31 January 2005

AMEC File: VM00343-700

VIA E-MAIL

AMEC Americas Limited
Energy and Mining Division
111Dunsmuir Street
Vancouver, British Columbia
V6B 5W3

Attention: Mr. Tom Nikiforuk, P.Eng.
Project Manager

Dear Sir,

Reference: **Mirador Copper Project**
Conceptual Foundation Design For Mine Structures

As requested, AMEC Earth and Environmental, a division of AMEC Americas Limited, have completed a revised conceptual geotechnical design for the proposed mill, crusher, and maintenance, offices and accommodation facilities at the Mirador mine site. This letter report supersedes our earlier memorandums entitled "Preliminary Review of Mill Foundations" (dated August 17, 2004) and "Preliminary Review of Foundation Conditions For Crusher, Maintenance, Offices and Accommodation Facilities" (dated November 12, 2004). This report provides a brief overview of the subsurface conditions at each facility and provides preliminary comments and recommendations regarding geotechnical foundation requirements for the various structures comprising the facilities.

1.0 INTRODUCTION

This revised conceptual design takes into account the location and layout of these facilities that were given on the following drawings provided by Mining and Metals Division of AMEC Americas Ltd.:

- Drawing A1-142314-100-C-0002 - Mirador Copper Project – Mill Site Plan, issued for Feasibility Report on November 16, 2004;
- Drawing A1-142314-100-C-SK03 – Mirador Copper Project – Crusher Site Plan, dated October 12, 2004 (received by e-mail on October 12, 2004); and
- Drawing A1-142314-100-C-0007 – Plot Plan of Maintenance, Offices and Accommodation Facilities, not dated (received by e-mail on October 1, 2004).

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The mill and crusher facilities will be located on the steep slopes at the proposed Mirador Project site. These slopes are overlain by colluvium and residual soils (saprolite) to a significant depth overlying weathered granitic rocks. The colluvium layers are inherently unstable and subject to downhill creep. Residual soils are a product of the in-situ weathering of local parent rocks where soluble and colloidal materials are leached out resulting in large void ratios and soft consistencies. Structures founded on these materials may undergo significant settlement or have a potential for collapse. Therefore residual soils are not considered to be good foundation soils. In areas where residual soils are present, deepening of foundations to rock will provide an effective means of developing adequate and uniform support for mill and crusher structures.

The administrative area will be located on alluvial deposits near the junction of the Quimi and Wawayme rivers. Alluvium (recent deposits from streams and rivers) is typically granular material (sands and gravels) that ranges from clean to very silty. At times alluvium may contain roots or other organic material. The density of the alluvial soils can range from very loose to dense. These deposits can have a highly variable stratigraphy both vertically and laterally, and are generally suitable for construction purposes. However, loose saturated deposits will require replacement or improvement to prevent excessive settlements under static loads or liquefaction due to dynamic loading.

2.0 GEOTECHNICAL SITE INVESTIGATION

2.1 Mill Site

Corriente, under supervision of AMEC Earth & Environmental, carried out a site investigation program at the proposed mill site from July 12 through July 26, 2004. The purpose of this geotechnical field investigation program was to acquire information required to provide preliminary geotechnical design recommendations for the proposed structure foundations. A total of 7 boreholes (BH04-16 to BH04-21 and BH04-26, Figure 1) were drilled to depths ranging from approximately 22.9 m to 32.6 m, using a rotary diamond drill rig. In addition to this geotechnical investigation, 4 test pits TP-10 to TP-13, Figure 1) were excavated to depths ranging from 1.9 to 2.1 m by Corriente field staff. Information regarding this work was summarized in a memorandum entitled “Ubicación y Levantamiento de los TP “TEST PIT” en la Zona del MILL” dated June 20, 2004.

The general soil profile found during these investigations comprised four main soil and rock layers overlain by organic topsoil and forest litter. The four stratum were:

- “Suelo fluviotorrencial” - loose, wet river deposits consisting of sand, muddy, gravely sand and boulders;
- “Suelo residual” - soft, wet residual soil composed of plastic, sandy clay;
- “Roca de apariencia intrusiva” - extremely weathered, extremely weak rock (appearance of clayey sand); and

- "Roca intrusiva" – highly weathered, weak, fractured rock.

Detailed descriptions (in Spanish) of these materials are provided in the borehole logs prepared by AMEC Earth & Environmental (Appendix A of this report).

Standpipe piezometers were installed in 4 of the 7 boreholes as follows:

Borehole Number	Approximate Ground Elevation (m)	Depth of Standpipe (m)	Stratum	Depth of Water Level (m)	Date of Reading	Approximate Water Elevation (m)
BH04-16	1448	25.45 to 28.25	Roca intrusive	Above drill platform	July 21, 2004	1448+
BH04-19	1472	27.60 to 32.61	Roca intrusive	3.65	July 21, 2004	1468
BH04-20	1454	20.05 to 24.66	Roca intrusive	2.67	July 21, 2004	1451
BH04-26	1463	------	Roca intrusive	1.81	July 21, 2004	1461

It is understood that each instrument has been monitored since July 21, 2004 and groundwater levels have remained relatively constant, near the existing ground surface.

Seepage was observed Test Pit TP-10 (located approximately 43 m north and 26 m west of BH-19).

2.2 Crusher Site

A geotechnical field investigation that involved drilling a total of 6 boreholes (GH01 to GH06) was carried out in the vicinity of the proposed crusher (Figure 2). Approximate coordinates of each borehole, as determined by a Global Positioning System (GPS) receiver is as follows:

Borehole Number	NORTH	EAST
GH01	9 604 766	786 259
GH02	9 604 674	786 306
GH03	9 604 548	786 056
GH04	9 604 496	786 158
GH05	9 604 468	785 987
GH06	9 604 354	786 043

It is understood that each of the boreholes were drilled using a rotary diamond drill rig to depths ranging from 45.7 m to 77.7 m.

Borehole logs were not available at the time this letter report was prepared, however, based on inspection of the core photographs the soil - rock profile in each of the six boreholes may be summarized as follows:

Borehole Number	Depth Interval of Various Foundation Materials (m)			
	Soil	**Soil/Rock**	**Weathered Rock**	**Rock**
GH-01	0 to 23	23 to 33	33 to 58	58+
GH-02	0 to 13	13 to 41	41 to 71	71+
GH-03	0 to 7	7 to 10	10 to 36	36+
GH-04	0 to 1	1 to 5	5 to 43	43+
GH-05	0 to 24	24 to 26	26 to 27	27+
GH-06	0	0 to 35	35 to 44	44+

It is understood that standpipe piezometers were not installed in any of the boreholes.

2.3 Administration Area

No borehole or test pit information is available from the area of the maintenance, offices and accommodation facilities. However, it is understood, based on site reconnaissance carried out by AMEC Earth and Environmental personnel and test pits west of the area (email from Michael Shelbourne dated September 30, 2004), the following subsurface conditions may be assumed at the site for preliminary geotechnical design purposes:

- Soil profile will likely consist of up to 1 m of organic soil overlying about 10 m of granular soils;
- Bedrock underlying the soil layers will likely range from fairly well-weathered rock at the soil-bedrock interface to fresh (slightly weathered) rock at a depth of about 20 m; and
- Water table is likely to be fairly high (say within 1 m to 2 m of ground surface).

3.0 FOUNDATION CONDITIONS

Foundation conditions at the mill, crusher, maintenance, offices and accommodation facilities were estimated based on the limited site investigations described in Section 2.0 of this memorandum. This information is adequate for conceptual geotechnical design purposes; however, additional boreholes and or test pits may be required, in order to complete preliminary and detailed geotechnical design for these structures.

3.1 Mill Site

Foundation conditions for the various mill components were estimated based on Drawing "A1-142314-100-C-0002 - Mirador Copper Project – Mill Site Plan, issued by AMEC Mining & Metals for Feasibility Report" on November 16, 2004. It is understood that the mill facility is centred along "Alignment L" which trends southwest to northeast, as shown in Figure 1.

The soil and rock profile of five boreholes located near the mill structures (Figure 1) are summarized below.

Geological Unit	Approximate Elevation of Top of Unit (m)				
	BH04-18	BH04-19	BH04-20	BH04-21	BH04-26
Suelo fluviotorrencial	1465.0	1472.0	1456.0	1465.5	1463.0
Suelo residual	1460.0	1467.0	1451.0	1463.5	1460.1
Roca de apariencia intrusiva	1455.2	1456.8	1448.2	1455.5	1456.0
Roca intrusiva	1453.5	1455.2	1447.0	1454.0	1449.6
• Sound Bedrock*	1450.0	1456.8	1443.0	1450.5	1443.0

*Note: Elevation estimated based on review of borehole logs, core photographs and laboratory data.

Based on preliminary drawings provided by AMEC Mining & Metals, mill structures (apron feeders, sag mill ball feeder, conveyor, grinding mills, rougher cell distributor, rougher cells, pumps, floatation cells, overhead crane, building footings, etc.) will be founded at elevations ranging from 1447 m to 1475 m. The majority of mill structures (along Alignment L) will likely be founded in sound bedrock below elevation 1450 m (BH-18 and BH-21). Foundations for structures north of Alignment L, in the vicinity of BH-19, can be expected to be in sound bedrock below elevation 1457 m. Structures south of Alignment L will potentially be founded in sound bedrock below elevation 1443 m (BH-20).

3.2 Crusher Area

It is understood that the crusher will be a heavily loaded structure that will transmit dynamic loads to its foundation. To negate differential settlements, these structures are usually founded on competent bedrock.

According to information shown on drawing A1-142314-100-C-SK0, the crusher is located between Borehole GH03 (approximate elevation 1306 m) and Borehole GH04 (approximate elevation 1323 m). Based on review of core photographs, the elevation of sound bedrock at Boreholes GH03 and GH04 is at about 1270 m and 1280 m, respectively.

3.3 Administration Area

It is understood that the structures comprising the maintenance, offices and accommodation facilities are non-critical or lightly loaded structures and equipment that will be founded on individual spread footings.

It is anticipated that these structures can be founded on the granular soils found at the proposed site. Based on site reconnaissance carried out by AMEC Earth and Environmental personnel and test pits west of the area, granular foundation soils will likely be encountered at a maximum depth of 1 m below ground surface

4.0 CONCEPTUAL GEOTECHNICAL DESIGN RECOMMENDATIONS

4.1 Mill Site

Based on geotechnical field investigation data presently available, both the suelo fluviotorrencia and suelo residual soil layers appear to be poor foundation soils having a relatively low resistance to shear failure and a relatively high potential for settlement. It may be feasible to found structures that are tolerant to settlement on suelo residual provided that the design bearing value is low in the order of 50 kPa. Structure foundations that require a higher allowable bearing capacity or are sensitive to settlement should be designed (over excavation or piles) to transmit loads directly to the competent rock layers underlying this layer or alternatively, less critical structures may be designed to accommodate settlement through periodic maintenance (shimming).

Roca de apariencia intrusive is an extremely weathered and extremely weak rock. These materials typically have a design bearing pressure in the order of 50 to 150 kPa. The underlying Roca intrusive is a less weathered rock and therefore could be expected to have a higher allowable bearing capacity, up to 1000 kPa in sound bedrock. It may be possible to increase these bearing capacities once these materials are subject to in situ testing during preliminary and final design.

Based on available geotechnical information, it appears to be feasible to found structures such as the SAG mills, overhead crane and building foundations in sound rock of the roca intrusive layer. Structures that transmit vibratory loads to roca intrusive layer should be subject to specific laboratory testing and soil-structure analyses during preliminary and detailed design to ensure this layer will not weaken and deform excessively over time and cause excessive settlement of the foundation in the long term.

Areas of significant groundwater seepage can be expected throughout the mill site. In most areas, it may be possible to handle the seepage encountered in excavations using sumps and pumps. Pump requirements can be estimated during preliminary and detailed design from the field investigation data. It is noted that the suelo residual layer may undergo settlements if dewatering is required, which may affect foundations constructed in this material.

It is recommended that a perimeter drainage system be constructed at footing elevation. A permanent drainage system underneath the floor slab may also be required.

In the upper 5 m of the overburden, a 2.5H:1V cut slope will be required. A 5 m wide bench should be incorporated at the upper overburden/saprolite interface. The saprolite should be cut at an overall slope of 1H:1V if less than 10 m high, smaller heights could be cut steeper.

4.2 Crusher Site

It is understood that the cut for the crusher structure will be in the order of 20 m to 25 m. According to information shown on drawing A1-142314-100-C-SK0, the elevation of the crusher foundation will be approximately 1280 m to 1285 m. This range of elevation is at or near the elevation of sound bedrock (Borehole GH03 and GH04). Bedrock at this elevation is expected to have a design bearing pressure in the order of 150 to 250 kPa.

The crusher will transmit vibratory loads to the foundation rock and therefore laboratory testing and soil-structure analyses should be carried out during preliminary and detailed design to ensure the foundation rock layer will not weaken and deform excessively over time and cause excessive settlement of the foundation in the long term. Provisions should be made at the preliminary and detailed design phases of the project to handle groundwater seepage during and after construction of the crusher.

4.3 Maintenance, Offices and Accommodation Facilities Site

The in situ soils underlying the proposed maintenance, offices and accommodation facilities consist of granular soils (presumably sands and gravels). The allowable bearing capacity for granular soils will almost always be governed by tolerable settlement. Spread footings for these types of structures are generally designed to a net allowable bearing pressure that will produce no more than one inch of maximum settlement or one-half inch of differential settlement between footings.

In the absence of subsurface geotechnical data at the location of these structures, it is considered prudent to use an allowable bearing capacity of 175 kPa for preliminary design purposes. This design bearing capacity may be increased based on the results of boreholes or test pits put down in support of the detailed design of the structures. Post construction settlements for footings designed and constructed as described above are not expected to exceed 25 mm.

Footings for these structures can be constructed on the undisturbed dense sand and gravel deposits or on structural fill materials placed directly over top of these deposits. Footing excavations may extend below the water level and therefore the water level may have to be brought down below the base of the excavation, which may require dewatering by sump pumps or well points.

A geotechnical engineer should inspect all bearing surfaces prior to footing construction. Foundation excavations and bearing surfaces should be protected from precipitation, excessive drying and the ingress of free water before, during and after footing construction. After the bearing surface is approved, a gravel layer should be placed immediately to protect the soil and provide a working surface for construction.

5.0 CLOSURE

Recommendations presented herein are based on a geotechnical evaluation of the findings of the previous site investigations and geotechnical assessments. This report has been prepared for the exclusive use of AMEC Americas Limited (Energy and Mining Division) and their appointed consultants for specific application to the area within this letter. Any use which a third party makes of this letter, or any reliance on or decisions made based on it, are the responsibility of such third parties. AMEC Earth & Environmental accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions based on this letter. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

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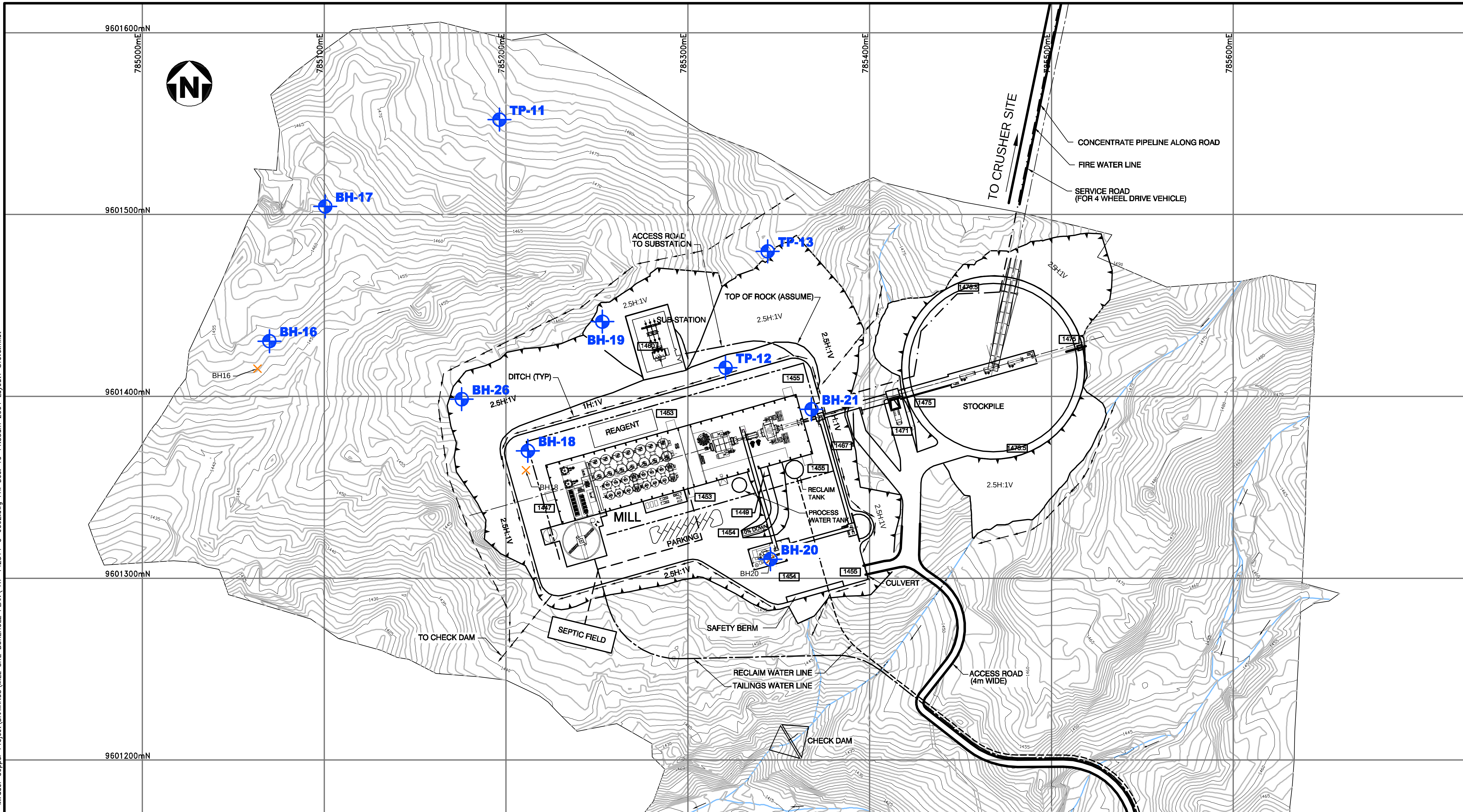
Attachments: Figure 1 Mill Site Test Hole Location Plan
Figure 2 Location of Boreholes GH01 to GH06
Appendix A – Borehole Logs



LEGEND

TEST HOLE LOCATION
TP = TEST PIT
BH = BOREHOLE

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Client

CORRIENTE
RESOURCES INC.

DWN BY:	SM
CHK'D BY:	KK
APP.	KK
SCALE	AS SHOWN

PROJECT
MIRADOR PROJECT
EQUADOR

TITLE
MILL SITE
TEST HOLE LOCATION PLAN

DATE:	DEC. 2004
PROJECT NO:	VM00343-700
REV. NO.:	-
FIGURE No.	FIGURE 1

*PLOT 1:1=A1 S:\PROJECTS\VM00343 - Mirador Copper Project\DRAWINGS\MILL SITE BOREHOLE PLAN\ A1-142314-C-0002.dwg Fri. Dec. 10 11:53am 2004 Layout1 STeve.milot

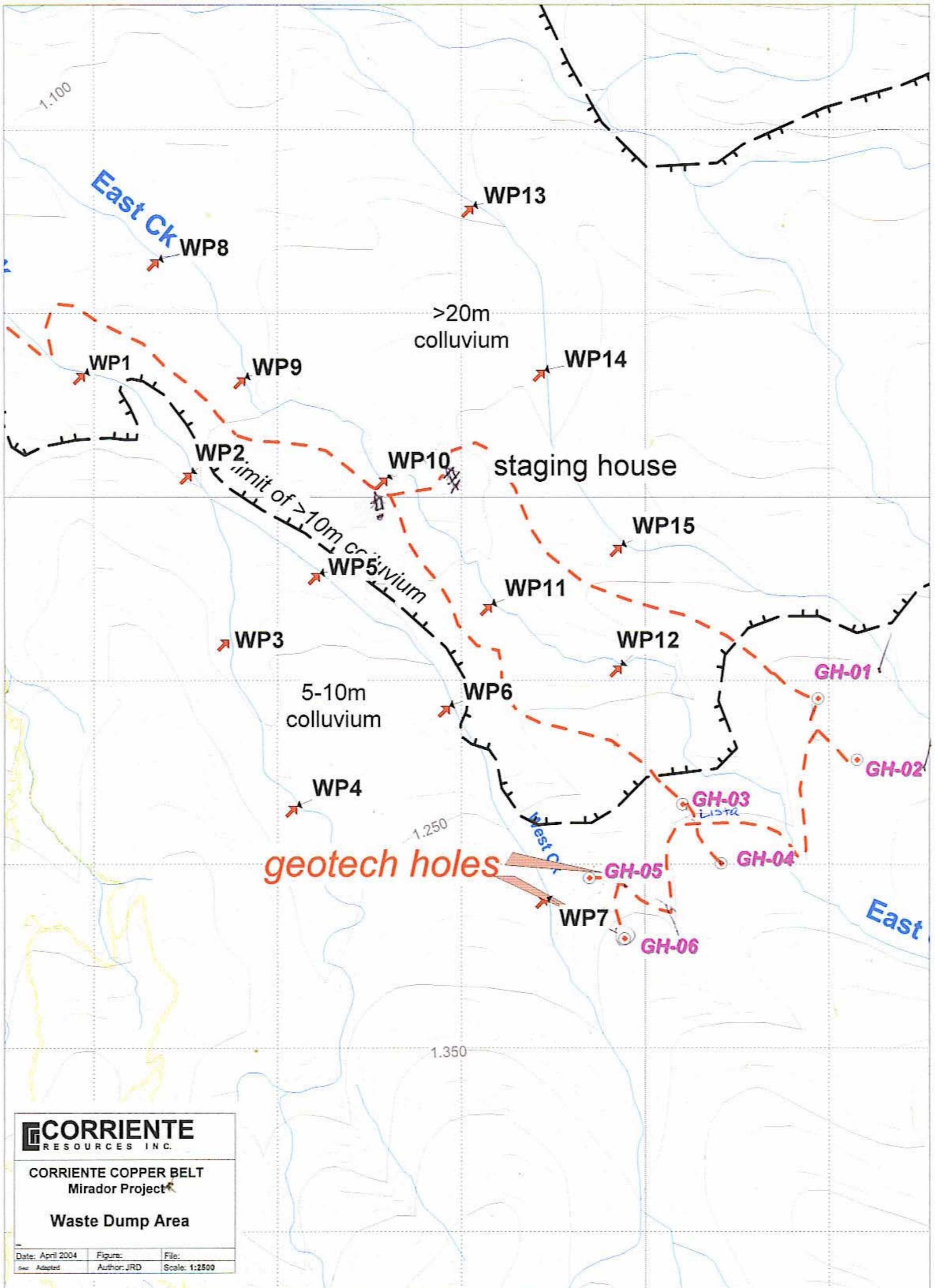

Figure 2 Location of Boreholes GH01 to GH06

APPENDIX A

BOREHOLE LOGS

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-16**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,430**
Easting (m): **785,070**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
0.0 HQ			Desde 0.00 hasta 3.00 m: Arena arcillosa, plastica, muy humeda, marron claro. << Suelo fluviotorrencial >>			100%	21/07/04 water level in piezometer at top of standpipe casing, above drill platform ground surface.	
1.0					1.52			
2.0				M-1		39%		
3.0			Desde 3.00 m hasta 15.50 m: Arcilla arenosa, plastica, muy humeda, de coloracion variada marron claro a pardo con plomo verdoso y plomo claro violaceo. << Suelo residual >>		3.05			
4.0					4.57	49%		
5.0						78%		
6.0					6.10		Lechada de cemento bentonita; Tubo de PVC de 40 mm diametro interior	
7.0					7.62	93%		
HQ 8.0								

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar: Granul.	L.L.	L.P.	H.Nat.
M-1	2.30 - 2.50				
M-2	10.40 - 10.65				
M-3	21.10 - 21.30				

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Site Description: **Mill Site**
Completion Dates: **14 to 15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.00 m**
BH04-16

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-16**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,430**
Easting (m): **785,070**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 HQ						95%		
9.0					9.14			
10.0						92%		
				M-2	10.67			
11.0						89%		
12.0					12.19			
13.0						5%		
					13.72			
14.0							Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
						92%		
15.0					15.24			
		x- x- x-				72%		
HQ 16.0								

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diámetro Tipo / mm	Material
0.00 - 3.00	HQ / 96	Suelo fluvio torrencial
3.00 - 15.50	HQ / 96	Suelo residual
15.50 - 21.34	HQ / 96	Roca volcanica ext. met.
21.34 - 23.00	HQ / 96	Roca volc. alt. a mod. met.
23.00 - 28.40	HQ / 96	Roca volcanica mod. met.
28.40 - 30.48	HQ / 96	Brecha de falla.
30.48 - 30.63	NTW / 76	Brecha de falla.
30.63 - 32.00	NTW / 76	Roca volcanica lig. met.

Resumen del Construcción del Piezómetro Tubo Abierto

Prof. (m)	Tubo de PVC	Relleno del Sondaje
0 - 23.80	solido	lechada de CB
23.80 - 24.95	solido	sello de bentonita
24.95 - 25.45	solido	derumbe
25.45 - 26.42	solido	filtro de arena
26.42 - 27.92	ranurado	filtro de arena
27.92 - 28.02	tapon	filtro de arena
28.02 - 28.25	-	filtro de arena
28.25 - 32.00	-	derumbe ?

Site Description: **Mill Site**
Completion Dates: **14 to 15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.00 m**
BH04-16

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-16**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,430**
Easting (m): **785,070**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◻ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
16.0 HQ		x- x- x-	Desde 15.50 m hasta 21.34 m: Roca extremadamente meteorizada, extremadamente débil con apariencia de suelo residual, de colores marrón claro a pardo verdoso. Se presenta en estado de arena arcillosa. << Roca de apariencia intrusiva >>	Core	16.76			
17.0 – 18.0		x- x- x-		Core	18.29	*91%*		
19.0		x- x- x-	(see table below)	Core	19.81	*90%*		
20.0 – 21.0		x- x- x-		Core; M-3	21.34	*82%*		
21.34 – 22.0		x: x: x:	Desde 21.34 m hasta 23.00 m: Roca altamente meteorizada, de dureza débil, poco fracturada (espaciamiento promedio de fracturas de 20 a 40 cm), presenta textura porfiritica, de colores plomo claro verdoso y marrón amarillento por meteorización de la roca. << Roca intrusiva >>	Core; M-4	22.86	*100%* **86%**	Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
23.0 – HQ 24.0		x: x: x:	Desde 23.00 m hasta 27.50 m: Roca moderadamente meteorizada a poco meteorizada, de dureza media a dura, poco fracturada (espaciamiento promedio de fracturas de 20 a 40 cm), textura porfiritica, de colores plomo verdoso con matices amarillentos y marrón rojizo por meteorización. << Roca intrusiva >>	Core		100% **80%**	23.80 m; Sello de bentonita	

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
21.54	Jn	20	Ondula	Alterada	Ox.
21.76	Jn	20	Ondula	Alterada	Ox.
21.95	Jn	10	Ondula	Alterada	Ox.
22.78	Jn	15	Ondula	Alterada	Ox.
22.80	Jn	20	Ondula	Alterada	Ox.
23.26	Jn	10	Ondula	Alterada	Ox.
23.32	Jn	30	Plano	Alterada	Ox.
23.72	Jn	40	Plano	Alterada	Ox.
23.83	Jn	35	Plano	Alterada	Ox.
23.90	Jn	30	Lig. Ondula	Lig. Alt.	Ox.

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Site Description: **Mill Site**
Completion Dates: **14 to 15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.00 m**
BH04-16

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-16**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,430**
Easting (m): **785,070**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◻ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
24.0 HQ		x: x: x:	Desde 23.00 m hasta 27.50 m: Roca moderadamente meteorizada a poco meteorizada, de dureza media a dura, poco fracturada (espaciamiento promedio de fracturas de 20 a 40 cm), textura porfiritica, de colores plomo verdoso con matices amarillentos y marrón rojizo por meteorización. << Roca intrusiva >>	Core; M-5	24.38		Sello de bentonita	
25.0		x: x: x:			25.91	100% **56%**	24.95 m; Derrumbe; 25.45 m; Filtro de arena	
26.0		x: x: x:					26.42 m; Filtro de arena	
27.0		x: x: x:	Desde 27.50 m hasta 28.40 m: Roca moderadamente meteorizada, de dureza media, fracturada y fallada con ángulos de 80 a 90 grados con relación a la horizontal, textura porfiritica, de colores plomo verdoso y marrón amarillento. << Roca intrusiva >>		27.43	100% **95%**	Tramo ranurado	
28.0		x/ x/ x/	Desde 28.40 m hasta 30.63 m: Zona de brecha de falla en estado de grava arcillosa arenosa, de 28.96 hasta 30.00 recuperación de muestras en estado de arcilla arenosa, plástica, poco consistente, muy húmeda. << Brecha de falla en intrusivo >>			96% **20%**	28.02 m; 28.25 m; Derrumbe	
29.0		x/ x/ x/			28.96			
30.0 HQ NTW		x/ x/ x/			30.48	39% **0%**	NTW 30.48 m	
31.0		x: x: x:	Desde 30.63 m hasta 32.00 m: Roca poco meteorizada, de dureza media a dura, muy fracturada por incidencia de la zona anterior de falla, textura porfiritica, de colores plomo verdoso a plomo violáceo. << Roca intrusiva >>			100% **7%**	Derrumbe	
NTW 32.0		x: x: x:	**FIN DEL SONDAJE A 32.00 m**		32.00			

Caracteristicas de las Discontinuidades (23.00 m – 27.50 m)

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
24.10	Jn	40	Ondula	Lig. Alt.	Ox.
24.38	Jn	35	Ondula	Alterada	Ox.
24.60	Jn	25	Ondula	Alterada	Ox.
24.74	Jn	30	Escalonada	Alterada	Ox.
24.82	Jn	60	Plano	Alterada	Ox.
25.07	Jn	50	Ondula	Alterada	Ox.
25.17	Jn	20	Ondula	Lig. Alt.	Ox.
25.50	Jn	20	Escalonada	Lig. Alt.	Ox.
25.60	Jn	20	Lig. Ondula	Lig. Alt.	Ox.
25.84	Jn	50	Plano	Fresca	-
26.25	Jn	40	Ondula	Decolorada	-
26.50	Jn	60	Plano	Fresca	-
26.85	Slick.	60	Plano lisa	Lig. Alt.	CL (1)
27.00	Jn	35	Ondula	Decolorada	-
27.48	Jn	40	Ondula	Alterada	-
27.55	Slick.	40	Plano lisa	Lig. Alt.	CL (1)
27.70	Slick.	40	Plano lisa	Alterada	CL (3)
27.90	Jn	40	Plano	Alterada	Ox.
28.20-28.40	Jn	40	Plano lisa	Alterada	Ox.
28.40-28.96	Tramo fragmentado, estado de grava arenosa.				
28.96-30.63	Tramo fragmentado, estado de arena arcillosa.				
30.63-31.20	Flt	90	Lig. Ondula	-	S (2)

Caracteristicas de las Discontinuidades (28.40 m – 30.63 m)

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
31.25	Jn	60	Lig. Ondula	Fresca	-
31.4-31.90	Tramo fragmentado				
31.85	Jn	80	Plano		

Site Description:	**Mill Site**
Completion Dates:	**14 to 15 July 2004**
Logged by:	**Armando Montoya**
Total Depth:	**32.00 m**

BH04-16

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-17**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,504**
Easting (m): **785,100**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
0.0 NTW – 4.60			Desde 0.00 hasta 4.60 m: Bloques de arenisca cuarzosa englobados en matriz de arena limosa gravosa, de compacidad baja, muy húmeda, blanco grisáceo los bloques y marrón claro la matriz. Los bloques, clastos y gravas son de formas sub-angulosas y están constituidos por arenisca cuarzosa. << Suelo fluviotorrencial >>	Core	1.52	39%		
				Core	3.05	39%		
				Core	4.57	30%		
4.60 – 8.0 NTW			Desde 4.60 m hasta 15.00 m: Arcilla arenosa, plástica, poco consistente, muy húmeda, de coloración marrón claro a pardo y verde plomizo. << Suelo residual >>	M-1; Core	6.10	78%		
				Core	7.62	80%		

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar			
		Granul.	L.L.	L.P.	H.Nat.
M-1	4.80 - 5.00				
M-2	10.10 - 10.30				
M-3	16.50 - 16.70				

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Site Description: **Mill Site**
Completion Dates: **15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **25.91 m**

BH04-17

Client: **Corriente Resources Inc.**	Driller: **Kluane**	Northing (m): **9,601,504**
Project: **Mirador Feasibility Study**	Method: **Rotary Diamond Drill**	Easting (m): **785,100**
Project No.: **142678**	Location: **Mill Site**	Elevation (masl): **TBD**
Borehole No.: **BH04-17**		

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 NTW – 15.0			Desde 4.60 m hasta 15.00 m: Arcilla arenosa, plástica, poco consistente, muy húmeda, de coloración marrón claro a pardo y verde plomizo. << Suelo residual >>	M-2	9.14	100%		
					10.67	81%		
					12.19	98%		
					13.72	99%		
					15.24	97%		
15.0 – NTW 16.0		x- x- x-	Desde 15.00 m hasta 16.90 m: Roca extremadamente meteorizada, extremadamente débil con apariencia de suelo residual, de colores marrón claro a pardo verdoso. Se presenta en estado de arena arcillosa. << Roca de apariencia intrusiva >>			94% 0%		

amec

Site Description:	**Mill Site**
Completion Dates:	**15 July 2004**
Logged by:	**Armando Montoya**
Total Depth:	**25.91 m**

BH04-17

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-17**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,504**
Easting (m): **785,100**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
16.0 NTW		x- x- x-		M-3	16.76			
17.0 – 18.0		x: x: x:	Desde 16.90 m hasta 19.81 m: Roca altamente a moderadamente meteorizada, de dureza muy débil a débil, textura porfiritica, poco fracturada, de colores verde a plomo grisáceo. << Roca intrusiva >>		18.29	*100%* **0%**		
19.0		x: x: x:		M-4	19.81	*97%* **95%**		
20.0		x: x: x:	Desde 19.81 m hasta 20.73 m: Recuperación de muestras en estado de arena, debido a la baja dureza de la roca intrusiva.			*65%* **0%**		
21.0		x: x: x:	Desde 20.73 m hasta 21.34 m: Roca altamente meteorizada, de dureza débil, poco fracturada, textura porfiritica, de colores verde algo plomizo.		21.34			
22.0 – 23.0		x: x: x:	Desde 21.34 m hasta 25.91 m: Roca con meteorización variable e intercalada, presentándose desde moderadamente meteorizada hasta roca fresca, de dureza débil hasta fuerte, poco fracturada, textura porfiritica, de colores plomo grisáceo y verde grisáceo. << Roca intrusiva >>		22.86	*91%* **86%**		
NTW 24.0		x: x: x:		M-5		*100%* **68%**		

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar			
M-4	18.29 - 18.60				
M-5	23.17 - 23.32				
M-6	25.05 - 25.17				

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
21.54	Jn	20	Ondula	Alterada	Ox.
21.76	Jn	20	Ondula	Alterada	Ox.
21.95	Jn	10	Ondula	Alterada	Ox.
22.78	Jn	15	Ondula	Alterada	Ox.
22.80	Jn	20	Ondula	Alterada	Ox.
23.26	Jn	10	Ondula	Alterada	Ox.
23.32	Jn	30	Plano	Alterada	Ox.
23.72	Jn	40	Plano	Alterada	Ox.
23.83	Jn	35	Plano	Alterada	Ox.
23.90	Jn	30	Lig. Ondula	Lig. Alt.	Ox.

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
17.70	Jn	60	Plano	Alterada	S
17.85	Jn	60	Plano	Alterada	S
18.20	Jn	40	Plano	Alterada	S
19.81-20.73	Recuperacion en estado de arena saturada.				
21.37	Jn	50	Plano lisa	Alterada	CL (1)
22.40	Jn	25	Plano	Fresca	-
23.17	Jn	40	Plano	Fresca	-
23.70	Jn	50	Ondula	Alterada	S (2)
23.90	Jn	60	Plano	Alterada	S (3)
24.18	Jn	40	Plano	Alterada	S (2)
24.21	Jn	50	Plana lisa	Alterada	S (1)
24.27	Jn	30	Plano	Alterada	S (2)
24.38	Jn	60	Ondula	Lig. Alt.	-
24.52	Jn	45	Plano	Fresca	-

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Site Description: **Mill Site**
Completion Dates: **15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **25.91 m** **BH04-17**

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-17**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,504**
Easting (m): **785,100**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10–90)	Standpipe Piezometer
24.0 NTW		x: x: x:		Core	24.38			
25.0		x: x: x:		M-6		100% **67%**		
NTW 26.0		x: x: x:	**FIN DEL SONDAJE A 25.91 m**	Core	25.91			
27.0								
28.0								
29.0								
30.0								
31.0								
32.0								

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
24.58	Jn	50	Plana lisa	Lig. Alt.	-
24.87	Jn	40	Ondula	Fresca	-
25.49	Jn	45	Plano	Lig. Alt.	-
25.65	Jn	60	Plano	Decolor.	-
25.73	Jn	40	Ondula	Decolor.	S (1)

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diámetro Tipo / mm	Material
0.00 - 4.60	NTW / 76	Suelo fluvio torrencial
4.60 - 15.00	NTW / 76	Suelo residual
15.00 - 16.90	NTW / 76	Roca volcanica ext. met.
16.90 - 19.81	NTW / 76	Roca volc. alt. a mod. met.
19.81 - 20.73	NTW / 76	Roca volc. en est. de arena
20.73 - 21.34	NTW / 76	Roca volc. alt. met.
21.34 - 25.91	NTW / 76	Roca volc. met. a fresca

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Site Description: **Mill Site**
Completion Dates: **15 July 2004**
Logged by: **Armando Montoya**
Total Depth: **25.91 m**

BH04-17

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-18**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,370**
Easting (m): **785,212**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◘ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	*Recovery and* **RQD**
0.0 NTW – 5.0			Desde 0.00 hasta 5.00 m: Arena limosa gravosa englobados en bloques de arenisca cuarzosa, poco densa, muy húmeda, marrón a pardo grisáceo. Los bloques son de formas sub-angulosas constituidos por areniscas cuarzosas de hasta 250 mm de tamaño máximo. << Suelo fluviotorrencial >>	Core	1.52	*76%*
					3.05	*48%*
					4.57	*41%*
				M-1		
5.0 – 8.0 NTW			Desde 5.00 m hasta 9.80 m: Arena arcillosa, plástica, poco consistente, muy húmeda, de coloración marrón claro a blanco grisáceo. << Suelo residual >>	Core	6.10	*37%*
					7.62	*64%*

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar: Granul.	L.L.	L.P.	H.Nat.
M-1	4.60 - 4.80				
M-2	9.60 - 9.80				

Atterberg Limits and Natural Moisture Content: 10 20 30 40 50 60 70 80 90

Standpipe Piezometer

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Site Description: **Mill Site**
Completion Dates: **14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m**
BH04-18

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-18**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,370**
Easting (m): **785,212**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 NTW – 9.0					9.14	97%		
9.0 – 9.80				M-2				
9.80 – 11.50		x- x- x-	Desde 9.80 m hasta 11.50 m: Roca extremadamente meteorizada, de dureza extremadamente débil a muy débil, en sectores se disgrega en forma de arena, textura porfiritica, no se aprecia fracturamiento, de colores blanco grisáceo. << Roca de apariencia intrusiva >>		10.67	61%		
11.50 – 13.00		x: x: x:	Desde 11.50 m hasta 13.00 m: Roca altamente meteorizada, de dureza muy debil que se rompe con la presion de la mano y se disgrega en forma de arenas dando lugar a roturas del testigo por maniobras de perforacion, textura porfiritica, poco fracturada, de colores blanco grisaceo algo verdoso. << Roca intrusiva >>		12.19	86%		
13.00 – 16.0 NTW		x: x: x:	Desde 13.00 m hasta 16.50 m: Roca moderadamente meteorizada, de dureza a media, regularmente fracturada con espaciamientos de fractura de 10 a 30 cm de espaciamiento, textura porfiritica, de colores blanco grisáceo. << Roca intrusiva >>	M-3	13.72 15.24	86% / 25% 99% / 61% 87% / 7%		

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
12.40	Jn	85	Plano	Alterada	S (1)
14.50	Flt	40	Plano lisa	Alterada	Slick.
14.85	Jn	70	Plano	Lig. Alt.	S
15.30	Jn	80	Plano	Lig. Alt.	-
15.50	Jn	90	Plano	Lig. Alt.	-
15.56-16.30	Tramo muy fracturado y fragmentado				

amec

Site Description: **Mill Site**
Completion Dates: **14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m**

BH04-18

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-18**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,370**
Easting (m): **785,212**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10–90)	Standpipe Piezometer
16.0 NTW		x: x: x:		Core	16.76			
		x x x	Desde 16.50 m hasta 22.86 m: Roca fresca a poco meteorizada en sectores de presencia de discontinuidades, de dureza media a dura, regularmente fracturada (presencia de fracturas longitudinales y transversales que motivan que los testigos se presenten fragmentados, textura porfiritica, de colores blanco grisáceo y verdoso. << Roca intrusiva >>					
17.0		x x x		M-4				
18.0		x x x		Core	18.29	*100%* **72%**		
19.0		x x x		Core	19.81	*100%* **66%**		
20.0 – 21.0		x x x		Core	21.34	*100%* **14%**		
22.0 NTW		x x x	**FIN DEL SONDAJE A 22.86 m**	M-5	22.86	*92%* **64%**		
23.0 – 24.0								

Muestras de roca :

No.	Prof. (m)	Ensayos a Efectuar			
M-3	13.72 - 13.95				
M-4	16.80 - 17.05				
M-5	22.70 - 22.86				

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
16.45	Jn	50	Ondula	Decolor.	-
17.05	Jn	80	Plano	Fresca	-
17.60	Jn	70	Plano	Decolor.	S (1)
17.70	Jn	20	Plano	Decolor.	-
18.18	Jn	55	Ondula	Decolor.	CL (1)
18.29	Jn	50	Plano	Decolor.	-
18.55	Jn	60	Plano	Decolor.	-
18.83	Jn	35	Plano	Fresca	-
19.14	Jn	35	Plano	Fresca	-
20.16-21.45	Tramo muy fracturado y fragmentado				
21.70	Jn	70	Ondula	Fresca	-
22.70	Jn	15	Plano	Fresca	Ca (1)

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diametro Tipo / mm	Material
0.00 - 5.00	NTW / 76	Suelo fluvio torrencial
5.00 - 9.80	NTW / 76	Suelo residual
9.80 - 11.50	NTW / 76	Roca volcanica ext. met.
11.50 - 13.00	NTW / 76	Roca volc. alt. met.
13.00 - 16.50	NTW / 76	Roca volc. mod. met.
16.50 - 22.86	NTW / 76	Roca volc. lig. met. a fresca

amec

Site Description: **Mill Site**
Completion Dates: **14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m**

BH04-18

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-19**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,441**
Easting (m): **785,253**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
0.0 HW			Desde 0.00 hasta 5.00 m: Bloques de cuarcita de hasta 0.5 m de tamaño máximo englobados en matriz de arena limosa gravosa, de compacidad baja, muy húmeda, blanco grisáceo los bloques y marrón claro la matriz. Los bloques castos y gravas son de formas sub-angulosas. En superficie se observan bloques de cuarcita de formas sub-angulosas de hasta 75 mm de tamaño máximo. << Suelo fluviotorrencial >>	Core	1.52	33%		
1.0 – 2.0				M - 1				
2.0 – 3.0				Core	3.05	56%		
3.0 – 4.5				Core	4.57	16%	21/07/04 3.65 m	
5.0			Desde 5.00 m hasta 15.24 m: Arena arcillosa, plástica, poco densa, muy húmeda, color pardo verdoso. << Suelo residual >>	Core	6.10	0%	Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
6.0 – 7.0				Core	7.62	28%		
8.0				Core				

Site Description: **Mill Site**
Completion Dates: **12 to 13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.61 m**

BH04-19

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-19**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,441**
Easting (m): **785,253**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 HQ								
						30%		
9.0					9.14			
						32%		
10.0								
					10.67			
11.0						72%		
12.0				M - 2	12.19			
13.0						85%		
					13.72			
14.0							Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
						95% 0%		
15.0					15.24			
HQ 16.0		x- x- x-	Desde 15.24 m hasta 16.60 m: Roca extremadamente meteorizada, ext. débil, escas recuperación de muestras, no se aprecia el grado de fracturamiento, de color pardo verdoso. << Roca de apariencia intrusiva >>			26% 0%		

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar			
		Gran.	L.L.	L.P.	H. Nat.
M-1	1.52 - 1.72				
M-2	11.90 - 12.13				

Muestras de roca:

No.	Prof. (m)	Ensayos a Efectuar			
M-3	17.45 - 17.72				
M-4	22.28 - 22.51				
M-5	27.43 - 27.75				
M-6	30.19 - 30.48				

amec

Site Description: **Mill Site**
Completion Dates: **12 to 13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.61 m**

