standard Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using a 10-lb.Rammer and 18-in. drop.

7. Free Swell Tests

The free swell tests are made in accordance to the procedures of the US Bureau of Reclamation, which provide percent total volume change from dry to a saturated condition.

Despiau Associates Corp.
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JOB NO.:	DA/11S3302
DATE:	November 2, 2011

SUMMARY OF SOIL CLASSIFICATION TESTS AND FREE SWELL TESTS

Boring No.	Sample Depth	Liquid Limit %	Plasticity Index %	% Passing US Sieve			Classification		% Free Swell	Clay Type Class.	
				10	40	200	AASHTO	USCS		AC*	CEAC**
2	3'-5'	29.0%	9.3%	97.9	56.6	48.4	A-4 (2)	SC	15%	0.19	0.28
4	3'-5'	N.P.	N.P.	87.6	40.4	25.1	A-2-4 (0)	SC	10%	-	-
5	1'-6"- 3'	48.2%	25.7%	100.0	96.1	89.3	A-7-6 (25)	CI	35%	0.29	0.5
6	5'-7'	N.P.	N.P.	98.3	48.3	35.0	A-2-4 (0)	SC	10%	-	-
10	1'-6"- 3'	44.5%	19.1%	99.7	89.4	81.0	A-7-6 (16)	CL	35%	0.24	0.39

* Activity Ratio
** Cation Exchange Activity

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