BH04-19

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-19**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,441**
Easting (m): **785,253**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
16.0 HQ		x- x- x-						
17.0		x: x: x:	Desde 16.60 m hasta 17.25 m: Roca altamente meteorizada, dureza muy débil a débil, muy fracturada y bloqueada, presenta textura porfiritica, de color verde claro grisáceo. << Roca intrusiva >>		16.76			
18.0		x: x: x:	Desde 17.25 m hasta 24.00 m: Roca medianamente meteorizada, de dureza débil motivo por lo cual se producen roturas de los testigos por maniobras de perforación, regularmente fracturada y bloqueada en sectores con espaciamientos de fractura variables desde 2 hasta 40 cm. Presenta textura porfiritica, de colores verde oscuro y blanco grisáceo. << Roca intrusiva >>	M - 3	18.29	*98%* **41%**		
19.0		x: x: x:			19.81	*100%* **47%**		
20.0		x: x: x:						
21.0		x: x: x:			21.34	*100%* **42%**		
22.0		x: x: x:					Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
23.0		x: x: x:		M - 4	22.86	*100%* **35%**		
HQ 24.0		x: x: x:				*100%* **52%**		

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugosa	Alteración	Rell. (mm)
16.64 - 17.20	Tramo bloqueado y fragmentado				
16.90	Jn	60	Plano	Alterada	S, gravel (30)
17.75	Flt	60	Plano lisa	Lig. Alt.	Slick.
18.60	Jn	40	Plano	Lig. Alt.	Ox.
18.70	Jn	25	Ondula	Lig. Alt.	Ox.
18.87 - 18.97	Tramo bloqueado en grava arenosa				
19.00	Jn	15	Plano	Alterada	S
19.04	Jn	55	Ondula	Alterada	-
19.30	Jn	35	Plano	Lig. Alt.	Ox.
20.00	Jn	15	Plano	Lig. Alt.	Ox.
20.14	Jn	35	Ondula	Decolor.	Ox.
20.27	Jn	20	Ondula	Decolor.	Ox.
20.32	Jn	5	Plano	Lig. Alt.	S (1)
20.40	Jn	10	Ondula	Lig. Alt.	S (1)
20.52	Jn	35	Plano	Lig. Alt.	Ox.
20.78	Jn	40	Ondula	Fresca	-
21.00	Jn	30	Plano	Fresca	-
21.06	Jn	80	Plano	Lig. Alt.	Ox.
21.26	Jn	20	Ondula	Lig. Alt.	Ox.
21.42	Jn	5	Plano	Lig. Alt.	Ox.
21.52 - 21.58	Tramo bloqueado y fragmentado, T.P. 3/4".				
21.56 - 21.60	Jn	90	Plano	Lig. Alt.	Ox.
21.70	Jn	55	Plano	Lig. Alt.	Ox.
21.79	Jn	10	Plano	Lig. Alt.	Ox.
22.08	Jn	35	Ondula	Lig. Alt.	Ox.
22.17	Jn	35	Ondula	Lig. Alt.	Ox.
22.64	Jn	65	Plano	Lig. Alt.	Ox.
22.66 - 22.30	Tramo bloqueado y fragmentado, T.M. 2".				
23.03	Jn	60	Ondula	Decolor.	Ox.
23.12	Jn	15	Ondula	Decolor.	Ox.
23.56	Jn	15	Plano	Decolor.	-
23.70	Jn	65	Plano	Decolor.	-
23.80 - 23.90	Jn	35	Lig. Ondula	Lig. Alt.	Ox.

amec

Site Description: **Mill Site**
Completion Dates: **12 to 13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.61 m**

BH04-19

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-19**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,441**
Easting (m): **785,253**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◻ Liquid Limit

Depth (m)	USC and **WPT k (cm/s)**	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	*Recovery* and **RQD**	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
24.0 HQ		x: x: x:	Desde 24.00 m hasta 29.10 m: Roca moderadamente a poco meteorizada, de dureza media a fuerte con algunos sectores aislados de dureza débil en donde se producen tramos bloqueados, regularmente fracturada, Presenta textura porfiritica, de colores plomo y blanco grisáceo. Presencia de testigos rotos por maniobras de perforación. << Roca intrusiva >>	Core	24.38		Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
25.0 – 26.0		x: x: x:		Core	25.91	*98%* **35%**	26.14 m	
26.0 – 27.0		x: x: x:		Core	27.43	*97%* **39%**	Sello de bentonita; 27.60 m	
27.0 – 28.0		x: x: x:		M - 5				
28.0 – 29.0		x: x: x:		Core	28.96	*98%* **95%**	Filtro de arena; 28.67 m	
29.0 – 30.0		x x x	Desde 29.10 m hasta 32.61 m: Roca fresca a poco meteorizada, de dureza fuerte a muy fuerte, poco fracturada con espaciamiento de fracturas promedio entre 10 y 40 cm. Presenta textura porfiritica, de colores plomo claro y blanco grisáceo con algunos lineamientos de color verde claro por alteración de epidotas y cloritas. << Roca intrusiva >>	Core			Filtro de arena; Tramo ranurado	
30.0 – 31.0		x x x		M - 6	30.48	*100%* **66%**	30.27 m; NTW 30.48 m	
31.0 – 32.0 NTW		x x x		Core	32.00	*100%* **79%**	Filtro de arena	

Caracteristicas de las Discontinuidades (24.00 – 29.10 m)

Prof. (m)	Tipo	Grado	Rugosa	Alteración	Rell. (mm)
24.26	Jn	20	Ondula	Lig. Alt.	Ox.
24.38	Jn	10	Plano	Lig. Alt.	Ox.
24.40	Jn	60	Plano	Decolor.	Ox.
24.85	Jn	20	Ondula	Lig. Alt.	Ox.
24.56	Jn	20	Ondula	Lig. Alt.	Ox.
24.60 - 24.65	Material de relleno				
24.60	Jn	30	Ondula	Lig. Alt.	Ox.
24.65	Jn	30	Ondula	Lig. Alt.	Ox.
24.84	Slick	60	Plano lisa	Lig. Alt.	Estrias
24.96	Slick	55	Plano lisa	Lig. Alt.	Estrias
25.00	Jn	20	Plano	Lig. Alt.	S, Ox (1)
25.33 - 25.90	Roca debil; disgregado el diam. del testigo				
26.00	Jn	20	Ondula	Lig. Alt.	Ox.
26.23	Jn	20	Plano	Lig. Alt.	Ox.
26.40	Jn	15	Plano	Decolor.	Ox.
26.42	Jn	50	Plano	Decolor.	-
26.50	Jn	60	Plano	Lig. Alt.	S, Ox
26.68	Jn	20	Plano	Lig. Alt.	S, Ox
26.76	Jn	25	Plano	Decolor.	Ox.
27.10	Jn	40	Escalonada	Lig. Alt.	Ox.
27.15	Jn	65	Plano	Lig. Alt.	Ox.
27.20 - 27.32					
27.43	Jn	0	Plano	Lig. Alt.	Ox.
27.76	Jn	40	Plano	Lig. Alt.	-
27.89	Jn	5	Plano	Decolor.	-
28.20	Jn	70	Plano	Decolor.	-
28.60	Jn	0	Plano	Decolor.	D
28.70	Jn	10	Plano	Decolor.	-
28.75	Jn	15	Plano	Decolor.	Ox.
28.85	Jn	0	Plano	Decolor.	Ox.
28.96	Jn	10	Ondula	Decolor.	Ox.
29	Jn	80	Ondula	Lig. Alt.	Ox.
29.15 - 29.40	Jn	85	Ondula	Lig. Alt.	Ox.
29.56	Jn	50	Ondula	Decolor.	-

Caracteristicas de las Discontinuidades (29.10 – 32.61 m)

Prof. (m)	Tipo	Grado	Rugosa	Alteración	Rell. (mm)
29.90	Jn	5	Plano	Decolor.	-
30.04	Jn	40	Ondula	Decolor.	-
30.20	Jn	5	Lig. Ondula	Decolor.	-
30.88	Jn	10	Plano	Decolor.	Ox.
31.03	Jn	20	Ondula	Decolor.	-
31.29 - 31.46	Jn	35	Ondula	Decolor.	-
32.06 - 32.20	Jn	5	Plano	Lig. Alt.	Ox.
32.38	Jn	40	Plano	-	-

amec

Site Description: **Mill Site**
Completion Dates: **12 to 13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.61 m**

BH04-19

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-19**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,441**
Easting (m): **785,253**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
32.0 NTW		x x x		Core		*75%* **28%**	Filtro de arena	
NIW		x x x	**FIN DEL SONDAJE A 32.61 m.**		32.61			
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
NTW 40.0								

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diámetro Tipo / mm	Material
0.00 - 5.00	HQ / 96	Suelo fluvio torrencial
5.00 - 15.24	HQ / 96	Suelo residual
15.24 - 16.60	HQ / 96	Roca volcanica ext. met.
16.60 - 17.25	HQ / 96	Roca volc. alt. a mod. met.
17.25 - 24.00	HQ / 96	Roca volc. mod. met.
24.00 - 29.10	HQ / 96	Roca volc. mod. a lig. met.
29.10 - 30.48	HQ / 96	Roca volc. lig. met. a fresca
30.48 - 32.61	NTW / 76	Roca volc. lig. met. a fresca

Resumen del Construcción del Piezómetro Tubo Abierto

Prof. (m)	Tubo de PVC	Relleno del Sondaje
0 - 26.14	solido	lechada de CB
26.14 - 27.60	solido	sello de bentonita
27.60 - 28.67	solido	filtro de arena
28.67 - 30.17	ranurado	filtro de arena
30.17 - 30.27	tapon	filtro de arena
30.27 - 32.61	-	filtro de arena

amec

Site Description: **Mill Site**
Completion Dates: **12 to 13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **32.61 m**

BH04-19

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-20**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,311**
Easting (m): **785,346**
Elevation (masl): **TBD**

Sample Type: Disturbed; No Recovery; SPT; Shelby; A-Casing; Core

Moisture Content: ▼ Plastic Limit; O Natural; □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD
0.0 HQ – 5.0			Desde 0.00 hasta 5.00 m: Escasa recuperación de boloneria englobada en matriz de arena limosa gravosa, medianamente densa, muy húmeda, de colores marrón claro a pardo. Los bloques, clastos y gravas son de formas sub-angulosas constituidos por areniscas cuarzosas dura, de hasta 0.5 m de tamaño máximo. << Suelo fluviotorrencial >>		1.52	*32%*
					3.05	*15%*
					4.57	*0%*
5.0 – 7.80			Desde 5.00 m hasta 7.80 m: Arcilla arenosa, plástica, blanda, muy húmeda, color plomo verdoso. << Suelo residual >>		6.10	*0%*
				M-1	7.62	*64%*
8.0 HQ		x- x- x-				

Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)

21/07/04 2.67 m

Lechada de cemento bentonita

Tubo de PVC de 40 mm diámetro interior

Piezometer / Standpipe

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar: Granul.	L.L.	L.P.	H.Nat.
M-1	7.40 - 7.62				

amec

Site Description: **Mill Site**
Completion Dates: **13 to 14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **24.66 m**

BH04-20

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-20**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,311**
Easting (m): **785,346**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 HQ – 9.0		x- x- x-	Desde 7.80 m hasta 9.00 m: Roca extremadamente meteorizada, extremadamente débil con apariencia de suelo residual, no se aprecia el grado de fracturamiento, de color pardo verdoso. << Roca de apariencia intrusiva >>	Core	9.14	*51%*		
9.0 – 16.0 HQ		x: x: x:	Desde 9.00 m hasta 24.66 m: Roca altamente meteorizada intercalada con roca moderadamente meteorizada. Dureza muy débil a débil, regularmente fracturada, presencia de rotura de muchos testigos por lo débil de la roca y maniobras de perforación. En sectores se aprecian tramos bloqueados, textura porfiritica, de colores verde claro y blanco grisáceo hasta los 12 m, luego se presenta de color verde con marrón rojizo y amarillento por oxidación y alteración (posiblemente alteración de magnetitas). << Roca intrusiva >>	Core; M-2 (at 13.72)	10.67	*31%*		Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior
					12.19	*74%*		
					13.72	*99%* **44%**		
					15.24	*93%* **19%**		
						98% **46%**		

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugosa	Alteración	Rell. (mm)
10.75	Jn	30	Plano	Alterada	Ox., S
10.85	Jn	30	Plano	Alterada	Ox.
11.17	Jn	20	Plano	Alterada	Ox.
11.24	Jn	30	Plano	Alterada	Ox.
11.26	Jn	40	Plano lisa	Lig. Alt.	-
11.34	Jn	20	Plano	Alterada	Ox.
12.56	Jn	30	Plano	Lig. Alt.	-
12.60-12.90	Jn	80	Plano	Alterada	S
13.25	Jn	35	Ondula	Lig. Alt.	Ox.
13.32	Slick.	50	Plano lisa	Lig. Alt.	Slick.
13.36	Jn	20	Ondula	Lig. Alt.	-
13.39	Jn	20	Ondula	Lig. Alt.	-
13.50	Slick.	30	Ondula	Lig. Alt.	Slick.
15.14	Jn	35	Ondula	Lig. Alt.	-
15.74	Jn	60	Ondula Lisa	Alterada	Slick.

amec

Site Description: **Mill Site**
Completion Dates: **13 to 14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **24.66 m**
BH04-20

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-20**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,311**
Easting (m): **785,346**
Elevation (masl): **TBD**

Sample Type: ■ Disturbed ▨ Shelby ◸ No Recovery ▤ A-Casing ☒ SPT ▩ Core

Moisture Content: ▼ Plastic Limit ○ Natural □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content	Standpipe Piezometer
16.0 HQ		x: x: x:					10 20 30 40 50 60 70 80 90	
					16.76		Lechada de cemento bentonita	
17.0							Tubo de PVC de 40 mm diámetro interior	
						98% **35%**		
18.0					18.29			
				M-3				
19.0						97% **49%**	18.77 m	
				M-4	19.81		Sello de bentonita	
20.0							20.05 m	
						70% **0%**	Filtro de arena	
21.0					21.34		21.19 m	
22.0						95% **16%**	Filtro de arena	
							Tramo ranurado	
HQ NTW					22.86		22.79 m	
23.0							NTW 22.86 m	
				M-5			Filtro de arena	
NTW 24.0						100% **47%**		

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugosa	Alteración	Rell. (mm)
16.10	Jn	70	Plano	Alterada	Ox.
17.45	Jn	75	Plano	Alterada	-
17.90-18.11	Flt	90	Plano lisa	Alterada	S, CL (3)
18.11-18.29	Tramo bloqueado en grava arenosa				
18.42	Jn	60	Ondula	Alterada	Ox., Mag.
18.60	Jn	65	Plano	Lig. Alt.	-
18.80	Jn	0	Ondula	Alterada	Ox., Mag.
18.90	Slick.	80	Ondula	Alterada	Ox., Mag.
19.03	Jn	25	Plano lisa	Alterada	-
19.19	Jn	25	Plano	Alterada	-
19.27	Jn	10	Plano	Alterada	Ox.
19.30	Jn	10	Plano	Alterada	Mag.
19.42	Jn	10	Ondula	Alterada	Ox., Mag.
20.00	Jn	45	Plano	Alterada	S (2)
20.00-21.35	Roca debil, se disgrega en forma de arena				
21.14	Jn	60	Lig. Ondula	Alterada	Ox., S (2)
23.50	Slick.	45	Plano lisa	Alterada	Ox., S (3)
23.56	Jn	15	Ondula	Alterada	Ox.
24.10	Slick.	70	Plano lisa	Alterada	Slick.
24.30	Jn	20	Plano	Alterada	Ox.
24.35	Jn	15	Plano	Alterada	Ox.
24.60		80	Plano	Alterada	Ox., Mag.

Muestras de roca:

No.	Prof. (m)	Ensayos a Efectuar			
M-2	13.50 - 13.72				
M-3	18.29 - 18.46				
M-4	19.49 - 19.69				
M-5	23.56 - 23.75				

Site Description: **Mill Site**
Completion Dates: **13 to 14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **24.66 m** **BH04-20**

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-20**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,311**
Easting (m): **785,346**
Elevation (masl): **TBD**

Sample Type: ■ Disturbed ▨ No Recovery ☒ SPT ▥ Shelby ▤ A-Casing ▦ Core

Moisture Content: ▼ Plastic Limit ○ Natural □ Liquid Limit

Depth (m)	**WPT k (cm/s)** *USC and*	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	*Recovery and* **RQD**	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
24.0 NTW		x: x: x:		▦	24.38		Filtro de arena	
NTW		x: x: x:	**FIN DEL SONDAJE A 24.66 m**	▦	24.66	*100%* **0%**		
25.0								
26.0								
27.0								
28.0								
29.0								
30.0								
31.0								
32.0								

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diámetro Tipo / mm	Material
0.00 - 5.00	HQ / 96	Suelo fluvio torrencial
5.00 - 7.80	HQ / 96	Suelo residual
7.80 - 9.00	HQ / 96	Roca volcanica ext. met.
9.00 - 22.86	HQ / 96	Roca volc. alt. a mod. met.
22.86 - 24.66	NTW / 76	Roca volc. alt. a mod. met.

Resumen de la Construcción del Piezómetro Tubo Abierto

Prof. (m)	Tubo de PVC	Relleno del Sondaje
0 - 18.77	solido	lechada de CB
18.77 - 20.05	solido	sello de bentonita
20.05 - 21.19	solido	filtro de arena
21.19 - 22.69	ranurado	filtro de arena
22.69 - 22.79	tapon	filtro de arena
22.79 - 24.66	-	filtro de arena

Site Description: **Mill Site**
Completion Dates: **13 to 14 July 2004**
Logged by: **Armando Montoya**
Total Depth: **24.66 m** **BH04-20**

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-21**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,393**
Easting (m): **785,368**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	WPT k (cm/s) USC and	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
0.0 NTW – 2.0			Desde 0.00 hasta 2.00 m: Escasa recuperación de bloques y gravas de arenisca cuarzosa, por correlación con el sondaje BH04-20 la matriz debe de estar conformada por arena limosa gravosa. << Suelo fluviotorrencial >>		1.52	*5%*		
2.0 – 8.0 NTW			Desde 2.00 m hasta 10.00 m: Arena arcillosa, plástica, poco densa, muy húmeda a saturada, color verde claro a pardo. << Suelo residual >>	M-1	3.05	*52%*		
					4.57	*82%*		
					6.10	*56%*		
					7.62	*47%*		

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar Granul.	L.L.	L.P.	H.Nat.
M-1	4.30 - 4.57				
M-2	10.30 - 10.55				

amec

Site Description: **Mill Site**
Completion Dates: **13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m** **BH04-21**

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-21**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,393**
Easting (m): **785,368**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD
8.0 NTW				Core		39%
9.0					9.14	55%
10.0		x- x- x-	Desde 10.00 m hasta 11.50 m: Roca extremadamente meteorizada, extremadamente débil, escasa recuperación de muestras en estado de suelo, no se aprecia el grado de fracturamiento, de colores verde claro a pardo. << Roca de apariencia intrusiva >>	M-2	10.67	30%
11.0		x: x: x:	Desde 11.50 m hasta 12.50 m: Roca altamente meteorizada, dureza muy débil, poco fracturada, de colores verde plomizo. << Roca intrusiva >>		12.19	
12.0		x: x: x:	Desde 12.50 m hasta 20.00 m: Roca moderadamente meteorizada, de dureza débil a media, regularmente fracturada (espaciamiento de fracturas promedio desde 5 hasta 50 cm), textura porfiritica, presencia de sectores con oxidación. << Roca intrusiva >>	M-3	13.72	98% **69%**
14.0					15.24	98% **58%**
15.0				M-4		100% **61%**
NTW 16.0						

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
13.10	Flt	70	Plano lisa	Lig. Alt.	Slick.
13.40	Flt	80	Lig. Ondula	Lig. Alt.	Slick.
13.72	Jn	65	Plano	Lig. Alt.	S, Ox. (1)
14.72	Jn	30	Ondula	Alterada	Ox.
14.85	Jn	70	Plano	Alterada	Ox.
14.92	Jn	40	Plano	Alterada	Ox.

Atterberg Limits and Natural Moisture Content: 10 20 30 40 50 60 70 80 90

Standpipe Piezometer

amec

Site Description: **Mill Site**
Completion Dates: **13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m**
BH04-21

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-21**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,393**
Easting (m): **785,368**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◻ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
16.0 NTW		x: x: x:	Desde 12.50 m hasta 20.00 m: Roca moderadamente meteorizada, de dureza débil a media, regularmente fracturada (espaciamiento de fracturas promedio desde 5 hasta 50 cm), textura porfiritica, presencia de sectores con oxidación. << Roca intrusiva >>	Core	16.76			
17.0		x: x: x:		Core		*100%* **50%**		
18.0		x: x: x:		Core	18.29			
19.0		x: x: x:		Core		*88%* **0%**		
20.0		x: x: x: / x x x	Desde 20.00 m hasta 22.86 m: Roca fresca a poco meteorizada, de dureza media a dura, poco fracturada con espaciamiento de fracturas promedio desde 10 hasta 40 cm, textura porfiritica, de colores verde plomizo. << Roca intrusiva >>	Core	19.81	*95%* **52%**		
21.0		x x x		M-5 / Core	21.34			
22.0		x x x		Core		*100%* **53%**		
NTW		x x x	**FIN DEL SONDAJE A 22.86 m**	Core	22.86			
23.0 – 24.0								

Muestras de roca :

No.	Prof. (m)	Ensayos a Efectuar			
M-3	12.40 - 12.62				
M-4	14.95 - 15.24				
M-5	20.70 - 20.90				

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
16.56	Flt	50	Plano lisa	Lig. Alt.	Slick.
17.40	Flt	40	Ondula	Decolor.	Slick.
17.48	Jn	55	Plano	Lig. Alt.	Ox., S (1)
17.84	Jn	65	Plano lisa	Lig. Alt.	Ox.
18.07	Jn	50	Lig. Ondula	Decolor.	Ox.
18.20	Jn	60	Plano	Decolor.	Ox.
18.35	Jn	60	Plano	Decolor.	-
18.45	Flt	75	Plano lisa	Lig. Alt.	Slick.
18.60	Jn	60	Plano	Lig. Alt.	Ox.
18.66	Jn	60	Plano	Lig. Alt.	Ox.
18.95	Jn	80	Lig. Ondula	Decolor.	-
19.05	Jn	50	Plano	Alterada	-
19.22	Jn	40	Plano	Lig. Alt.	Ox.
19.30	Jn	65	Plano	Lig. Alt.	-
19.60	Jn	50	Lig. Ondula	Lig. Alt.	-
19.90	Jn	80	Ondula	Lig. Alt.	Ox.
19.93-20.08	Tramo bloqueado				
20.08	Jn	30	Plano	Lig. Alt.	Ox.
20.35	Jn	40	Plano	Lig. Alt.	Ox.
20.45	Jn	65	Ondula	Lig. Alt.	-

Caracteristicas de las Discontinuidades

Prof. (m)	Tipo	Grado	Rugossidad	Alteración	Rell. (mm)
20.70	Jn	60	Plano lisa	Lig. Alt.	Ox.
20.90	Jn	40	Escalonada	Decolor.	-
21.15	Jn	50	Plano	Decolor.	-
21.34	Jn	20	Ondula	Decolor.	Ox.
21.44	Jn	5	Plano	Decolor.	-
21.70	Jn	30	Ondula	Decolor.	-
21.86	Jn	30	Plano	Decolor.	-
21.92	Jn	50	Ondula	Fresca	-
22.14	Jn	25	Plano	Decolor.	-
22.24	Jn	35	Plano	Decolor.	-
22.35	Jn	60	Plano lisa	Lig. Alt.	-
22.43	Jn	35	Escalonada	Lig. Alt.	Ox.
22.76	Jn	75	Ondula	Lig. Alt.	-

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diametro Tipo / mm	Material
0.00 - 2.00	NTW / 76	Suelo fluvio torrencial
2.00 - 10.00	NTW / 76	Suelo residual
10.00 - 11.50	NTW / 76	Roca volcanica ext. met.
11.50 - 12.50	NTW / 76	Roca volc. alt. met.
12.50 - 20.00	NTW / 76	Roca volc. mod. met.
20.00 - 22.86	NTW / 76	Roca volc. lig. met. a fresca

amec

Site Description: **Mill Site**
Completion Dates: **13 July 2004**
Logged by: **Armando Montoya**
Total Depth: **22.86 m**

BH04-21

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-26**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,398**
Easting (m): **785,176**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: Plastic Limit, Natural, Liquid Limit

Depth (m)	WPT k (cm/s) / USC and	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content	Standpipe Piezometer
0.0 HQ – 2.95			Desde 0.00 m hasta 2.95 m: Areniscas en matriz arenosa, medianamente meteorizado. << Suelo fluviotorrencial >>	Core	1.52	*91%* **16%**	05/08/04 1.81 m	
				Core	3.05	*65%* **41%**		
2.95 – 7.00			Desde 2.95 m hasta 7.00 m: << Suelo residual >>	Core	4.57	*88%* **0%**		
				M-1	6.10	*79%* **0%**	Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
				Core	7.62	*93%* **0%**		
7.00 – 8.0 HQ			Desde 7.00 m hasta 13.40 m: << Roca de apariencia intrusiva >>	Core				

Muestras de suelo:

No.	Prof. (m)	Ensayos a Efectuar			
		Granul.	L.L.	L.P.	H.Nat.
M-1	5.66 - 5.95				

Site Description: **Mill Site**
Completion Dates: **26 July 2004**
Logged by: **Eduardo Vaca**
Total Depth: **32.61 m**
BH04-26

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-26**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,398**
Easting (m): **785,176**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◘ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
8.0 HQ		x- x- x-		Core		*82%* **0%**		
9.0		x- x- x-		Core	9.14			
10.0		x- x- x-		Core		*93%* **0%**		
		x- x- x-		Core	10.67			
11.0		x- x- x-		Core		*100%* **0%**		
12.0		x- x- x-		Core	12.19			
		x- x- x-		M-2				
13.0		x- x- x-		Core		*89%* **0%**		
		x: x: x:	Desde 13.40 m hasta 25.91 m: << Roca intrusiva >>	Core	13.72			
14.0		x: x: x:		Core			Lechada de cemento bentonita Tubo de PVC de 40 mm diámetro interior	
		x: x: x:		Core		*94%* **0%**		
15.0		x: x: x:		Core	15.24			
HQ 16.0		x: x: x:		Core		*73%* **0%**		

amec

Site Description: **Mill Site**
Completion Dates: **26 July 2004**
Logged by: **Eduardo Vaca**
Total Depth: **32.61 m**

BH04-26

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-26**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,398**
Easting (m): **785,176**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
16.0 HQ		x: x: x:		Core	16.76			
17.0		x: x: x:		Core		99% 0%		
18.0		x: x: x:		M-3	18.29			
19.0		x: x: x:		Core	19.81	31% 0%		
20.0		x: x: x:		Core		99% 0%		
21.0		x: x: x:		Core	21.34			
22.0		x: x: x:		Core		100% 0%	Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior	
23.0		x: x: x:		Core	22.86			
HQ 24.0		x: x: x:		Core		100% 0%		

Site Description: **Mill Site**
Completion Dates: **26 July 2004**
Logged by: **Eduardo Vaca**
Total Depth: **32.61 m**

BH04-26

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-26**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,398**
Easting (m): **785,176**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, ◻ Liquid Limit

Depth (m)	USC and WPT k (cm/s)	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	Recovery and RQD
24.0 HQ		x: x: x:		Core	24.38	
25.0		x: x: x:		Core	25.91	72% **0%**
26.0 – 29.0		x: x: x:	Desde 25.91 m hasta 29.10 m: Ligeramente meteorizada. << Roca intrusiva >>	M-2, Core	27.43	100% **91%**
				Core	28.96	100% **58%**
29.0 – 32.0 NTW		x x x	Desde 29.10 m hasta 32.61 m: Fresca, mayor fracturamiento al retirar el testigo. << Roca intrusiva >>	Core	30.48	95% **59%**
				M-5, Core	32.00	97% **72%**

Muestras de roca:

No.	Prof. (m)	Ensayos a Efectuar			
M-2	12.32 - 12.65				
M-3	17.93 - 18.20				
M-4	25.91 - 26.31				
M-5	30.92 - 31.17				

Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)

Standpipe Piezometer: Lechada de cemento bentonita; Tubo de PVC de 40 mm diámetro interior

amec

Site Description: **Mill Site**
Completion Dates: **26 July 2004**
Logged by: **Eduardo Vaca**
Total Depth: **32.61 m**
BH04-26

Client: **Corriente Resources Inc.**
Project: **Mirador Feasibility Study**
Project No.: **142678**
Borehole No.: **BH04-26**

Driller: **Kluane**
Method: **Rotary Diamond Drill**
Location: **Mill Site**

Northing (m): **9,601,398**
Easting (m): **785,176**
Elevation (masl): **TBD**

Sample Type: Disturbed, No Recovery, SPT, Shelby, A-Casing, Core

Moisture Content: ▼ Plastic Limit, O Natural, □ Liquid Limit

Depth (m)	USC and **WPT k (cm/s)**	Lithologic Symbol	Lithologic Description	Sample Type	Core Run End (m)	*Recovery* and **RQD**	Atterberg Limits and Natural Moisture Content (10 20 30 40 50 60 70 80 90)	Standpipe Piezometer
32.0 **NTW**		x x x		Core		*100%* **48%**		
NTW		x x x	**FIN DEL SONDAJE A 32.61 m**	Core	32.61			
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
40.0								

Resumen del Diámetro del Sondaje y Tipo de Material

Prof. (m)	Diámetro Tipo / mm	Material
0.00 - 2.95	HQ / 96	Suelo fluvio torrencial
2.95 - 7.00	HQ / 96	Suelo residual
7.00 - 13.40	HQ / 96	Roca volcanica ext. met.
13.40 - 25.91	HQ / 96	Roca volc. alt. a mod. met.
25.91 - 29.10	HQ / 96	Roca volc. mod. a lig. met.
29.10 - xxx	HQ / 96	Roca volc. lig. met. a fresca
xxx - 32.61	NTW / 76	Roca volc. lig. met. a fresca

Resumen del Construcción del Piezómetro Tubo Abierto

Prof. (m)	Tubo de PVC	Relleno del Sondaje
	solido	lechada de CB
	solido	sello de bentonita
	solido	filtro de arena
	ranurado	filtro de arena
	tapon	filtro de arena
	-	filtro de arena

amec

Site Description: **Mill Site**
Completion Dates: **26 July 2004**
Logged by: **Eduardo Vaca**
Total Depth: **32.61 m**

BH04-26

MEMO

To	Tom Nikiforuk		
From	Stu Anderson		
Tel	604 473 5312	**AMEC File No.**	VM00343 Task
Fax	604 294 4664	**cc**	Peter Lighthall
Date	19 November 2004		Joyce Chen

Subject Summary of Open Pit Design - Report

1.0 INTRODUCTION

Corriente Minerals is developing the Mirador mine, located within the Corriente Copper Belt which is a copper porphyry district that extends over an area at least 80 km north-south and 40 km east-west in Southeast Ecuador. The area around the Mirador mine site is part of a rift system and has had two or possibly three metal-forming events in its history.

The mine area is located within the mountainous region of Ecuador south of the Rio Wawayme with topography varying from Elevation 1100m to 1600m. Climate is tropical, with precipitation in the area has been estimated at between 3 m and 4 m a year.

Predominant rock types within the deposit include an “explosive” breccia and Zamora granodiorite to quartz monzonite. The upper 60m of these rocks are extremely weathered (includes saprolite) with weathering decreasing with depth. Post mineral mafic dykes are encountered in the southern end of the deposit, trend east-west and dip steeply to the north.

2.0 INVESTIGATION

2.1 General

Several investigations including test pits and drillholes were completed for the proposed mine site facilities. Within the proposed open pit, geotechnical information from exploration drilling (Rock Quality Designation or RQD) and from six geotechnical drill holes, M85 to M90 completed in July of 2004 were summarised to develop overall open pit slope angles. Vibrating wire piezometers were installed in 5 of the 6 geotechnical drillholes to provide an understanding of the groundwater table in the area. All piezometers were sealed below the saprolitic layer encountered in the drillholes.

The rock core information recorded included estimates of hardness, defect characteristics and rock quality. This information was analysed and Rock Mass Ratings (RMR) and Geological Strength Indices (GSI) were determined for the various rock types identified

Lab testing of both the saprolite and rock core including Atterberg index tests, sieve analyses, hydrometer tests, determination of specific gravity, point load and unconfined compression tests were also completed. These tests were carried out by Caminosca Caminos y Canales C. Ltda. Test results were reviewed and information incorporated into the stability analysis.

Structural mapping of the rock mass was completed by Corriente staff, but was limited to data points obtained from stream beds within the valleys. Very little natural rock exposure exists in the mine area due to the saprolite cover and as a result, structural control for the pit slopes could not be identified with confidence.

There is limited information about the hydrogeology of the proposed open pit area. Five vibrating piezometers were installed in March 2004. By April, the water level had stabilized. The water levels are given below in Table 3.2.

Table 3.2 Water Table Elevations

PIEZOMETER	WATER TABLE ELEVATION	WATER TABLE DEPTH
M87	1301 m	41
M85	1363 m	29
M89	1289 m	-19 (artesian)
M90	1347 m	43
M88	1223 m	87

In the west, the water table is approximately 70m below the surface and follows the general topography. In the south, the water table is approximately 50m below the surface. In the southeast, the water table is close to the surface and follows the topography. Artesian conditions are noted in the northeast quadrant and may play a role in the east wall of the starter pit. It is inferred that the groundwater is generally migrating from the southeast to the north.

2.2 Summary

The open pit is located in fairly mountainous terrain with slopes extending up to 1600 m elevation in the southern area of the pit to approximately 1200 m to the north. A natural slope analysis indicates that ground slope heights ranging from 100 m in height to 200 m possess angles of between 35° and 50°. Slopes higher than 200 m in height rarely exist in the area and those that were identified and measured indicate overall slope angles of 20° and 30°.

The RQD results from both the exploration and geotechnical drilling at the Mirador deposit are typically in the Very Poor (<25%) to Poor (25% to 50%) range of values. This suggests that emphasis on the rock mass stability of the pit slopes will be necessary. Structural controls, other than the dyking trend is unknown within the deposit.

A review of the six geotechnical drill holes displays a pattern in several drill holes of good to excellent RQD values within the softer or more mafic rock types (dykes) or at depth near the end of each drill hole. These transitions are generally sharp with no transition zone from poor to good rock. There is little evidence of infill in the broken core at depth and the fractures are generally very irregular in section. In some areas the core is quite broken and shattered. High RQD values in the intrusive dykes suggest that dyke emplacement occurred post fracturing and anhydrite placement within the country rock. The sharp contacts observed in the core between the porphyry dykes and the country rock (granodiorite and quartz monzonite), the lack of fragments within the dyke mass, and the high RQD values; however, may indicate that the country rock was relatively competent during formation.

In general, the north end of the deposit had more anhydrite that altered to gypsum as well as a higher percentage of faulting encountered during drilling. Rock quality in the northern area of the pit is poor while marginally higher RQD values in the southeast reflect post-mineral units that were not yet mineralized with anhydrite and, therefore, escaped the gypsum-induced fracturing event and subsequent leaching.

There are also some similarities between this project and two similar open pits in which anhydrite has been leached from defects, leaving an angular, but tightly knitted rock mass:

- Freeport's Grasberg open pit, where two large failures have recently occurred, is in a rock mass which is an “explosive” breccia called “Poker Chip”, that has anhydrite-infilled defects. The anhydrite has been leached, leaving an angular, but tightly knitted rock mass. Open pit wall angles were approx. 45 degrees for up to 200 m within this rock mass. Discussions with on-site personnel indicated that the rock mass stays relatively intact until it is disturbed, in which case it falls apart. Disturbance can be as little as water flow over the surface in some instances.

- In Southern Peru Copper’s Toquepala open pit, the pit walls are also formed in a highly well fractured rock mass. There, slopes initially cut at 45 degrees remained stable up to about 100 m in height, and then failed. Experience has shown that they have adequate stability at overall wall angles of about 40 degrees over heights of 100 m.

3.0 OPEN PIT DESIGN

Rock mass strength parameters were developed using the Rock Mass Rating System (RMR) and Geologic Strength Index (GSI) after Bieniawski, (1989). Simplified geologic sections were developed by Corriente and utilised to identify pit wall geology based on pit slopes initially developed by Corriente and then updated by AMEC. Two distinct rock types appear in the sections, the Zamora granodiorite (JZGD) and the breccia (BRMN). Strength parameters were developed using Hoek’s m and s criteria and a resulting shear strength in the form of a cohesion value and friction angle were developed. These values are presented on Table 3.1. In the northeast sector of the pit, it appears from available geotechnical data that the pit walls will be formed in faulted material that has poorer quality than in other sectors. This is reflected in lower strength parameters in the table below.

Table 3.1 Strength Parameters

ROCK TYPE	GSI	INTACT UCS (MPA)	s	m_b	c (MPA)	ϕ (°)
BRMN	42	33	0.0002	0.785	0.589	33
JZGD	42	32	0.0002	1.033	0.980	29
JZGD (northeast)	28	10	0.00003	0.612	0.335	21

Stability analyses for various slope heights and configurations were completed. The pit shell developed for the deposit requires significant slopes to be present. The southern and southwestern portion of the pit requires a highwall of over 500 m in height, while the northern portion, is approximately 200 m in height.

Parametric analyses of slope angles and heights were analysed with various water table locations to identify approximate overall pit slope angles. The analysis was completed using SLOPEW and SLIDE geotechnical software. The results of the analyses can be found in the tables below:

Table 3.2 Factors of Safety for a 500m Pit Wall Height (based on Hoek-Brown Criteria)

SLOPE ANGLE \ WATER TABLE	HIGH	MEDIUM	LOW
37.5°	1.09	1.33	1.52
40°	1.10	1.29	1.49
42.5°	0.96	1.19	1.43

Table 3.3 Factors of Safety for a 300m Pit Wall Height (based on Mohr-Coulomb)

SLOPE ANGLE \ WATER TABLE	HIGH	MEDIUM	LOW
35°	1.42	1.55	1.66
40°	1.29	1.41	1.49
45°	1.20	1.30	1.39

Table 3.4 Factors of Safety for a 200m Pit Wall Height (Based on Mohr-Coulomb)in the Northeast Sector

SLOPE ANGLE \ WATER TABLE	HIGH	MEDIUM	LOW
35°	1.14	1.23	1.31
40°	1.02	1.15	1.2
45°	0.95	1.03	1.1

As shown by the results, the groundwater table will have a significant impact on the stability of the slope. Typically, factors of safety of 1.3 are required for open pit design. Assuming that Corriente will be implementing a drainage program, it is assumed that the high phreatic surface will not be present and that a moderate phreatic surface level can be assumed, the recommended pit slope angles for the various pit sectors are as follows:

Table 3.5 Recommended Overall Pit Slope Angles in Rock

SECTOR	OVERALL SLOPE ANGLE (°)	MAXIMUM WALL HEIGHT (M)
1: 330 to 060	35	200
2: 060 to 150	42	300
3: 150 to 180	40	450
4: 180 to 270	38	600

5: 270 to 330	40	160

Table 3.6 Recommended Overall Pit Slope Angles in Saprolite

SECTOR	OVERALL SLOPE ANGLE (°)	MAXIMUM WALL HEIGHT (M)
All Sectors	30	50 m

It should be noted that the saprolite exposed in the pit excavation should be cut to an overall slope angle of no more than 30°. Bench faces can be cut steep in the saprolite, provided no relict jointing is present, but berms should be wide to accommodate failure.

Where transitions exist between saprolite and rock, it is prudent for the pit design to incorporate a larger width berm to accommodate failure of material. For the 600 m highwall, the pit operator may wish to include larger berms at 200 m elevation intervals for the catchment of rock fall and allow equipment access for clean-up. Over time, it is expected that the majority of the pit berms will deteriorate to the point where little catchment will be available in certain areas of the pit. The larger berms will at least assist with catchment of some of the localized rock fall and failures and can be cleared when accumulations of material are large enough to reduce the effective catchment.

4.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the Mirador open pit is located in a geotechnically challenging rock mass. Drilling has indicated a very low to low RQD value for the host rock, granodiorite and breccia, that is expected to be present in the proposed pit walls. Precipitation is expected to be approximately 3m to 4 m per year and a high groundwater table does exist with artesian conditions expected in the northern sections of the pit area. A significant saprolitic cover also exists in and around the pit. Recommended pit slope angles for the various sectors of the proposed pit are shown on Tables 4.1 and 4.2 below:

Table 4.1 Recommended Overall Pit Slope Angles in Rock

SECTOR	OVERALL SLOPE ANGLE (°)	MAXIMUM WALL HEIGHT (M)
1: 330 to 060	35	200
2: 060 to 150	42	300
3: 150 to 180	40	450
4: 180 to 270	38	600
5: 270 to 330	40	160

Table 4.2 Recommended Overall Pit Slope Angles in Saprolite

SECTOR	OVERALL SLOPE ANGLE (°)	MAXIMUM WALL HEIGHT (M)
All Sectors	30	50 m

In order for pit slope angles to be improved, the following additional work is recommended

- Additional geotechnical logging of any further exploration drillholes to increase the geotechnical database on the characteristics of the rock mass.
- A detailed geologic/lithologic model incorporating such items as rock lithology, contact boundaries, faults and dyking. This will allow for projection of lithologic information onto and behind proposed pit walls for stability analysis.
- Additional geotechnical drilling to assess the hydrogeology of the pit area. A memorandum has been issued to Corriente describing the minimum work required.
- A hydrogeologic model to develop an understanding of the groundwater hydrology and the impact the pit will provide to the regime as well as what impact the drainage facilities (horizontal drains and/or drainage galleries) will have on optimising the pit walls.
- Additional rock strength testing on the various lithologic rock types within the pit to increase the confidence level in the rock strengths used for stability analysis.
- Additional investigations into the characteristics and particularly persistence of major and intermediate scale structures.
- A review of stability of the overall and bench face slope angles with the benefit of the improved lithologic and hydrogeologic interpretations. The slope angles recommended are relatively low in comparison to many open pits, but are considered realistic for the rock quality indicated. There is potential for increasing the slope angles based on additional investigation and analyses.

Recommendations presented herein are based on a geotechnical evaluation of the findings of the site investigation noted. If conditions other than those reported are noted during subsequent phases of the project, AMEC should be notified and be given the opportunity to review and revise the current recommendations, if necessary. Recommendations presented herein may not be valid if an adequate level of review or inspection is not provided during construction.

This report has been prepared for the exclusive use of Corriente Minerals for specific application to the area within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Respectfully submitted,

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MIRADOR MINING DEVELOPMENT
CAMP – CRUSHER – PIT ACCESS ROAD
PRELIMINARY STUDIES

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MIRADOR MINING DEVELOPMENT
CAMP – CRUSHER – PIT ACCESS ROAD
PRELIMINARY STUDIES

CHAPTER I: GENERAL DESCRIPTION

1.1. INTRODUCTION

After acceptance by ECUACORRIENTE of the Technical-Economic Tender presented by CAMINOSCA for performing Preliminary Engineering Road Studies for the Camp – Crusher – Pit access road, specialists from CAMINOSCA moved to the Mirador Mine area in order to perform field and office investigations.

The field work executed and the results obtained for the various specialties that participated are described below, as well as the results from design work in the office.

After utilizing the information obtained in the field and by means of technical and economical evaluations of the works required to access the Mine in the Mirador Mining Development, the following general objectives were achieved:

- Provide an access road for the Mine for its later operation.
- Evaluation of the access road at preliminary engineering level.
- Providing adequate transport of materials and equipment, reducing mobilization costs.
- Evaluation of operating and maintenance conditions for the works.
- Minimizing environmental impact from the designed works on the zone traversed by the road.

The performed study complies with the requirements from ECUACORRIENTE S.A. due to the fact that it will allow access to the Mine and the selection of the most convenient alternative to carry out definitive studies and construction.

The studies were performed in conformity with prevailing standards and specifications from MOP [*Ministerio de Obras Públicas y Comunicaciones del Ecuador*] (Ministry of Public Works and Communications of Ecuador).

1.2. ROUTE DESCRIPTION

1.2.1. Route Location

The access to the Mine (Camp – Crusher – Pit) is located in the zone comprised by the Cóndor Mountain Range [*Cordillera del Cóndor*] foothills and the basin from Wawayme River and its tributaries, which flow into Quimi River, Zamora Chinchipe province, southeastern Ecuador.

The defined route was divided into two sections, based in their individual dimensions and as per ECUACORRIENTE requirements for the future operation of the mine.

The coordinates for departure and arrival points for each section are presented below.

LOCATION	LATITUDE	LONGITUDE	ELEVATION
Camp (0+000)	9 605 725,77	784 599,84	1 024,17
Crusher (4+260)	9 604 607,32	786 081,35	1 282,17
Pit (5+840,853)	9 604 405,79	785 174,18	1 302,23

- **Section 1: Camp – Crusher**

From station 0+000, located 3.1-km from the Mining Development's main camp on the existing road to Cóndor Mountain Range, elevation 1 024,17-m.a.s.l., it ascends northeast, crossing Wawayme River twice due to difficult topographic conditions. Two bridges have been planned for these two locations, the first at station 0+133 (bridge beginning) and the second at station 0+597; in each case the river is crossed by means of a 30-m span steel bridge. The road then continues northeast, ascending towards the area planned for the Crusher implantation at station 4+260 from the southwest area at an elevation of 1 282,17-m.a.s.l.

- **Section 2: Crusher – Pit**

It starts at km 4,26 of the access road under study, 1 282,17-m.a.s.l. A 40-m width transition has been planned; from here road width is 24.30-m, traversing southwest and ascending to reach the site planned for start-up of operations for Mine exploitation (Pit) at 1 302,23-m.a.s.l. after a 1,58-km run (5+840,85).

In general, both horizontal and vertical alignments for Section 1 have been designed with the characteristics required for a 25-km/h design speed road. For Section 2, the speed was defined as 10-km/h as a function of the design vehicle.

1.2.2. Topography

The terrain traversed the access road to the Mine corresponds to a mountainous topography with high transversal grades, comprising the hillsides descending towards Wawayme River and its tributaries. Geographically, the work area is located within the coordinates 9 605 700 N, 784 900 E, and 9 604 400 N, 785 200 E, with an elevation differential comprised within 1 025 and 1 305-m.a.s.l.

The high transversal grades determine major earthwork for road implementation. Similarly, deep ravines merit the use of large culverts and bridges. For Section 2, two ravines will have to be covered.

1.2.3. Climatology

The zone’s climate is influenced by several regional factors, such as:

- Atmospheric circulation identified with the Intertropical Convergence Front.
- Southwest trade winds
- The Amazon plains as generators of moist air masses.
- Inherent characteristics from the Andes Eastern Mountain Range [*Cordillera Oriental de los Andes*].

These factors are easily superimposed due to the zone’s altitude and relief, generating a transition climate between the Andean and Amazon zones classified as ‘Very Moist Tropical Megathermic’.

This climate presents the following characteristics: A very rainy period from March to July, governed by Amazon influence, and a less rainy period from November to January. Mean temperatures are 17,5 °C; average rainfall is 1 600-mm/yr.

CHAPTER II: GEOMETRIC DESIGN

2.1. FIELD WORK

Firstly, the route the access road is to follow to reach the Crusher and then the Mine was evaluated based on a 1 , 10,000 restitution provided by ECUACORRIENTE and on centerline localization work previously performed by CAMINOSCA for the preliminary project provided by ECUACORRIENTE.

The established route corridor was taken to the field to assess its feasibility, laying out a basic gradient line for the subsequent work of laying out the polygonal and surveying of a topographic band at 1 , 1 000 scale.

Due to the high transversal grades and design limitations pertaining to the longitudinal gradient of the road, several attempts were made to obtain the gradient line and on the already defined route a preliminary polygon was laid out, staked and stationed every 20-m or less. Geometric leveling data was taken at every station, placing BMs at approximately every 500-m located at polygonal reference points.

The polygon was provided with reference points every 500-m by means of 2 plain concrete monuments that will serve for their later retrieval. The survey of the topographic band, required for the geometric designs of the horizontal alignment and vertical profile, was finally performed.

The aforementioned field work was performed by means of Total Stations and precision levels, in conformity with MOP standards and specifications established for this type of work.

2.2. DESIGN STANDARDS

The geometric design of this access road has utilized parameters established in accordance with the area's topographic conditions, traffic volume and composition during the construction of the works and their subsequent operation and maintenance, and with ECUACORRIENTE's instructions and requirements for the Project. To that effect, prevailing MOP Standards for the study and design of Class IV roads were adopted, which are published in the MOP-1 973 Manual for Geometric Design of Roads [*Manual de Diseño Geométrico de Carreteras*], the MOP-001-E-2003 Design Standards [*Normas de Diseño*], and the Manual for Design of Subsidiary Roads [*Manual de Diseño de Caminos Vecinales*]. These standards are mainly based on AASHTO recommendations.

- **Section 1: Camp – Crusher**

The design parameters utilized correspond to those of a Class IV road, a Type 6 subsidiary road with a 7,20-m wide roadway and a wearing surface of base and/or subbase-type granular material, and for mountainous terrain. Minimum values were utilized for those sectors where topographic conditions so required. These values are as follows:

Design speed	:	25 kph
Minimum radius	:	30 m
Maximum gradient	:	12 %
Maximum banking	:	8 %
Roadway width	:	7,20 m
Roadway transversal grade	:	4 %
Pavement structure	:	Wearing surface granular layer, CBR > 30
Ditches	:	0,70 m (Coated with plain concrete)
Minimum Right Of Way	:	15 m

- **Section 2: Crusher – Pit**

This section, due to its requirement of exclusive use for mining operation, and in conformity with its design vehicle similar to a CAT 785 C, does not correspond to any MOP road classification that would regulate its type and dimensioning since no experience exists in Ecuador that is specific to mining operation roads. The adopted design parameters are presented below.

Design speed	:	10 kph
Minimum radius	:	30 m
Maximum gradient	:	6 %
Minimum gradient	:	0,5%
Roadway width	:	24,30 m
Roadway transversal grade	:	4 %
Pavement structure	:	Wearing surface granular layer, CBR > 30

2.3. HORIZONTAL ALIGNMENT AND VERTICAL PROFILE

The study of the 1 : 1,000 topographic band performed in this Project has the objective of determining a road design that is technically and economically adjusted to existing conditions. The study was later validated by studies performed by Road, Geologic-Geotechnical, and Hydraulic specialists from CAMINOSCA. The respective design plans for the access road to the Mine were subsequently produced.

Once the physical conditions of the zone were verified, the geometric design of the access road was performed for both sections, for their horizontal alignment as well as for their vertical profile.

The horizontal and vertical designs comply with the specifications and recommendations for a road with design speeds of 25-kph (Section 1) and 10-kph (Section 2), except for several points where the standard was relaxed in order to accommodate local topographic conditions and geologic-geotechnical and environmental recommendations; this permitted to obtain a technically and economically convenient project that also provides safety, adequate circulation during the construction of the works, and permits maintenance during the operation phase.

Geometric design was assisted by Eagle Point software, which permits processing the horizontal and vertical designs and their optimization as per existing topography, thus allowing economy in earthwork.

The following Table presents a summary of the resulting horizontal and vertical characteristics of the performed design.

TABLE 2.1

DESIGN SUMMARY
CAMP – CRUSHER – PIT ACCESS ROAD

		SECTION 1	SECTION 2
	UNIT	CAMP-CRUSHER	CRUSHER - PIT
Road length	m	4+260,00	1+580,85
Design speed	kph	25	10
HORIZONTAL ALIGNMENT			
Number of horizontal curves	unit	34	17
Minimum radius	m	28,00	30,00
Maximum radius	m	250,00	50,00
Average radius	m	56,47	33,06
Average curve length	m	64.54	43,58
Tangent length	%	49 %	53 %
Curve length	%	51 %	47 %
VERTICAL PROFILE			
Number of vertical curves	unit	11	4
Average vertical curves per km	unit/km	2,6	1,9
Minimum longitudinal gradient	%	0,62	1,60
Maximum longitudinal gradient	%	11,13	7,18
Average longitudinal gradient	%	5,64	4,51
Minimum length utilized	m	60,00	60,00
Maximum length utilized	m	160,00	200,00
Average curve length	m	99,09	140,00

The horizontal and vertical characteristics for each section are shown in Tables 2.2 to 2.5 below.

TABLE 2.2

ROAD LAYOUT

SUMMARY OF HORIZONTAL ALIGNMENT

SECTION UNDER STUDY: CAMP-CRUSHER					
Station at beginning of section		0+000,00	Road Length		
Station at end of section		4+260,00	4.260,00		
Equations	1			-	
	2			-	
	3			-	
Length to deduct (increase)				**-**	
DESIGN PARAMETERS					
ADOPTED DESIGN SPEED			**25**	**KPH**	
DESCRIPTION		**CIRCULAR**	**SPIRAL**	**BOTH**	
Minimum radius utilized		28,00	-		
Maximum radius utilized		250,00	-		
Average radius		56,47		56,47	
Average curve length				64,54	
RADIUS RANGE		**NUMBER**	**LENGTH**	**% ROAD LENGTH**	**% CURVE LENGTH**
=>20	<40	12	905,42	21,1%	41,3%
=>40	<60	13	746,29	17,4%	34,0%
=>60	<80	5	415,75	9,7%	18,9%
=>80	<100	1	39,81	0,9%	1,8%
=>100	<120	0	-	0,0%	0,0%
=>120	<140	0	-	0,0%	0,0%
=>140	<160	2	55,91	1,3%	2,5%
=>160	<180	0	-	0,0%	0,0%
=>180	<200	0	-	0,0%	0,0%
=>200	<300	1	31,08	0,7%	1,4%
CURVES		**34**	**2.194,25**	**51,0%**	100,0%
TANGENTS			2.105,75	49,0%	
TOTAL			4.260,00	100,0%	

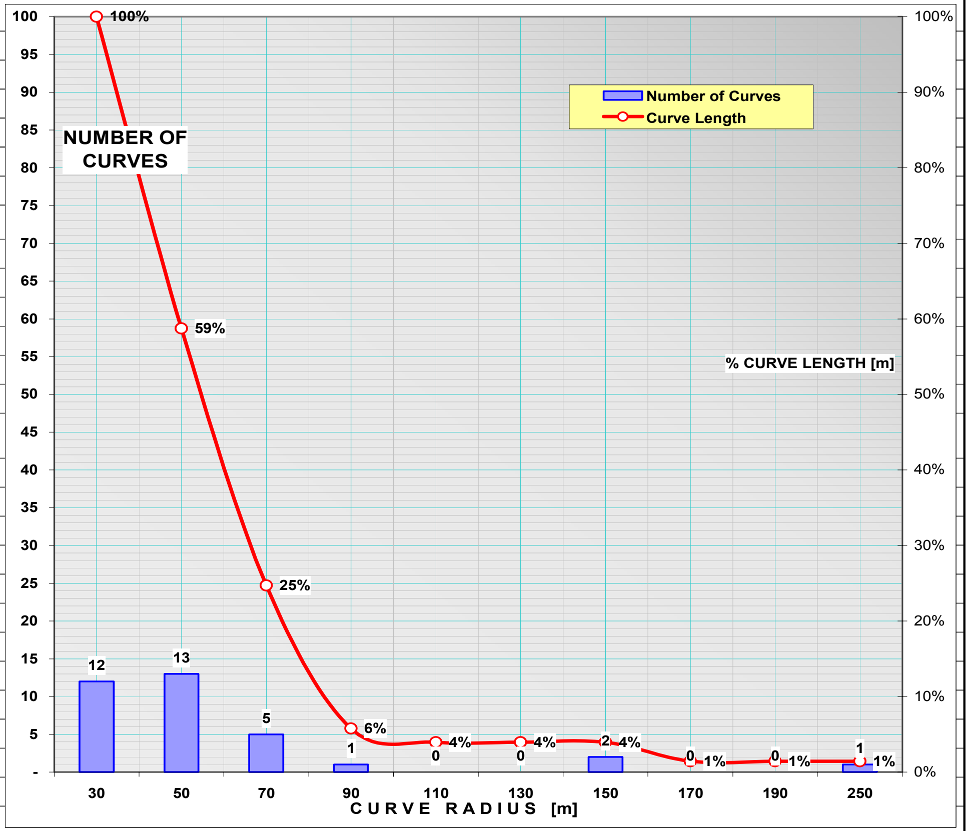


TABLE 2.3

ROAD LAYOUT

SUMMARY OF VERTICAL PROFILE

SECTION UNDER STUDY: CAMP-CRUSHER					
Station at beginning of section		0+00,00	Road Length		
Station at end of section		4+260,00	4.260,00		
Equations	1			-	
	2			-	
	3			-	
Length to deduct (increase)				**-**	
DESIGN PARAMETERS					
ADOPTED DESIGN SPEED			**25**	**km/h**	
SEGMENT GRADES		**VERTICAL CURVES**		**BOTH**	
Minimum grade	0,62	Minimum length		60,00	
Maximum grade	11,13	Maximum length		160,00	
Average grade	5,64	Average length		99,09	
		Length in vert. curves		1.090,00	

GRADE RANGE		NUMBER	LENGTH	% ROAD LENGTH
>=0	<=1	1	160,00	3,8%
>1	<=2	0	-	0,0%
>2	<=3	1	890,00	21,2%
>3	<=4	3	830,00	19,8%
>4	<=5	2	245,00	5,8%
>5	<=6	0	-	0,0%
>6	<=7	1	680,00	16,2%
>7	<=8	0	-	0,0%
>8	<=10	0	-	0,0%
>10	<=12	3	1.385,00	33,1%
SEGMENTS		**11**	**4.190,00**	**100,0%**
VERTICAL CURVES			**1.090,00**	**26,0%**

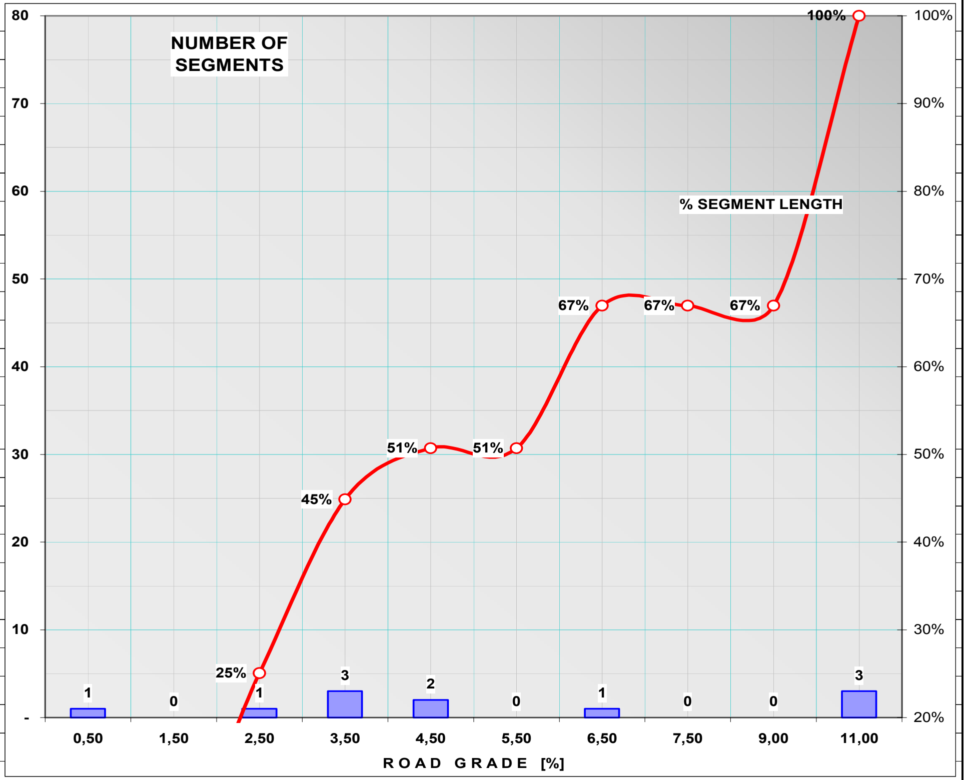


TABLE 2.4

ROAD LAYOUT

SUMMARY OF HORIZONTAL ALIGNMENT

SECTION UNDER STUDY: CRUSHER - PIT					
Station at beginning of section			4+300,00	**Road Lenght**	
Station at end of section			5+840,85	**1.580,85**	
Equations		1			-
		2			-
		3			-
Length to deduct (increase)					**-**
DESIGN PARAMETERS					
ADOPTED DESIGN SPEED				**10**	**km/h**
DESCRIPTION			**CIRCULAR**	**SPIRAL**	**BOTH**
Minimum radius utilized			30,00	-	
Maximum radius utilized			50,00	-	
Average radius			33,06		33,06
Average curve length					43,58
RADIUS RANGE		**NUMBER**	**LENGTH**	**% ROAD LENGTH**	**% CURVE LENGTH**
=>1	<20	0	-	0,0%	0,0%
=>20	<25	0	-	0,0%	0,0%
=>25	<30	0	-	0,0%	0,0%
=>30	<35	12	380,96	24,7%	51,4%
=>35	<40	2	195,69	12,7%	26,4%
=>40	<45	2	137,14	8,9%	18,5%
=>45	<50	0	-	0,0%	0,0%
=>50	<55	1	27,04	1,8%	3,6%
=>55	<60	0	-	0,0%	0,0%
=>60	<65	0	-	0,0%	0,0%
CURVES		**17**	**740,83**	**48,1%**	100,0%
TANGENTS			800,02	51,9%	
TOTAL			1.580,85	100,0%	

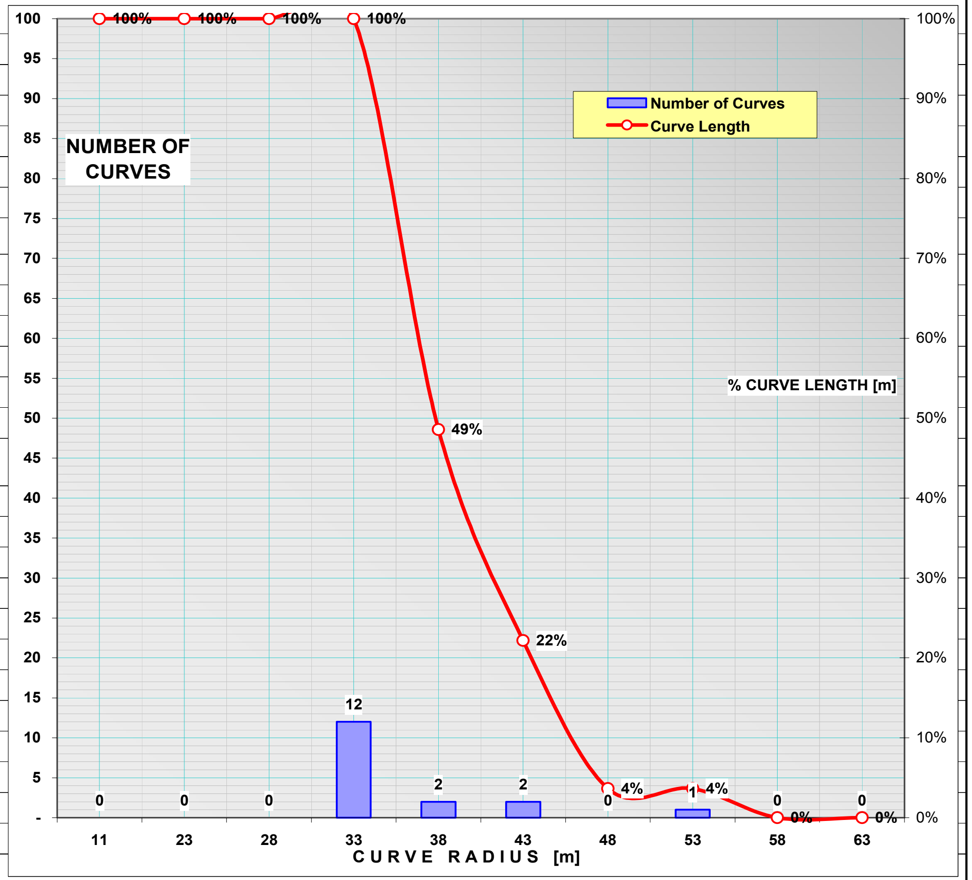
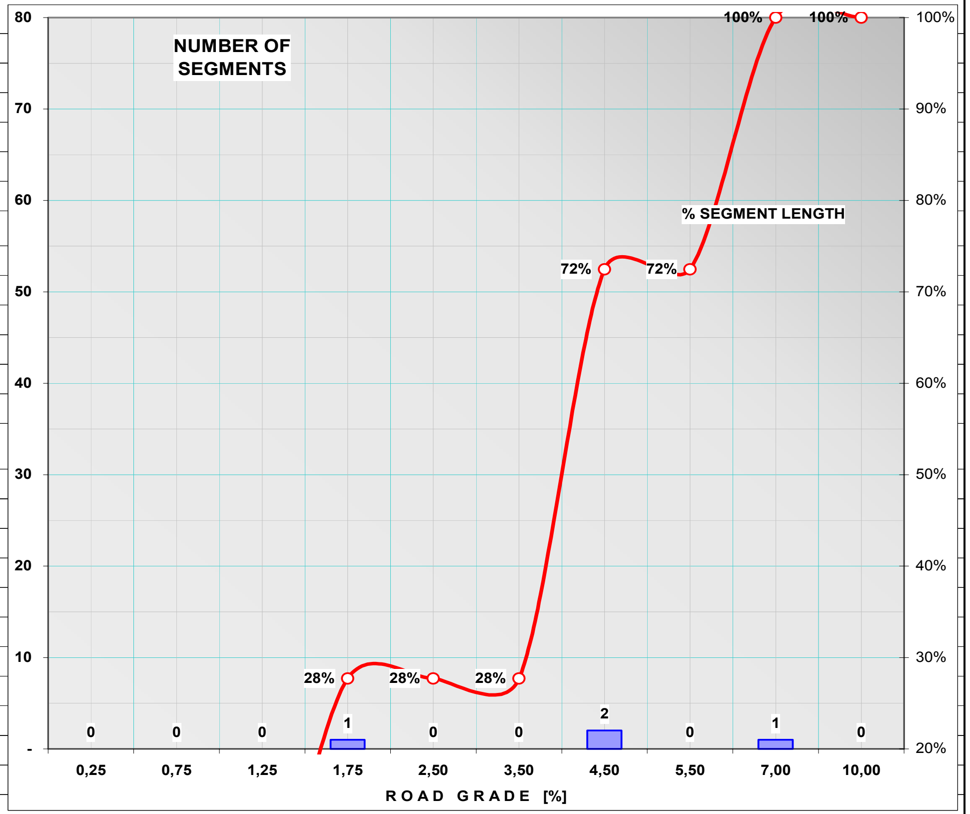


TABLE 2.5

ROAD LAYOUT

SUMMARY OF VERTICAL PROFILE

SECTION UNDER STUDY: CRUSHER - PIT					
Station at beginning of section			4+260,00	Road Lenght	
Station at end of section			5+840,85	1.580,85	
Equations		1			-
		2			-
		3			-
Length to deduct (increase)					-
DESIGN PARAMETERS					
ADOPTED DESIGN SPEED				25	km/h
SEGMENT GRADES			VERTICAL CURVES		BOTH
Minimum grade		1,60	Minimum length		60,00
Maximum grade		7,18	Maximum length		200,00
Average grade		4,51	Average length		140,00
			Length in vert. curves		420,00
GRADE RANGE		NUMBER	LENGTH	% ROAD LENGTH	
>=0	<=0.5	0	-	0,0%	
>0.5	<=1	0	-	0,0%	
>1	<=1.5	0	-	0,0%	
>1.5	<=2	1	161,00	27,7%	
>2	<=3	0	-	0,0%	
>3	<=4	0	-	0,0%	
>4	<=5	2	260,00	44,8%	
>5	<=6	0	-	0,0%	
>6	<=8	1	160,00	27,5%	
>8	<=12	0	-	0,0%	
SEGMENTS		**4**	**581,00**	**100,0%**	
VERTICAL CURVES			**420,00**	**72,3%**	



2.4. CROSS-SECTIONS

- **Section 1: Camp – Crusher**

The adopted typical cross-section corresponds to that of a Class IV road, Type 6 subsidiary road on mountainous terrain, which defined the following parameters:

- A 7,20-m wide roadway, with a 4 % transversal grade for each side of the centerline.
- For cut and fill cross-sections, ditches of triangular shape have been designed for the roadside; they will be coated if the longitudinal gradient exceeds 4 %.
- Slopes have been designed in conformity with recommendations of geologic and geotechnical specialists, as follows: For fills, H1.5:V1; for cuts, values range from H1:V2 to H1:V4 depending on soil type. When cut height exceeds 6-m, 3-m wide berms will be constructed every 6-m in height.
- Pavement structure thicknesses correspond to those of improvement materials for the subgrade, subbase and base as per pavement design recommendations. Values are 0,40, 0,25 and 0.15-m respectively, which include the placement of geotextile and geomesh.
- Banking and extra width have been defined as per MOP standards for this type of road for a design speed of 25-kph.

- **Section 2: Crusher – Pit**

The adopted typical cross-section corresponds to the following characteristics:

- A 24,30-m wide roadway, with a 4 % transversal grade for each side of the centerline.
- For fill cross-sections, a 6-m wide, 2,20-m tall safety berm have been designed for the edge of the road. It will be constructed with rock fill material.
- Slopes have been designed in conformity with recommendations from geologic and geotechnical specialists, as follows: For fills, H1.5 : V1; for cuts, values range from H1 : V2 to H1 : V4 depending on soil type. When cut height exceeds 6-m, 3-m wide berms will be constructed every 6-m height.
- Pavement structure thicknesses correspond to subgrade and subbase improvement materials as per pavement design recommendations. Values are 0,60 and 0,40-m respectively, including placement of geotextile and geomesh.
- Due to the low design speed, no banking or extra width have been implemented.

2.5. DRAWINGS FOR HORIZONTAL AND VERTICAL PROJECT

Based on coordinate and elevation data from the 1 : 1,000 topographic band, and from data obtained from field measurements, the respective geometric calculations were performed, resulting in data that served to prepare preliminary drawings for each Section of the geometric project, for both plan and profile views.

The project was designed with the assistance of the Eagle Point software licensed to CAMINOSCA. This permits the optimization of earthwork cross-sections, whose data was later processed by AutoCAD 2004 software to obtain the final drawings which were plotted to obtain the respective plans. The horizontal project was presented in 1 : 1,000 scale, and the vertical project in 1 : 100. Also present were data from horizontal curves, reference points and drainage, together with stations with their respective terrain and design elevations, and construction lateral cuts and fills. Format is the one required by MOP.

The resulting plans of the performed road design may be seen in detail in Chapter IX (Plans). Plan numbers range from 270-VIA-001-A to 270-VIA-006-A.

CHAPTER III: HYDROLOGIC-HYDRAULIC STUDY

3.1. GENERAL DESCRIPTION OF THE ZONE UNDER STUDY

The Project zone is located at northwest Zamora Chinchipe province on the western foothills of the Cóndor mountain range [*Cordillera del Cóndor*], within coordinates 9 605 700 N, 784 600 E, and 9 604 400 N, 785 200 E. Elevations range between 1 025 and 1 305-m.a.s.l.

The zone comprises the access to the mining exploitation area, which has an approximate length of 5.8-km and traverses the lower foothills of the Cóndor mountain range. It is covered by tropical forests with exuberant vegetation typical of the zone; its soil has low permeability and is well drained due to natural sloping. Meteorological conditions include a 1 600-mm annual mean rainfall and a mean temperature of almost 18°C.

The road project is located in the middle portion of the Cóndor mountain range foothills, with morphologically medium to large ravines which are tributaries of Quimi River and flow transversally to the road.

The drainage system of the contributing basins is relatively large, therefore presenting large areas that generate significant flows at the access road crossing points.

3.2. OBJECTIVE

The main objective of this study is to complement road design from a hydraulic standpoint, for the purpose of conducting rainfall flowing onto the road and cut slopes into natural drainages.

In order to achieve this objective, surface drainage works have been designed that allow recollection of runoff and its subsequent evacuation by means of ditches and culverts into existing natural drainages.

3.3. DESIGN OF ROAD TRANSVERSAL DRAINAGE (CULVERTS)

3.3.1. Hydrographic Basin

Based on the 1:1 000 topographic restitution published by IGM [*Instituto Geográfico Militar*] (Military Institute of Geography) and considering the horizontal design of the road, the hydrologic divides delimiting the contributing basins crossing the design road were laid out.

With this information, the area of each contributing basin was calculated to obtain design flows for drainage structures.

The delimitation of contributing basins is shown in Chapter X, Section 10.2, Figure 3.1.

3.3.2. Return Period

It is necessary to maintain a correspondence between the magnitude of a flood flow and its time of occurrence; this time or recurrence interval is denominated Return Period (Tr) and is defined as the average interval in years within which a flood flow of a given magnitude is reached or exceeded.

As per existing recommendations for adoption of a Return Period for the design of various road drainage structures, a Return Period between ten and twenty-five years is established for culverts in main roads. However, due to the fact that the road is of vital importance and the zone receives moderately high rainfall with the presence of sediments and carried vegetation from basins' higher areas, the Return Period adopted for design flow calculation was 25 years, which will permit the design of structures capable of allowing the passage of flood flows and carried sediments during years characterized by exceptionally high rainfall.

3.3.3. Calculation of Maximum Flows

In accordance with MOP recommendations from the Standard for Design of Drainage Works [*Normas de Diseño de Obras de Drenaje*], the 'Rational' method was utilized for the calculation of the maximum design flow, which permits flow determination as a function of rainfall data, basin area, and soil type.

The formula utilized for the calculation of maximum flow by way of this method is expressed as follows:

$$Q = 2.778 * C * I * A$$

Where:

Q	=	Maximum flow	[l/s]
C	=	Runoff coefficient	
I	=	Rainfall intensity	[mm/h]
A	=	Basin area	[ha]

3.3.3.1 Determination of the Runoff Coefficient

Its use in the formula implies a fixed relationship between peak runoff rate and rainfall rate for the drainage basin. The total rainfall proportion reached by storm drainages depends of soil permeability, drainage basin slope, soil conditions and characteristics, rainfall intensity, vegetation, etc.

A value of C = 0.30 was adopted for the Project after considering the type of vegetation cover, the low permeability of the soil, and the moderate slope of the terrain.

3.3.3.2 Calculation of the Rainfall Intensity

Rainfall intensity calculation was based in the equations provided by INAMHI [*Instituto Nacional de Meteorlogía e Hidrología*] (National Institute of Meteorology and Hydrology) which has performed a zonification of intensities for various sectors of Ecuador. In this manner, according to the geographic location of the Project zone and the corresponding zonification of intensities, the Project is located on Zone 27, where the equation representing rainfall intensity is:

5 min < tc < 46 min

$$I_{TR} = 76.133 * tc^{(-0.3477)} * Id_{TR}$$

Where:

I_{TR}	=	Rainfall intensity	[mm/h]
tc	=	Concentration time	[min]
Id_{TR}	=	Rainfall intensity isoline	[mm/h]

The rainfall intensity isoline was determined as a function of the Return Period, the Project's geographic location, and the intensity zonification. In this case, the intensity isoline is 5.0-mm/h.

The concentration time was determined by means of Kirpich equation, which is expressed as follows:

$$tc = \left(0.87 \frac{L^3}{H}\right)^{0.385}$$

Where:

tc	=	Concentration time	[h]
L	=	Length of main riverbed	[km]
H	=	Elevation difference	[m]

The following Table shows the calculation of rainfall intensities and flood flows for main contributing basins, considering a Return Period of 25 years.

TABLE 3.1

CONTRIBUTING AREAS & MAXIMUM FLOWS

Subbasin [No.]	Abscissa [m]	Area [ha]	Cover Type	C [-]	I [mm/h]	Q_{TR} (TR = 25 years) [m3/s]
A9+A17+ A19	0+150.00	428.60	Forest	0.30	128.35	45.85
A9+A17	0+610.00	418.73	Forest	0.30	132.07	46.09
A11+A15	0+944.00	154.09	Forest	0.30	133.41	17.13
A13+A14	2+241.16	57.16	Forest	0.30	160.44	7.64
A13	3+766.92	48.97	Forest	0.30	177.32	7.24
A11	4+215.00	128.18	Forest	0.30	155.21	16.58
A10	4+380.71	21.21	Forest	0.30	211.78	3.74

A9	4+600.00	176.89	Forest	0.30	155.21	22.88
A7	5+002.74	3.78	Forest	0.30	217.53	0.69
A5	5+048.57	83.71	Forest	0.30	166.43	11.61
A2	5+664.17	0.71	Forest	0.30	217.53	0.13

3.3.4. Culvert Dimensioning Criteria

The calculation of culvert hydraulic capacity consisted in its dimensioning based on the elevation of the road's wearing surface, grade, and minimum pipe diameter. The maximum flow that could be carried, as well as the verification of the admissible maximum speed and the admissible maximum backwater at the inlet, were obtained as results.

In relation with the admissible maximum backwater at culvert inlet, it was considered that culverts must operate under 'free inlet' condition; therefore, the admissible maximum backwater may be 20 % greater than culvert height. A 'free outlet' condition was also adopted for the culvert outlet.

It should be noted that a 5-min concentration time was utilized in the intensity equation for those culverts for which the calculated concentration time was less than 5-min.

The following Table presents a general listing of the proposed culverts. It contains data such as: Location abscissa; maximum design flow; dimension; grade; inlet, invert and outlet elevations; inlet, outlet and total lengths; skew angle; and inlet and outlet types.

CULVERT LISTING

Abscissa [m]	Q_{TR} (TR=25 yr) [m^3/s]	Grade [%]	Dimension [mm]	Inlet Elevation [m.a.s.l.]	Invert Elevation [m.a.s.l.]	Outlet Elevation [m.a.s.l.]	Inlet Length [m]	Outlet Length [m]	Length [m]	Skew	Inlet Type	Outlet Type
0+352.30	2.07	2.00	1,200	1,037.71	1,037.60	1,037.47	5.50	6.75	12.25	103º 21'	2	1
0+944.00	17.13	12.90	d = 10.58 m *	1,088.90	1,088.15	1,087.07	5.85	8.40	14.30	101º 39'	1	1
1+240.00	2.07	2.00	1,200	1,124.19	1,124.10	1,123.98	4.30	6.00	10.30	90º 0'	2	1
1+403.74	2.07	6.00	1,200	1,129.61	1,129.35	1,128.74	4.30	10.20	14.50	77º 41'	2	1
1+620.00	2.07	8.00	1,200	1,143.49	1,143.04	1,142.12	5.65	11.50	17.20	80º 37'	2	1
1+850.00	2.07	6.00	1,200	1,157.80	1,157.25	1,156.37	9.15	14.60	23.80	73º 13'	2	1
2+241.16	7.64	7.73	d = 6.05 m *	1,174.47	1,173.86	1,172.84	7.85	13.15	21.15	106º 0'	1	1
2+540.00	2.07	2.00	1,200	1,200.09	1,200.00	1,199.86	4.30	6.80	11.10	68º 45'	2	1
2+730.95	2.07	Varies	1,200	1,218.37	1,213.58	1,201.47	2.00	47.00	49.00	77º 53'	2	1
2+800.00	2.07	Varies	1,200	1,228.41	1,227.31	1,221.95	4.00	20.50	24.50	90º 0'	2	1
3+160.00	2.07	2.00	1,200	1,255.58	1,255.49	1,255.37	4.50	6.00	10.50	103º 22'	2	1
3+410.00	2.07	2.00	1,200	1,258.48	1,258.29	1,258.08	9.40	10.40	19.80	123º 34'	2	1
3+766.92	7.24	18.33	S = 5.0x5.0	1,258.84	1,256.08	1,250.15	15.05	32.35	48.20	92º 30'	1	1
3+858.23	2.07	Varies	1,200	1,269.82	1,267.81	1,259.42	1.00	22.00	23.00	77º 48'	2	1
4+020.00	2.07	Varies	1,200	1,275.28	1,273.85	1,261.65	2.00	32.90	34.90	90º 0'	2	1
4+215.00	16.58	15.05	d = 10.58 m *	1,271.21	1,269.20	1,265.20	13.35	26.55	40.30	84º 51'	1	1
4+390.00	3.74	9.66	d = 6.05 m *	1,273.16	1,270.95	1,267.67	22.90	34.00	57.20	90º 0'	1	1
4+600.00	22.88	Varies	S = 6.0x5.0 m	1,268.14	1,264.14	1,259.54	23.30	34.50	58.30	57º 51'	1	1
4+717.00	2.07	2.00	1,200	1,280.27	1,279.95	1,279.62	16.15	16.60	32.75	69º 58'	2	1
5+048.57	11.61	Varies	S = 6.0x5.0 m	1,269.49	1,262.98	1,240.00	37.10	217.15	254.25	VAR	1	1
5+344.55	2.07	Varies	1,200	1,295.03	1,292.40	1,253.72	6.00	120.00	126.00	90º 0'	2	1
5+476.92	2.07	Varies	1,200	1,297.63	1,297.35	1,284.28	10.00	36.25	46.25	90º 0'	2	1
5+610.00	2.07	Varies	1,200	1,298.41	1,295.20	1,271.14	5.00	62.60	67.60	90º 0'	2	1
5+664.17	0.13	Varies	1,200	1,298.40	1,298.19	1,255.84	14.00	125.00	139.00	90º 0'	2	1

* Vault utilized for the passage of coarse sediment present in ravine bed

3.4. LONGITUDINAL DRAINAGE

3.4.1. Lateral Ditches

Lateral ditches consist in open channels constructed next to and alongside the road for the purpose of conducting runoff from the road and adjacent areas towards the nearest drainage course.

In this case, for closed cuts it is recommended the construction of lateral ditches on both sides of the road. In practice, water speed in a concrete coated ditch is limited to 4-m/s to avoid erosion.

The proposed lateral ditch is of triangular shape, with a 2H:1V slope next to the road, a cut slope varying between 1H: 2V and 1H:3V, and a 0.30-m useful height. Ditch grade will be similar to that of the road, with a minimum value of 0.50 %.

3.4.2. Ditches at the Base of Berms

Due to the necessity of constructing berms on slopes for certain road sections, it will be required to drain slope runoff with concrete-coated triangular ditches.

The geometric and constructive characteristics of these ditches are shown in the detail plans of drainage structures.

A general listing of ditches to be constructed at the base of berms is shown below.

BERM DITCHES

Abscissas		Length	Side
Initial	Final	[m]	
0+655.00	0+880.00	225.00	Left
0+790.00	0+865.00	75.00	Left
1+100.00	1+200.00	100.00	Left
1+560.00	1+575.00	15.00	Left
2+840.00	2+890.00	50.00	Left
2+940.00	2+980.00	40.00	Left
3+260.00	3+280.00	20.00	Left
3+465.00	3+535.00	70.00	Left
3+620.00	3+735.00	115.00	Left
3+645.00	3+700.00	55.00	Left
3+710.00	3+725.00	15.00	Left
3+820.00	3+880.00	60.00	Left
4+050.00	4+155.00	105.00	Left
4+110.00	4+140.00	30.00	Left
4+120.00	4+140.00	20.00	Left
4+290.00	4+358.35	68.35	Left
4+300.00	4+355.00	55.00	Left

4+400.00	4+440.00	40.00	Left
4+420.00	4+440.00	20.00	Left
4+490.00	4+495.00	5.00	Left
4+625.00	4+670.00	45.00	Left
4+730.00	4+970.00	240.00	Left
4+790.00	4+965.00	175.00	Left
4+810.00	4+960.00	150.00	Left
4+825.00	4+895.00	70.00	Left
4+910.00	4+955.00	45.00	Left
4+850.00	4+895.00	45.00	Left
4+910.00	4+940.00	30.00	Left
5+095.00	5+105.00	10.00	Left
5+160.00	5+185.00	25.00	Left
5+195.00	5+225.00	30.00	Left
5+260.00	5+290.00	30.00	Left
5+355.00	5+455.00	100.00	Left
5+490.00	5+590.00	100.00	Left
5+510.00	5+585.00	75.00	Left
5+558.64	5+580.00	21.36	Left
5+620.00	5+664.17	44.17	Left
5+670.00	5+830.00	160.00	Left
5+625.00	5+655.00	30.00	Left
5+680.00	5+765.00	85.00	Left
5+630.00	5+640.00	10.00	Left
5+685.00	5+700.00	15.00	Left
5+690.00	5+695.00	5.00	Left
5+690.00	5+695.00	5.00	Left
0+565.00	0+590.00	25.00	Right
0+635.00	0+885.00	250.00	Right
0+805.00	0+865.00	60.00	Right
0+835.00	0+850.00	15.00	Right
1+145.00	1+325.00	180.00	Right
1+730.00	1+765.00	35.00	Right
2+055.00	2+210.00	155.00	Right
2+265.00	2+310.00	45.00	Right
2+355.00	2+395.00	40.00	Right
2+755.00	2+775.00	20.00	Right
2+835.00	2+865.00	30.00	Right
2+935.00	2+975.00	40.00	Right
3+010.00	3+030.00	20.00	Right
3+465.00	3+510.00	45.00	Right
4+315.00	4+325.00	10.00	Right

3.5. SPECIAL DRAINAGE ELEMENTS

3.5.1. Slope Protection Flume

In places where cut slopes are of considerable height, slope protection flumes have been designed with a grade according to the one adopted for the slope. Their purpose is to conduct surface runoff collected by the crown ditch towards the road ditch and onto the nearest culvert.

Since the flows to be delivered are small ($Q \leq 50$-l/s), a 0.40-m side square duct has been designed in reinforced concrete with removable covers for maintenance.

Collector boxes will be constructed at the upper and lower ends. The lower one will serve to partially dissipate the kinetic energy of the discharged water by means of a stilling basin; subsequent discharge into the road ditch will be done utilizing a thick-walled spillway.

The location of slope protection flumes is shown in the following table.

Abscissa	Side
0+270.00	Right
0+557.36	Right
0+630.00	Right
0+630.00	Left
1+100.00	Left
1+130.00	Right
1+547.21	Left
1+710.00	Right
2+050.00	Right
2+270.00	Right
2+350.00	Right
2+750.00	Right
2+830.00	Right
2+930.00	Right
3+010.00	Right
3+257.17	Right
3+460.00	Right
3+615.00	Left
3+815.00	Left
4+045.00	Left
4+280.00	Left
4+410.00	Left
4+730.00	Left
5+155.80	Left
5+250.00	Left
5+350.00	Left
5+620.00	Left
5+660.00	Left

3.5.2 Design of the Impact Screen Dissipator

Due to the fact that in some sites of the access road the topography of the terrain is very uneven, the design of the corresponding culverts was somewhat specialized. It considered a flume-type structure to permit overcoming the desired height and the discharge of water in outlying areas that do not pose erosion risks that endanger the road structure.

In order to evacuate the runoff collected by the collector box at the culvert inlet, and to subsequently deliver it to natural drainages, an impact dissipator was designed for the culvert outlet for the purpose of energy dissipation and reduction of the exit speed towards the natural drainage.

The design of the impact dissipator was performed following the recommendations from the book titled Design of Small Canal Structures, where the dimensioning of the dissipator is done based on Froude's number. With this value, the table Fr vs. W/d of said reference provides the W/d (width-to-depth) ratio, which in turn serves to obtain the remaining dimensions of the dissipator from formulas found in the bibliography.

The following table specifies culvert locations, inlet diameters and flume inclination angles utilized to design the energy dissipators.

Abscissa	Diameter [mm]	Flume Angle [deg]
2+730.95	1,200	30
2+800.00	1,200	30
4+020.00	1,200	30
5+344.55	1,200	30
5+476.92	1,200	30
5+610.00	1,200	30
5+664.17	1,200	30

The resulting design of the impact screen dissipator is presented below:

IMPACT SCREEN DESIGN

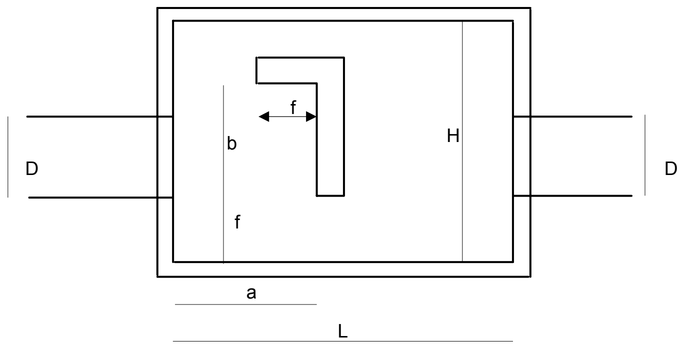
Collector Data:

Design flow	Qd	[m^3/s]	2.070
Inlet speed	Vi	[m/s]	9.77
Inlet depth	yi	[m]	0.29
Froude's number	Fr	-	5.79
Inlet Area	A	[m^2]	0.212
Width / Depth	W/yi	-	7.59

Structure Dimensions:

Structure width	W	[m]	2.20
Structure length	L	[m]	2.90
Orifice aperture	f	[m]	0.40
Structure height	H	[m]	1.70
Impacter separation	a	[m]	1.10
Impacter height	b	[m]	0.80
Outlet wall height	c	[m]	1.10
Pipe diameter	D	[mm]	1,200

Impacter Scheme



Note: The obtained dimensions are the minimum required for the design.

3.6. BRIDGES

In order to complement the hydraulic design of the road, the design of two bridges has been considered. They are located at abscissas 0+133 and 0+597, which correspond to the crossing of Wawayme River at the lower portion of the contributing basin, where considerable flows are transported.

3.6.1. Bridge at 0+133.00

Since at this point the contributing basin area collects water from higher basins and therefore a considerable flow is generated, a 30-m span steel bridge has been proposed.

In this location, the characteristics of the contributing basin are summarized in the following table.

Basin area	428.60 km^2
Length of main riverbed	4.36 km
Basin elevation difference	938.0 m
Basin mean grade	15.30 %

After applying the rainfall intensity equations provided by INAMHI, the Rational Method for calculation of maximum flows, and data from contributing basin characteristics, the generated flow for a Return Period of 25 years is calculated as 45.85-m^3/s.

In order to determine the maximum flood elevation and the hydraulic characteristics of the river at this location, the HEC-RAS software (from the US Army Corps of Engineers) was utilized to obtain the results shown in the following table.

Design flow (TR = 25 years)	45.85 m^3/s
Maximum flood elevation	1.024.10 m.a.s.l.
Mean speed	2.93 m/s
Depth	2.30 m
River regime	Supercritical

From this data, it is determined that the minimum lower elevation of the bridge beam must be 1,026.10-m.a.s.l. in order to obtain a minimum clearance of 2.0-m (as per MOP standards for bridge design).

In reference to scouring, the coarse granular material present in the riverbed acts as a protective covering that prevents an excessive deepening of the riverbed. Therefore, scouring or the riverbed reaches an approximate value of 0.40-m.

3.6.2. Bridge at 0+597.00

In a similar manner as for the previous bridge, at this point the contributing basin area collects water from the higher basins and therefore generates a considerable flow. A 30-m span steel bridge has been proposed.

At this location, the characteristics of the contributing basin are summarized in the following table.

Basin area	418.73 km^2
Length of main riverbed	4.05 km
Basin elevation difference	898.0 m
Basin mean grade	22.17 %

After applying the rainfall intensity equations provided by INAMHI, the Rational Method for calculation of maximum flows, and data from contributing basin characteristics, the generated flow for a Return Period of 25 years is calculated as 46.09-m^3/s.

In order to determine the maximum flood elevation and the hydraulic characteristics of the river at this location, the HEC-RAS software (from the US Army Corps of Engineers) was utilized to obtain the results shown in the following table.

Design flow (TR = 25 years)	46.09 m^3/s
Maximum flood elevation	1,058.56 m.a.s.l.
Mean speed	3.11 m/s
Depth	2.44 m
River regime	Supercritical

From this data, it is determined that the minimum lower elevation of the bridge beam must be 1,060.56-m.a.s.l. in order to obtain a minimum clearance of 2.0-m (as per MOP standards for bridge design).

In reference to scouring, the coarse granular material present in the riverbed acts as a protective covering that prevents an excessive deepening of the riverbed. Therefore, scouring or the riverbed reaches an approximate value of 0.30-m.

CHAPTER IV: GEOLOGIC-GEOTECHNICAL STUDY

4.1. INTRODUCTION

4.1.1. Objective

This study was performed for the purpose of determining the morphologic and geologic-geotechnical conditions of the area for the road layout proposed by the preliminary design of the access road to the Crusher and Open Pit sites.

4.1.2. Location and Accesses

The site under study is located on the left-hand margin of the headwaters of Wawayme River, within the western foothills of Cóndor mountain range in northeastern Zamora Chinchipe province.

The only accesses to the zone under study are the Chuchumbletza – Tundayme road (currently in a bad condition) and a summer road on the left margin of Quimi River passing through ECUACORRIENTE's camp and continuing on the left margin of Wawayme River.

4.1.3. Work Performed

Initially, an evaluation and analysis of local geologic information provided by ECUACORRIENTE was performed, together with a photogeologic analysis.

Based on a 1:1,000 topographic survey of the terrain band selected for the designed road, a reconnaissance and geologic survey were performed in order to planimetrically determine geologic units, stratigraphic aspects, geotechnical conditions, and geodynamic risk processes present in the area.

In a complementary fashion, subsurface direct geotechnical investigations were performed by means of the execution of test pits for the purpose of determining the stratigraphic profile of several sectors of the projected road, as well as obtaining disturbed samples of the materials in order to determine their physical and index properties and define a USCS (Unified Soil Classification System) soil classification. This would provide an indirect knowledge of the geomechanical properties of these materials. Additionally, sampling of the sites designated as source of road construction materials was performed for the purpose of assessing their capability as such and estimating available reserves.

4.2. GEOLOGY

4.2.1. Geomorphology

In a general fashion, the morphology of the zone (band) under study for the implantation of the road presents itself as heterogeneous.

In its initial portion, the band is located on an alluvial terrace partially covered by colluvial and talus deposits with a gentle grade. In this portion, colluvial deposits consist of sporadic blocks up to 2-m diameter and gravels within a silty-sandy matrix; this area is vulnerable to the impact of landslides that may originate at higher areas and may deposit on lower areas due to road cuts.

The band then traverses cutting hillsides with more pronounced grades formed by colluvial deposits and by the Zamora Batholith until reaching the Crusher site.

Finally, the band continues until the Open Pit through an uneven area crossed by two deep ravines whose hillsides present strong grades. This zone is vulnerable to phenomena such as mud and debris flows that, when conducted through these ravine's riverbeds, may cause erosion and instability in these hillsides.

Elevations throughout the layout vary between 1,000 and 1,400-m.a.s.l.

Zone drainage, in accordance with dominant lithology, is of dendritic type. It is considered that road subgrade permeability will be determined mainly by the granulometry of deposits in initial or lower road areas and by the fracturing of the rock mass at higher areas.

4.2.2. Litho-stratigraphy

Superficially, the area presents colluvial and alluvial deposits covering part of the rock base formed by the granite rocks of the Zamora batholith, which has a meteorization profile with a thickness that in some cases exceeds 30-m.

4.2.2.1. Alluvial Deposits (Qal)

They are located in the riverbeds of main rivers as well as partially on secondary drainages. They are formed by rounded blocks of up to three meters in diameter and by rounded to subrounded gravels. The fraction of sand and fines is scarce, and in some cases it has been completely removed.

4.2.2.2. Colluvial Deposits (Qc)

They are located mainly at the base of local foothills, forming small rounded and elongated hillocks partially covering alluvial terraces on lower elevations, and have been locally eroded by Wawayme River (Map 270-GEO-001-A). They are constituted by sporadic subangular blocks of up to 2-m in diameter, a greater percentage of blocks with diameters between 0.25 and 1-m, and gravels, supported y a silty-sandy matrix.

4.2.2.3. Residual Soil Deposits (Saprolites) (QSR)

They are found partially covering granite rocks, corresponding to a product of their meteorization and are constituted by silty sand and clayey silts, occasionally with centimeter-size residual clasts that disaggregate with a hammer strike. It presents light yellowish to reddish colors; its thickness varies, sometimes exceeding 30-m.

4.2.2.4. Zamora Batholith (JZ)

The majority of the area under study is formed by intrusive rocks from the Zamora batholith, constituted mainly by granodiorites and in a lesser quantity by granites and diorites. The age of these rocks is placed in the Jurassic period, ranging between 110 and 200 million years. The quality of outcrops of these rocks is variable; in some cases they appear very meteorized, with a layer of residual soil and meteorized rock reaching 30-m or more, while in ravine outcrops the meteorization profile has a thickness not greater than 1-m or is absent, in which case the rock is found fresh and unaltered.

The dominant lithology of the area within the batholith is hornblende and biotite granodiorites, and in a lesser quantity granites. The same can be seen in the alluvial deposits of Wawayme River and its tributaries.

Towards east in the area under study, the Zamora batholith is overlaid in inconformity by the Hollín formation of the Cretacic period; southward, volcanic and subvolcanic fine-grained rocks have been found that are related to volcanic activity contemporary with the plutonic phase, which are included in the Misahuallí subdivision (Litherland *et al*, 1994).

4.2.3. Geologic Structures

From the analysis performed on previous studies, on studies performed by ECUACORRIENTE, and on the geologic field survey, is deduced that in all of the zone under study no evidence exists of faulted structures of regional or local character. Similarly, in the contact band between volcanic elements and the Zamora batholith, the presence of structures or discontinuities that significantly affect the rock mass has not been detected.

The diaclasing of granite rocks presents a N-S and NW-SE general fracturing.

4.3. GEOLOGIC-GEOTECHNICAL ASPECTS OF THE LAYOUT

In order to perform the geologic-geotechnical description, the geologic sectorization along the road centerline has been taken as reference, which was determined during the geologic field survey and presented in the geologic semi-detail plans (270-GEO-003-A and 270-GEO-004-A) and in the geologic semi-detail profiles (plans 270-GEO-004-A, -005-A and -006-A).

Alluvial Deposits (Q_{al})

These deposits outcrop only at ravine riverbeds and are found below the level of the subgrade; therefore, no abscissas for their crossing points with the road centerline have been provided.

They are constituted approximately by 15% of subrounded blocks with a diameter greater than 1-m, 65% of rounded to subrounded blocks between 0.25 and 1-m diameter, and 20% of rounded gravels; fines are absent due to the fact that in this zone the energy of the river removes particles the size of sand or smaller. The contribution comes mainly from intrusive rocks and, in a lesser percentage, from quartzy sandstone from the Hollín formation.

Colluvial Deposits (Q_C)

Abscissas: 0+000 – 0+810; 0+870 – 2+800; 3+740 – 4+810.

They partially cover the zone's alluvial terraces, forming elongated hills that are partially eroded by Wawayme River. The thickness of these deposits range from a few centimeters to more than 10-m.

They are constituted by sporadic subangular blocks of up to 2-m in diameter, a greater percentage of blocks of diameters between 0.25 and 1-m, and gravels, within a silty-sandy matrix. The main contribution is intrusive, with a lesser percentage of sandstone blocks.

The investigations performed in this sector (test pits 3 and 4) indicate the presence of colluvial material constituted approximately by 5% of blocks of diameter greater than 1-m, 25% of blocks of diameter between 0.25 and 1-m, 20% of angled gravels, and 50% of silty-sandy matrix. The thickness of this deposit is considered to be greater than 10-m.

The main contribution comes mainly from intrusive rocks, and in a lesser percentage, from sandstone blocks and gravels.

Residual Soil Deposits (Saprolite) (Q_{SR})

Abscissas: 0+810 – 0+870; 2+800 – 3+740; 4+810 – 4+890; 4+950 -5+200;
5+300 – 5+360; 5+460 – 5+490; 5+580 – 5+840.

They are found covering mainly granite rocks. They correspond to a product of the meteorization of preexisting rocks and are formed by silty sand and clayey silts and occasionally by centimeter-size residual clasts that disaggregate under a hammer strike. They present light yellowish to reddish colors and their thickness varies, sometimes exceeding 30-m.

Zamora Batholith (Jz)

Abscissas: 4+890 – 4+950; 5+200 – 5+300; 5+360 – 5+460; 5+490 – 5+580.

It is locally covered by colluvial deposits of variable thickness. It is considered that in this zone the thickness of residual soil and meteorized rock is greater than 30-m.

Between abscissas 2+900 and 3+600, the road layout is located on residual soil (ML and SM) from intrusive rock (test pits 7 and 8). There is a difference in soil color, from light grey in test pit 7 to ocher in test pit 8, due to a change in the mineral composition of the rock.

Subsequently, the layout between abscissas 3+600 and 4+900 is located on the higher portion of the zone of accumulation of colluvial materials; therefore, the meteorization profile of the intrusive rock is located at less than 10-m under the surface.

Geostructural Conditions

Structural data from intrusive rock diaclases have been taken from nearby ravines. These data reflects a perpendicular diaclasing typical of this type of rocks.

J1: 285/70
J2: 190/75
J3: 175/90

Outcrops found in ravines show that this families of diaclases are repeated every 1-m on average. The joints appear flat and without fill, with a persistence in excess of 5-m.

4.3.1. Summary

The geologic formations outcropping within the layout for the construction of the access road to the Crusher and Open Pit areas are summarized in the following Table.

TABLE 4.1

ABSCISSAS	GEOLOGIC UNIT	MATERIAL TYPE	LENGTH & PERCENTAGE
0+000 – 0+810; 0+870 – 2+800; 3+740 – 4+810.	Colluvial Deposits (Qc)	Blocks less than 1-m dia. and gravels in a silty-clayey matrix	3.810 m 65 %
0+810 – 0+870; 2+800 – 3+740; 4+810 – 4+890; 4+950 – 5+200; 5+300 – 5+360; 5+460 – 5+490; 5+580 – 5+840.	Residual Soil Deposits (Saprolite) (Q_{SR})	Coarse to medium sands and sandy silts	1.680 m 29 %
4+890 – 4+950; 5+200 – 5+300; 5+360 – 5+460; 5+490 – 5+580.	Zamora Batholith (JZ)	Granodiorites and a lesser quantity of granites and diorites	350 m 6 %

4.3.2 Geodynamic Processes

No zones with unstable hillsides have been observed within the layout for the access road to the Crusher and Open Pit. However, surface and residual soils in a condition of high or saturated water content will become potentially unstable.

4.3.3 Degree of Meteorization of the Materials

The meteorization affects in a general manner the most superficial parts of the rocks; hence, knowledge of the degree of meteorization is of great importance for the study of slopes, quality of subgrade, and the rippability and usage of materials.

Rock meteorization has been subdivided in the following degrees:

- Completely meteorized rock – residual soil (Saprolite)
- Meteorized rock
- Medium meteorized rock
- Sound rock

In the area within the layout for the access road to the Crusher and Open Pit, the outcropping rocks from the Zamora batholith have a varying meteorization level with an estimated thickness of up to 30-m, considering this surface layer as a sandy-silty soil.

4.3.4 Assessment of Excavation Materials

The scarification or rippability is a property of a material that determines whether its ripping or removal may be done by hand or machine. In general, for excavation purposes materials are classified in three categories:

1. Category 1 (Soil)

Materials whose excavation requires common equipment or manual processes utilizing simple tools, are generally considered as soil.

2. Category 2 (Marginal)

It corresponds to materials formed by decomposed rock, very compact soils, and all those whose excavation does not require explosives but requires machinery with 320-HP at the wheel with its respective scarifiers.

3. Category 3 (Rock)

It comprises all rock masses, stratified deposits, and all materials presenting the characteristics of solid rock, cemented so solidly that they can only be excavated by means of explosives.

4.3.5 Estimated Material Percentages for Excavation Purposes

The materials present in the routes analyzed for the access to the Crusher and Open Pit sites correspond to intrusive rocks, residual soil deposits (saprolite), and colluvial deposits, as indicated in Table 4.1.

According to the proposed classification, at this level of study it is considered that the materials to be removed during the construction of the road belong to the categories 1, 2 and 3 in the following percentages:

Category 1 (Soil) : 65 %
Category 2 (Marginal) : 29 %
Category 3 (Rock) : 6 %

Field investigations were based in direct methods, which consisted in the excavation of test pits, and disturbed and undisturbed sampling, at the locations indicated in the Geologic Map (Plan 270-GEO-001-A).

The samples obtained from these excavations were subjected to soil classification tests as per the USCS system. The specific weight, cohesion, and friction angle of the materials composing these units were additionally determined.

4.3.5.1 Test Pits

Thirteen (13) test pits were excavated for the investigation of surface materials and three (3) undisturbed samples were taken.

The approximate abscissas for the location of the sites of these investigations are shown in Table 4.2 below.

TABLE 4.2

TEST PIT	ABSCISSA
1	0 + 145
2	0 + 605
3	0 + 980
4	1 + 650
5	2 + 227
6	2 + 708
7	3 + 155
8	3 + 565
9	4 + 018
10	4 + 545
11	5 + 040
12	5 + 480
13	5 + 792
MI - 1	2 + 255
MI - 2	5 + 560

4.3.5.2 Laboratory Tests

For the purpose of determining index and physical properties of the materials forming the subgrade of the road alternative under study, laboratory tests were performed on the retrieved samples. The results obtained are shown in Chapter X, Section 10.3.

A summary of these results is shown in Table 4.3 below.

TABLE 4.3

SUMMARY OF RESULTS FROM LABORATORY TESTS

Test Pit	Abscissa	Depth [m]	Gravel [%]	Sand [%]	Fines [%]	W [%]	WL [%]	WP [%]	IP [%]	H. Opt [%]	D.Max. [%]	USCS
1	0+145	0.50	55	22	24	12.03	NP	NP	NP	12.27	2.061	GM
2	0+605	0.50	47	48	6	14.84	NP	NP	NP	18.00	1.883	GM
3	0+980	0.50	0	41	56	63.49	NP	NP	NP	29.00	1.385	MH
		1.00	2	45	53	50.30	63.50	39.80	23.70			MH
		1.50	3	41	56	44.85	54.10	29.20	24.90			CH
4	1+650	0.50	5	45	50	55.76	64.20	34.10	30.10	30.00	1.384	MH
5	2+227	0.50	11	48	41	54.26	54.60	34.70	19.90	21.60	1.593	SM
		1.00	12	57	31	28.57	59.00	36.20	22.80			SM
6	2+708	0.50	13	36	51	43.26	55.00	32.40	22.60	29.15	1.427	MH
7	3+155	0.50	7	49	44	25.43	43.50	32.70	10.80	26.50	1.463	SM
8	3+565	0.50	1	28	71	31.80	42.80	28.50	14.30	24.26	1.563	ML
		1.00	4	59	38	18.11	41.20	30.20	11.00			SM
9	4+018	0.50	11	47	41	38.55	45.70	28.90	16.80	24.65	1.513	SM
10	4+545	0.50	1	25	74	37.12	45.1	29.7	15.40	22.97	1.563	ML
11	5+040											Rock
12	5+480	0.60	38	11	51	48.83	93	57.4	35.60	19.9	1.692	MH
			12	21	67	22.37	42.6	32.3	10.30			ML
13	5+792	0.50	10	35	55	35.21	54.4	33.2	21.20	27.5	1.476	MH

4.3.6 Geologic Study of Slopes

During the geologic field surveys, a general reconnaissance was performed for the natural slopes and existing cut slopes in the zone of the access road to the Cóndor Mirador Military Camp.

In function of the evaluations performed and of geologic cross-sections, it was determined that cut slopes will be executed mainly on colluvial deposits, residual soil, and partially on light-to-medium meteorized intrusive rocks.

The details of the stratigraphic disposition of these cut slopes are shown in plan 270-GEO-007-A (Transversal Geologic-geotechnical Profiles).

4.3.7 Stability Study

4.3.7.1 Geologic-geotechnical Investigations

For the purpose of knowing the nature and the spatial and stratigraphic distribution of the materials present along the layout of the road, 13 test pits were excavated; their location is shown in plan 270-GEO-001-A (Geologic Plan) and their description in Section 10.3.1.

4.3.7.2 Geotechnical Conditioning

The assessment of the geologic surveys, when interpreted jointly with the results of laboratory tests, permits to issue the following geologic-geotechnical criteria.

a) Lithologic Conditioning

The materials exposed by the excavations belong to colluvial deposits and/or residual soils of variable thickness that overlay the rock base. The results from classification tests show that they are silty, clayey and sandy-silty soils. As a result from observations during the material's field exposure and from their geotechnical classification, it was determined that they are susceptible to erosion and present low geomechanical parameters.

b) Morphologic Conditioning

From a morphological standpoint, the hillsides over which the road will be implanted present medium-to-high grades.

c) Physical Characteristics and Geomechanical Properties

The physical properties of the materials were determined by means of tests for unit weight and density, associated with granulometry and classification tests. Their results are found in Sections 10.3.2 and 10.3.3.

The geotechnical parameters utilized for slope stability analysis based on the materials present in the layout of the road are the following.

TABLE 4.4

SAMPLE	ABSCISSA	MATERIAL	DENSITY [g/cm^3]	COHESION [kg/cm^2]	FRICTION ANGLE [deg]	USCS
MI-1	2+255	Residual soil	1.735	0.27	5	ML
MI-2	5+560	Residual soil	1.733	0.27	6	MH

4.3.7.3 Stability Analysis

The stability analysis was performed following the general methodology of Limit Equilibrium, which relates existing motion-resisting forces with the forces mobilized to produce movement in a given slice surface. The results of the slope stability assessment were obtained in terms of safety factors.

The stability analysis was assisted by X-STABL software based on the Bishop method.

The analysis was performed for static and dynamic conditions. A seismic horizontal acceleration of 0.35*g was utilized as dynamic parameter for this zone, as recommended in the Ecuadorian Construction Code [*Código Ecuatoriano de la Construcción*], Chapter I.

Additionally, the stability analysis was performed considering slice surfaces of circular shape for various slope heights.

Stability analyses were performed for hillsides, taking as a reference the geologic-geotechnical models from Profile 6 at abscissa 2+180 (found in Chapter IX), and the graphs resulting from the stability analysis are shown in Section 10.3.4.

The stability analysis considered hillside cut slopes with a 1H : 1.5V grade relationship for colluvials or residual soil (saprolite).

TABLE 5.5

STABILITY ANALYSIS RESULTS
TYPICAL PROFILE AT ABSCISSA 2+180

Profile	Safety Factor (FS)			Slice Model
	Slope Height	Crusher Data		
		Static	Dynamic	
6	8	1.536	1.450	Colluvial, circular slice
	16	0.970	0.895	Colluvial, circular slice
	24	0.722	0.657	Colluvial, circular slice
	32	0.596	0.538	Colluvial, circular slice

4.3.7.4 Evaluation of Stability Analysis Results

For the evaluation of the results from the stability analysis in terms of safety factors, various authors recommend that a slope may be considered as stable if the values obtained for its safety factor lie within 1.3 and 1.5 for static analyses, and within 1.0 and 1.1 for dynamic analyses, depending on the degree of risk for the zone and/or works.

We considering that adequate limits for road cut slopes are a static safety factor of 1.35, and a dynamic safety factor of 1.1.

- The undisturbed samples utilized to obtain the parameters for soil geomechanical properties were taken from a depth between 1.00 and 1.50-m, which corresponds to the superficial portion of the terrain.

- With the density, cohesion and friction data obtained from laboratory tests, a safety factor analysis was performed which provided values of less than those of the limit equilibrium (slice condition) for slope heights in excess of 15-m.

Static Analysis:

The static safety factor for colluvial deposits and/or residual soils (saprolite), varies according to slope height: 0.596 for a 32-m slope, and 1.536 for an 8-m slope. These results represent slice conditions for slopes taller than 8-m.

Dynamic Analysis:

The dynamic safety factor for colluvial deposits and/or residual soils (saprolite), varies according to slope height: 0.538 for a 32-m slope, and 1.450 for an 8-m slope. These results represent slice conditions for slopes taller than 8-m.

4.3.7.5 Conclusions

- The height of cut slopes on colluvial deposit and/or residual soil (saprolite) must not exceed 8-m with a 1H : 1.5V grade in order to obtain safety factor values that guarantee their stability.

- For cut slopes on colluvial deposits and/or residual soil (saprolite) with a height greater than 8-m, the construction of 3-m wide berms every 8-m in height is recommended, together with their respective drainage ditches.

- For sections presenting cut slopes in rock covered by residual soil, the construction of cut slopes in rock with a 1H : 3V grade and a maximum height of 10-m is recommended. When the design proposes cuts of greater height, a 3-m wide intermediate berm shall be constructed with its respective drainage ditch.

4.4 MATERIAL SOURCES

The works projected for the access road to the Crusher and Open Pit require adequate materials for the construction of the pavement, base, subbase, improvement, aggregates for concrete, ancillary works, etc.

Within the area of influence for the construction of the access road, a geologic evaluation was performed for the areas considered as potential sources of material for the construction of the road, emphasizing on the determination of the geologic and geotechnical characteristics of the materials, location, accesses, possible uses, estimated volumes, and exploitation conditions.

Two sites were identified as material sources:

- Mine 1:Alluvial materials from Quimi River, across from the Military Camp.
- Mine 2 (Churubia):Alluvial materials from Quimi River, downstream from the town of Tundayme.

The materials from these mines were utilized as aggregates for the construction of the road to the Cóndor Mirador detachment.

The location of these mines is shown in plan 270-GEO-009-A.

Section 10.3.5 presents a summary of the results obtained from laboratory tests on disturbed samples of materials from these sites.

4.4.3 Mine 1 – Quimi River

4.4.3.1 Location and Access

It is located on an alluvial terrace of Quimi River, on the right-hand margin of the confluence of Tundayme and Quimi rivers, at UTM coordinates 9,604,734 N, 780,203 E, and approximately 5.5-km from the abscissa 0+000 of the road under study. The access to this mine is by a subsidiary car road parallel to the left margin of Quimi River.

4.4.3.2 Geologic Description

It corresponds geologically to an alluvial deposit constituted by blocks, washed rocks and sands of intrusive, volcanic and partially sedimentary origin. The total thickness of the deposit is unknown, but it may be greater than 3-m.

The materials of this mine have the following approximate constitution.

Constitution		Composition	
Washed rocks larger than 25-cm	50%	Intrusive rocks	95%
Washed rocks between 8 and 25-cm	25%	Volcanic rocks	4%
Gravels, sands and fines	25%	Sedimentary rocks (sandstones)	1%

4.4.3.3 Exploitation Conditions and Approximate Volume

The mine is not currently being exploited. Its materials will have to be sifted and crushed. The mine located on the right-hand margin of Quimi River is 200-m long and 100-m side. It has an approximate volume of 50,000-m^3, renewable by river floods.

Its exploitation requires crossing Quimi River through its riverbed, which restricts exploitation during floods.

4.4.3.4 Qualification

This mine may be utilized as a source of aggregates for concrete and of material for base, subbase and improvement. To that effect, the aggregates must receive an appropriate granulometric stabilization for the material to comply with the applicable standards.

4.4.4 Mine 2 – Churubia

4.4.4.1 Location and Access

It is located on a small island on the right-hand margin of Quimi River, UTM coordinates 9,605,281 N, 777,774 E, downstream of the town of Tundayme, at approximately 8-km from the abscissa 0+000 of the road under study. Access to the mine is by a subsidiary road from the town of Tundayme.

4.4.4.2 Geologic Description

It corresponds geologically to an alluvial deposit constituted by blocks, washed rocks and sands of intrusive, volcanic and partially sedimentary origin. The total thickness of the deposit is unknown, but it may be greater than 10-m.

The materials of this mine have the following approximate constitution.

Constitution		**Composition**	
Blocks between 3-in and 10-in	41 %	Intrusive rocks	90 %
Gravels	40 %	Volcanic rocks	8 %
Sand	18 %	Sedimentary rocks (sandstones)	2 %
Fines	1 %		

4.4.4.3 Exploitation Conditions and Approximate Volume

This mine is currently being slightly exploited to supply local needs. Its exploitation will require the use of backhoes, sifting, screening and crushing.

The deposit located on the central part of the riverbed is approximately 200-m long and 100-m wide. Its thickness is estimated to be less than 3-m, thus providing an approximate volume of 50,000-m^3 that is renewable by river floods.

Alluvial terraces with older material are found towards the river margins. Their exploitation requires removing surface soil with a tractor, crushing, sifting and screening. Its volume is an estimated 100,000-m^3.

4.4.4.4 Qualification

The results from laboratory tests indicate that the materials of this mine present a 20 % wear from abrasion and a high organic content; therefore, it is indispensable to wash this material prior to its utilization as aggregates for concrete.

The materials from this mine may be utilized for base, subbase and road improvement. They will need an adequate granulometric stabilization for the material to comply with the applicable standards for each pavement layer.

4.4.5 Mine Utilization

Considering the location of the mines, their exploitable volume, and their quality for base, subbase, improvement and fills, both mines comply with the requirements for being used for construction materials. The utilization of materials from the Churubia mine is recommended.

4.5 BRIDGES

The construction of two bridges at the initial section of the road has been projected in order to cross one of the tributaries of Wawayme River from its left margin. No investigation have been performed to define the bearing capacity of the materials at foundation level of the bridge abutments; their schematic geologic profiles are presented in plan 270-GEO-008-A.

4.5.3 Bridge at Abscissa 0+133

4.5.3.1 Location

The bridge is located between abscissas 0+133 to 0+163 of the access road to the Crusher. Its geographic position corresponds approximately to the UTM coordinates 9,605,645 N, 784,640 E (wetland center)

4.5.3.2 Geology of the Bridge Implantation Area

Colluvial deposits outcrop at the wetland margins, and alluvial deposits at its bed.

Alluvial Deposits (Qal)

They are formed by rounded blocks of up to 3-m in diameter and rounded to sub-rounded gravels. The fraction of sands and fines is scarce.

Colluvial Deposits (Qc)

They are formed by sporadic sub-angular blocks of up to 2-m in diameter, a larger percentage of blocks between 0.25 and 1-m in diameter, and gravels, within a silty-clayey matrix.

4.5.3.3 Geomorphology

The valley formed by the wetland has a gentle relief in the shape of an open ‘V’, with hillsides of an average 30° transversal grade on the left margin, and of an average 24° on the right-hand margin; they are located over colluvial and alluvial deposits.

4.5.3.4 Geodynamic Processes

The area under the proposed bridge crossing has good stability conditions on its hillsides.

4.5.3.5 Defense Works

The protection of the approach fills of the bridge require the construction of concrete or gabion walls, both downstream and upstream of the projected structure.

4.5.3.6 Construction Materials

For the construction of the bridge it will be necessary to have construction materials for the manufacture of concrete, for which it is recommended the utilization of aggregates from the Churubia mine, located at approximately 8.1-km from the bridge.

4.5.3.7 Conclusion and Recommendations

- Both margins of the bridge implantation area are composed by colluvial deposits and its riverbed by alluvial deposits.

- At this level of study, the elevation for the foundation of both bridge abutments is recommended to be 1,022-m.a.s.l.

- A direct type foundation has been considered for the abutments. In accordance with the geologic cross-section at bridge centerline, the foundation materials are expected to be constituted by colluvial deposits with an estimated admissible bearing capacity of:

Q_{adm} = 1.00 kg/cm^2

- At this moment, no investigation of any kind has been performed to determine the admissible bearing capacity of the materials at the elevation of abutment foundation.

- For the purpose of obtaining geomechanical parameters to calculate the admissible bearing capacity and determining the elevation for abutment foundation, it is necessary to perform a geotechnical investigation. It is recommended to make a boring of an approximate 10-m depth with the execution of Standard Penetration Tests (SPT) every meter on each margin of the wetland, as well as two Seismic Refraction lines, 110-m each, parallel to the riverbed, one on each margin.

4.5.4 Bridge at Abscissa 0+597

4.5.4.1 Location

The bridge is located approximately between the abscissas 0+597 and 0+627 of the layout of the access road to the Crusher. Its geographic location corresponds approximately to the UTM coordinates 9,605,500 N, 784,920 E (wetland center).

4.5.4.2 Geology of the Bridge Implantation Area

Colluvial deposits outcrop at the wetland margins, and alluvial deposits at its bed.

Alluvial Deposits (Qal)

They are formed by rounded blocks of up to 3-m in diameter and rounded to sub-rounded gravels. The fraction of sands and fines is scarce.

Colluvial Deposits (Qc)

They are formed by sporadic sub-angular blocks of up to 2-m in diameter, a larger percentage of blocks between 0.25 and 1-m in diameter, and gravels, supported by a silty-clayey matrix.

Residual Soil Deposits (Saprolite) (Q_{SR})
They correspond to a product from the meteorization of rocks from the base and are constituted by silty sand and clayey silts, occasionally with residual clasts of centimeter-size. Its thickness varies, reaching over 30-m.

4.5.4.3 Geomorphology

The valley formed by the wetland has a gentle relief in the shape of an open ‘V’, with hillsides of an average 32° transversal grade on the left margin, and of an average 40° on the right-hand margin; they are located over colluvial deposits.

4.5.4.4 Geodynamic Processes

The area under the proposed bridge crossing has good stability conditions on its hillsides.

4.5.4.5 Defense Works

The protection of the approach fills of the bridge require the construction of concrete or gabion walls, both downstream and upstream of the projected structure.

4.5.4.6 Construction Materials

For the construction of the bridge it will be necessary to have construction materials for the manufacture of concrete, for which it is recommended the utilization of aggregates from the Churubia mine, located at approximately 8.7-km from the bridge.

4.5.4.7 Conclusions and Recommendations

- Both margins of the bridge implantation area are composed by colluvial deposits and its riverbed by alluvial deposits.

- The elevation for bridge abutment foundation is recommended to be 1,056-m.a.s.l. for the left abutment, and 1,057.50-m.a.s.l. for the right abutment.

- Based on surface geologic surveys, it has been designed that bridge abutment foundations will rest directly on colluvial deposits with an estimated admissible bearing capacity of:

Q_{adm} = 1.00 kg/cm^2

- No investigation of any kind has been performed to determine the admissible bearing capacity of the materials at the elevation of abutment foundation.

- For the purpose of obtaining geomechanical parameters to calculate the admissible bearing capacity and determining the elevation for abutment foundation, it is necessary to perform a geotechnical investigation. It is recommended to make a boring of an approximate 10-m depth with the execution of Standard Penetration Tests (SPT) every meter on each margin of the wetland, as well as two Seismic Refraction lines, 110-m each, parallel to the riverbed, one on each margin.

4.6 CONCLUSIONS AND RECOMMENDATIONS

- The project of the access road to the Crusher and Open Pit has a length of 5.84-km.

- The lithology of the geologic formations of the region is of continental origin. The geologic units of the implantation zone of the road are clearly defined as: Intrusive rocks (granodiorites, granites and diorites), colluvial deposits, and residual soils (saprolite). They are located on hills and zones of gentle morphology.

- Regionally, the area under study presents a mountainous morphology with medium-to-high grades.

- At this level of study, it is estimated that the materials to be excavated for the construction of the road are classified as:

Soil	:	65%
Marginal	:	29%
Rock	:	6%

- The study of cut slopes was based on geologic-geotechnical models obtained from field surveys, observation of the behavior of natural slopes, and on the results from laboratory tests.The results from the stability analysis permitted to perform typical designs for cut slopes in various materials:

  - The height of cut slopes on colluvial deposit and/or residual soil (saprolite) must not exceed 8-m with a 1H : 1.5V grade in order to obtain safety factors that guarantee their stability.
  - For cut slopes on colluvial deposit or residual soil (saprolite) with a height over 8-m and a 1H : 1.5V grade, the construction of a 3-m wide berm every 8-m in height is recommended, together with its respective drainage ditch.
  - For sections containing cut slopes on rock covered by residual soil, cut slopes on rock with a 1H : 3V grade and a maximum 10-m height are recommended. If the design calls for a greater height, an intermediate 3-m wide berm must be constructed together with its respective drainage ditch.

- For cut slopes on either colluvial deposit or residual soil (saprolite), it is recommended the implementation of surface drainage (crown ditches and berm ditches) in order to control surface erosion and improve their stability.

- In order to define the geologic-geotechnical model for each of the projected bridges, it is recommended to perform the following investigations for each bridge:

-
  - A boring of an approximate depth of 10-m, with Standard Penetration Tests (SPT) every meter, on each margin of the wetlands.

  - Two Refraction Seismic lines 110-m long each, parallel to the wetland bed, one on each margin.

4.7 REFERENCES

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CHAPTER V: PAVEMENT DESIGN

5.1 DESIGN PROCEDURE

This study has considered the road as divided into two sections having their own particular characteristics both in their cross-sections as in their geotechnical zonification:

Section 1: From abscissa 0+000 to 4+260, with a road width of 7.20-m
Section 2: From abscissa 4+260 to 5+840.85, with a road width of 24.30-m

5.1.1 Section 1: Camp – Crusher

The utilized design procedure was de one recommended by:

- AASHTO Guide for Design of Pavement Structures, 1993.
- Spectra Pave 2, Methodology for the Use of Geosynthetics.

5.1.2 Section 2: Crusher – Pit

The loads to be applied on this Section, as well as the traffic, have been defined from the considerations of AASHTO's traditional design procedure through the calculation of thicknesses by means of the Equivalent Axles technique. For this reason, other procedures have been adopted in order to guarantee the design and stability of the pavement; they utilize methodologies to define pavement thicknesses in airports and mining roads.

The utilized design procedures are the ones recommended by:

- LCN Method
- CBR Method
- FAA (Federal Aviation Administration) Method, 1974
- Department of Transport of Canada, 1969
- Geogrid Base Reinforcement, Geosynthetics, 2004

5.2 USEFUL LIFE AND DESIGN PERIODS

The analysis periods for the pavement structure for the Camp – Crusher section of the access road (abscissas 0+000 to 4+260) have been planned for a period of 20 years, first estimating the accumulated traffic to subsequently design the thicknesses of the structure.

The analysis period for the Crusher – Open Pit section of the access road (Haul Road) (Abscissas 4+260 to 5+840.85) has been planned for 25 years. For this period, the traffic was initially estimated taking into account: Daily production of the mine, type of vehicle to be utilized for hauling, load to be hauled, number of vehicles, and gross load per vehicle.

5.3 TRAFFIC AND NUMBER OF EQUIVALENT AXLES

With the information provided by the mining company, and with the analysis of the activity to be performed, traffic projections were established for the access road, with the following considerations.

5.3.1 Section 1: Camp – Crusher

- During the design periods (for 10 and 20 years of operation), traffic will be constant.
- Traffic on the access road during the operation period will be only for personnel transport, supply, maintenance and operation.

With this information, Equivalent Axles (ESALs) numbers were calculated for the design periods, which are shown on Table 5.1 below, based on AADT for a single direction:

TABLE 5.1

NUMBER	PERIOD	ESAL
1	10	659.648
2	20	1,259.328

5.3.2 Section 2: Crusher – Pit

Vehicle type	:	785 C work truck
Manufacturer	:	Caterpillar
Daily number of vehicles	:	150 (AADT)
Total load from each loaded vehicle	:	250-ton.
Distribution of loaded weight:		
Front	:	33 % (82.5-ton.)
Rear	:	76 % (167.5-ton.)
Tire pressure:		
Front	:	105-psi
Rear	:	105-psi
Design period	:	25 years

The AADT of 150 is considered to remain constant during the design period.

5.4 SUBGRADE SOIL

5.4.1 Section 1: Camp – Crusher

In this Section, nine (9) test pits were performed, spaced approximately every 500-m, having a depth of 1.50-m below subgrade level. In these test pits, disturbed samples were taken every 0.50-m, and laboratory tests were performed to determine natural moisture content, granulometry, Atterberg limits, compaction, and CBR. The respective results are shown in Table 5.2 below.

TABLE 5.2

GENERAL SUMMARY OF LABORATORY RESULTS

TEST PIT Nr.	ABSCISSA	DEPTH [m]	CLASSIFICATION OF SUBGRADE MATERIAL									GEOLOGY
			W %	WL %	WP %	IP %	H.OPT %	D.MAX g/cm^3	CBR 90%	SUCS	AASHTO	
1	0 + 145	0.50	12.03	NP	NP	NP	12.27	2.061	16.50	GM	A-1-b	Alluvial
2	0 + 605	0.50	14.84	NP	NP	NP	18	1.883	11.60	GM	A-1-a	Alluvial
3	0 + 980	0.50	63.49	78.50	40.50	38.00	29.00	1.385	3.90	MH	A-7-5	Colluvial
		1.00	50.30	63.50	39.80	23.70	----	----	----	MH	A-7-5	Colluvial
		1.50	44.85	54.10	29.20	24.90	----	----	----	CH	A-7-6	Colluvial
4	1 + 650	0.50	55.76	64.20	34.10	30.10	30.00	1.384	4.20	MH	A-7-5	Colluvial
5	2 + 227	0.50	54.26	54.60	34.70	19.90	21.60	1.593	5.10	SH	A-7-5	Colluvial
		1.00	28.57	59.00	36.20	22.80	----	----	----	SM	A-2-7	Colluvial
6	2 + 708	0.50	43.26	55.00	32.40	22.60	29.15	1.427	5.10	MH	A-7-5	Colluvial
7	3 + 155	0.50	25.43	43.50	32.70	10.80	26.50	1.463	4.10	SM	A-7-5	Residual
8	3 + 565	0.50	31.80	42.80	28.50	14.30	24.26	1.563	2.90	ML	A-7-6	Residual
		1.00	18.11	41.20	30.20	11.00	----	----	----	SM	A-7-5	Residual
9	4 + 018	0.50	38.55	45.70	28.90	16.80	24.65	1.513	4.60	SM	A-7-6	Colluvial

Note: Compaction tests for materials from test pits C1 and C2 are of Modified type; for the remaining test pits, they are of Standard type.

Ranges and averages for the results obtained from soil analysis for the subgrade of this Section are shown in Table 5.3

TABLE 5.3

GEOMECHANICAL PARAMETERS OF SUBGRADE SOIL

Detail	**Range**		**Average (%)**
	Minimum (%)	**Maximum (%)**	
T- 200 pass-through	6	71	43.5
Liquid limit	41.2	78.5	54.7
Plastic limit	28.5	40.5	33.4
Natural moisture content	12.03	63.49	37.0
CBR – Residual soil	----	----	3.5
CBR – Colluvial deposit	----	----	4.6
Swelling	0.09	1.31	----
AASHTO classification	Mostly A-7-5		----
SUCS classification	Mostly MH and SH		----

TABLE 5.4

SUBGRADE MATERIAL TYPE AS PER LAYOUT

ABSCISSA (FROM - TO)	**SUBGRADE SOIL MATERIAL**	**CBR** [%]
0+000 – 0+810	Colluvial	14.0
0+810 – 0+870	Residual	----
0+870 – 2+800	Colluvial	4.58
2+800 – 3+740	Residual	3.5
3+740 – 4+300	Colluvial	4.6

The design considered an average value of 3.5% for the CBR.

The resilience modulus of the subgrade was calculated with the equation:

M_R [psi] = 1,500 * CBR

5.4.2 Section 2: Crusher – Pit

In this Section, four (4) test pits were performed, spaced approximately every 500-m, having a depth of 1.50-m below subgrade level. In these test pits, disturbed samples were taken every 0.50-m, and tests were performed to determine natural moisture content, granulometry, Atterberg limits, compaction, and CBR. The respective results are shown in Table 5.5 below.

TABLE 5.5

GENERAL SUMMARY OF LABORATORY TESTS

TEST PIT Nr.	**ABSCISSA**	**DEPTH [m]**	**CLASSIFICATION OF SUBGRADE MATERIAL**									**GEOLOGY**
			W %	**WL** %	**WP** %	**IP** %	**H.OPT** %	**D.MAX** g/cm³	**CBR** 90%	**SUCS**	**AASHTO**	
10	4 + 545	0.5	37.12	45.1	29.7	15.40	22.97	1.563	5.6	ML	A-7-6	Colluvial
11	5 + 000	0.5	----	----	----	----	----	----	----	----	----	Intrusive rock
12	5 + 480	0.6	48.83	93	57.4	35.60	19.9	1.692	5.05	MH	A-7-5	Residual
		----	22.37	42.6	32.3	10.30	----	----	----	ML	A-7-5	Residual
13	5 + 792	0.5	35.21	54.4	33.2	21.20	27.5	1.476	4.55	MH	A-7-5	Residual

Ranges and averages for the results obtained from soil analysis for the subgrade of this Section are shown in Table 5.6

TABLE 5.6

GEOMECHANICAL PARAMETERS OF SUBGRADE SOIL

Detail	Range		Average (%)
	Minimum (%)	Maximum (%)	
T- 200 pass-through	51	74	61.75
Liquid limit	42.6	93	58.80
Plastic limit	29.7	57.4	38.15
Natural moisture content	22.37	48.33	35.88
CBR – Residual soil	----	----	5.0
CBR – Colluvial deposit	----	----	5.6
Swelling	0.22	2.14	----
AASHTO classification	Mostly A-7-5		----
SUCS classification	Mostly MH and ML		----

TABLE 5.7

SUBGRADE MATERIAL AS PER LAYOUT

ABSCISSA (FROM - TO)	**SUBGRADE SOIL MATERIAL**	**CBR** [%]
4+300 – 4+810	Colluvial	5.6
4+810 – 4+890	Residual	----
4+890 – 4+950	Meteorized to fresh rock	----
4+950 – 5+200	Residual	----
5+200 – 5+300	Meteorized to fresh rock	----
5+300 – 5+360	Residual	5.05
5+360 – 5+460	Meteorized to fresh rock	----
5+460 – 5+490	Residual	5.05
5+490 – 5+580	Meteorized to fresh rock	----
5+580 – 5+840	Residual	4.55

The design considered an average value of 5% for the CBR.

5.5 STRUCTURAL PARAMETERS OF SOIL AND MATERIALS

5.5.1 Section 1: Camp – Crusher

For the determination of the resilience modulus of the materials, it was decided to utilize the correlations with typical CBR values for improvement, subbase and granular base that are shown in the nomograms from Figs. 2.6 and 2.7 from Part II of the AASHTO-93 Guide. The values utilized are shown in Table 5.8

TABLE 5.8

STRUCTURAL PARAMETERS OF SOIL AND MATERIALS

MATERIAL	**CBR** [%]	**M_R** [psi]	**'a' Coefficient** [cm^{-1}]
Subgrade Residual soil	3.5	5,250	----
Subgrade Colluvial material	4.6	6,900	----
Improvement	30	15,027	0.046
Granular subbase	30	15,027	0.046
Granular base	80	27,000	0.053

5.5.2 Section 2: Crusher – Pit

As previously indicated, the zone has available rock aggregates of good quality and adequate materials to be utilized for improvement of the subgrade and subbase, as well as for hydraulic concrete.

Representative samples were taken from Churubia Mine at the terraces located on the margins of Quimi River. A granulometry was performed on an integral sample with the following results:

Block, sieve	> 3-in	41 %
Gravel, sieve	3-in	40 %
Sand, sieve	Nr. 4	18 %
Fines, sieve	Nr. 200	1 %

The following parameters were adopted for pavement design

TABLE 5.9

GEOMECHANICAL PARAMETERS OF SOILS AND MATERIALS

ITEM	**CBR** [%]
Subgrade	5
Improvement	30
Subbase (Class 3)	30
Base	80

5.6 PAVEMENT DESIGN CONDITIONS

5.6.1 Section 1: Camp – Crusher

5.6.1.1 Drainage and Environment

The project zone has a medium-to-high rainfall. For this reason, a good drainage efficiency was defined for the design.

Under this conditions, infiltration water will be evacuated from the pavement structure within a single day. According to Table 2.4 from the AASHTO-93 Guide, the drainage coefficient affecting the pavement structure has a value of 0.9 for the granular base and subbase.

5.6.1.2 State and Service Index

The following Service Indexes were adopted:

Initial Service Index	:	PSIo	= 4.0
Final Service Index	:	PSIf	= 2.0

The difference between Initial and Final is 2.0.

5.6.1.3 Reliability Level

The Reliability Level represents the degree of certainty of the design and determines the duration conditions within the design period, for the purpose of ensuring that the design will reach the defined Service Index by the end of the period.

Table 2.2 from the AASHTO Guide proposes a 50 – 80% range for local roads in a rural zone. Due to the aforementioned considerations, a 70% Reliability Level was adopted.

The standard deviation stipulated in the Guide is 0.45 for flexible pavements.

5.7 DIMENSIONING OF THE FLEXIBLE PAVEMENT

5.7.1 Section 1: Camp – Crusher

5.7.1.1 Structural Number

Structural Numbers (SN) for the two periods were determined with the basic equation for design of flexible pavements, found in the AASHTO Guide. For each period, SNs vary in function of the equivalent axles (W18) which is shown in Table 5.10 below.

TABLE 5.10

YEARS	ESAL	STRUCTURAL NUMBER
10	659,648	2.86
20	1,259,328	3.16

With the SNs, the coefficients for each material, and the 0.9 drainage factor applied to the granular subbase and base, the design of pavement thicknesses was performed.

5.7.1.2 Pavement Thickness

Table 5.11 presents a design summary for the 10-yr period, with geosynthetic reinforcement.

TABLE 5.11

ALTERNATIVE	THICKNESS [cm]
Granular base	15
Subbase	25
Improvement	40
Type I biaxial geomesh	---

Table 5.12 presents a design summary for the 20-yr period, with geosynthetic reinforcement.

TABLE 5.12

ALTERNATIVE	THICKNESS [cm]
Granular base	20
Subbase	25
Improvement	40
Type I biaxial geomesh	---

5.7.2 Section 2: Crusher – Pit

5.7.2.1 Pavement Thickness

Tables 5.13 and 5.14 present a design summary for the 25-yr period, with and without geosynthetic reinforcement.

TABLE 5.13

PAVEMENT THICKNESS, WITHOUT GEOSYNTHETIC REINFORCEMENT

ALTERNATIVE	**THICKNESS** [cm]
Granular base	20
Subbase	40
Improvement	80

TABLE 5.14

PAVEMENT THICKNESS, WITH GEOSYNTHETIC REINFORCEMENT

ALTERNATIVE	**THICKNESS** [cm]
Granular base	15
Subbase	25
Type I biaxial geomesh	---
Improvement	60
Type I biaxial geomesh	---

5.8 REFERENCES

- AASHTO, Guide for Design of Pavement Structures. 1993.
- MOP, MOP-001-F-2002 Specifications.
- Airports [*Aeropuertos*]. F. López Pedraza. Published by Ediciones Paraninfo, Madrid, 1970.
- Design and Evaluation of Pavements in Airports [*Diseño y Evaluación de Pavimentos en Aeropuertos*]. Francisco Fernando Rodante Lazo. Mexico, 1977.
- Guidelines for Mine Haul Road Design. University of Alberta. USA, 2001.
- Geogrid Base Reinforcement. TENSAR Geosynthetics. USA, 2004.

CHAPTER VI: PRELIMINARY STRUCTURAL PROJECT FOR BRIDGES OVER WAWAYME RIVER

6.1 GEOMETRIC DEFINITION OF THE PROJECT

In accordance with the geometric conditions of the crossing of river by the road centerline, considering the recommendations from the hydrologic-hydraulic study, and those from the geologic-geotechnical study, and in accordance with the characteristics and requirements from MOP, the following structure was adopted.

Two bridges with a 30.00-m span isostatic section, including three I-section beams separated 3.00-m between axes, a reinforced concrete deck with 1.40-m cantilevers from outer beam axes, simply supported at both ends on abutments perpendicular to the longitudinal axis.

The starting abscissas for the bridges are 0+133 and 0+597.

In conformity with topographic conditions, lateral screens and gabion walls have been provided for fill containment at both accesses.

6.2 STRESSES

6.2.1 Load and Geometric Conditions

The transversal cross-section of the bridge has a roadway width of 7.30-m (two lanes), and two sidewalks 0.75-m wide each; that is, the total width is 8.80-m.

In conformity with road design requirements, the deck has a 2% transversal grade on each side of the centerline.

A 5.0-cm thick wearing surface of asphalt pavement has been designed for a future stage.

The longitudinal grade of the bridge is 0% (bridge at 0+133) and 5% (bridge at 0+597), with the exception of the camber indicated in plans which must be provided during construction. The road must meet with bridge elevations at both ends of the bridge.

6.2.1.1 Permanent Loads

The permanent loads (dead load, AASHTO, 3.3) considered on the superstructure are the dead weight of the structure and the superimposed loads (such as those from sidewalks, protections, and wearing surface).

The permanent loads considered on the infrastructure are its own dead load, the one from the superstructure, and the pressure from earth fill.

6.2.1.2 Live Loads

The standard truck established by MOP (HS MOP 2000) was utilized. It consists of a semitrailer truck with a 2.5-t weight on each wheel of the front axle and 10.0-t for the intermediate and rear axles, producing a total weight of 45.0-t. The longitudinal separation between axles is 4.20-m and the transversal separation between wheels is 1.80-m.

The stresses considered in the design are those producing the largest strains after comparing those produced by loads from the standard truck with the ones from the corresponding equivalent loads.

The maximum live load reaction on superstructure supports must be withstood by the infrastructure.

6.2.1.3 Other Loads

The dynamic effect from vehicular traffic loads is considered by means of an impact factor that increments the stresses from live loads acting on the superstructure, as per AASHTO, 3.8.

Loads due to effects from wind, contraction, temperature changes, earthquakes are also considered as per AASHTO 3.15, 3.16 and 3.21, respectively. Seismic loads are considered as per the prevailing Ecuadorian Construction Code [*Código Ecuatoriano de la Construcción*].

The design of sidewalks and protections considers the loads established in AASHTO 3.14 and 2.7.4.1, respectively.

Abutment design considers the action of loads transmitted by the superstructure and the effects from the pressure of earth fill.

6.2.2 Load Hypotheses

The load combinations considered in the design are the ones applicable within those established in Table 3.22.1A from AASHTO 3.22.

Load distribution among the longitudinal beams, inner as well as outer, was performed in accordance with the procedure established in AASHTO 3.23.

6.2.3 Support Conditions

The superstructure rests on the abutments by means of synthetic rubber (neoprene) support devices combined with interspersed steel plates, vulcanized under pressure and heat (elastomeric supports).

This type of supports permits that calculation conditions of the superstructure, considered as simply supported at its ends, are fulfilled under actual operation since this material, due to its deformation capacity, allows horizontal displacements of the superstructure produced by the contraction of concrete, temperature changes, braking and other loads. Additionally, it produces friction forces that prevent large displacements, therefore acting in this case as a fixed support.

In transversal direction, the design calls for the construction of anti-seismic locks at the abutments, next to the outer beams, in order to avoid large lateral displacements caused by the design earthquake.

6.3 ADMISSIBLE STRESSES AND MATERIAL STRENGTH

6.3.1 Structural Concrete

The concrete utilized for all of the infrastructure elements (foundation, abutments and lateral screens) shall have a ‘strength specified by compression’ (obtained by means of standard cylinder tests after 28 days) of f’c = 240-kg/cm^2.
The concrete utilized for superstructure elements (deck slab, sidewalks and protections) shall have a ‘resistance specified by compression’ (obtained by means of standard cylinder tests after 28 days) of f’c = 280-kg/cm^2.

6.3.2 Steel for Reinforced Concrete

The corrugated steel reinforcement bars shall have a ‘strength specified by fluency’ of fy = 4,200-kg/cm^2.

6.3.3 Structural Steel

The structural steel for beams assembled with welded plates and their stiffeners will be ASTM A588 Low-alloy, High-resistance Structural Steel, with a minimum fluency stress specification of 3,520-kg/cm^2. The mechanical properties of this steel shall be verified by means of laboratory tests and import certificates.

The structural steel for bracings and shear connectors will be ASTM A588 Structural Steel, with a minimum fluency stress specification of 2,540-kg/cm^2. The mechanical properties of this steel shall be verified by means of laboratory tests and import certificates.

6.3.4 Welding Electrodes

The welding of all elements and parts of the structures will be performed by E 8016-C2 electrodes for shop and field, as per AWS specifications.

6.3.5 Support Devices

Support devices will have a Shore hardness of 60°. It must be verified that a good resistance exists against detachment between neoprene layers and steel plates.

6.4 STRUCTURAL DESIGN

6.4.1 Superstructure

All members of the superstructure must be designed to withstand the stress combinations that are applicable to them, as per AASHTO 3.22.

Steel beams are designed for flexion and shear stresses, as per design by way of admissible stresses (AASHTO 10.31), and considering the following construction stages.

When the concrete slab does not reach the specified minimum compression strength: Actions from the structure's dead weight load, supported by the cross-section of the steel beams, braced only at the points where diaphragms or bracings in a vertical plane exist, as per AASHTO 10.34.

When the concrete slab has reached the specified minimum compression strength: Actions from the structure's dead weight load, from live load, and from superimposed loads due to sidewalks, protections and wearing surface (which causes plastic flow on the concrete slab); supported by the compound steel and concrete cross-section, considering modular relations of n and 3n, as per AASHTO 10.38.

The detailing of steel beams is completed by the design of the transversal stiffeners of the end and intermediate panels (AASHTO, 10.34.4), of the longitudinal stiffeners (AASHTO 10.34.5), of the contact stiffeners for the supports (AASHTO 10.34.6), and of the shear connectors (AASHTO, 10.38.2).

The design thus obtained is revised as per deflection limitations from AASHTO 10.6.

Bracing systems in the vertical plane (diaphragms), as well as in the lower horizontal plane, are designed considering the specified wind loads.

The reinforced concrete deck and the sidewalks are designed by means of the Load and Strength Factors method in compliance with AASHTO 8.16, 8.17, 8.20, 8.21, 8.22, 8.23 and 8.24.

Protections are designed by means of the Admissible Stresses method, as per AASHTO 8.15.

6.4.2 Substructure

Support devices are designed by means of the B method from AASHTO 14.6.5.

The support abutments at each end of the bridge and their foundation, made with reinforced concrete, are designed as per AASHTO 5.14, 4.4.11 and 8.16.

The performed preliminary project can be seen in detail in the structural plans 270-EST-001-A to 270-EST-005-A. The corresponding calculation memories can be found in Section 10.4 of the Annex.

CAHPTER VII: WORK QUANTITIES, UNITARY PRICES, BUDGETS, AND INVESTMENT WORK SCHEDULE

This chapter summarized the procedures utilized and the results obtained from the Costs, Unitary Prices and Referential Budget Study.

7.1 GENERAL CALCULATION CRITERIA

The following aspects were considered for the work quantification of project construction:

- Topographic survey of the road
- Typical cross-sections of the road
- Slope stabilization
- Pavement structure
- Drainage and sub-drainage
- Environmental mitigation measures
- Design of support walls
- Infrastructure and superstructure of bridges
- Traffic signalization

In all cases, the technical, geometric and structural characteristics of the works correspond to those of the design proposed in this study.

7.2 WORK QUANTITIES

The work quantities for the items required for the construction of the Project were estimated based on geologic, geotechnical, road, structural, hydraulic and environmental designs, performed by this consulting company.

The items quantified correspond to the following scope and description.

7.2.1 Basic Works and Platform

It exclusively comprises the activities related with the construction of the basic platform of the road at the surface. This process considered excavation and fill volumes up to subgrade and grade level, in function of the local topography and geologic and geotechnical conditions, and applying this criteria to the shaping of cut and fill slopes, as follows.

For the quantification, utilization and distribution of excavation material, the following criterion was utilized:

Description	Soil 303-2(2)	Marginal 303-2(4)	Rock 303-2(3)
Colluvial	100%		
Marginal	45%	55%	
Rock	5%	20%	75%
Landslides	10%	5%	5%

In the particular case of embankment fills, cut soil needs to be treated prior to its utilization. It consists in mixing it with imported material, rocky or fine, in varying proportion depending on soil type. Mix percentages are shown in the following table.

Type of Soil	Usable Soil	Rock Material	Fine Soil
Colluvial	50%	50%	
Residual	40%	60%	
Meteorized rock	60%		40%
Rock	50%		50%

It is expected that the defense wall (rock fill) to be constructed from abscissas 4+300 to 5+840 will be built with refuse material from rock excavation at the Mine. The qualification of this material will be done in the field.

7.2.2 Material Transport

Calculations for material transport were made taking into account the mobilization of:

- Surpluses from road excavation
- Surplus material from structure excavation
- Transport of granular material from the mine to the road

Based on geotechnical studies, the following dumpsites were established:

Dumpsite	Location	
1	4+950	5+200
2	5+250	5+350
3	5+550	5+840

Which are located by the roadside and its construction will not cause damage to local landholders. Additionally, lateral dumping in convenient sites has been considered.

For the transport of rock material for the production of improvement material, subbase, base and aggregates for structural concrete, the following sources were considered.

Mine	Distance from Road [km]	Access km	Capacity	Production Materials
Churubia quarry	8.00	0+000	Undetermined	Improvement material, subbase, base, asphalt concrete and cement concrete
Military Camp quarry	6.00	0+000	Undetermined	Improvement material, subbase, base, asphalt concrete and cement concrete
km 4+800 to 5+800	0.00	4+800	Undetermined	Improvement material, subbase, base, asphalt concrete and cement concrete

For this budget, due to the aforementioned road conditions, the Churubia mine was chosen for improvement material, rock aggregates for concrete, and material for concrete.

7.2.3 Roadway

This group consists of the materials utilized to build it, that is: Improvement material, subbase, base, geomesh and geotextile.

The following designs were defined in order to determine the pavement structure.

Pavement Structure
Section 0+000 to 4+260

Material	Thickness
Geotextile and Type I biaxial geomesh	---
Improvement material	0.40 m
Subbase	0.25 m
Base	0.15 m

Pavement Structure
Section 0+000 to 4+260

Material	Thickness
Geotextile and Type I biaxial geomesh	---
Improvement material	0.60 m
Type I biaxial geomesh	---
Subbase	0.25 m
Base	0.15 m

7.2.4 Drainages

Volumes from drainage works refer to culverts, road ditches, crown ditches and subdrainage. These volumes were determined as per the characteristics of each of the works, depending also on local topography and on hydraulic and geotechnical conditions. The details of type structures can be seen in the hydraulic plans.

7.2.5 Bridge and Walls

The volumes corresponding to bridge items were determined as per structural geometry and characteristics of the infrastructure and superstructure. The definitive design plans were utilized for the quantification of said volumes.

Due to the availability of good quality rock material in the zone, it was deemed convenient to utilize gabions and reinforced earth structures for the design of support walls for this road. Their application will depend on the conditions and limitations of each site. Their location is shown in the following table.

LOCATION		Side	Length [m]	Type
2+315.00	2+375.00	L	60.00	Reinforced earth structure, Gabions
2+700.00	2+760.00	L	60.00	Gabions
3+545.00	3+595.00	R	50.00	Reinforced earth structure, Gabions
3+618.00	3+655.00	R	37.00	Gabions
3+796.00	3+820.00	R	24.00	Gabions
3+850.00	3+885.00	R	35.00	Gabions
3+905.00	3+940.00	R	35.00	Gabions
5+400.00	5+420.00	R	20.00	Gabions
5+455.00	5+495.00	R	40.00	Gabions
5+505.00	5+530.00	R	25.00	Gabions

7.2.6 Traffic Control Installations

They consist basically in preventive, informative and mandatory vertical signaling, and road guards.

7.2.7 Environmental Impact Mitigation Works

These items were established for the sites that will be intervened, such as the dumpsites alongside the road, as means of prevention against possible landslides in areas of high risk that have to be revegetated or arborized. They include some signs of informative and preventive character. Additionally and as part of indirect costs, the construction of latrines and grease accumulation structures have been planned; they will be placed where they are deemed necessary and will be utilized during the construction phase. Security guard houses will be placed in specific locations.

The results from the calculation of work volumes (based on 1 : 1,000 detail design road plans and on structural planes prepared by the consulting company), the information compiled by field technicians, and the field measurements, are summarized in the following Tables.

TABLE 7.1

WORK QUANTIFICATION
SECTION 1: CAMP – CRUSHER (0+000 – 4+260)

ITEM	D E S C R I P T I O N	UNIT	QTY.
1.00	**BASIC WORKS OR PLATFORM**		
302-1	Grubbing, tree removal and cleaning	ha	12.27
303-2(2)	Excavation in soil	m3	251,175.73
303-2(4)	Excavation in marginal	m3	58,686.05
303-2(3)	Excavation in rock	m3	-
303-2(5)	Excavation in mud	m3	12,558.79
304 1(1)	Borrow material, local	m3	20,472.16
304 1(2)	Borrow material, imported	m3	8,773.78
303-(4)1	Landslide clearing	m3	26,394.63
2.00	**MATERIAL TRANSPORT**		
309-2(2)	Transport of excavation material (500-m free haul)	m3 – km.	647,089.37
3.00	**ROADWAY STRUCTURE**		
402-2(1)	Subgrade improvement with selected soil	m3	16,572.45
403-1	Subbase, Class 3	m3	10,003.82
404-1	Base, Class 2	m3	5,871.60
402-7(1)	Geomesh, biaxial, Type 1	m2	37,548.42
402-7(3)	Geotextile (separator)	m2	32,650.80

206 (4)	Geosynthetic mantle	m2	-
4.00	**BRIDGES**		
307-2(2)	Excavation and fill for bridges	m3	4,454.12
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	22.84
503 (2)	Structural concrete, Class B (f'c = 240 kg/cm^2)	m3	295.49
503(1)	Structural concrete, Class A (f'c = 280 kg/cm^2)	m3	123.68
503(6)E	Expansion joint, MOP Type III	m	29.20
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	44,108.73
505(1)	Supply, manufacture and assembly of ASTM A-36 steel	kg	1,621.10
505(2)a	Supply of ASTM A-588 structural steel	kg	61,000.00
505(3)b	Manufacture of ASTM A-588 structural steel	kg	61,000.00
505(4)c	Assembly of ASTM A-588 structural steel	kg	61,000.00
507(2)	Paint for structural steel	kg	61,000.00
505(8)	Neoprene supports, stup type, hardness = 60, 32x32x4 cm	pc	12.00
402-2(1)	Subgrade improvement with selected soil	m3	914.47
605-1(2)	Filter material, Class 1, Type A	m3	57.94
607-6E	PVC pipe, dia. = 10 cm, drainage grade	m	45.38
5.00	**DRAINAGE**		
5.01	**Culverts**		
307-2(1)	Excavation and fill for structures	m3	2,995.46
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	117.03
503 (3)	Structural concrete, Class B (f'c = 240 kg/cm^2), curing agent included	m3	1,620.55
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	137,847.67
602-(2A)a	Corrugated steel pipe, dia. = 120 cm, th. = 2 mm	m	255.65
602-(2A)b	Corrugated steel pipe, dia. = 150 cm, th. = 3.5 mm	m	-
602-(5A)b	Pipe arch, corrugated steel, dia. = 605, rise = 442, th. = 3.5	m	21.55
602-(5A)c	Pipe arch, corrugated steel, dia. = 1,058, rise = 542, th. = 7.0	m	55.40
511-1(1)	Rock fill, loose rock, min. dia. = 0.30 m, max. dia. = 0.70 m	m3	334.05
5.02	**Ditches and Subdrainage**		
307-3(1)	Excavation for ditches and guide channels	m3	9,487.09
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	946.04
503 (3)	Structural concrete, Class B (f'c = 240 kg/cm^2), curing agent included	m3	402.71
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	16,108.37
605-1(2)	Filter material, Class 1, Type A	m3	3,188.55
606 1(1a)	Geotextile, for subdrainage, unwoven	kg	16,108.37
6.00	**RETAINING WALLS**		

307-2(1)	Excavation and fill for structures	m3	7,077.32
508 (3)	Gabion walls	m3	4,091.00
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	10,647.70
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	145.30
7.00	**TRAFFIC CONTROL SIGNALIZATION**		
708-5(1)a	Roadside signals, 0.75x0.75 cm, preventive	pc	48.00
708-5(1)a	Roadside signals, 0.75x0.75 cm, restrictive	pc	24.00
708-5(1)a	Roadside signals, 0.75x0.75 cm, informative	pc	19.00
703 (1)	Road guard	m	506.00
8.00	**ENVIRONMENTAL MITIGATION**		
310-(2)	Control and reshaping of surplus material in dumpsites	m3	265,052.80
206(1)	Sown areas - Revegetation of dumpsites and slope protection	m2	42,755.86
206(2)	Planted areas – Trees and shrubs	pc	4,750.00
212-(1)	Sanitary fills	pc	3.00
220-(1)	Environmental talk	pc	3.00
220-(3)	Informative posters	pc	200.00

TABLE 7.2

WORK QUANTIFICATION
SECTION 2: CRUSHER – PIT (4+260 – 5+840)

ITEM	D E S C R I P T I O N	UNIT	QTY.
1.00	**BASIC WORKS OR PLATFORM**		
302-1	Grubbing, tree removal and cleaning	ha	4.55
303-2(2)	Excavation in soil	m3	127,615.38
303-2(4)	Excavation in marginal	m3	93,946.19
303-2(3)	Excavation in rock	m3	87,636.26
303-2(5)	Excavation in mud	m3	6,380.77
304 1(1)	Borrow material, local	m3	58,688.00
304 1(2)	Borrow material, imported	m3	

			25,152.00
303-(4)1	Landslide clearing	m3	21,840.66
2.00	**MATERIAL TRANSPORT**		
309-2(2)	Transport of excavation material (500-m free haul)	m3 – km.	1,037,493.58
3.00	**ROADWAY STRUCTURE**		
402-2(1)	Subgrade improvement with selected soil	m3	19,227.48
403-1	Subbase, Class 3	m3	12,341.26
404-1	Base, Class 2	m3	-
402-7(1)	Geomesh, biaxial, Type 1	m2	37,675.59
402-7(2)	Geomesh, biaxial, Type 2	m2	33,094.28
402-7(3)	Geotextile (separator)	m2	32,761.38
206 (4)	Geosynthetic mantle	m2	48,960.73
4.00	**DRAINAGE**		
4.01	**Culverts**		
307-2(1)	Excavation and fill for structures	m3	8,687.44
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	253.53
503 (3)	Structural concrete, Class B (f'c = 240 kg/cm^2), curing agent included	m3	5,442.02
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	508,658.64
602-(2A)a	Corrugated steel pipe, dia. = 120 cm, th. = 2 mm	m	453.95
602-(2A)b	Corrugated steel pipe, dia. = 150 cm, th. = 3.5 mm	m	-
602-(5A)b	Pipe arch, corrugated steel, dia. = 605, rise = 442, th. = 3.5	m	57.60
602-(5A)c	Pipe arch, corrugated steel, dia. = 1,058, rise = 542, th. = 7.0	m	-
402-2(1)	Gabion walls	m3	-
605-1(2)	Filter material, Class 1, Type A	m3	-
511-1(1)	Rock fill, loose rock, min. dia. = 0.30 m, max. dia. = 0.70 m	m3	180.25
5.02	**Ditches and Subdrainage**		
307-3(1)	Excavation for ditches and guide channels	m3	3,938.07
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	-
503 (3)	Structural concrete, Class B (f'c = 240 kg/cm^2), curing	m3	

	agent included		171.00
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	6,840.00
605-1(2)	Filter material, Class 1, Type A	m3	2,339.86
606 1(1a)	Geotextile, for subdrainage, unwoven	kg	9,318.92
6.00	**RETAINING WALLS**		
307-2(1)	Excavation and fill for structures	m3	2,571.80
508 (3)	Gabion walls	m3	1,460.00
504(1)	Reinforcing steel bars (fy = 4,200 kg/cm^2)	kg	3,797.50
503 (4)	Structural concrete, Class C (f'c = 180 kg/cm^2)	m3	48.00
7.00	**TRAFFIC CONTROL SIGNALIZATION**		
708-5(1)a	Roadside signals, 0.75x0.75 cm, preventive	pc	12.00
708-5(1)a	Roadside signals, 0.75x0.75 cm, restrictive	pc	7.00
708-5(1)a	Roadside signals, 0.75x0.75 cm, informative	pc	5.00
703 (1)	Road guard	m	-
8.00	**ENVIRONMENTAL MITIGATION**		
310-(2)	Control and reshaping of surplus material in dumpsites	m3	225,105.79
206(1)	Sown areas - Revegetation of dumpsites and slope protection	m2	91,827.16
206(2)	Planted areas – Trees and shrubs	pc	10,203.00
212-(1)	Sanitary fills	pc	1.00
220-(1)	Environmental talk	pc	1.00
220-(3)	Informative posters	pc	50.00

7.3 UNIT PRICES

7.3.1 Basic Criteria

Unit price analysis requires a number of previous conditions that permit having enough judgment elements for the correct quantification of the main items of the works.

The Project budget was made in function of the following fundamental aspects:

- Reference date: September 2004
- Unit prices were prepared by CAMINOSCA.
- All unit price components are market components (without 12 % V.A.T.)
- Actual quantities are those resulting from the study of the works to be executed.
- Experience of CAMINOSCA in similar projects.

This chapter summarized the referential analyses of direct costs for labor, construction mechanized equipment and materials, that are necessary for the execution of civil works items for the construction of the project.

7.3.2 Objective and Scope of Cost Study

Costs are basic inputs that take part in the determination of the definitive referential budget.

The following aspects were analyzed to generate the referential budget for the works:

- Determination of hourly costs of ownership and equipment operation.
- Determination of hourly costs of qualified and non-qualified labor, in open air
- Calculation of the costs of basic inputs of unit prices, materials.
- Estimate of the yield of the machinery and equipment to be utilized
- Unit price analysis to determine construction costs
- Estimate of work volumes for the proposed items

7.3.3 Unit Price Components

The unit price of each item is defined by the sum of direct costs for labor, equipment, materials and transport, and of indirect costs.

Direct cost is composed as follows.

O **Labor Cost:** Corresponds to the hourly wages of mechanical equipment operators and construction workers that participate in the execution of the item; includes social duties.

E **Equipment Cost:** Obtained from the analysis of hourly costs of ownership and operation, under average conditions, for each of the machines participating as equipment for the execution of the item.

H **Tool Cost:** In accordance with common practice in Ecuador, it is considered as 5% of the labor cost.

M **Material Cost:** Is the value of the various materials quantified for the execution of the item, considering the quantity or consumption of the material to be utilized and its unit price. Using as reference the market analysis performed in the project zone, a database was prepared that fed, in turn, the unit price analysis of the various items.

S **Unit Cost Without Material Transport:** It is the quotient between the sum of equipment costs, labor and tools, and the adopted average yield.

T **Transport Cost:** It is the value corresponding to the transport of materials to the site where they will be utilized.
The location of the mines for basic materials determines the mean transport distance for each material, specifically: Improvement material, subbase, base, and other rock aggregates.
The materials obtained from these mines comply with the requirements from MOP general specifications.

CUD **Direct Unit Cost:** Equals the sum of M, S and T

CI **Indirect Cost:** It was determined by considering the following components and values:

A.	GENERAL EXPENSES	15.0%
B.	UNFORESEEABLES	4.0%
C.	PROFIT	8.0%
D.	SENIORITY	1.0%
	TOTAL INDIRECT COST	28.0%

The referential indirect cost adopted is 28%, for road work as well as for structural components.

For the determination of each of the aforementioned costs, mean operation conditions were considered. These conditions must prevail in the works and in the construction methods for each activity to be executed, in order to always keep work planning and execution in harmony.

7.3.4 Technical Specifications

The general reference model considered for the analysis of construction processes was the Manual of General Specifications for the Construction of Roads and Bridges [*Manual de Especificaciones Generales para Construcción de Caminos y Puentes*] MOP-001-F 2002, year 2002 edition, from MOP.

This manual provides a reference for the minimum characteristics of mechanized equipment, personnel and materials to be complied with by the constructor for the execution of each of the proposed items.

7.4 BUDGETS

7.4.1 Categorized Referential Budget

Based on the calculated work volumes and referential prices, the referential financial budget of the Project was obtained, whose globalized summary in function of the works components indicated below.

REFERENTIAL BUDGET

September 2004
Section 1: Camp – Crusher (0+000 – 4+260)

ITEM	GENERAL SUMMARY		SUBTOTAL [USD]	%
1.00	BASIC WORKS OR PLATFORM		763,886.68	17.64
2.00	MATERIAL TRANSPORT		770,036.35	17.79
3.00	ROADWAY STRUCTURE		594,535.25	13.73
4.00	BRIDGES		426,173.24	9.84
5.00	DRAINAGE		1,193,576.61	27.57
6.00	RETAINING WALLS		227,630.54	5.26
7.00	TRAFFIC CONTROL SIGNALIZATION		29,420.60	0.68
8.00	ENVIRONMENTAL MITIGATION		324,070.70	7.49
	A.- Project Cost		4,329,329.97	100.00
	B.- General Contingents	5.0%	216,466.50	
	C.- Construction Designs	4.0%	181,831.86	
	D.- Construction Supervision	8.0%	378,210.27	
	TOTAL COST OF PROJECT		**5,105,838.60**	
	Total length of Project =	4.26	km	
	Actual cost per kilometer =	1,198,553.7	USD/km	

REFERENTIAL BUDGET

September 2004
Section 2: Crusher – Pit (4+260 – 5+840)

ITEM	GENERAL SUMMARY		SUBTOTAL [USD]	%
1.00	**BASIC WORKS OR PLATFORM**		1,768,350.37	27.53
2.00	**MATERIAL TRANSPORT**		1,234,617.36	19.22
3.00	**ROADWAY STRUCTURE**		921,369.10	14.35
4.00	**BRIDGES**		-	0.00
4.00	**DRAINAGE**		2,024,780.61	31.53
6.00	**RETAINING WALLS**		81,104.05	1.26
7.00	**TRAFFIC CONTROL SIGNALIZATION**		29,420.60	2,265.12
8.00	**ENVIRONMENTAL MITIGATION**		390,104.97	6.07
	A.- Project Cost		6,422,591.58	100.00
	B.- General Unforeseeables	**5.0%**	321,129.58	
	C.- Construction Designs	**4.0%**	269,748.85	
	D.- Construction Supervision	**8.0%**	561,077.60	
	TOTAL COST OF PROJECT		**7,574,547.61**	
	Total length of Project =	1.58	km	
	Actual cost per kilometer =	4,791,430.7	USD/km	

7.5 SCHEDULE

7.5.1 Introduction

The construction of the Camp – Crusher – Pit access road will be performed with the following considerations:

1) The Churubia mine will be habilitated for exploitation, expanding the work platforms for the placement of industrial equipment.

2) The existing access road to the works will be habilitated.

3) By design, two schedules were prepared (Section 1, from 0+000 to 4+260, and Section 2, from 4+260 to 5+840) which may be executed simultaneously once the pilot road for Section 1 has been made.

7.5.2 Construction Time Estimates

The objective of proposed schedules is to coordinate the construction of the road and bridges for both Sections.

The work for the first Section will start with the construction of the pilot road up to abscissa 4+260, where the construction of Section 2 is to begin. From this milestone, the simultaneous construction of both Sections is planned.

The habilitation of the pilot road will take an estimated two months, and the equipment mobilization to begin working on Section 2, 15 days. This means that the second work front will begin activities 2.5 months after the initiation of the second front.

It is planned for both fronts to have a construction time of 5 months with a 2.5 months lag between fronts. This determines the total construction time to be 7.5 months.

Section 10.5 contains the detailed budget for the works for each Section, and the Valued Disbursement Schedule based on the aforementioned criteria.

CHAPTER VIII: CONCLUSIONS AND RECOMMENDATIONS

- The studies were performed at preliminary engineering level and included the selection of the route corridor utilizing a 1 : 10,000 aerophotogrammetric restitution provided by ECUACORRIENTE. Field inspections were made over this layout to verify the advantages of this corridor; a gradient line was laid out over which a preliminary polygon staked every 20 m or less was placed. A topographic band between 80 and 150-m wide was surveyed, where a regional geologic study and geotechnical mapping were performed. By means of a geometric layout and geotechnical investigations, slope parameters were defined and the type and stratigraphy of materials were estimated. Traffic estimates were made prior to pavement design. Drainage studies were performed for the required major and minor ancillary works. The preliminary structural project was prepared for the two bridges required over Wawayme River. Work quantification and construction budget estimations were finally performed for each Section. Plans were made at 1 : 1,000 scale in compliance with the respective formats. These studies were made in conformity with MOP standards.

- Section 1 has a total cost of USD 5 105 838,60. It includes the construction cost, unforeseeables, and project engineering (an approximate 18 % of the construction cost). It has a length of 4.26-km and an estimated 5-month construction term.

- Section 2 has a greater cost due to the fact that the width of the basic platform is 3,4 times the one from Section 1, even though it has a shorter length. Total budget is USD 7 574 547,61 for 1 58-km and an estimated 5-month execution.

- ECUACORRIENTE can initiate the construction of the pilot road based on these preliminary studies. To this effect, it must have the topographic layout of the road centerline and construction laterals for Section 1 in order to mobilize machinery, prepare a second work front for Section 2, perform the definitive studies for the Project, and prepare construction plans. The execution term of the pilot road is estimated to be 2,5 months; it will provide a definitive and safe access during the operation of the mine.

- The definitive studies of the Project must be submitted as part of the Environmental Management Plan of the Mining Development and its environmental permit.

- After the road has been constructed, ECUACORRIENTE must register it in the Provincial Directorate of Public Works [*Dirección Provincial de Obras Públicas*] of the province of Zamora, which belongs to MOP. Registration must be as Private Road, and the respective rights paid in compliance with the Ecuadorian Law of Roads [*Ley y Reglamento de Caminos de la República del Ecuador*]

CHAPTER IX: PLANS

270-EST-001-A	BRIDGE ON ABSC. 0+133 LOCATION PLAN - ELEVATION - SECTION
270-EST-002-A	BRIDGE ON ABSC. 0+597 LOCATION PLAN - ELEVATION - SECTION
270-EST-003-A	BRIDGE ON ABSC. 0+133 ABTUMENT & BOARD SLAB
270-EST-004-A	BRIDGE ON ABSC. 0+597 ABTUMENT & BOARD SLAB
270-EST-005-A	METALLIC BRIDGE (L=30.00m BEAMS GEOMETRY, ELEVATION, PLAN & SECTIONS
270-EST-006-A	RETAINING WALLS
270-GEN-001-A	GENERAL ARRANGEMENT PLAN
270-GEO-001-A	GEOLOGIC MAP
270-GEO-002-A	GEOLOGIC MAP ABSC: 0+000 - 3+200
270-GEO-003-A	GEOLOGIC MAP ABSC: 3+200 - 5+840.85
270-GEO-004-A	GEOLOGIC PROFILE ABSC: 0+000 - 2+000
270-GEO-005-A	GEOLOGIC PROFILE ABSC: 2+000 - 4+000
270-GEO-006-A	GEOLOGIC PROFILES ABSC: 4+000 - 5+840.85
270-GEO-007-A	GEOLOGIC SECTIONS ABS 0+170 - 5+760
270-GEO-008-A	BRIDGE LOCATION GEOLOGIC PROFILES
270-GEO-009-A	LOCATION OF MATERIAL SOURCES
270-GEO-010-A	LOCATION OF GEOTECHNICAL INVESTIGATIONS
270-HID-001-A	CULVERT PROFILES

270-HID-002-A	CULVERT PROFILES ABSC: 3+766,92 - 4+717,00
270-HID-003-A	CULVERT PROFILES ABSC: 5+048,57 - 5+664,17
270-HID-004-A	MISCELLANEOUS DRAINAGE STRUCTURES PLAN, SECTIONS AND DETAILS
270-HID-005-A	CULVERT INLET AND OUTLET DIMENSIONS AND REINFORCEMENT
270-HID-006-A	SUPERSPAN AND BOX CULVERT SECTIONS AND DETAILS
270-TOP-001-A	TOPOGRAPHIC PLAN
270-VIA-001-A	PLAN & PROFILE km 0+000 - km 1+000
270-VIA-002-A	PLAN & PROFILE km 1+000 - km 2+000
270-VIA-003-A	PLAN & PROFILE km 2+000 - km 3+000
270-VIA-004-A	PLAN & PROFILE km 3+000 - km 4+000
270-VIA-005-A	PLAN & PROFILE km 4+000 - km 5+000
270-VIA-006-A	PLAN & PROFILE km 5+000 - km 5+840,853

CARACTERÍSTICAS GEOTÉCNICAS DEL SITIO DE IMPLANTACIÓN DEL MILLSITE

CAPÍTULO 1: INTRODUCCIÓN

1.1 ANTECEDENTES GENERALES

El nuevo sitio propuesto para la implantación del Millsite se encuentra alrededor del punto de coordenadas 774 075 Este y 9´605 227 Norte en el flanco occidental de una pequeña cordillera que se extiende a lo largo de la margen izquierda del río Zamora, entre El Pincho y Chuchumbleza. El área investigada tiene aproximadamente una superficie de aproximadamente 52 hectáreas que se encuentra sobre los 800 metros de altura sobre el nivel del mar.

El acceso al sitio se produce desde la carretera Zamora – Gualaquiza, en el sector de La Palmira entre el Pangui y Chuchumbleza, se desprende un camino vecinal que se dirige hacia el Este, a los dos kilómetros de distancia este camino se bifurca, el ramal que se dirige hacia el Noreste se aproxima cerca del área estudiada.

El sitio de implantación del Millsite se encuentra en el interior del área de influencia de la línea de transmisión Sabanilla – Tundayme, misma que fue objeto de un estudio geológico y geotécnico elaborado recientemente por CAMINOSCA para CORRIENTE.

1.2 OBJETIVOS

Conocer la estratigrafía y naturaleza de los suelos presentes en el sito de implantación así como determinar las características geotécnicas y variación de la capacidad de carga en función de la profundidad.

1.3 METODOLOGÍA E INVESTIGACIONES REALIZADAS

Sobre la base de una propuesta presentada por CAMINOSCA, para la ejecución de sondeos manuales con avance a percusión y ensayos de penetración estándar (SPT) cada metro, CORRIENTE definió los sitios exactos donde debían realizarse estas perforaciones. Originalmente estuvieron programadas 11 perforaciones, sin embargo, se ejecutaron dos adicionales en razón de que en una fila de tres perforaciones la resistencia de los materiales atravesados no permitió profundizar la investigación. Complementariamente, se excavaron dos calicatas en los mismos sitios perforados, con la finalidad de obtener muestras cúbicas inalteradas; sin embargo, las características de los materiales dificultaron la obtención de muestras idóneas para ensayos triaxiales. Sin embargo en una de las calicatas se recolectó una muestra para ensayos de consolidación y compactación. La ubicación de cada uno de los sitios investigados se presenta en el Cuadro 1 (Apéndice A).

En cada sitio investigado se procedió a realizar el análisis estratigráfico respectivo, la clasificación manual – visual de los suelos y se seleccionaron muestras representativas de los mismos para posteriores ensayos de laboratorio. En total se efectuaron 35 ensayos de clasificación, 13 mediciones de la densidad, 1 ensayos de compresión simple, 7 ensayos triaxiales no consolidados no drenados, 1 ensayo de consolidación y 1 ensayo de compactación proctor estándar.

Los registros de perforación se encuentran en el Apéndice B y los resultados del laboratorio de los suelos están contenidos en el Apéndice C.

Una vez obtenidos los resultados de los ensayos de laboratorio de mecánica de los suelos, se procesó la información de campo y se efectuaron las evaluaciones correspondientes. El cálculo de las capacidades de carga de los suelos en los sitios investigados se efectuó empleando las ecuaciones de Meyerhoff (1965), Bowles (1977) y Teng (1962), los valores obtenidos fueron promediados para obtener el promedio de estos resultados.

CAPÍTULO 2: CARACTERIZACIÓN GEOLÓGICA Y GEOTÉCNICA DEL SITIO

2.1 MARCO GEOLÓGICO REGIONAL

El área de implantación del Mill Site está localizada en la parte sur oriental del país, en las estribaciones orientales de la Cordillera Real. El basamento rocoso de la zona está conformado por las rocas intrusivas jurásicas pertenecientes al Batolito de Zamora, el cual es cubierto discordantemente por las areniscas cretácicas de la Formación Hollín.

Esta relación estratigráfica puede apreciarse a lo largo de la carretera Chuchumbleza – Tundaime, en la margen izquierda del río Zamora, donde las areniscas de la Formación Hollín presentan una estratificación subhorizontal y forman escarpes subverticales sobre las rocas del Batolito Zamora.

2.2 GEOMORFOLOGÍA

El área destinada para la implantación de las obras está ubicada sobre una superficie estructural que desciende con una inclinación promedia de nueve grados hacia el Occidente desde una pequeña cordillera que se extiende a lo largo de la margen izquierda del río Zamora. El relieve ligeramente ondulado y atravesado por pequeños drenajes cuyos cauces, especialmente en las partes bajas, no superan el metro de profundidad.

En cuanto a fenómenos morfodinámicos que puedan afectar al sector de implantación de las obras, se reconocieron procesos erosivos de baja intensidad. No se identifican procesos de inestabilidad del terreno.

2.3 ESTRATIGRAFÍA Y LITOLOGÍA

El substrato rocoso en el área de implantación del Millsite es conformado por las areniscas cuarzosas pertenecientes a la Formación Hollín. No existen afloramientos de estas rocas en el sector.

El basamento rocoso está cubierto por un manto de materiales superficiales que alcanza espesores variables entre 2 y cerca de 12 metros. Estos suelos son derivados de la meteorización y erosión de las areniscas Hollín y pueden ser clasificados en dos unidades que se describen a continuación.

2.3.1 Depósitos Coluviales

El material detrítico y fino granular, producto de la meteorización y erosión de los macizos rocosos, es transportado por acción de la gravedad hasta zonas de poca pendiente donde forman acumulaciones caóticas conocidas genéricamente como coluviales. Están constituidos por fragmentos angulosos y subangulares soportados por una matriz limosa y arcillosa con arena y gravas. El porcentaje de material detrítico puede variar entre 20% a 40% y es conformado por bloques y fragmentos de arenisca meteorizada y fragmentos de cuarzo. La matriz es cohesiva, tiene una plasticidad media a alta, no es consolidada y presenta escasa resistencia a la erosión.

Los coluviales presentan una alta porosidad, principalmente aquellos que tienen un porcentaje de detritos superior al 40 %; sin embargo no se observaron vertientes ni escurrimiento desde su interior aunque es evidente la humedad que presentan.

En las perforaciones se recuperaron muestras de material retrabajado, clasificado como coluvial, que presentan fragmentos subredondeados de cuarzo lechoso de hasta 3 centímetros de diámetro mezclados con fragmentos angulosos de arenisca meteorizada y cuarzo, lo que indica la presencia de antiguos cauces en el sector.

Los parámetros geotécnicos que caracterizan a estos suelos se presentan en el Cuadro 2 de donde se destaca que por lo general la humedad natural es relativamente baja y se encuentra relativamente alejada del límite líquido, lo que en cierta medida es favorable para las condiciones de estabilidad de estos suelos.

2.3.2 Suelos Residuales

Son formados por la alteración de las rocas del basamento y de los coluviales en un ambiente cálido y húmedo. Se presentan como un manto que cubre prácticamente toda el área, su coloración es habana amarillenta y ocasionalmente rojiza, alcanzan espesores de hasta cinco metros. En cualquier caso, los suelos son limo arcillosos y limo arenosos de consistencia blanda, tienen un comportamiento plástico en condiciones naturales donde se encuentra húmedos hasta saturados. Durante la época de estiaje estos suelos residuales se presentan superficialmente con una consistencia frágil a deleznable y a la vez con una resistencia firme; sin embargo, a poca profundidad (algunas decenas de centímetros) se encuentran húmedos a causa de su muy limitada capacidad de drenaje y su gran capacidad de almacenar el agua en el interior de la estructura molecular.

La matriz fina soporta detritos en proporciones extremadamente variables, los cuales están constituidos por granos redondeados y subredondeados de cuarzo. Estos fragmentos tienen un tamaño promedio de 2 a 3 milímetros aunque ocasionalmente aparecen detritos subangulares hasta de 2 centímetros de largo, donde se incluyen fragmentos de arenisca meteorizada, los cuales en conjunto no sobrepasan del 5% en volumen.

Los parámetros geotécnicos que caracterizan a los suelos residuales se presentan en el Cuadro 3 y al igual que lo indicado para los coluviones, se observa que estos suelos no están saturados, su humedad natural está relativamente alejada del límite líquido. Esta condición es favorable para la estabilidad de estos suelos.

Se obtuvo una muestra representativa del suelo residual sobre la cual se realizaron ensayos de compactación y de consolidación. El ensayo de compactación es útil para determinar las características de este suelo si se lo utilizara como material de relleno. El ensayo proctor determinó que este suelo alcanza una densidad seca máxima de 1,42 gr/cm^3 con una humedad del 30% durante un proceso de compactación. Este resultado permite concluir que este suelo se puede utilizar en rellenos y terraplenes con un control adecuado de la humedad ya que la humedad natural es ligeramente menor que la humedad óptima del ensayo proctor.

Por otra parte, con la finalidad de conocer los parámetros a partir de los cuales se deberán calcular los asentamientos y tiempos de consolidación, en función de las cargas de trabajo previstas en la obra, se realizó un ensayo de consolidación en este mismo suelo, los parámetros resultantes se encuentran en el reporte respectivo.

Los suelos residuales son muy vulnerables a la acción del agua y a las actividades antrópicas si no están protegidos con un manto vegetal; en efecto, los suelos residuales que se encuentran protegidos por una cobertura vegetal tipo bosque no presentan indicios de inestabilidad; por el contrario, son relativamente frecuentes los procesos de reptación en laderas cubiertas por pasto.

CAPÍTULO 3: EVALUACIÓN DE LA CAPACIDAD DE CARGA DE LOS SUELOS

En el Cuadro 4 se presenta una síntesis de la litología, clasificación de los suelos y variación de la capacidad de carga admisible en función de la profundidad. Adjunto a este Cuadro se presenta un gráfico con los resultados obtenidos en todos los sondeos y sus variaciones con la profundidad. En términos generales se aprecia que a una profundidad de un metro solamente en los Sondeos B e I, la carga admisible es igual o menor que 1 kg/cm^2. En el resto de sitios esta carga es mayor que 1,3; a una profundidad de 2 metros este parámetro aumenta a valores cercanos o mayores a los 2 kg/cm^2 valor que es superado a medida que se profundiza el suelo. Únicamente en un caso, el sondeo B, la carga admisible disminuye a una profundidad de 5 metros.

CAPÍTULO 4: CONCLUSIONES Y RECOMENDACIONES

- En general las condiciones geológicas y geotécnicas de los suelos en los sitios de implantación de las obras son adecuadas y tienen capacidades de carga apropiadas para la cimentación de estructuras.

- Los materiales que resulten de las excavaciones que se practiquen pueden ser utilizados en la conformación de rellenos y terraplenes.

- En sus condiciones naturales los suelos presentes en el sitio de implantación del Millsite tienen buenas condiciones de humedad natural lo que en cierta medida asegura las condiciones de estabilidad del sitio.

- La implantación de las estructuras afectará la circulación natural de la escorrentía, por lo que se recomienda su encauzamiento por medio de cunetas impermeabilizadas y alcantarillas. Como obras de protección de estos suelos se recomienda implementar la protección vegetal en las áreas que se intervengan.

- Por otra parte, los sitios seleccionados para la implantación no están amenazados directamente por fenómenos de inestabilidad con lo cual la integridad de la obra está asegurada y su vulnerabilidad frente a este tipo de amenazas es casi despreciable.

CAPÍTULO 6: REFERENCIAS

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APÉNDICE A: CUADROS Y GRÁFICO

CUADRO 1

UBICACIÓN Y PROFUNDIDADES ALCANZADAS EN LAS INVESTIGACIONES

Trabajo	Código	Coordenadas		Profundidad (m)
		Norte	Este	
Perforaciones manuales con avance a percusión	A	9 605 307	773 961,1	7,0
	B	9 605 342	774 027,4	8,0
	C	9 605 374	774 096,8	12,0
	D	9 605 192	774 010,2	12,0
	E	9 605 227	774 075,9	12,0
	F	9 605 259	774 146,0	2,0
	G	9 605 082	774 066,3	2,0
	H	9 605 119	774 132,8	2,0
	I	9 605 154	774 198,9	5,0
	J	9 605 065	774 243,7	9,0
	K	9 605 099	774 312,0	3,0
	L	9 605 139	774 042,6	8,0
	M	9 605 204	774 174,9	3,0
Excavación de calicatas	C-1	9 605 080	774 062	1,5
	C-2	9 605 225	774 073	2,0

CUADRO 2

PRINCIPALES CARACTERÍSTICAS GEOTECNICAS DE LA MATRIZ DE LOS DEPÓSITOS COLUVIALES

Parámetro	Máximo	Mínimo	Promedio
% que pasa el tamiz 4	100	69	96,06
% que pasa el tamiz 200	99	25	68,82
Contenido de Grava [%]	31	0	3,94
Contenido de Arena [%]	61	1	27,24
Contenido de Finos [%]	99	25	68,82
Humedad natural [%]	40,03	18,75	26,76
Límite líquido [%]	122,7	33,1	61,26
Límite plástico [%]	41,8	20,4	29,59
Índice plástico [%]	87,5	8,3	31,65
Cohesión [t/m^2]	8,7	2,2	4,43
Angulo de fricción	10,5	7,6	9,53
Densidad natural [t/m^3]	2,153	1,688	1,93
Densidad seca [t/m^3]	1,637	1,207	1,48
Densidad máxima seca [t/m^3]	1,420		
Humedad óptima (%)	30		
Clasificación SUCS	CH, CL, MH, SC		

CUADRO 3

PRINCIPALES CARACTERÍSTICAS GEOTECNICAS DE LOS SUELOS RESIDUALES

Parámetro	Máximo	Mínimo	Promedio
% que pasa el tamiz 4	100	89	99
% que pasa el tamiz 200	100	21	68
Contenido de Grava [%]	11	0	1,19
Contenido de Arena [%]	78	0	30,63
Contenido de Finos [%]	100	21	68,19
Humedad natural [%]	29,87	14,62	22,33
Límite líquido [%]	96,5	26,7	53,26
Límite plástico [%]	34,9	16,8	24,48
Índice plástico [%]	61,6	63	28,78
Cohesión [t/m^2]	8,6	0,8	3,50
Angulo de fricción	10	6	8,67
Resistencia a la compresión simple [t/m^2]	41,8		
Densidad natural [t/m^3]	2,125	1,196	2,06
Densidad seca [t/m^3]	1,742	1,511	1,62
Clasificación SUCS	CH, CL, MH, SC, SM		

CUADRO 5

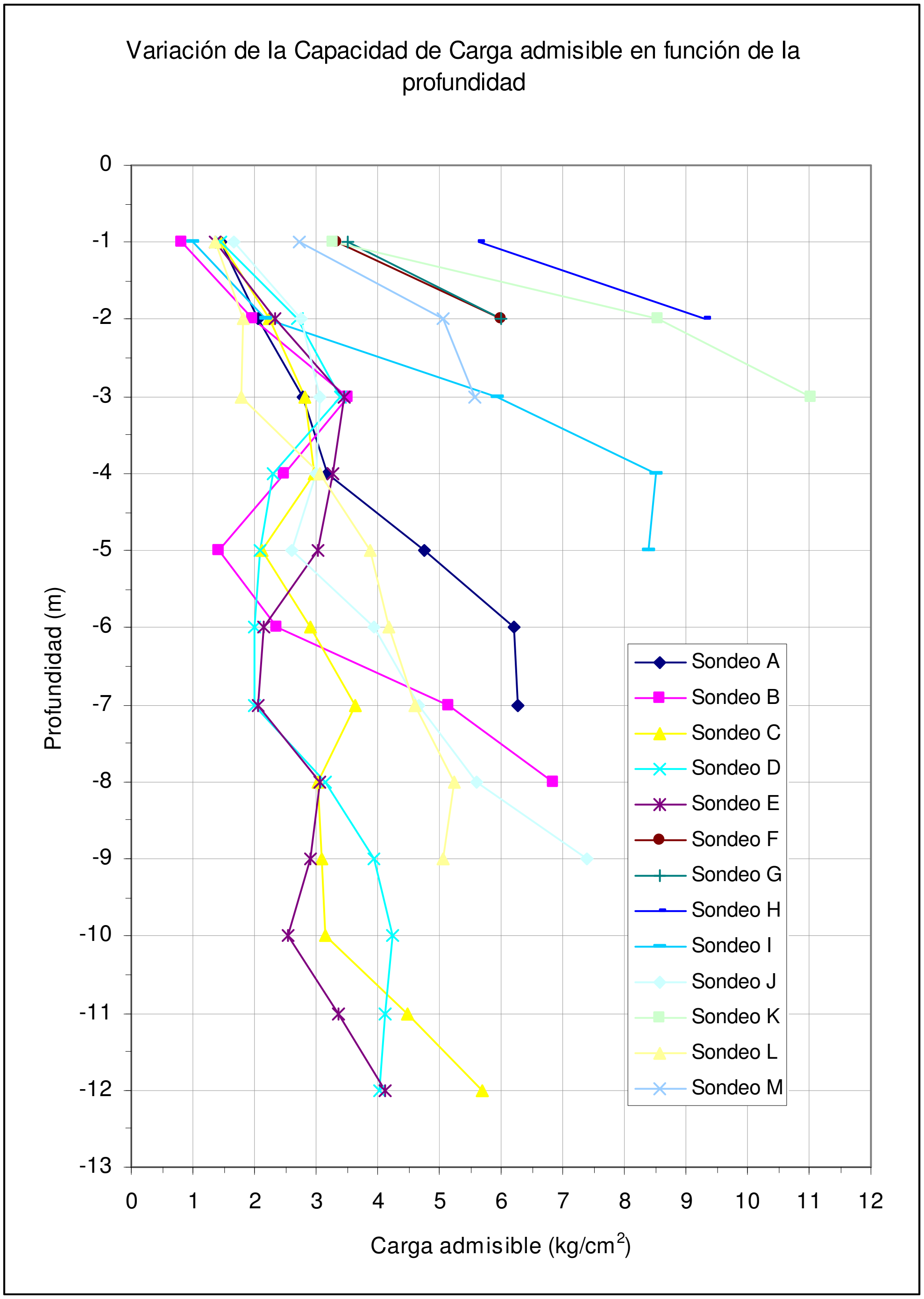
ESTRATIGRAFÍA Y CAPACIDAD DE CARGA DE LOS SUELOS PRESENTES EN LOS SITIOS DE INVESTIGACION

Sondeo	Profundidad m	Litología	SUCS	Densidad kg/cm^3	Profundidad del nivel freático m	Carga admisible kg/cm^2
A	1	Suelo residual, conformado por arcilla de color café amarillento, alta plasticidad, humedad alta a saturada, consistencia firme a rígida. Contiene un 5% de gravas subangulares de cuarzo de hasta 5 mm. Hacia la base el color es blanquecino.	CH	1,960	3,75	1,47
	2					2,05
	3					2,77
	4		CL	2,120		3,18
	5					4,75
	6		CH	2,047		6,22
	7			2,110		6,29
B	1	Depósito coluvial, café amarillento a rojizo en la base, humedad alta, plasticidad alta, consistencia de muy blanda a muy firme, contiene esporádicas gravas de cuarzo.	MH	1,907	4,3	0,81
	2					1,96
	3					3,53
	4					2,48
	5	Suelo residual, arena arcillosa de color gris claro, humedad alta, plasticidad baja, consistencia firme a rígida.	SC	2,037		1,43
	6					2,38
	7					5,16
	8					6,84
C	1	Depósito Coluvial, al tope limo de color café claro, plasticidad alta. Luego matriz arena arcillosa cambiando a arena limosa de color café rojizo, humedad alta densidad relativa media a densa. Contiene esporádicas gravas de cuarzo y fragmentos de hasta 10 cm.	MH	1,89	4,15	1,47
	2		SC	2,028		2,23
	3					2,82
	4					3,96
	5					2,13
	6		SM			2,92
	7					3,63
	8					3,03
	9					3,09
	10	Suelo residual, arcilla de café amarillento con pintas violetas, humedad y plasticidad altas, consistencia muy firme a rígida.	CH	2,128		3,14
	11					4,49
	12					5,71

Sondeo	Profundidad m	Litología	SUCS	Densidad kg/cm^3	Profundidad del nivel freático m	Carga admisible kg/cm^2
D	1	Coluvial, limo arenoso de color rojizo, humedad y plasticidad altas, consistencia media a muy firme, contiene arena fina y fragmentos de cuarzo y arenisca meteorizada.	MH	1,93	3,50	1,47
	2					2,71
	3		CH	1,964		3,40
	4					2,30
	5	Suelo residual, arcilla arenosa de color café amarillento, humedad y plasticidad altas, consistencia firme a muy firme, contiene fragmentos de cuarzo y arenisca meteorizada hasta 2 cm.				2,09
	6					2,00
	7					2,01
	8					3,16
	9					3,93
	10	Suelo residual arena limosa de color café amarillento, humedad alta, plasticidad baja, compacidad compacta, contiene fragmentos de cuarzo y arenisca meteorizada hasta 2 cm.	SM	2,028		4,25
	11					4,13
	12					4,04
E	1	Coluvial, limo color café amarillento rojizo, humedad y plasticidad alta, consistencia media a firme, con gravas de cuarzo y arenisca meteorizada.	MH	1,688	5,45	1,37
	2					2,35
	3			1,869		3,46
	4	Coluvial, arcilla café amarillenta, plasticidad alta, consistencia muy firme.	CH	1,96		3,28
	5					3,03
	6	Coluvial, matriz areno arcillosa, café amarillenta, compacidad media, con gravas de cuarzo y arenisca meteorizada.	SC	1,993		2,16
	7					2,07
	8					3,05
	9	Suelo residual, arcilla de color gris a blanquecino, plasticidad baja, consistencia muy firme a rígida.	CL	2,072		2,91
	10					2,54
	11					3,36
	12					4,11
F	1	Coluvial, matriz arcillosa, color café, plasticidad alta consistencia media, con gravas.	CH	2,069	0,20	3,38
	2	Suelo residual, arcilla de color gris claro, plasticidad alta, presenta laminaciones horizontales de oxidación, contiene fragmentos de arenisca ligeramente meteorizadas.				6,01
G	1	Coluvial, matriz limosa de color café amarillento con tintes rojizos, plasticidad alta, consistencia media a rígida. Contiene gravas subangulares de arenisca cuarzosa blanca de hasta 2 cm.	MH	1,889	>2,0	3,50
	2					6,01

Sondeo	Profundidad m	Litología	SUCS	Densidad kg/cm^3	Profundidad del nivel freático m	Carga admisible kg/cm^2
H	1	Coluvial, matriz arcillosa de color café amarillenta con tintes rojizos, plasticidad baja, consistencia firme a rígida. Contiene un 30 % de gravas subangulares de arenisca cuarzosa blanca de hasta 2 cm.	CL	2,026	>2,0	5,63
	2					9,31
I	1	Coluvial, limo color amarillento, plasticidad alta, consistencia media, con fragmentos angulares de cuarzo de hasta 1 cm.	MH	1,889	>5,0	1,00
	2		CH	1,999		2,19
	3	Coluvial, arcilla color café rojizo, plasticidad alta, consistencia firme a rígida, contiene un 5 % de gravas de cuarzo.				5,93
	4					8,53
	5	Arcilla de color grisáceo humedad y plasticidad altas, consistencia rígida.				8,41
J	1	Coluvial, limo color amarillento, plasticidad alta, consistencia media, con un 15 % de gravas de cuarzo de hasta 2 cm.	MH	1,889	>9,0	1,66
	2		SC	1,951		2,76
	3	Matriz areno arcillosa, color café rojiza.	MH	1,889		3,07
	4	Coluvial, limo color con tintes grices y rojizos, plasticidad baja, consistencia firme, con un 30 a 40 % de gravas de cuarzo de hasta 3 cm.	ML	2,153		3,01
	5					2,61
	6					3,93
	7					4,67
	8	Arena limosa color café, compacidad media.	SM	2,028		5,61
	9	Limo de color gris claro, con manchas rojizas, humedad y plasticidad altas, consistencia rígida.	CH	1,999		7,41
K	1	Coluvial, matriz limosa de color café amarillento cambiando a gris claro a rojizo, plasticidad alta, consistencia blanda a rígida. Contiene un 20 a 30 % de gravas de cuarzo de hasta 2 cm.	CH	1,953	>4,0	3,26
	2					8,56
	3					11,02

Sondeo	Profundidad m	Litología	SUCS	Densidad kg/cm^3	Profundidad del nivel freático m	Carga admisible kg/cm^2
L	1	Coluvial, limo color amarillento, plasticidad alta, consistencia media, con esporádicas gravas de cuarzo subangulares de hasta 5 cm.	MH	1,889	5,20	1,37
	2					1,81
	3	Coluvial, arena arcillosa, café rojiza, compacidad media, con un 15 % de gravas de cuarzo y arenisca meteorizada de hasta 3 cm.	SC	2,028		1,78
	4					3,05
	5					3,87
	6	Arcilla de color gris claro con tintes rojizos, plasticidad baja de consistencia muy firme a rígida.	CL	2,06		4,18
	7					4,61
	8		MH			5,24
	9	Arena arcillosa gris claro muy compacta.	CH			5,07
M	1	Coluvial, arena limosa, blanca, grano fino, compacidad suelta, con gravas de hasta 2 cm.	SM	2,028	0,20	2,73
	2	Arcilla gris blanquecino, humedad y plasticidad alta, consistencia rígida.	CH	1,999		5,08
	3	Arena amarillenta de grano fino, humedad alta y compacidad muy compacta.	SC	2,028		5,56

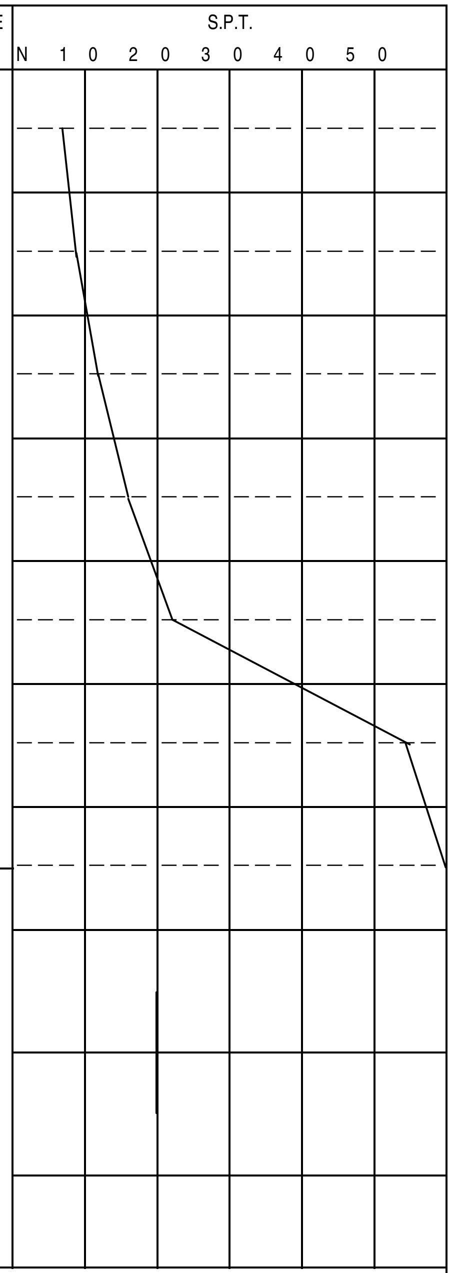


Variación de la Capacidad de Carga admisible en función de la profundidad
Profundidad (m)
Carga admisible (kg/cm2)
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
0
1
2
3
4
5
6
7
8
9
10
11
12
Sondeo A
Sondeo B
Sondeo C
Sondeo D
Sondeo E
Sondeo F
Sondeo G
Sondeo H
Sondeo I
Sondeo J
Sondeo K
Sondeo L
Sondeo M

REGISTRO DE PERFORACION

PROYECTO	: MILL SITE	PERFORACION	: A
OBRA	: CIMENTACION	COORDENADAS	: 9605307 N
UBICACION	: PLATAFORMA A		: 773961,1 E
FECHA	: 06- MARZO-2005	PERFORADOR	: G. MORLES
		JEFE DE CAMPO	: J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
	v v v	Cobsertura vegetal 0,50 m	CH	3-3-5 N=8
1.0		Sielo residual. Arcilla plástica, café amarillenta, con esporádicas gravas subangulares de cuarzo de 5 mm de diámetro, de consistencia firme.	CH	3-4-5 N=9
2.0		2,60 m	CH	3-5-7 N=12
3.0		Suelo residual. Arcilla de baja plasticidad, de color café amarillento, con manchas rojizas, húmedo, con un 5% de gravas subangulares de cuarzo lechoso de hasta 5cm, de consistencia muy firme 4,90 m	CL	3-8-9 N=17
4.0			CL	6-9-13 N=22
5.0		Suelo residual. Arcilla plástica, de color blanco con manchas rojizas, con espor{adicas gravas subangulares de cuarzo de hasta 5cm de diámetro, de consistencia rígida.	CH	15-24-31 N=55
6.0			CH	R
7.0				
8.0				
9.0				



NIVEL FREATICO (NF.): 3,75 m

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO A
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA A	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

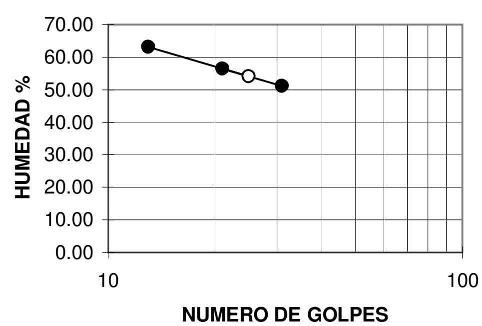
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	98.52	82.19	20.01	26.26	
	2	82.56	68.81	18.10	27.11	26.69
LIMITE LIQUIDO						
31	3	33.97	28.76	18.46	50.58	
21	4	34.45	29.03	19.60	57.48	
13	5	37.58	31.08	20.70	62.62	54.09
LIMITE PLASTICO						
	6	17.12	15.50	9.57	27.32	
	7	17.87	16.60	11.90	27.02	
	8	19.48	17.94	12.08	26.28	26.87

peso de la muestra humeda	100.35 g
peso de la muestra seca	79.21 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	2.56g	3.23	96.77
No 10	3.70g	4.67	95.33
No 40	6.60g	8.33	91.67
No 200	27.90g	35.22	64.78

GRAFICO LIMITE LIQUIDO



Grava	3%
Arena	32%
Finos	65%

LL	54.1%
LP	26.9%
IP	27.2%

SUCS	CH
AASHTO	A-7-6
IG(86)	17

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO A
OBRA	: CIMENTACION	MUESTRA No	: M - 4
UBICACIÓN	: PLATAFORMA A	PROFUNDIDAD	: 3,55-4,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

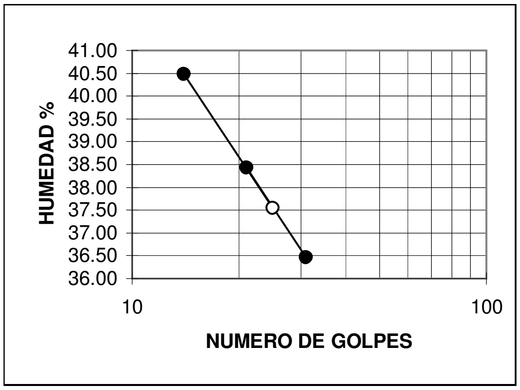
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
CONTENIDO DE HUMEDAD NATURAL						
	1	71.34	62.72	18.77	19.61	
	2	80.89	70.63	20.82	20.60	20.11
LIMITE LIQUIDO						
31	3	34.44	30.18	18.44	36.29	
21	4	33.66	29.13	17.45	38.78	
14	5	36.80	31.52	18.42	40.31	37.55
LIMITE PLASTICO						
	6	17.85	16.76	11.76	21.80	
	7	14.80	13.83	9.52	22.51	
	8	12.38	11.12	5.45	22.22	22.18

peso de la muestra humeda	100.78 g
peso de la muestra seca	83.91 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.28g	0.33	99.67
No 40	0.54g	0.64	99.36
No 200	5.02g	5.98	94.02

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	6%
Finos	94%

LL	37.6%
LP	22.2%
IP	15.4%

SUCS	CL
AASHTO	A-6
IG(86)	15

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO A
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA A	PROFUNDIDAD	: 5,00-5,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

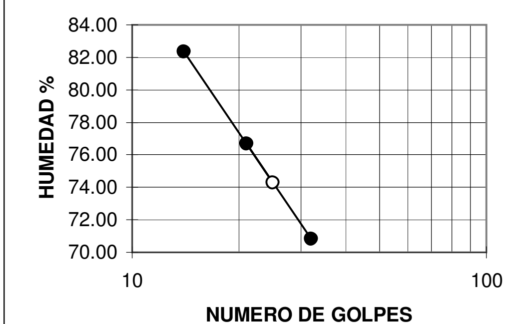
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	61.85	54.08	20.32	23.02	
	2	61.59	53.95	20.83	23.07	23.04
LIMITE LIQUIDO						
32	3	34.10	28.40	20.37	70.98	
21	4	33.80	27.00	18.10	76.40	
14	5	33.50	26.62	18.28	82.49	74.27
LIMITE PLASTICO						
	6	18.37	17.15	12.10	24.16	
	7	15.90	14.66	9.80	25.51	
	8	18.05	16.84	12.02	25.10	24.93

peso de la muestra humeda	102.40 g
peso de la muestra seca	83.22 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40		0.00	100.00
No 200	1.63g	1.96	98.04

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	2%
Finos	98%

LL	74.3%
LP	24.9%
IP	49.3%

SUCS	CH
AASHTO	A-7-6
IG(86)	56

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO A
OBRA	: CIMENTACION	MUESTRA No	: M - 6
UBICACIÓN	: PLATAFORMA A	PROFUNDIDAD	: 5,55-6,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	83.81	72.67	20.53	21.37	
	2	90.09	77.09	17.93	21.97	21.67

LIMITE LIQUIDO

31	3	29.28	24.24	17.68	76.83	
21	4	34.10	27.53	20.00	87.25	
13	5	32.80	26.00	18.55	91.28	81.78

LIMITE PLASTICO

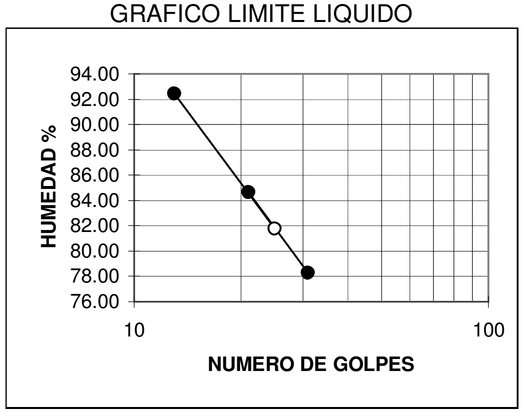
	6	18.07	16.80	12.07	26.85	
	7	18.16	16.83	12.00	27.54	
	8	19.47	17.90	12.18	27.45	27.28

peso de la muestra humeda	100.08 g
peso de la muestra seca	82.26 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40		0.00	100.00
No 200	3.03g	3.68	96.32

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	4%
Finos	96%

LL	81.8%
LP	27.3%
IP	54.5%

SUCS	CH
AASHTO	A-7-6
IG(86)	61

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO B
OBRA	: CIMENTACION	MUESTRA No	: M - 4
UBICACIÓN	: PLATAFORMA B	PROFUNDIDAD	: 3,55-4,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	69.65	54.56	16.35	39.49	
	2	78.88	62.03	20.49	40.56	40.03
LIMITE LIQUIDO						
32	3	32.70	26.32	19.28	90.63	
21	4	33.40	26.20	18.75	96.64	
14	5	32.86	25.40	18.25	104.34	94.40
LIMITE PLASTICO						
	6	10.40	8.93	5.34	40.95	
	7	18.14	16.34	12.03	41.76	
	8	14.94	13.33	9.55	42.59	41.77

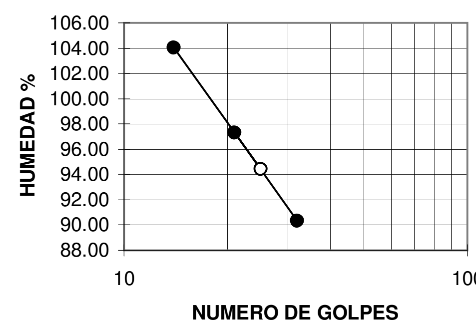
peso de la muestra humeda 100.73 g

peso de la muestra seca 71.94 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40		0.00	100.00
No 200	1.07g	1.49	98.51

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	1%
Finos	99%

LL	94.4%
LP	41.8%
IP	52.6%

SUCS	MH
AASHTO	A-7-5
IG(86)	66

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO B
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA B	PROFUNDIDAD	: 6,00-6,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	72.18	60.19	20.79	30.43	
	2	76.07	63.32	19.81	29.30	29.87
LIMITE LIQUIDO						
30	3	35.20	30.85	17.90	33.59	
20	4	38.37	33.74	20.64	35.34	
13	5	36.20	31.50	18.67	36.63	34.35
LIMITE PLASTICO						
	6	17.67	16.71	12.18	21.19	
	7	17.65	16.66	12.00	21.24	
	8	12.22	11.00	5.26	21.25	21.23

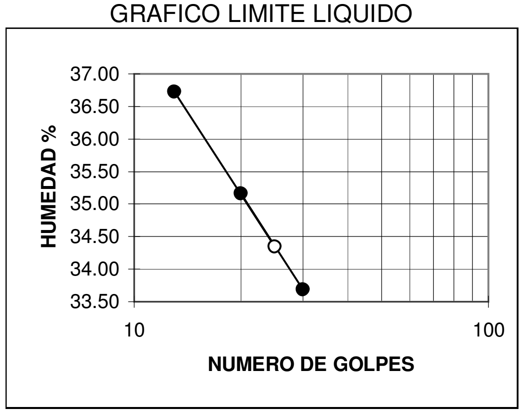
peso de la muestra humeda 109.99 g

peso de la muestra seca 84.69 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	0.75g	0.89	99.11
No 10	2.48g	2.93	97.07
No 40	12.11g	14.30	85.70
No 200	66.92g	79.01	20.99

GRAFICO LIMITE LIQUIDO



Grava	1%
Arena	78%
Finos	21%

LL	34.3%
LP	21.2%
IP	13.1%

SUCS	SC
AASHTO	A-2-6
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO B
OBRA	: CIMENTACION	MUESTRA No	: M - 8
UBICACIÓN	: PLATAFORMA B	PROFUNDIDAD	: 7,55-8,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

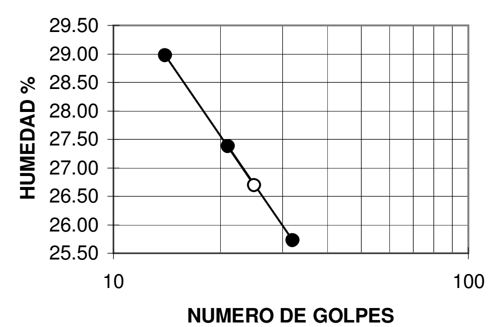
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	85.40	75.45	20.32	18.05	
	2	82.66	72.57	20.20	19.27	18.66
LIMITE LIQUIDO						
32	3	36.32	32.40	17.18	25.76	
21	4	34.79	30.94	16.84	27.30	
14	5	38.58	34.47	20.30	29.00	26.69
LIMITE PLASTICO						
	6	12.45	11.42	5.27	16.75	
	7	17.70	16.90	12.13	16.77	
	8	17.27	16.52	12.04	16.74	16.75

peso de la muestra humeda	101.19 g
peso de la muestra seca	85.28 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40	0.24g	0.28	99.72
No 200	55.85g	65.49	34.51

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	65%
Finos	35%

LL	26.7%
LP	16.8%
IP	9.9%

SUCS	SC
AASHTO	A-2-4
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO C
OBRA	: CIMENTACION	MUESTRA No	: M - 3
UBICACIÓN	: PLATAFORMA C	PROFUNDIDAD	: 2,55-3,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	62.04	53.21	19.67	26.33	
	2	64.68	55.60	20.79	26.08	26.21

LIMITE LIQUIDO

POCO MATERIAL PARA HACER LIMITES

LIMITE PLASTICO

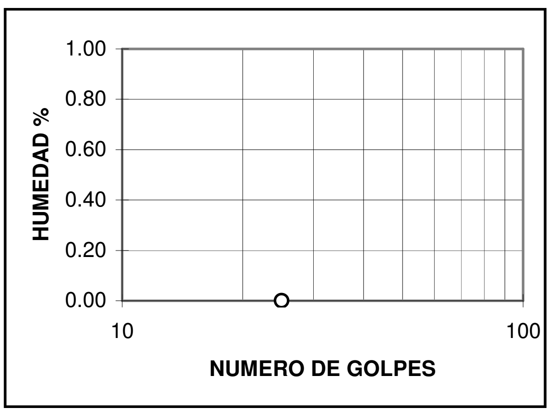
peso de la muestra humeda 101.26 g

peso de la muestra seca 80.23 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	3.20g	3.99	96.01
No 10	9.82g	12.24	87.76
No 40	23.06g	28.74	71.26
No 200	43.89g	54.70	45.30

GRAFICO LIMITE LIQUIDO



Grava	4%
Arena	51%
Finos	45%

LL	
LP	
IP	

SUCS	
AASHTO	
IG(86)	

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO C
OBRA	: CIMENTACION	MUESTRA No	: M - 7
UBICACIÓN	: PLATAFORMA C	PROFUNDIDAD	: 6,55-7,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

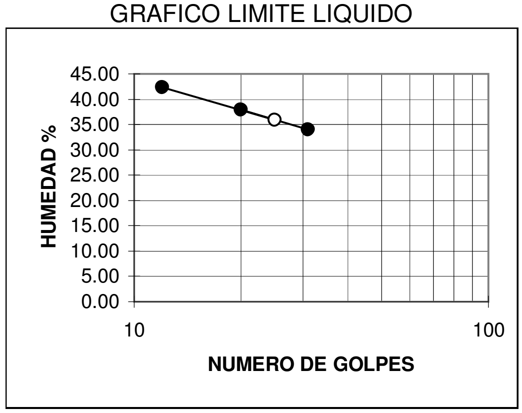
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	69.47	61.42	20.54	19.69	
	2	64.53	56.94	19.00	20.01	19.85
LIMITE LIQUIDO						
31	3	31.22	27.66	17.24	34.17	
20	4	33.27	29.17	18.30	37.72	
12	5	35.87	30.87	19.10	42.48	35.95
LIMITE PLASTICO						
	6	11.54	10.60	7.24	27.98	
	7	16.80	15.78	12.08	27.57	
	8	16.87	15.82	12.00	27.49	27.68

peso de la muestra humeda	100.85 g
peso de la muestra seca	84.15 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"	5.01g	5.95	94.05
3/8"	10.77g	12.80	87.20
No 4	19.65g	23.35	76.65
No 10	35.42g	42.09	57.91
No 40	45.27g	53.80	46.20
No 200	61.78g	73.42	26.58

GRAFICO LIMITE LIQUIDO



Grava	23%
Arena	50%
Finos	27%

LL	36.0%
LP	27.7%
IP	8.3%

SUCS	SM
AASHTO	A-2-4
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO C
OBRA	: CIMENTACION	MUESTRA No	: M - 11
UBICACIÓN	: PLATAFORMA C	PROFUNDIDAD	: 10,55-11,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

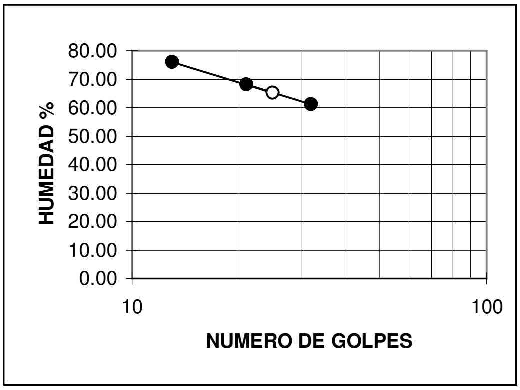
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
CONTENIDO DE HUMEDAD NATURAL						
	1	74.41	64.25	18.56	22.24	
	2	71.21	62.02	19.04	21.38	21.81
LIMITE LIQUIDO						
32	3	30.65	25.74	17.62	60.47	
21	4	32.85	27.17	18.96	69.18	
13	5	33.90	27.90	19.94	75.38	65.15
LIMITE PLASTICO						
	6	18.05	16.82	11.80	24.50	
	7	17.13	16.13	12.12	24.94	
	8	10.60	9.50	5.14	25.23	24.89

peso de la muestra humeda	101.38 g
peso de la muestra seca	83.23 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.83g	1.00	99.00
No 40	1.64g	1.97	98.03
No 200	7.59g	9.12	90.88

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	9%
Finos	91%

LL	65.2%
LP	24.9%
IP	40.3%

SUCS	CH
AASHTO	A-7-6
IG(86)	41

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO D
OBRA	: CIMENTACION	MUESTRA No	: M - 4
UBICACIÓN	: PLATAFORMA D	PROFUNDIDAD	: 3,55-4,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
CONTENIDO DE HUMEDAD NATURAL						
	1	72.57	57.48	16.75	37.05	
	2	76.80	61.87	20.40	36.00	36.53
LIMITE LIQUIDO						
31	3	33.37	27.90	17.84	54.37	
21	4	32.90	27.60	18.58	58.76	
14	5	35.05	28.90	19.35	64.40	56.91
LIMITE PLASTICO						
	6	17.24	16.28	12.07	22.80	
	7	10.46	9.54	5.52	22.89	
	8	10.30	9.37	5.30	22.85	22.85

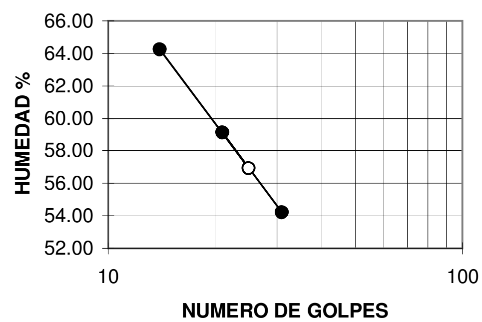
peso de la muestra humeda 100.21 g

peso de la muestra seca 73.40 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.41g	0.56	99.44
No 40	6.61g	9.01	90.99
No 200	18.88g	25.72	74.28

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	26%
Finos	74%

LL	56.9%
LP	22.8%
IP	34.1%

SUCS	CH
AASHTO	A-7-6
IG(86)	25

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO D
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA D	PROFUNDIDAD	: 4,00-4,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

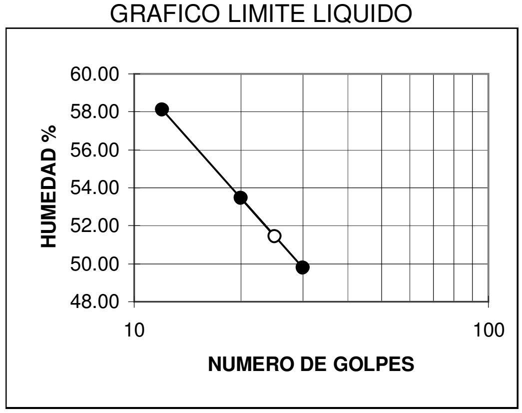
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	96.86	79.90	20.26	28.44	
	2	89.22	74.01	20.40	28.37	28.40
LIMITE LIQUIDO						
30	3	35.66	30.65	20.46	49.17	
20	4	32.80	27.75	18.50	54.59	
12	5	35.66	29.68	19.30	57.61	51.45
LIMITE PLASTICO						
	6	17.10	16.00	11.85	26.51	
	7	17.94	16.67	11.80	26.08	
	8	10.74	9.62	5.37	26.35	26.31

peso de la muestra humeda	107.55 g
peso de la muestra seca	83.76 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.20g	0.24	99.76
No 40	5.41g	6.46	93.54
No 200	30.83g	36.81	63.19

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	37%
Finos	63%

LL	51.4%
LP	26.3%
IP	25.1%

SUCS	CH
AASHTO	A-7-6
IG(86)	15

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO D
OBRA	:	MUESTRA No	: M - 10
UBICACIÓN	: PLATAFORMA D	PROFUNDIDAD	: 9,55-10,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	70.00	63.85	20.60	14.22	
	2	61.20	55.92	20.77	15.02	14.62
LIMITE LIQUIDO						
31	3	33.24	29.94	18.55	28.97	
20	4	36.72	32.76	19.77	30.48	
12	5	39.50	34.78	20.05	32.04	29.70
LIMITE PLASTICO						
	6	16.39	15.53	11.88	23.56	
	7	15.66	14.93	11.83	23.55	
	8	15.75	15.02	11.84	22.96	23.36

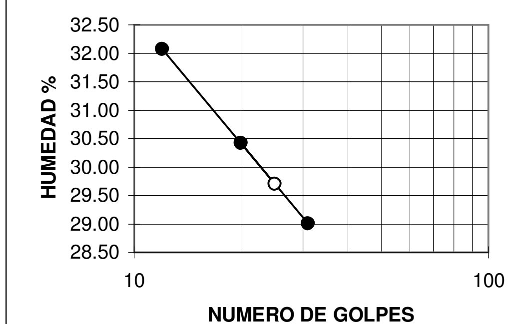
peso de la muestra humeda 103.74 g

peso de la muestra seca 90.51 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"	3.67g	4.05	95.95
No 4	10.13g	11.19	88.81
No 10	27.84g	30.76	69.24
No 40	46.33g	51.19	48.81
No 200	67.66g	74.76	25.24

GRAFICO LIMITE LIQUIDO



Grava	11%
Arena	64%
Finos	25%

LL	29.7%
LP	23.4%
IP	6.3%

SUCS	SM
AASHTO	A-2-4
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	:CALICATA E
OBRA	: CIMENTACION	MUESTRA No	: CUBICA
UBICACIÓN	: PLATAFORMA E	PROFUNDIDAD	: 1,50-1,80 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

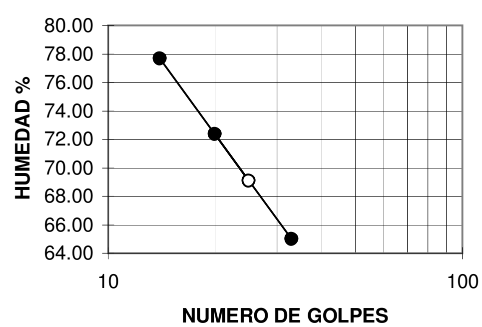
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	78.93	62.12	20.20	40.10	
	2	67.27	53.79	19.71	39.55	39.83
LIMITE LIQUIDO						
33	3	34.32	28.03	18.28	64.51	
20	4	34.07	27.20	17.85	73.48	
14	5	36.64	29.40	20.00	77.02	69.08
LIMITE PLASTICO						
	6	17.20	15.80	12.18	38.67	
	7	16.63	15.34	11.92	37.72	
	8	9.83	8.56	5.27	38.60	38.33

peso de la muestra humeda	100.96 g
peso de la muestra seca	72.20 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	1.02g	1.41	98.59
No 40	6.07g	8.41	91.59
No 200	21.76g	30.14	69.86

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	30%
Finos	70%

LL	69.1%
LP	38.3%
IP	30.7%

SUCS	MH
AASHTO	A-7-5
IG(86)	23

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO E
OBRA	: CIMENTACION	MUESTRA No	: M - 3
UBICACIÓN	: PLATAFORMA E	PROFUNDIDAD	: 2,55-3,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

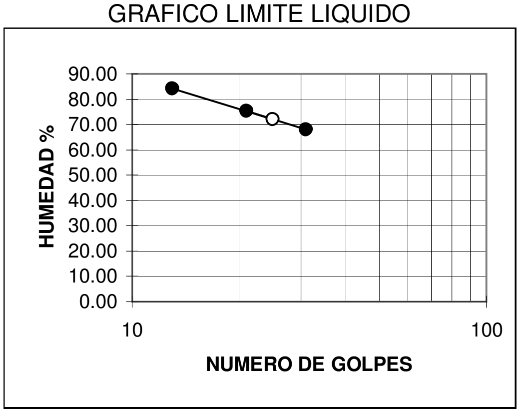
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	58.05	48.58	20.75	34.03	
	2	58.69	49.12	20.70	33.67	33.85
LIMITE LIQUIDO						
31	3	33.17	27.92	20.15	67.57	
21	4	32.42	26.25	18.16	76.27	
13	5	33.50	26.98	19.20	83.80	72.08
LIMITE PLASTICO						
	6	17.86	16.27	12.00	37.24	
	7	11.67	10.13	5.98	37.11	
	8	17.60	16.10	12.12	37.69	37.34

peso de la muestra humeda 100.81 g
peso de la muestra seca 75.32 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	1.70g	2.26	97.74
No 40	7.46g	9.91	90.09
No 200	20.38g	27.06	72.94

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	27%
Finos	73%

LL	72.1%
LP	37.3%
IP	34.7%

SUCS	MH
AASHTO	A-7-5
IG(86)	28

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO E
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA E	PROFUNDIDAD	: 3,00-3,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	59.53	51.47	20.52	26.04	
	2	60.89	52.27	19.10	25.99	26.01
LIMITE LIQUIDO						
30	3	34.00	28.88	19.10	52.35	
22	4	32.35	26.80	16.84	55.72	
14	5	35.53	29.43	19.67	62.50	54.51
LIMITE PLASTICO						
	6	17.24	16.15	12.10	26.91	
	7	16.93	15.92	12.20	27.15	
	8	13.50	12.74	9.96	27.34	27.13

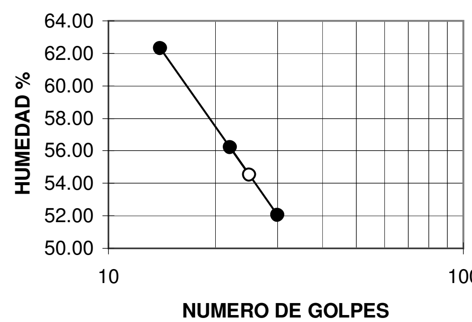
peso de la muestra humeda 100.02 g

peso de la muestra seca 79.37 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		1.02	98.98
No 40		6.07	93.93
No 200		21.76	78.24

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	22%
Finos	78%

LL	54.5%
LP	27.1%
IP	27.4%

SUCS	CH
AASHTO	A-7-6
IG(86)	32

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO E
OBRA	: CIMENTACION	MUESTRA No	: M - 8
UBICACIÓN	: PLATAFORMA E	PROFUNDIDAD	: 7,55-8,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

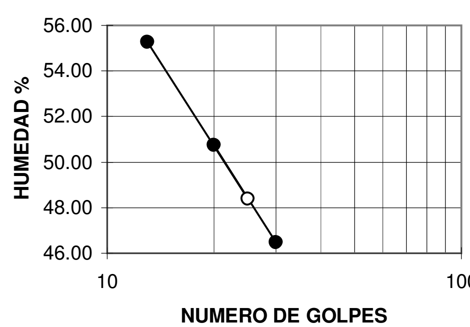
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	66.81	59.61	20.23	18.28	
	2	70.80	62.71	20.61	19.22	18.75
LIMITE LIQUIDO						
30	3	31.53	27.02	17.33	46.54	
20	4	32.38	27.38	17.50	50.61	
13	5	32.40	27.21	17.83	55.33	48.39
LIMITE PLASTICO						
	6	17.48	16.38	12.06	25.46	
	7	15.36	14.28	9.92	24.77	
	8	16.10	15.27	11.95	25.00	25.08

peso de la muestra humeda	101.36 g
peso de la muestra seca	85.36 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	0.98g	1.15	98.85
No 10	1.71g	2.00	98.00
No 40	2.68g	3.14	96.86
No 200	53.45g	62.62	37.38

GRAFICO LIMITE LIQUIDO



Grava	1%
Arena	61%
Finos	37%

LL	48.4%
LP	25.1%
IP	23.3%

SUCS	SC
AASHTO	A-7-6
IG(86)	4

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO E
OBRA	: CIMENTACION	MUESTRA No	: M - 12
UBICACIÓN	: PLATAFORMA E	PROFUNDIDAD	: 11,55-12,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	74.24	63.03	20.47	26.34	
	2	77.87	65.41	20.15	27.53	26.93
LIMITE LIQUIDO						
32	3	32.44	29.49	18.07	25.83	
21	4	35.70	32.00	19.19	28.88	
14	5	35.34	31.41	18.84	31.26	27.55
LIMITE PLASTICO						
	6	12.10	10.98	5.40	20.07	
	7	11.90	10.83	5.36	19.56	
	8	19.16	17.98	12.03	19.83	19.82

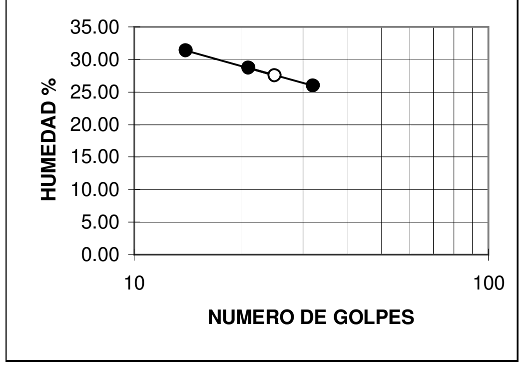
peso de la muestra humeda 100.12 g

peso de la muestra seca 78.88 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	3.38g	4.29	95.71
No 10	8.83g	11.19	88.81
No 40	18.96g	24.04	75.96
No 200	34.90g	44.25	55.75

GRAFICO LIMITE LIQUIDO



Grava	4%
Arena	40%
Finos	56%

LL	27.5%
LP	19.8%
IP	7.7%

SUCS	CL
AASHTO	A-4
IG(86)	2

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO F
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA F	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	71.55	62.48	20.55	21.63	
	2	84.67	73.94	20.46	20.06	20.85
LIMITE LIQUIDO						
32	3	33.76	28.30	19.20	60.00	
22	4	35.06	28.78	18.87	63.37	
15	5	35.16	28.35	18.28	67.63	62.35
LIMITE PLASTICO						
	6	14.98	14.04	9.50	20.70	
	7	16.58	15.80	12.10	21.08	
	8	16.28	15.54	12.03	21.08	20.96

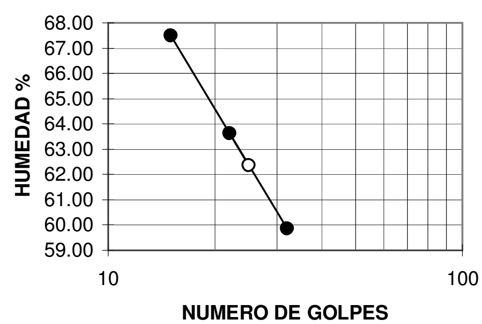
peso de la muestra humeda 100.41 g

peso de la muestra seca 83.09 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40	0.71g	0.85	99.15
No 200	32.18g	38.73	61.27

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	39%
Finos	61%

LL	62.4%
LP	21.0%
IP	41.4%

SUCS	CH
AASHTO	A-7-6
IG(86)	23

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO G
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA G	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	65.67	58.53	20.56	18.80	
	2	60.09	53.76	20.18	18.85	18.83
LIMITE LIQUIDO						
32	3	34.02	29.08	19.60	52.11	
21	4	36.98	31.11	20.60	55.85	
13	5	34.32	28.37	18.50	60.28	54.32
LIMITE PLASTICO						
	6	12.40	10.78	5.28	29.45	
	7	18.84	17.30	12.12	29.73	
	8	15.42	14.16	9.88	29.44	29.54

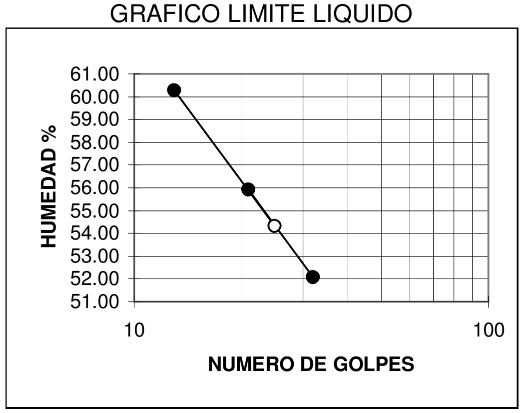
peso de la muestra humeda 100.10 g

peso de la muestra seca 84.24 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.10g	0.12	99.88
No 40	1.13g	1.34	98.66
No 200	14.15g	16.80	83.20

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	17%
Finos	83%

LL	54.3%
LP	29.5%
IP	24.8%

SUCS	MH
AASHTO	A-7-6
IG(86)	23

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO H
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA H	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

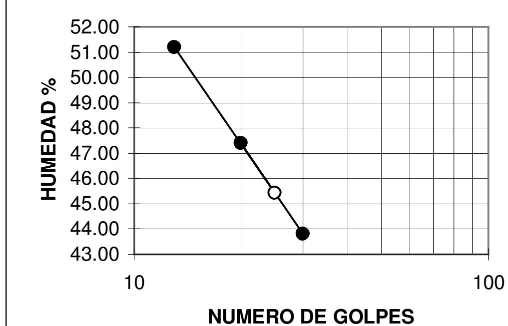
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	84.61	73.71	20.27	20.40	
	2	83.44	73.15	20.08	19.39	19.89
LIMITE LIQUIDO						
30	3	37.47	32.35	20.60	43.57	
20	4	34.20	29.14	18.57	47.87	
13	5	37.08	31.56	20.73	50.97	45.43
LIMITE PLASTICO						
	6	18.70	17.32	11.90	25.46	
	7	11.15	9.92	5.14	25.73	
	8	19.25	17.80	12.08	25.35	25.51

peso de la muestra humeda	100.38 g
peso de la muestra seca	83.72 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.11g	0.13	99.87
No 40	0.80g	0.96	99.04
No 200	10.69g	12.77	87.23

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	13%
Finos	87%

LL	45.4%
LP	25.5%
IP	19.9%

SUCS	CL
AASHTO	A-7-6
IG(86)	19

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO I
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA I	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	71.73	58.13	20.45	36.09	
	2	68.00	54.98	20.48	37.74	36.92
LIMITE LIQUIDO						
32	3	34.16	26.00	18.13	103.68	
21	4	33.22	25.10	17.80	111.23	
15	5	31.23	23.87	17.57	116.83	108.04
LIMITE PLASTICO						
	6	17.47	16.00	12.12	37.89	
	7	18.40	16.70	12.13	37.20	
	8	12.05	10.17	5.27	38.37	37.82

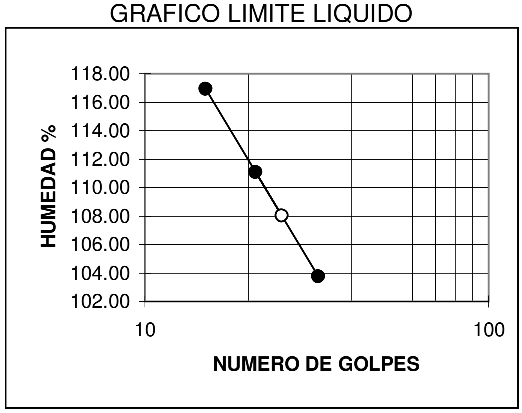
peso de la muestra humeda 101.22 g

peso de la muestra seca 73.93 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.00g	0.00	100.00
No 40	0.00g	0.00	100.00
No 200	0.57g	0.77	99.23

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	1%
Finos	99%

LL	108.0%
LP	37.8%
IP	70.2%

SUCS	CH
AASHTO	A-7-5
IG(86)	85

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO I
OBRA	: CIMENTACION	MUESTRA No	: M - 4
UBICACIÓN	: PLATAFORMA I	PROFUNDIDAD	: 3,55-4,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

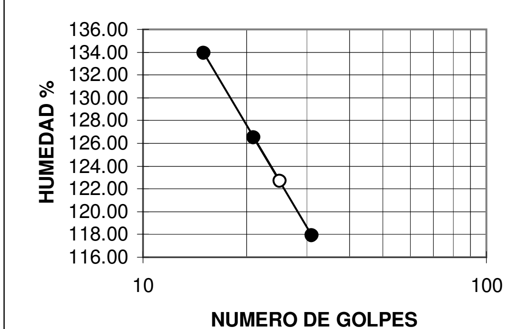
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	59.66	50.82	20.53	29.18	
	2	67.39	57.03	20.36	28.25	28.72
LIMITE LIQUIDO						
31	3	33.02	25.57	19.24	117.69	
21	4	33.05	25.06	18.77	127.03	
15	5	31.12	23.25	17.36	133.62	122.67
LIMITE PLASTICO						
	6	11.26	9.73	5.36	35.01	
	7	11.17	9.66	5.40	35.45	
	8	16.74	15.53	12.07	34.97	35.14

peso de la muestra humeda	102.34 g
peso de la muestra seca	79.51 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40		0.00	100.00
No 200	0.41g	0.52	99.48

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	1%
Finos	99%

LL	122.7%
LP	35.1%
IP	87.5%

SUCS	CH
AASHTO	A-7-5
IG(86)	105

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO I
OBRA	: CIMENTACION	MUESTRA No	: M - 5
UBICACIÓN	: PLATAFORMA I	PROFUNDIDAD	: 4,55-5,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

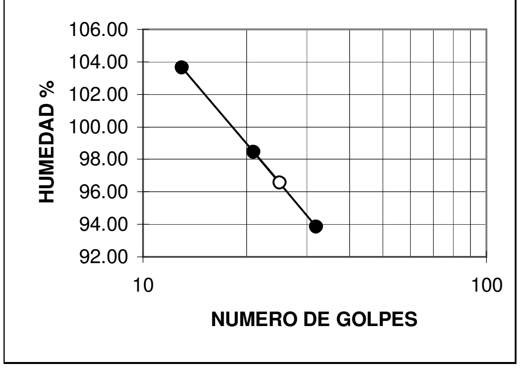
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	90.87	75.92	20.55	27.00	
	2	74.35	62.89	19.55	26.44	26.72
LIMITE LIQUIDO						
32	3	32.90	26.12	18.87	93.52	
21	4	31.94	25.40	18.80	99.09	
13	5	34.30	26.26	18.48	103.34	96.55
LIMITE PLASTICO						
	6	17.40	16.00	11.95	34.57	
	7	17.78	16.28	12.02	35.21	
	8	15.73	14.20	9.82	34.93	34.90

peso de la muestra humeda	100.83 g
peso de la muestra seca	79.57 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.00g	0.00	100.00
No 40	0.00g	0.00	100.00
No 200	0.35g	0.44	99.56

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	0%
Finos	100%

LL	96.5%
LP	34.9%
IP	61.6%

SUCS	CH
AASHTO	A-7-5
IG(86)	75

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO J
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA J	PROFUNDIDAD	: 2,00-2,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

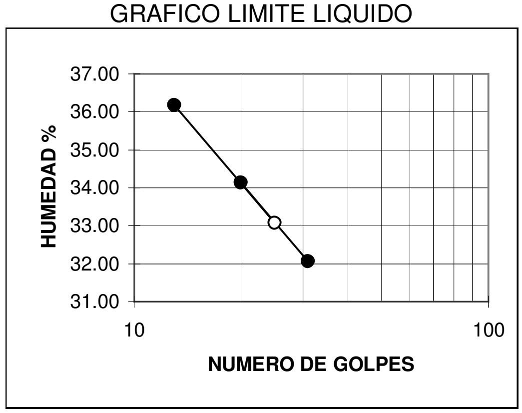
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	60.65	54.02	18.20	18.51	
	2	61.05	54.19	19.65	19.86	19.19
LIMITE LIQUIDO						
31	3	36.38	32.53	20.51	32.03	
20	4	35.94	31.97	20.36	34.19	
13	5	35.86	31.50	19.44	36.15	33.08
LIMITE PLASTICO						
	6	17.29	16.36	11.75	20.17	
	7	18.38	17.36	12.43	20.69	
	8	16.59	15.82	12.03	20.32	20.39

peso de la muestra humeda	100.14 g
peso de la muestra seca	84.02 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	26.20g	31.18	68.82
No 10	30.39g	36.17	63.83
No 40	39.16g	46.61	53.39
No 200	63.39g	75.45	24.55

GRAFICO LIMITE LIQUIDO



Grava	31%
Arena	44%
Finos	25%

LL	33.1%
LP	20.4%
IP	12.7%

SUCS	SC
AASHTO	A-2-6
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO J
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA J	PROFUNDIDAD	: 2,00-2,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	60.65	54.02	18.20	18.51	
	2	61.05	54.19	19.65	19.86	19.19

LIMITE LIQUIDO

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
31	3	36.38	32.53	20.51	32.03	
20	4	35.94	31.97	20.36	34.19	
13	5	35.86	31.50	19.44	36.15	33.08

LIMITE PLASTICO

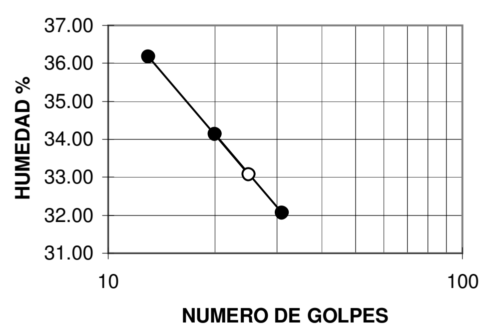
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	6	17.29	16.36	11.75	20.17	
	7	18.38	17.36	12.43	20.69	
	8	16.59	15.82	12.03	20.32	20.39

peso de la muestra humeda 100.14 g
peso de la muestra seca 84.02 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	26.20g	31.18	68.82
No 10	30.39g	36.17	63.83
No 40	39.16g	46.61	53.39
No 200	63.39g	75.45	24.55

GRAFICO LIMITE LIQUIDO



Grava	31%
Arena	44%
Finos	25%

LL	33.1%
LP	20.4%
IP	12.7%

SUCS	SC
AASHTO	A-2-6
IG(86)	0

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO J
OBRA	: CIMENTACION	MUESTRA No	: M - 7
UBICACIÓN	: PLATAFORMA J	PROFUNDIDAD	: 6,55-7,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

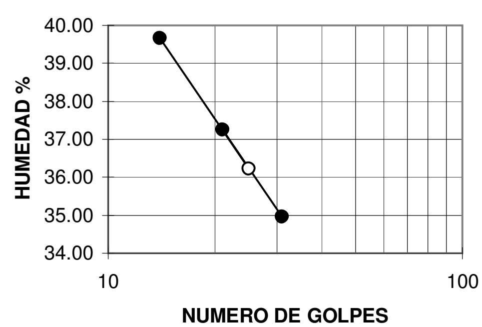
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	89.15	78.04	19.73	19.05	
	2	81.25	70.93	20.51	20.47	19.76
LIMITE LIQUIDO						
31	3	35.70	31.50	19.40	34.71	
21	4	31.94	28.35	18.84	37.75	
14	5	36.34	31.48	19.15	39.42	36.23
LIMITE PLASTICO						
	6	17.80	16.60	12.23	27.46	
	7	16.95	15.89	11.98	27.11	
	8	17.16	16.08	12.08	27.00	27.19

peso de la muestra humeda	100.84 g
peso de la muestra seca	84.20 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	0.76g	0.90	99.10
No 10	1.71g	2.03	97.97
No 40	3.24g	3.85	96.15
No 200	20.38g	24.20	75.80

GRAFICO LIMITE LIQUIDO



Grava	1%
Arena	23%
Finos	76%

LL	36.2%
LP	27.2%
IP	9.0%

SUCS	ML
AASHTO	A-4
IG(86)	7

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO J
OBRA	: CIMENTACION	MUESTRA No	: M - 9
UBICACIÓN	: PLATAFORMA J	PROFUNDIDAD	: 8,55-9,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

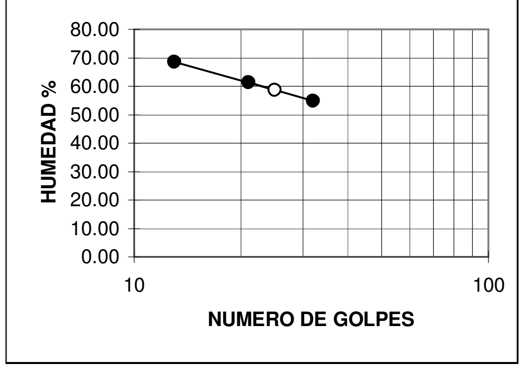
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	41.74	37.68	19.03	21.77	
	2	42.20	38.15	20.10	22.44	22.10
LIMITE LIQUIDO						
32	3	32.58	27.56	18.47	55.23	
21	4	33.53	28.05	19.00	60.55	
13	5	32.15	26.13	17.40	68.96	58.61
LIMITE PLASTICO						
	6	16.25	14.82	9.97	29.48	
	7	18.20	16.83	12.19	29.53	
	8	18.65	17.15	12.11	29.76	29.59

peso de la muestra humeda	100.24 g
peso de la muestra seca	82.09 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.12g	0.15	99.85
No 40	1.00g	1.22	98.78
No 200	9.16g	11.16	88.84

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	11%
Finos	89%

LL	58.6%
LP	29.6%
IP	29.0%

SUCS	CH
AASHTO	A-7-6
IG(86)	30

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO K
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA K	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	91.02	78.06	18.08	21.61	
	2	75.69	66.26	20.51	20.61	21.11
LIMITE LIQUIDO						
32	3	34.93	29.74	20.63	56.97	
21	4	32.08	26.62	17.65	60.87	
13	5	33.85	27.90	18.88	65.96	59.33
LIMITE PLASTICO						
	6	17.60	16.36	12.03	28.64	
	7	10.86	9.62	5.27	28.51	
	8	16.98	15.86	12.00	29.02	28.72

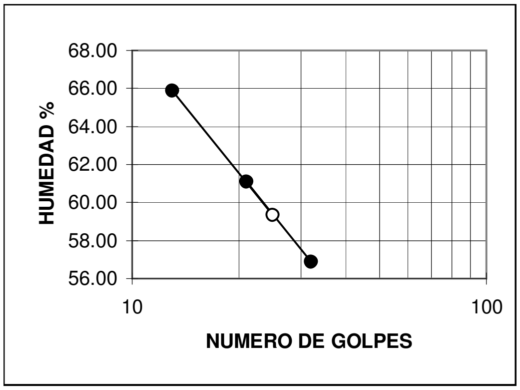
peso de la muestra humeda 100.11 g

peso de la muestra seca 82.66 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.15g	0.18	99.82
No 40	0.73g	0.88	99.12
No 200	10.50g	12.70	87.30

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	13%
Finos	87%

LL	59.3%
LP	28.7%
IP	30.6%

SUCS	CH
AASHTO	A-7-6
IG(86)	30

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO L
OBRA	: CIMENTACION	MUESTRA No	: M - 4
UBICACIÓN	: PLATAFORMA L	PROFUNDIDAD	: 3,55-4,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

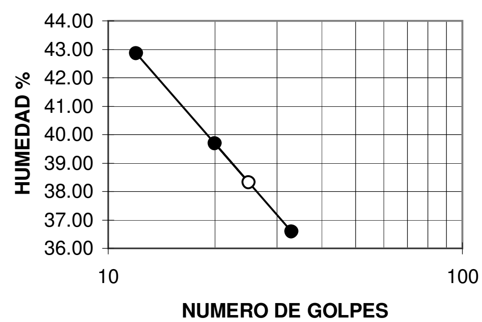
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	58.35	51.91	20.24	20.33	
	2	57.92	51.16	20.22	21.85	21.09
LIMITE LIQUIDO						
33	3	34.48	30.79	20.62	36.28	
20	4	37.72	32.66	20.10	40.29	
12	5	37.10	32.10	20.35	42.55	38.31
LIMITE PLASTICO						
	6	10.96	9.92	5.34	22.71	
	7	16.28	15.52	12.20	22.89	
	8	18.61	17.38	11.96	22.69	22.76

peso de la muestra humeda	101.59 g
peso de la muestra seca	83.90 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4	5.57g	6.64	93.36
No 10	10.29g	12.27	87.73
No 40	19.36g	23.08	76.92
No 200	43.90g	52.33	47.67

GRAFICO LIMITE LIQUIDO



Grava	7%
Arena	46%
Finos	48%

LL	38.3%
LP	22.8%
IP	15.5%

SUCS	SC
AASHTO	A-6
IG(86)	4

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO L
OBRA	: CIMENTACION	MUESTRA No	: SHELBY
UBICACIÓN	: PLATAFORMA L	PROFUNDIDAD	: 7,00-7,50 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

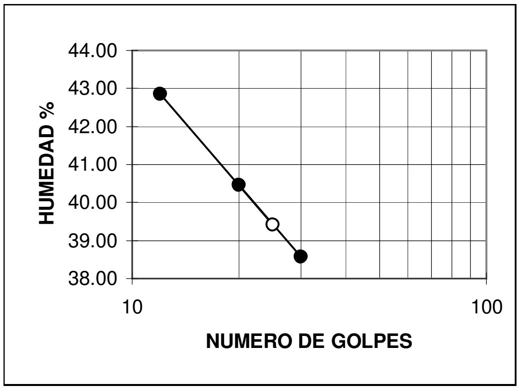
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
CONTENIDO DE HUMEDAD NATURAL						
	1	90.39	74.30	20.30	29.80	
	2	86.51	71.51	20.78	29.57	29.68
LIMITE LIQUIDO						
30	3	35.14	30.50	18.35	38.19	
20	4	34.05	29.40	18.10	41.15	
12	5	36.92	31.66	19.30	42.56	39.42
LIMITE PLASTICO						
	6	18.20	17.02	11.68	22.10	
	7	20.30	18.80	12.22	22.80	
	8	18.70	17.45	11.97	22.81	22.57

peso de la muestra humeda	108.98 g
peso de la muestra seca	84.04 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.94g	1.12	98.88
No 40	3.38g	4.02	95.98
No 200	22.38g	26.63	73.37

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	27%
Finos	73%

LL	39.4%
LP	22.6%
IP	16.9%

SUCS	CL
AASHTO	A-6
IG(86)	12

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO L
OBRA	: CIMENTACION	MUESTRA No	: M - 8
UBICACIÓN	: PLATAFORMA L	PROFUNDIDAD	: 7,55-8,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

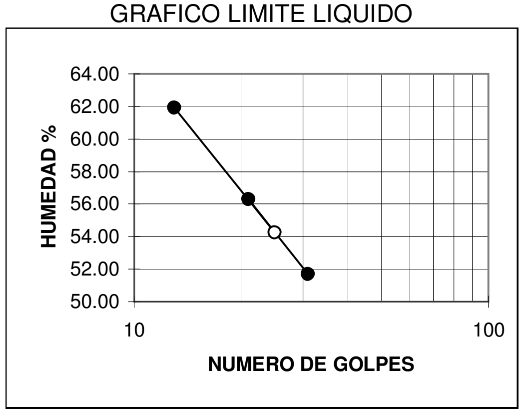
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	93.95	81.08	20.38	21.20	
	2	76.19	66.02	20.67	22.43	21.81
LIMITE LIQUIDO						
31	3	32.30	27.80	19.07	51.55	
21	4	34.36	29.40	20.63	56.56	
13	5	34.66	28.40	18.27	61.80	54.23
LIMITE PLASTICO						
	6	10.98	9.70	5.37	29.56	
	7	11.74	10.30	5.53	30.19	
	8	17.80	16.44	11.83	29.50	29.75

peso de la muestra humeda	100.68 g
peso de la muestra seca	82.65 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40	0.07g	0.08	99.92
No 200	22.89g	27.69	72.31

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	28%
Finos	72%

LL	54.2%
LP	29.8%
IP	24.5%

SUCS	MH
AASHTO	A-7-6
IG(86)	18

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO L
OBRA	: CIMENTACION	MUESTRA No	: M - 9
UBICACIÓN	: PLATAFORMA L	PROFUNDIDAD	: 8,00-8,15 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

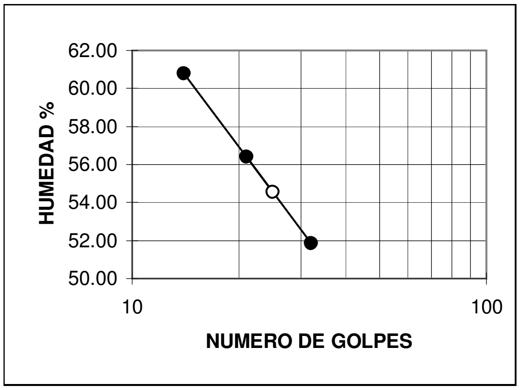
No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	73.41	66.15	20.30	15.83	
	2	61.86	56.30	20.06	15.34	15.59
LIMITE LIQUIDO						
32	3	34.07	28.38	17.40	51.82	
21	4	34.20	28.17	17.50	56.51	
14	5	34.84	28.40	17.80	60.75	54.54
LIMITE PLASTICO						
	6	19.20	17.84	11.87	22.78	
	7	13.87	12.63	7.24	23.01	
	8	12.00	10.73	5.28	23.30	23.03

peso de la muestra humeda	101.76 g
peso de la muestra seca	88.04 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10		0.00	100.00
No 40	2.00g	2.27	97.73
No 200	47.77g	54.26	45.74

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	54%
Finos	46%

LL	54.5%
LP	23.0%
IP	31.5%

SUCS	SC
AASHTO	A-7-6
IG(86)	10

ENSAYO DE CLASIFICACION

PROYECTO	: MILL SITE	POZO No	: SONDEO M
OBRA	: CIMENTACION	MUESTRA No	: M - 2
UBICACIÓN	: PLATAFORMA M	PROFUNDIDAD	: 1,55-2,00 m
FECHA	: MARZO-2005	CALCULADO POR	: ING. B.ALVAREZ

CONTENIDO DE HUMEDAD NATURAL

No.gol	Capsula No	P.Humedo	P.Seco	P.capsula	Humedad	Media/valor
	1	70.87	63.26	20.36	17.74	
	2	83.13	74.26	20.94	16.64	17.19
LIMITE LIQUIDO						
31	3	33.74	28.45	18.12	51.21	
21	4	36.00	29.63	19.00	59.92	
13	5	36.66	30.54	20.78	62.70	55.30
LIMITE PLASTICO						
	6	18.80	17.52	12.00	23.19	
	7	11.90	10.77	5.97	23.54	
	8	16.24	14.97	9.57	23.52	23.42

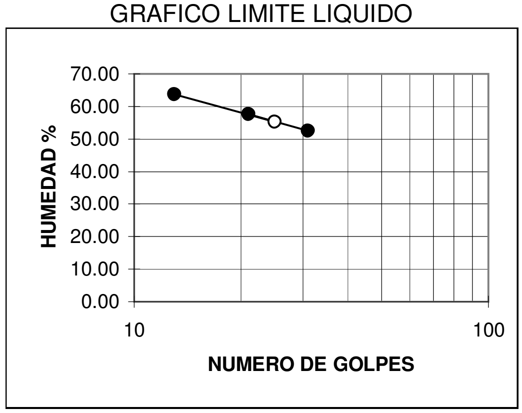
peso de la muestra humeda 100.29 g

peso de la muestra seca 85.58 g

GRANULOMETRIA

TAMIZ	P.retenido	% retenido	% q' pasa
2"		0.00	100.00
1 1/2"		0.00	100.00
1"		0.00	100.00
3/4"		0.00	100.00
1/2"		0.00	100.00
3/8"		0.00	100.00
No 4		0.00	100.00
No 10	0.04g	0.05	99.95
No 40	1.58g	1.85	98.15
No 200	26.21g	30.63	69.37

GRAFICO LIMITE LIQUIDO



Grava	0%
Arena	31%
Finos	69%

LL	55.3%
LP	23.4%
IP	31.9%

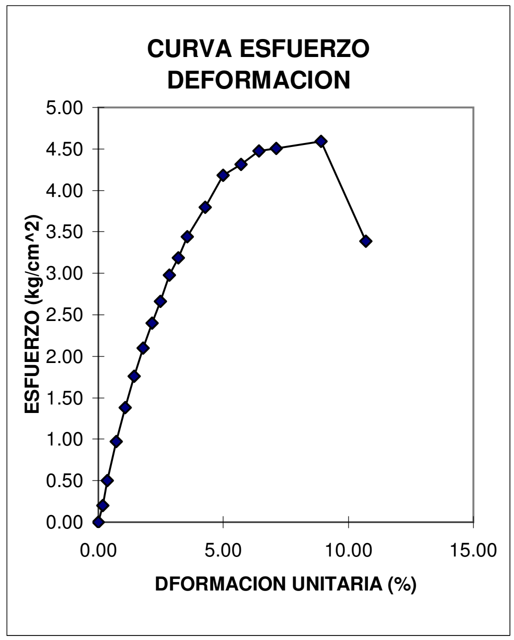
SUCS	CH
AASHTO	A-7-6
IG(86)	21

ENSAYO DE RESISTENCIA A LA COMPRESION SIMPLE

PROYECTO	: MILL SITE	MUESTRA No	: SONDEO A
OBRA	:	PROFUND.	: 5,55-6,00m
UBICACION	:	FECHA	: MARZO-2005

DS	3.61	Peso inicial	151.23		
DC	3.57	Vol. inicial	71.64	Calculado por	: B. Alvarez
DI	3.57	γ_m. inicial	2.111	Cnte. anillo kg	0.1120
DM	3.58	γ_d. inicial	1.742		
AM	10.05				
HM	7.13				

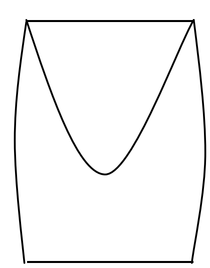
DEFORMACION pulg.	DIAL DE CARGA pulg x 10^ -4	DEFOR. UNITAR %	ESFUERZO kg/cm^2
0	0	0.00	0.00
5	18	0.18	0.20
10	45	0.36	0.50
20	88	0.71	0.97
30	125	1.07	1.38
40	160	1.42	1.76
50	192	1.78	2.10
60	220	2.14	2.40
70	245	2.49	2.66
80	275	2.85	2.98
90	295	3.21	3.18
100	320	3.56	3.44
120	356	4.27	3.80
140	395	4.99	4.18
160	410	5.70	4.31
180	429	6.41	4.48
200	435	7.12	4.50
250	452	8.91	4.59
300	340	10.69	3.39



RESISTENCIA A LA COMPRESION SIMPLE

q_u= 4.18 kg/cm^2

GRAFICO DE LA MUESTRA ENSAYADA



CONTENIDO DE HUMEDAD

CAPSULA No	653
P.CAP.+S. HUM.	171.27
P.CAP. +S.SECO	144.89
P. CAPSULA	20.47
HUMEDAD %	21.20

ENSAYO DE COMPACTACION

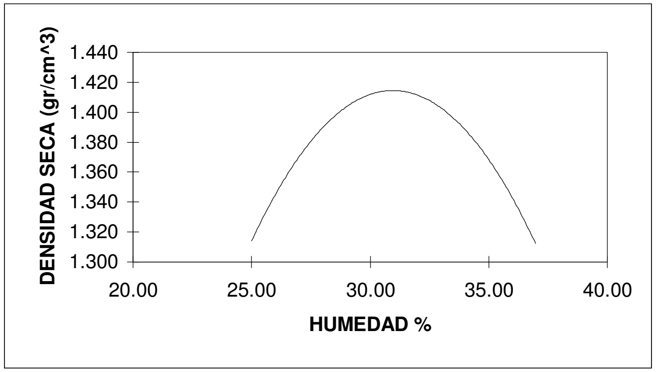
PROYECTO : MILL SITE
OBRA : CIMENTACION
LOCALIZACION : PLATAMORMA E
MUESTRA No : E - 1
PROFUNDIDAD : 1,50-1,80

FECHA : MAR-05

TIPO DE COMPACTACION : ESTANDAR
GOLPES POR CAPA : 25
NUMERO DE CAPAS : 3
PESO DEL MARTILLO : 5.5 lbs.
ALTURA DE CAIDA : 12"

DATOS DEL MOLDE
DIAMETRO 4 "
VOLUMEN 943 cm^3
PESO 4008 gr.

DENSIDAD				
MUESTRA No.	1	2	3	4
PESO MOLDE + SUELO (gr.)	5600	5736	5757	5706
PESO MOLDE (gr.)	4008	4008	4008	4008
PESO SUELO (gr:)	1592	1728	1749	1698
CONTENIDO DE AGUA	25.98	29.34	32.79	36.97
DENSIDAD HUMEDA (gr/cm^3)	1.688	1.832	1.855	1.801
DENSIDAD SECA (gr/cm^3)	1.340	1.417	1.397	1.315



d máx. (gr/cm^3)**:** 1.420 **W ópt.** (%)**:** 30.00

CONTENIDO DE AGUA								
MUESTRA No	1		2		3		4	
RECIPIENTE+SUELO HUMEDO (gr.)	61.81	72.89	60.22	65.58	70.50	64.77	82.10	90.43
RECIPIENTE +SUELO SECO (gr.)	53.10	61.92	51.10	55.43	58.05	53.79	65.36	71.71
PESO DEL RECIPIENTE	19.51	19.78	20.39	20.41	20.02	20.35	20.41	20.71
CONTENIDO DE AGUA (%)	25.93	26.03	29.70	28.98	32.74	32.83	37.24	36.71
CONTENIDO PROMEDIO DE AGUA (%	25.98		29.34		32.79		36.97	

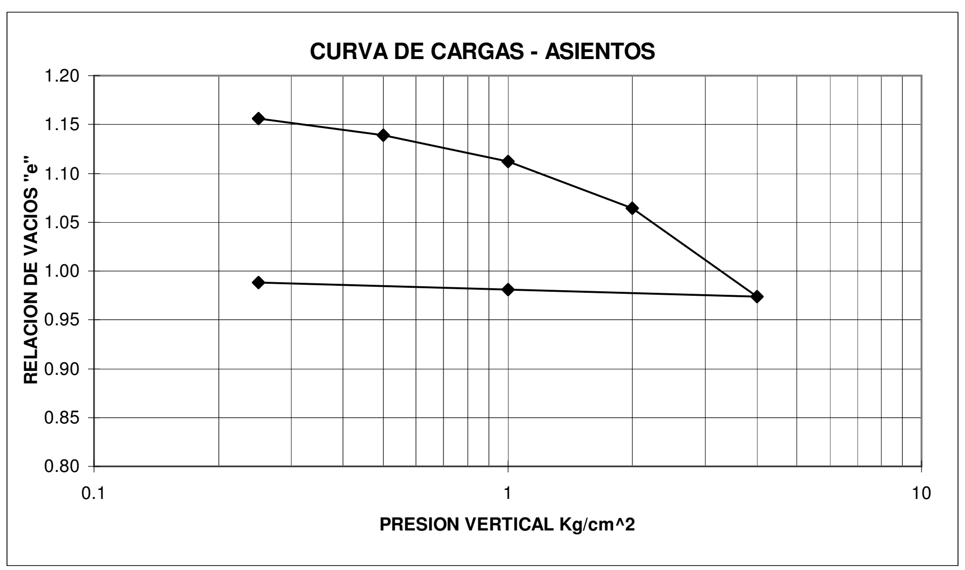
ENSAYO DE CONSOLIDACION

PROYECTO : MIL SITE — MUESTRA No : E - 1
OBRA : — PERFORACION : E
UBICACION : PLATAFORMA E — PROFUNDIDAD : 1,50-1,80 m.
FECHA : marzo de 2005

DETERMINACION DE HUMEDAD	AL PRINCIOIO DE LA PRUEBA	AL FINAL DE LA PRUEBA
ANILLO + P. SUELO HUMEDO	672.10	667.90
ANILLO + P. SUELO SECO	631.40	631.40
PESO DEL ANILLO	533.10	533.10
PESO DEL SUELO SECO (WS)	98.30	98.30
CONTENIDO DE HUMEDAD (W%)	41.40	37.13

ANILLO No — DIAMETRO (cm) 6.34 — AREA (cm^2) 31.57

ALTURA DE LA MUESTRA AL PRINCIPIO	(H1)	25.3	mm
PESO ESPECIFICO RELATIVO DE SOLIDOS	(Ss)	2.679	Kg/cm^3
ALTURA DE SOLIDOS	(HS)	11.62	mm
VARIACION EN LA ALTURA DE LA MUESTRA AL PRINCIPIO Y FINAL DE LA PRUEBA	(ΔH)	2.14	mm
ALTURA FINAL DE LA MUESTRA	(H2)	23.16	mm
ALTURA INICIAL DEL AGUA	(Hw1)	12.89	mm
ALTURA FINAL DEL AGUA	(Hw2)	11.56	mm
RELACION DE VACIOS INICIAL	(e_0)	1.18	
RELACION DE VACIOS FINAL	(e_f)	0.99	
GRADO DE SATURACION INICIAL	(G_{W1})	94.26	%
GRADO DE SATURACION FINAL	(G_{W2})	100.18	%



HISTORIAL DE CARGAS

PROYECTO : MIL SITE — MUESTRA No : E - 1
OBRA : — PERFORACION : E
UBICACION : PLATAFORMA E — PROFUNDIDAD : 1,50-1,80 m.
FECHA : marzo de 2005 — EXPANSION : 0.0 mm

TIEMPO	CARGA					
	0.25 kg/cm^2	0.50 kg/cm^2	1.0 kg/cm^2	2.0 kg/cm^2	4.0 kg/cm^2	8.0 kg/cm^2
MIN.	lect.x0.0025	lect.x0.0025	lect.x0.0025	lect.x0.0025	lect.x0.0025	lect.x0.0025
0.1	56.0	141.0	228.0	410.0	756.0	
0.2	59.0	143.0	236.0	421.0	772.0	
0.3	63.0	144.0	244.0	429.0	780.0	
0.4	66.0	145.0	248.0	437.0	795.0	
0.5	67.0	146.0	250.0	441.0	799.0	
0.6	69.0	147.0	253.0	445.0	804.0	
0.7	70.0	148.0	254.0	449.0	807.0	
0.8	71.0	149.0	255.0	453.0	815.0	
0.9	72.0	150.0	256.0	455.0	819.0	
1	73.0	151.0	257.0	457.0	823.0	
2	76.0	154.0	264.0	465.0	839.0	
3	78.0	155.0	266.0	472.0	852.0	
4	79.0	156.0	269.0	476.0	858.0	
5	80.0	157.0	271.0	477.0	866.0	
10	82.0	160.0	276.0	483.0	882.0	
15	83.0	161.0	279.0	488.0	891.0	
30	86.0	163.0	282.0	494.0	902.0	
60	88.0	165.0	285.0	500.0	911.0	
100	89.0	166.0	287.0	504.0	915.0	
200	91.0	168.0	290.0	508.0	919.0	
300	93.0	169.0	292.0	509.0	921.0	
400	94.0	170.0	293.0	511.0	923.0	
500	94.5	171.0	294.0	512.0	925.0	
1440	96.0	173.0	296.0	516.0	929.0	

DESCARGA

TIEMPO MIN.	CARGA Kg/cm^2	LEC. DIAL X 0.0025
0	4.00	929
180	1.00	897
180	0.25	863
180	0.00	841

OBSERVACIONES

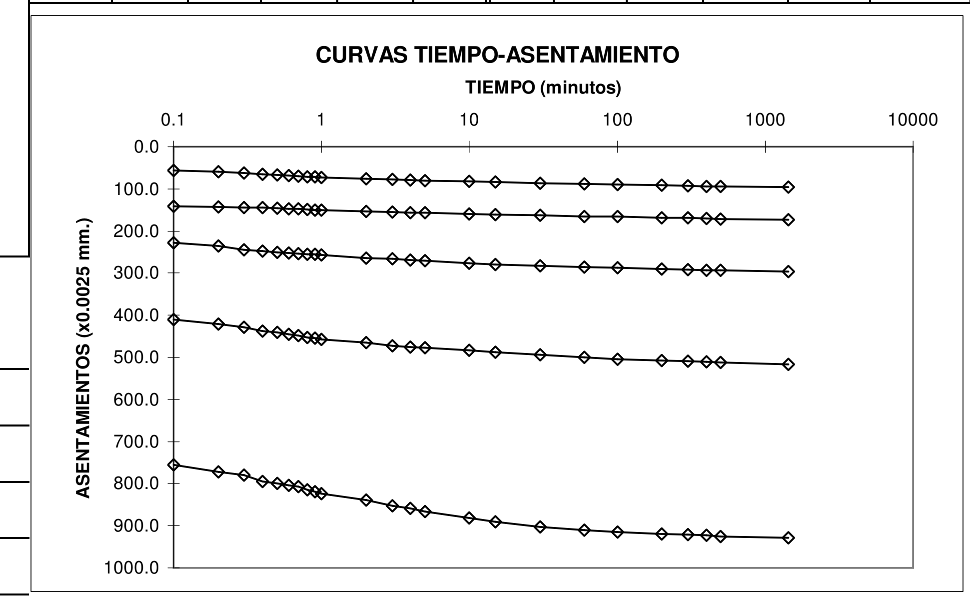
PROYECTO : MIL SITE — MUETRA No : E - 1
OBRA : — PERFORACION : E
UBICACION : PLATAFORMA E — PROFUNDIDAD : 1,50-1,80 m.
FECHA : marzo de 2005

DATOS Y RESULTADOS

t	P	&	g	H	e	Hm	t_{50}	e_m	a_v	c_v	k_m
min	Kg/cm^2	mm	%	mm		mm	seg		cm^2/Kg	cm^2/seg	cm/seg
0000	0.00	0.00	0.00	25.30	1.18	25.2	42	1.166	0.0839	0.7434	2.9E-05
1440	0.25	0.24	0.96	25.06	1.16	25	90	1.147	0.0673	0.3409	1.1E-05
1440	0.50	0.44	1.74	24.86	1.14	24.7	30	1.126	0.0538	1.0019	2.5E-05
1440	1.00	0.75	2.97	24.55	1.11	24.3	37.2	1.088	0.0481	0.7798	1.8E-05
1440	2.00	1.31	5.18	23.99	1.06	23.5	48	1.019	0.0451	0.5649	1.3E-05
1440	4.00	2.36	9.327	22.94	0.97						

DESCARGA

t	P	&	g	H	e
000	4.00	2.36	9.33	22.94	0.97
180	1.00	2.28	9.01	23.02	0.98
180	0.25	2.19	8.66	23.11	0.99
180	0.00	2.14	8.44	23.16	0.99



DENSIDAD DE LA MASA METODO DE LA PARAFINA

PROYECTO : MILL SITE
OBRA :
UBICACION : FECHA : 15-05-054

PERFORACION	SONDEO A		SONDEO E	
PROFUNDIDAD	3,55-4,00		7,55-8,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	58.37	40.69	63.42	47.69
PESO MUESTRA+PARAFINA	61.04	44.08	67.41	50.32
PESO MUESTRA SUMERGIDA	30.55	21.08	30.97	23.58
PESO PARAFINA	2.67	3.39	3.99	2.63
VOLUMEN DE LA MUESTRA	30.49	23	36.44	26.74
DENSIDAD DE LA MASA(T/ m^3)	2.122	2.117	1.982	2.003
DENSIDAD PROMEDIO (T / m^3)	2.120		1.993	

PERFORACION	SONDEO I		SONDEO C	
PROFUNDIDAD	4,55-5,00		10,55-11,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	47.43	48.29	32.35	33.05
PESO MUESTRA+PARAFINA	52.48	53.82	37.14	36.76
PESO MUESTRA SUMERGIDA	23.25	23.61	16.62	17.07
PESO PARAFINA	5.05	5.53	4.79	3.71
VOLUMEN DE LA MUESTRA	29.23	30.21	20.52	19.69
DENSIDAD DE LA MASA(T/ m^3)	2.010	2.008	2.131	2.125
DENSIDAD PROMEDIO (T / m^3)	2.009		2.128	

PERFORACION	SONDEO L		SONDEO J	
PROFUNDIDAD	7,55-8,00		6,55-7,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	64.16	64.06	59.62	57.1
PESO MUESTRA+PARAFINA	67.61	68.75	66.68	62.75
PESO MUESTRA SUMERGIDA	33.2	32.8	31.16	29.89
PESO PARAFINA	3.45	4.69	7.06	5.65
VOLUMEN DE LA MUESTRA	34.41	35.95	35.52	32.86
DENSIDAD DE LA MASA(T/ m^3)	2.099	2.085	2.156	2.150
DENSIDAD PROMEDIO (T / m^3)	2.092		2.153	

PERFORACION	SONDEO E		SONDEO K	
PROFUNDIDAD	2,55-3,00		1,55-2,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	47.81	43.91	42.94	37.25
PESO MUESTRA+PARAFINA	50.66	46.17	44.23	39.93
PESO MUESTRA SUMERGIDA	22	20.07	20.73	17.94
PESO PARAFINA	2.85	2.26	1.29	2.68
VOLUMEN DE LA MUESTRA	28.66	26.1	23.5	21.99
DENSIDAD DE LA MASA(T/ m^3)	1.876	1.862	1.946	1.960
DENSIDAD PROMEDIO (T / m^3)	1.869		1.953	

DENSIDAD DE LA MASA METODO DE LA PARAFINA

PROYECTO : MILL SITE
OBRA :
UBICACION : FECHA : 15-05-054

PERFORACION	SONDEO B		SONDEO I	
PROFUNDIDAD	3,55-4,00		3,55-4,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	33.92	33.87	37.86	44.16
PESO MUESTRA+PARAFINA	36.85	36.32	40.77	51.24
PESO MUESTRA SUMERGIDA	15.82	15.8	17.45	19.76
PESO PARAFINA	2.93	2.45	2.91	7.08
VOLUMEN DE LA MUESTRA	21.03	20.52	23.32	31.48
DENSIDAD DE LA MASA(T/ m^3)	1.910	1.904	1.886	1.872
DENSIDAD PROMEDIO (T / m^3)	1.907		1.879	

PERFORACION	SONDEO F		SONDEO E	
PROFUNDIDAD	1,55-2,00		11,55-12,00	
MUESTRA No.	1	2	1	2
PESO MUESTRA NATURAL	44.23	44.48	43.12	39.43
PESO MUESTRA+PARAFINA	47.77	45.93	46.6	41.92
PESO MUESTRA SUMERGIDA	22.7	22.54	22	20.03
PESO PARAFINA	3.54	1.45	3.48	2.49
VOLUMEN DE LA MUESTRA	25.07	23.39	24.6	21.89
DENSIDAD DE LA MASA(T/ m^3)	2.094	2.043	2.081	2.063
DENSIDAD PROMEDIO (T / m^3)	2.069		2.072	

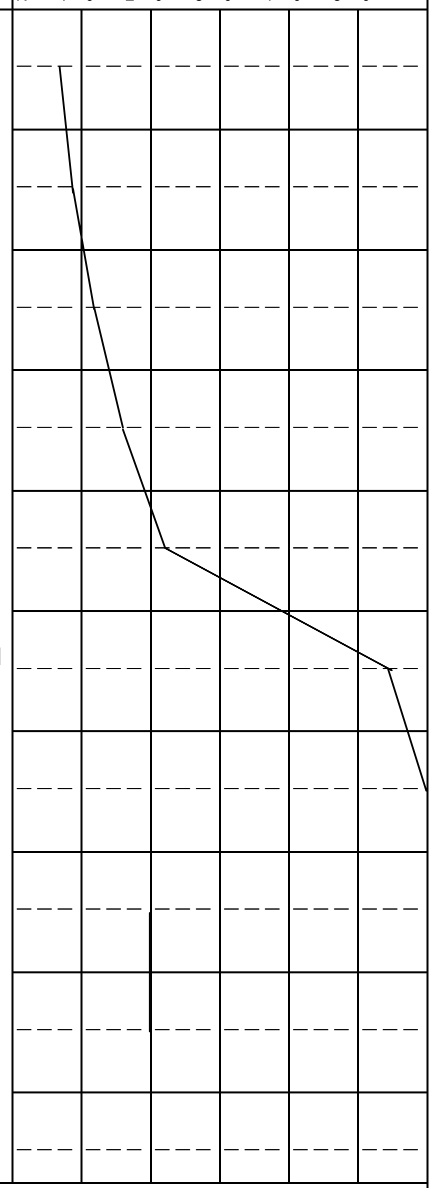
PERFORACION	SONDEO L	
PROFUNDIDAD	8,00-8,15	
MUESTRA No.	1	2
PESO MUESTRA NATURAL	62.96	55.5
PESO MUESTRA+PARAFINA	66.76	60.06
PESO MUESTRA SUMERGIDA	31.67	27.59
PESO PARAFINA	3.8	4.56
VOLUMEN DE LA MUESTRA	35.09	32.47
DENSIDAD DE LA MASA(T/ m^3)	2.041	2.027
DENSIDAD PROMEDIO (T / m^3)	2.034	

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA A
FECHA : 06- MARZO-2005

PERFORACION : A
ABSC.-COTA : 9605307 N
: 773961,1 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
		Cobsertura vegetal hasta 0.50m	CH	3-3-5 N=8	
1.0		Arcilla plástica, café amarillenta, con esporádicas gravas subangulares de cuarzo de 5mm de diámetro, de consistencia semidura.	CH	3-4-5 N=9	
2.0			CH	3-5-7 N=12	
		hasta 2.60m			
3.0		Arcilla de baja plasticidad, de color café amarillento, con manchas rojizas, húmedo, con un 5% de gravas subangulares de cuarzo lechoso de hasta 5cm, de consistenciadura.	CL	3-8-9 N=17	
4.0			CL	6-9-13 N=22	
5.0		hasta 4.90m			
		Arcilla plástica, de color blanco con manchas rojizas, con espor{adicas gravas subangulares de cuarzo de hasta 5cm de diámetro, de consistencia rígida.	CH	15-24-31 N=55	
6.0			CH	R	
7.0					
8.0					
9.0					



NIVEL FREATICO (NF.): 3,75m

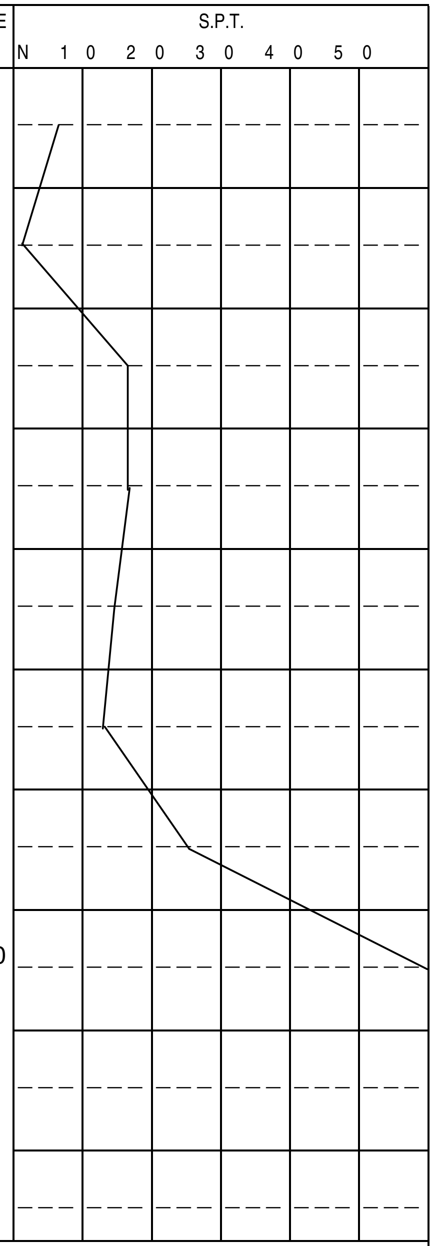
REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA B
FECHA : 06-MARZO-2005

PERFORACION : B
ABSC.-COTA : 9605342 N
: 7740274 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
	v v v	Cobsertura vegetal hasta 0.50m	MH	3-3-5 N=8
1.0 – 2.0		Limo plástico,café amarillento, húm. con gravas de cuarzo esporádicas de hasta 5 mm de diámetro, húmedo, de consistencia media a muy blanda a partir de 1.0m de profundidad.	MH	1-1-1 N=2
3.0		Limo plástico, caf{e amarillento, húmedo, con gravas de cuarzo esporádicas, de consistencia dura. hasta 3.50m	MH	2-5-12 N=17
			MH	6-7-10 N=17
4.0 – 5.0		Coluviales, con 90% de matriz limo plástica, de color café rojiza, con gravas de cuarzo entre 0.5 y 1cm, de consistencia semidura. hasta 4.90m	MH	4-6-9 N=15
6.0 – 7.0		Arena arcillosa, de color gris claro, h{umeda, de consistencia semidura a dura a la base.	SC	3-6-7 N=13
			SC	9-11-15 N=26
8.0		Arena arcillosa, de color gris claro, húmeda, de consistencia rígida.	SC	23-29-40 N=69
9.0				

S.P.T.



NIVEL FREÁTICO (NF.): 4,30m

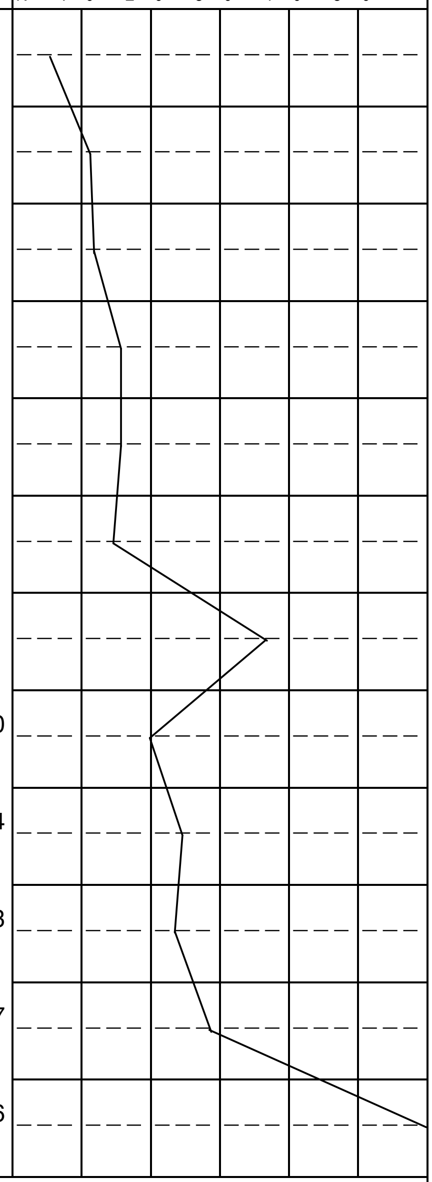
REGISTRO DE PERFORACIÓN

PROYECTO : MILL SITE
OBRA :
UBICACIÓN : PLATAFORMA C
FECHA : 7- MARZO-2005

PERFORACIÓN : C
ABSC.-COTA : 9605374 N
: 774096,8 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCIÓN DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
1.0		Cobsertura vegetal hasta 0.60m Limo plástico, café claro, húmedo, con esporádicas gravas de cuarzo. de consistencia media.	MH	3-3-3 N=6
2.0		Coluvial en matriz areno arcillosa, de color caf{e rojizo, húmeda, con gravas de cuarzo y areniscas meteorizadas, de consisstencia semidura. hasta 5.50m	SC	3-5-6 N=11
3.0			SC	4-6-6 N=12
4.0			SC	5-7-9 N=16
5.0			SC	6-8-8 N=16
6.0			SM	7-7-8 N=15
7.0		Coluvial, con matriz areno limosa, y gravas de hasta 10cm, húmeda, de consistencia dura. hasta 9.65m	SM	8-16-21 N=37
8.0			SM	25-10-10 N=20
9.0			SM	11-11-14 N=25
10.0		Arcila de alta plasticidad, de color caf{e amarillento, con gravillas, húmedo, de consistencia dura. hsta 10.60m	CH	10-11-13 N=24
11.0		Coluvial en matriz arcillosa con arena de consistencia dura hasta 10.90m	CH	10-12-17 N=29
12.0		Arcilla plástica, blanca con pintas vio letas, húmedo de consistsencia rígida	CH	29-31-36 N=67

S.P.T.



NIVEL FREATICO (NF.): 4,15m

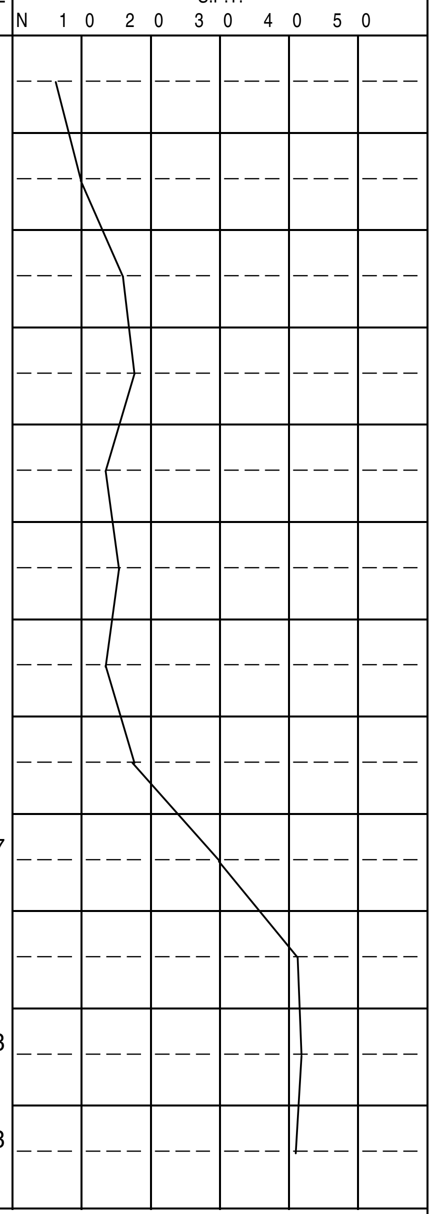
REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA D
FECHA : 05-MARZO-2005

PERFORACION : D
ABSC.-COTA : 9605192 N
: 774010,2 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
1.0	v v v	Cobsertura vegetal hasta 0.50m		3-4-3 N=7
2.0				3-5-5 N=10
3.0				4-7-10 N=17
4.0			CH CH	5-7-11 N=18
5.0				5-6-8 N=14
6.0				5-6-10 N=16
7.0				6-6-8 N=14
8.0				7-8-10 N=18
9.0				11-13-17 N=30
10.0			SM	9-19-22 N=41
11.0				23-19-23 N=42
12.0				17-18-23 N=41

S.P.T.



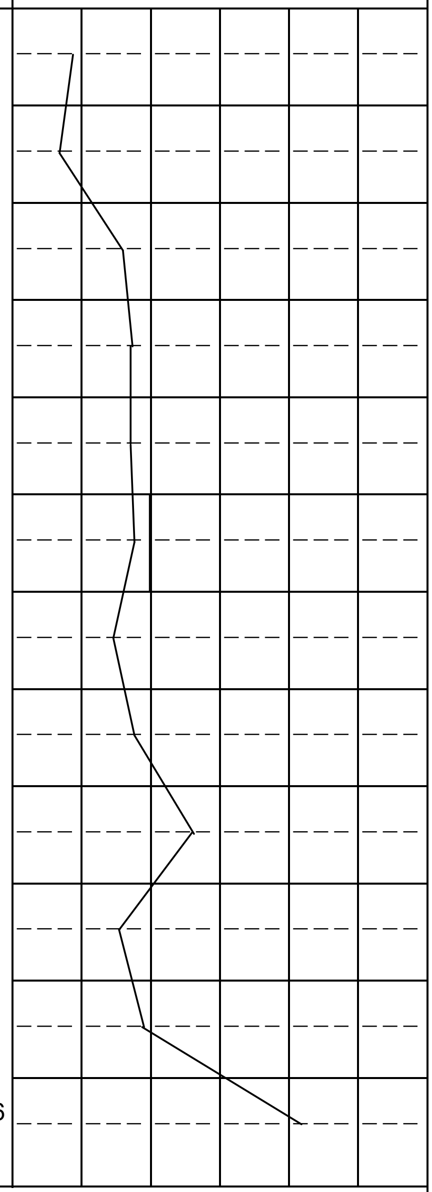
NIVEL FREATICO (NF.):

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA E
FECHA : 04-MARZO-2005

PERFORACION : E
ABSC.-COTA : 9605227 N
: 774075,9 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
1.0	Cobsertura vegetal hasta 0.60m Limo plástico, caf{e amarillento con esporádocos fragmentos de cuarzo de consistencia media.	MH	4-5-4 N=9	
2.0	coluvial, en matriz limo arcilloso plás-tico, de color caf{e amarillento rojizo con gravas de cuarzo y areniscas meteorizadas	MH	3-3-4 N=7	
3.0		MH	7-7-9 N=16	
4.0	hsta 3.50m Arcilla de alta plasticidad, café ama-rillenta húmeda, de consistencia dura.	CH	6-7-10 N=17	
5.0		SC	4-7-10 N=17	
6.0	Coluvial en matriz areno arcillosa, de color café amarillento, con gra-vas de cuarzo y areniscas meteo-rizadas, de consisstencia semidura.	SC	5-8-10 N=18	
7.0		SC	7-7-8 N=15	
8.0		SC	5-7-11 N=18	
9.0		SC	8-12-15 N=27	
10.0	hasta 9.70m Arcilla de baja plasticidad, de color plomo rojizo, de consistencia dura hasta 10,60m	CL	7-6-10 N=16	
11.0		CL	5-7-12 N=19	
12.0	Arcilla de baja plasticidad, de color amarillo blancuzco, h{umedo con gravillas de consistencia dura a rígi-da a la base	CL	11-16-26 N=42	



NIVEL FREATICO (NF.): 5,45m

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA F
FECHA : 08-MARZO-2005

PERFORACION : F
ABSC.-COTA : 9605259 N
: 774146 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI- GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
	v v v v v v	Cobsertura vegetal hasta 0.60m	CH	2-3-4 N=7	
1.0		Coluvial, en matriz arcillosa plástica, de color café con gravas.Cons.media			
		Arcilla con arenisca, de color gris claro, con laminaciones horizontales con oxidaciones, ligeramente me teorizadas de consistencia rígida.	CH	24-38-R R	
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					

NIVEL FREATICO (NF.): 0,20m

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA G
FECHA : 03- MARZO-2005

PERFORACION : G
ABSC.-COTA : 9605082 N
: 774066,3 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
	v v v v v v	Cobsertura vegetal hasta 0.25m	MH	1-3-3 N=6	
1.0		Limo plástico, de color café amari- llento, con tintes rojizos, con gravas subangulares de arenisca cuarzosa blanca entre 0.5 y 2 cm de di{ametro de consistencia media a rígida a la base.	MH	31-47-R R	
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					

NIVEL FREATICO (NF.):

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA H
FECHA : 10-MARZO-2005

PERFORACION : H
ABSC.-COTA : 9605119,0 N
: 774132,8 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
1.0	v v v	Cobsertura vegetal hasta 0.60m Coluvial, en matriz arcillosa de baja plasticidad,café amarillenta con tintes rojizoscon un 30% de gravas de cuarzo subangulares de hasta 1cm de diámetro, de consistencia semidura hasta 1.50m y rígida a partir de 1.50m.	CL	3-3-8 N=11	
2.0			CL	R	
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					

NIVEL FREATICO (NF.):

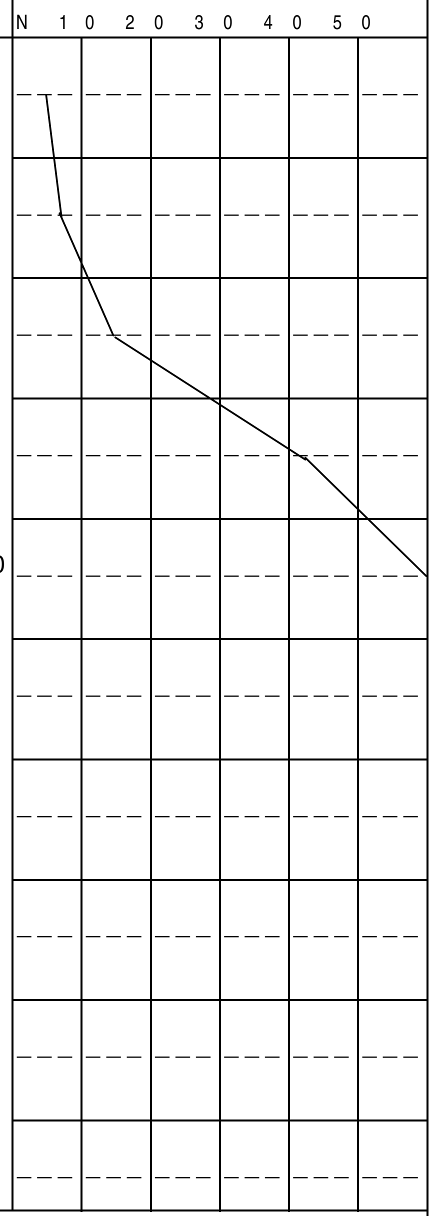
REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA I
FECHA : 09-MARZO-2005

PERFORACION : I
ABSC.-COTA : 9605154 N
: 774198,9 E
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
	v v v	Cobsertura vegetal hasta 0.50m	MH	1-2-3 N=5
1.0		Limo plástico, caf{e amarillento, con esporádicos fragmentos de cuarzo de hasta 1cm, consistencia media. hsta 1.70m	CH	2-3-4 N=7
2.0		Arcilla plástica, café rojizo, húmedo, h{umeda, de consistencia media. hsta 2.70m	CH	4-6-9 N=15
3.0		Arcilla plástica, de color caf{e violeta, húmedo, de consistencia rígida.	CH	6-18-25 N=43
4.0		hasta 4.50m	CH	21-35-40 N=75
5.0		Arcilla plástica, de color plomo grisá-ceo, húmedo, de consistencia rígida.		
6.0				
7.0				
8.0				
9.0				

S.P.T.



NIVEL FREATICO (NF.):

REGISTRO DE PERFORACION

PROYECTO	: MILL SITE	PERFORACION	: J
OBRA	:	ABSC.-COTA	: 9605065 N
UBICACION	: PLATAFORMA J		: 774243,7 E
FECHA	: 10-MARZO-2005	PERFORADOR	: G. MORLES
		JEFE DE CAMPO	: J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
	v v v	Cobsertura vegetal hasta 0.60m	MH	2-2-3 N=5
1.0		Coluvial con 85% de matriz limo plástico, caf{e amarillento, con 15% de gravas de cuarzo entre 0.5 y 2cm de consistencia media.		4-6-8 N=14
2.0		Coluvial con 30% de grava de cuarzo de hasta 3 cm,matriz areno arcillosa, café rojiza, húmeda, semidura.	SC	
3.0		similar al anterior en matriz limosa muy plástica, de color café amarillenta, hasta 2.80m	MH	5-6-8 N=14
4.0		Limo de baja plásticidad, de color ca{e con tintes plomo rojizos, con 40% de gravas de cuarzo de hasta 3 cm, húmeda, de consistencia dura. hasta 4.60m	ML	9-8-8 N=16
			ML	5-6-10 N=16
5.0		Limo de baja plasticidad, de color café con tintes plomo rojizos, húmedo de consistencia semidura. hasta 5.90m	ML	5-7-7 N=14
6.0		Coluvial 30% gravas, matriz limo de baja plasticidad, hasta 6,30m		
7.0		Limo de bja plasticidad, de color plomo grisáceo, con tintes rojizos, de consistencia rígida. hasta 7.50m	ML	13-16-18 N=34
8.0		Arna limosa, de color caf{e amarillento, de compacidad meida. hasta 8,40m	SM	9-11-14 N=25
9.0		Limo de baja plásticidad, de color gris claro, con manchas rojizas y violetas, de consistencia dura, húmedo, de consistencia rígida.	ML	45-R R

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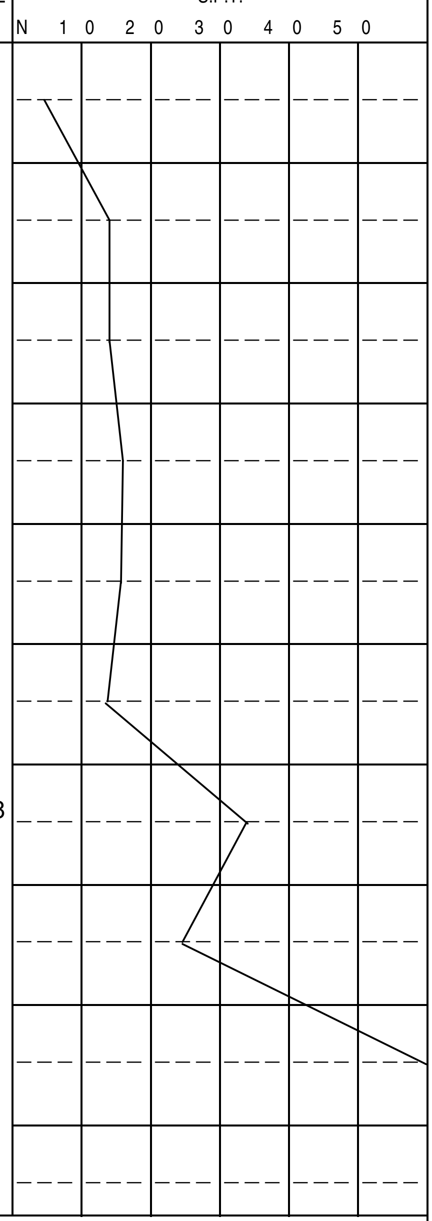
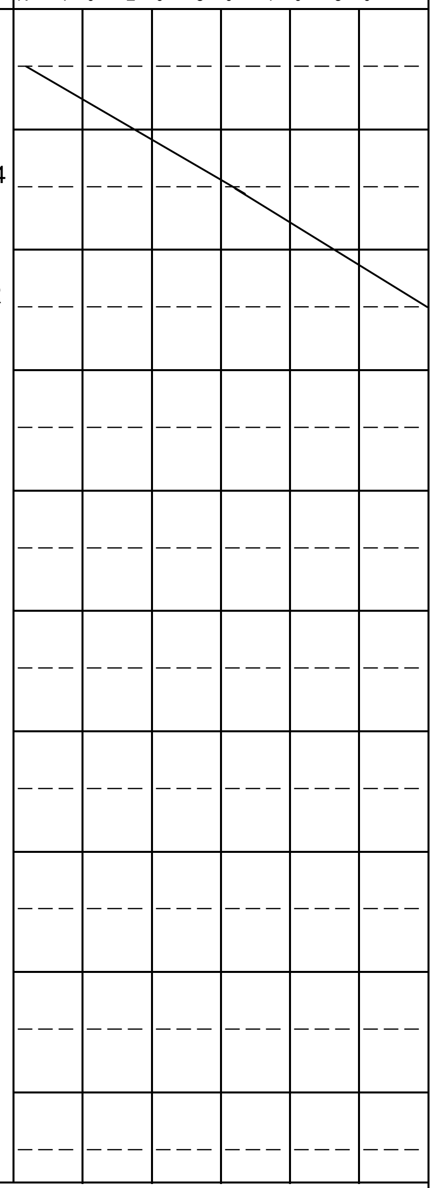


NIVEL FREATICO (NF.):

REGISTRO DE PERFORACION

PROYECTO	: MILL SITE	PERFORACION	: K
OBRA	:	ABSC.-COTA	: 9605099 N
UBICACION	: PLATAFORMA K		: 774312 E
FECHA	: 09-MARZO-2005	PERFORADOR	: G. MORLES
		JEFE DE CAMPO	: J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES	S.P.T. N 10 20 30 40 50
	v v v v v v	Cobsertura vegetal hasta 0.60m	MH	1-1-2 N=3	
1.0		Coluvial con 70% matriz limosa plástica, café amarillento, con gravas de cuarzohasta 1cm, consist. Blanda hasta 1.40m	MH	14-19-14 N=33	
2.0		Limo plástico, de color gris claro, con 20% de gravas de cuarzo hasta 2cm, húmeod, de consistencia rígida Hata 2.60m	MH	23-50-R R	
3.0		Limo plástico, rojizo con oxidaciones con esporádicas gravas de cuarzo de hasta 1cm de consistencia rígida.	MH		
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					



NIVEL FREATICO (NF.):

REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA L
FECHA : 11-MARZO-2005

PERFORACION : L
ABSC.-COTA :
:
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATIGRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
		Cobsertura vegetal hasta 0.50m		2-3-3
1.0		Limo plástico,café amarillento, con esporádicas gravas de cuarzo sub angulares hasta 5cm, h{umedo de consistencia media. Hasta 1.70m	MH	N=6
				3-5-5
2.0			SC	N=10
		Coluvial, 75% de matriz arenos arci-llosa de color café rojizo,con 25% gravas de cuarzo y arenisca meteo-rizada de hasta 3 cm, húmedo, de consistencia semidura.	SC	5-6-9 N=15
3.0				
			SC	6-6-9 N=15
4.0				
		hasta 4.50m	SC	11-14-10
5.0		Coluvial, 75% de matriz arenos arci-llosa de color café rojizo, con gravas de cuarzo y arenisca meteorizados de hasta 3cm,consistencia dura.		N=24
				6-8-15
6.0		Desde 5.80m, arcillas de baja plasti-cidad de color gris claro, húmedo, de consistencia dura.	CL	N=23
			CL	9-14-16
7.0		Arcilla de baja plasticidad, de color gris claro con tintes rojizos,con gra-vas de grano fino a medio, de consis tencia dura.		N=30
				10-17-35
8.0		Limo plástico, gris claro con tintes rojizos, húmedo de consistencia rígida, hasta 8.05 m	MH	N=52
		Arena arcillosa, de color gris claro h{umeda, de consistencia rígida.	SC	R
9.0				

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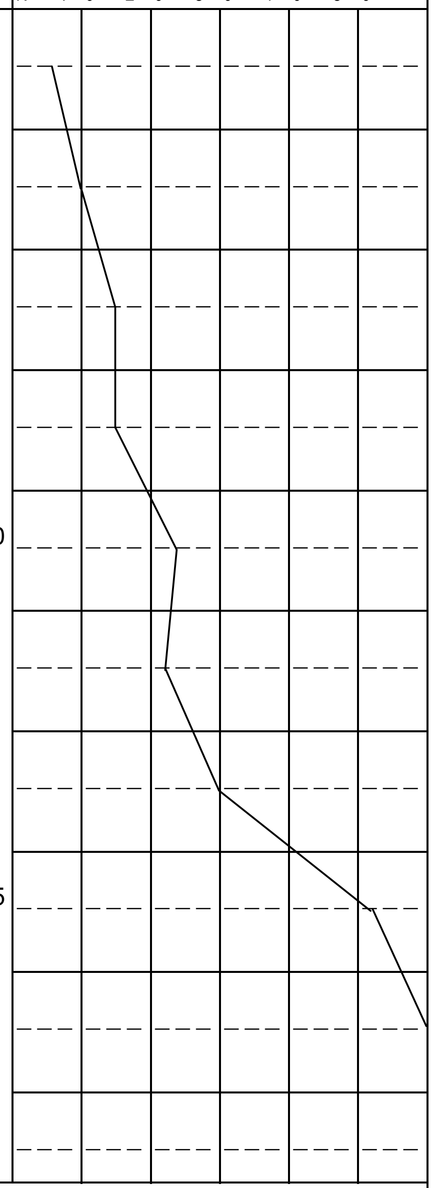


NIVEL FREATICO (NF.): 5,20m

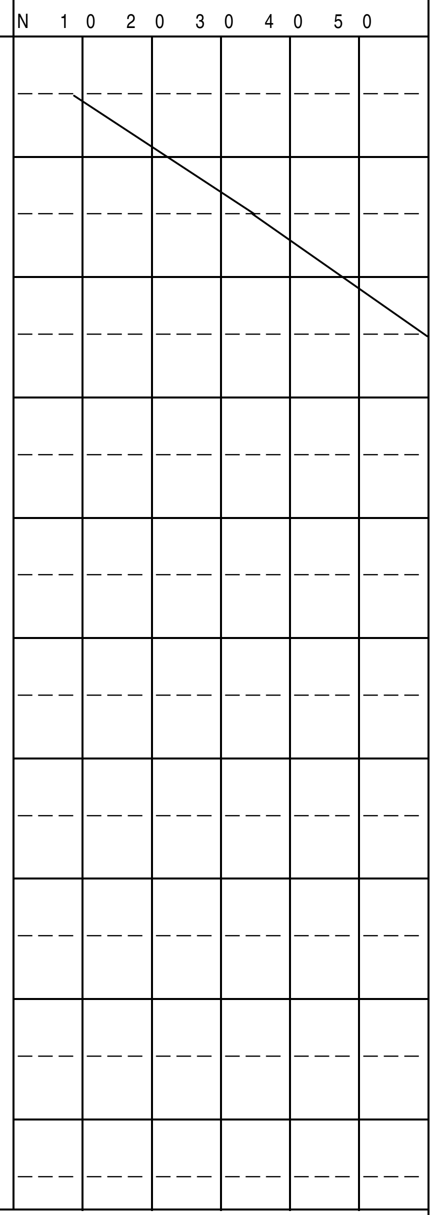
REGISTRO DE PERFORACION

PROYECTO : MILL SITE
OBRA :
UBICACION : PLATAFORMA M
FECHA : 11-MARZO-2005

PERFORACION : M
ABSC.-COTA :
:
PERFORADOR : G. MORLES
JEFE DE CAMPO : J.L. TORRES

PROF. MTS.	ESTRATI-GRAFIA	DESCRIPCION DEL SUELO	S.U.C.S.	NUMERO DE GOLPES
	v v v	Cobsertura vegetal hasta 0.70m	SM	1-2-7 N=9
1.0		Arena fina limosa, blanca, con gravas subangulares de cuarzo de hasta 2 cm, de compacidad suelta. hasta 1.50m		8-17-18
2.0		Arcilla plástica, de color plomo blancuzco, h{umedo de consistencia r{igida. hasta 2.30m	CH	N=35
3.0		Arenisca amarillenta,de grano fino húmedo de consistencia rígida	SC	50-R R
4.0				
5.0				
6.0				
7.0				
8.0				
9.0				

S.P.T.



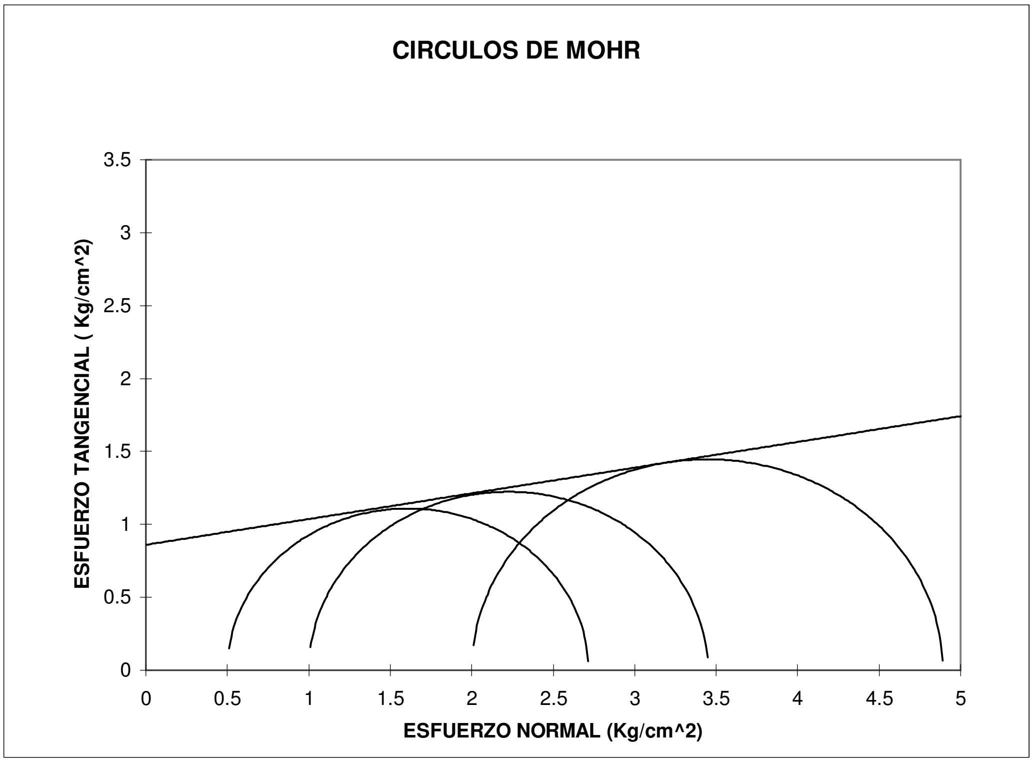
NIVEL FREATICO (NF.): 0,20m

ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO : MILL SITE
OBRA : CIMENTACION
UBICACION : PLATAFORMA A

MUESTRA No. : SHELBY
PROFUND. : 5,00-5,50 m
FECHA : MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	2.22	0.50	2.72	1.11	1.61
2	2.45	1.00	3.45	1.22	2.22
3	2.89	2.00	4.89	1.45	3.45



COHESION (kg/cm^2)	0.86
FRICCION (GRADOS)	10

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.63	3.67	3.65
ALTURA MEDIA	(cm)	7	6.9	7.03
HUMEDAD FINAL	(%)	23.03	23.01	23.00
DENSIDAD HUMEDA	(gr/cm^3)	2.092	1.972	2.077
DENSIDAD SECA	(gr/cm^3)	1.700	1.603	1.689

PROYECTO	: MILL SITE	MUESTRA No.	: SHELBY
OBRA	: CIMENTACION	PROFUND.	: 5,00-5,50 m
UBICACION	: PLATAFORMA A	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

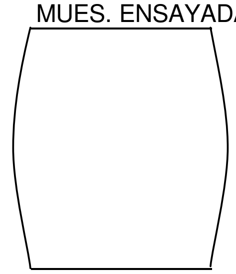
Ds	3.58	Peso inicial	151.66		
Dc	3.64	Vol. inicial	72.51	Calculado por	: B.ALVAREZ
Di	3.65	δ m. inicial	2.092	Cnte.anillo Kg	0.1120
Dm	3.63	δ d . inicial	1.700		
Am	10.36				
Hm	7	Presión lateral	0.5 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	18	2.02	0.18	0.19
10	26	2.91	0.36	0.28
20	42	4.70	0.73	0.45
30	63	7.06	1.09	0.67
40	77	8.62	1.45	0.82
50	88	9.86	1.81	0.93
60	108	12.10	2.18	1.14
70	126	14.11	2.54	1.33
80	146	16.35	2.90	1.53
90	158	17.70	3.27	1.65
100	174	19.49	3.63	1.81
120	200	22.40	4.35	2.07
140	216	24.19	5.08	2.22
160	228	25.54	5.81	2.32
180	236	26.43	6.53	2.39
200	242	27.10	7.26	2.43
250	256	28.67	9.07	2.52
300	262	29.34	10.89	2.52

CONTENIDO DE HUMEDAD

CAPSULA No.	115
P. CAP.+ S HUM	172.30
P.CAP + S.SECO	143.86
P. CAPSULA	20.37
HUMEDAD %	23.03

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SHELBY
OBRA	: CIMENTACION	PROFUND.	: 5,00-5,50 m
UBICACION	: PLATAFORMA A	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

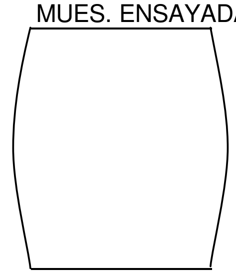
Ds	3.67	Peso inicial	143.57	
Dc	3.67	Vol. inicial	72.79	Calculado por : B.ALVAREZ
Di	3.64	δ m. inicial	1.972	Cnte.anillo Kg 0.1120
Dm	3.67	δ d . inicial	1.603	
Am	10.55			
Hm	6.90	Presión lateral	1.0 Kg/cm^2	

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	22	2.46	0.18	0.23
10	33	3.70	0.37	0.35
20	51	5.71	0.74	0.54
30	72	8.06	1.10	0.76
40	93	10.42	1.47	0.97
50	118	13.22	1.84	1.23
60	132	14.78	2.21	1.37
70	156	17.47	2.58	1.61
80	176	19.71	2.94	1.81
90	192	21.50	3.31	1.97
100	203	22.74	3.68	2.08
120	222	24.86	4.42	2.25
140	243	27.22	5.15	2.45
160	254	28.45	5.89	2.54
180	264	29.57	6.63	2.62
200	276	30.91	7.36	2.71
250	288	32.26	9.20	2.78
300	302	33.82	11.04	2.85

CONTENIDO DE HUMEDAD

CAPSULA No.	158
P. CAP.+ S HUM	161.12
P.CAP + S.SECO	134.37
P. CAPSULA	18.10
HUMEDAD %	23.01

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SHELBY
OBRA	: CIMENTACION	PROFUND.	: 5,00-5,50 m
UBICACION	: PLATAFORMA A	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

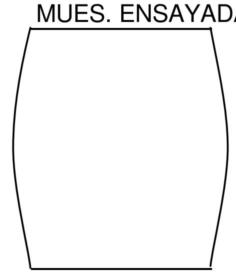
Ds	3.67	Peso inicial	152.5		
Dc	3.66	Vol. inicial	73.42	Calculado por	: B.ALVAREZ
Di	3.57	δ m. inicial	2.077	Cnte.anillo Kg	0.1120
Dm	3.65	δ d . inicial	1.689		
Am	10.44				
Hm	7.03	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	22	2.46	0.18	0.24
10	48	5.38	0.36	0.51
20	76	8.51	0.72	0.81
30	108	12.10	1.08	1.15
40	135	15.12	1.45	1.43
50	156	17.47	1.81	1.64
60	178	19.94	2.17	1.87
70	194	21.73	2.53	2.03
80	215	24.08	2.89	2.24
90	230	25.76	3.25	2.39
100	242	27.10	3.61	2.50
120	264	29.57	4.34	2.71
140	284	31.81	5.06	2.89
160	300	33.60	5.78	3.03
180	312	34.94	6.50	3.13
200	325	36.40	7.23	3.23
250	348	38.98	9.03	3.39
300	365	40.88	10.84	3.49

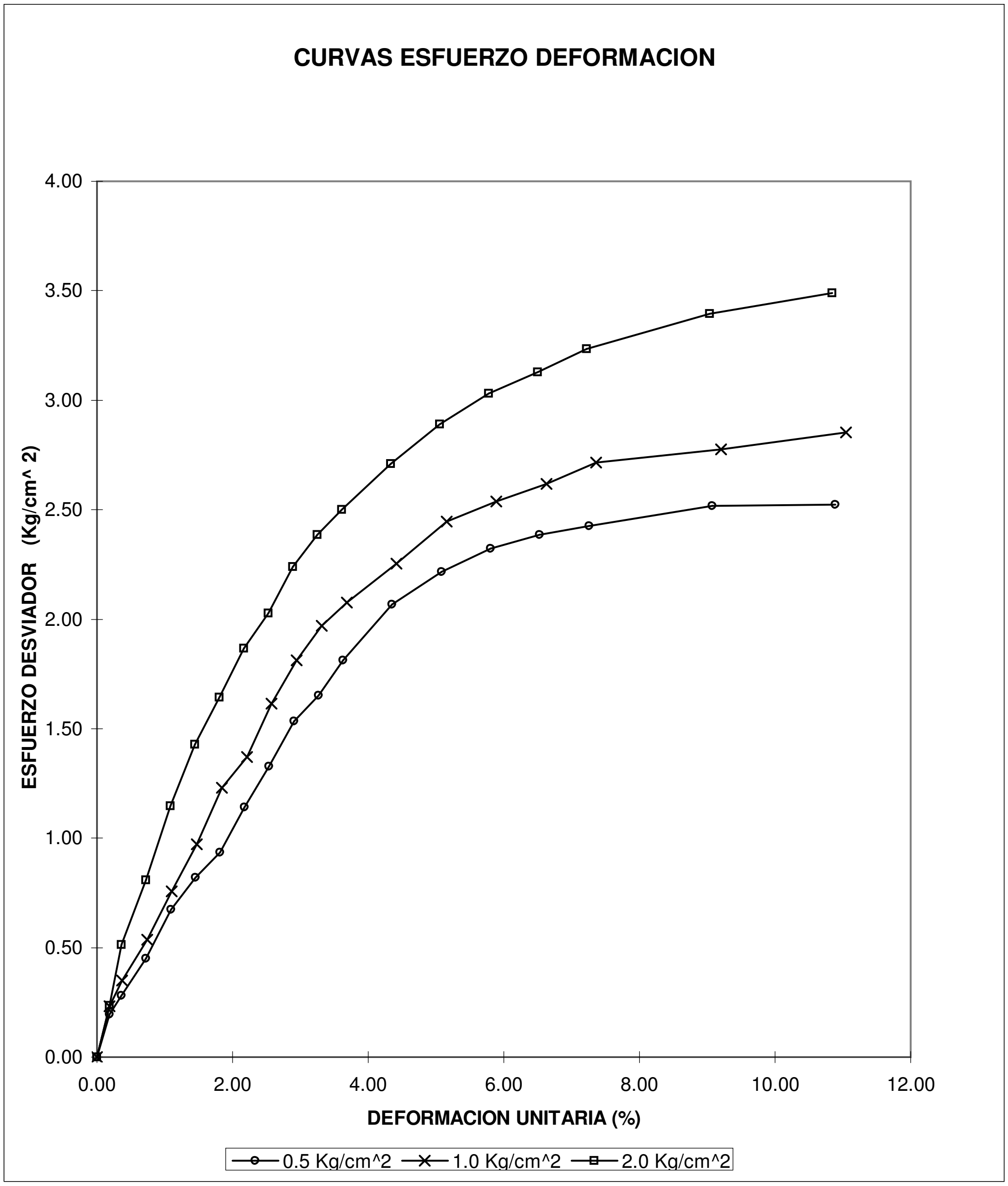
CONTENIDO DE HUMEDAD

CAPSULA No.	142
P. CAP.+ S HUM	171.45
P.CAP + S.SECO	142.81
P. CAPSULA	18.28
HUMEDAD %	23.00

GRAFICO DE LA MUES. ENSAYADA



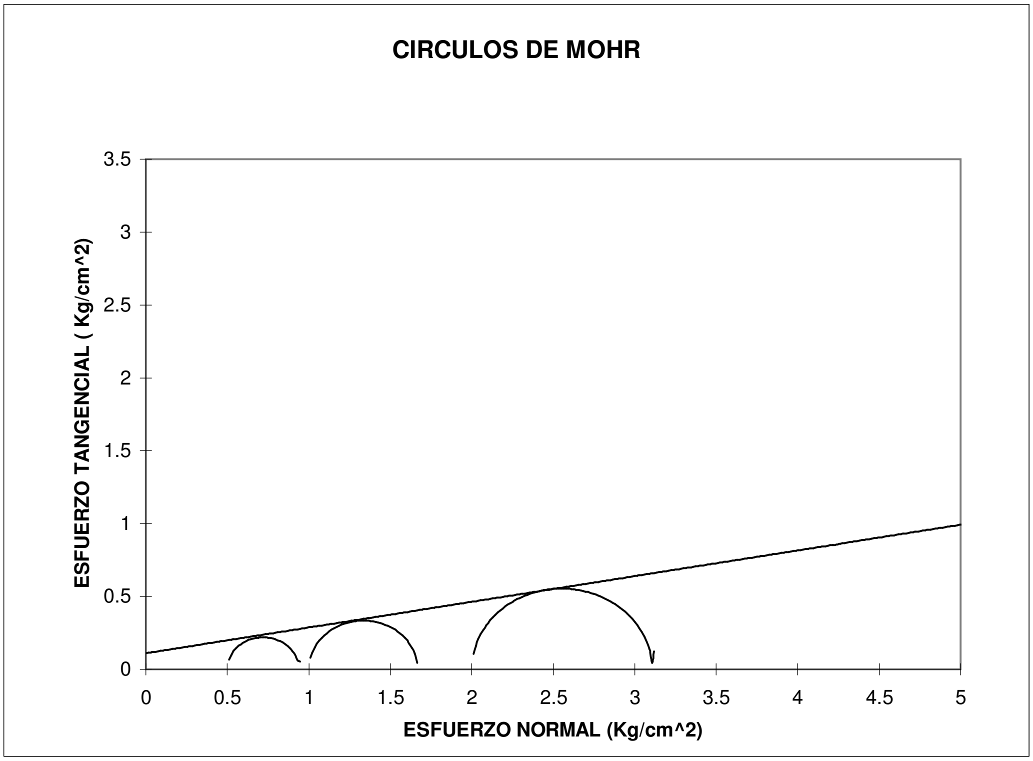
PROYECTO	: MILL SITE	MUESTRA No.	: SHELBY
OBRA	: CIMENTACION	PROFUND.	: 5,00-5,50 m
UBICACION	: PLATAFORMA A	FECHA	: MARZO-2005



ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO B
OBRA	: CIMENTACION	PROFUND.	: 6,00-6,50 m
UBICACION	: PLATAFORMA B	FECHA	: MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	0.44	0.50	0.94	0.22	0.72
2	0.67	1.00	1.67	0.33	1.33
3	1.11	2.00	3.11	0.55	2.55



COHESION (kg/cm^2)	0.11
FRICCION (GRADOS)	10

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.60	3.65	3.60
ALTURA MEDIA	(cm)	6.99	6.67	6.95
HUMEDAD FINAL	(%)	29.86	29.87	29.85
DENSIDAD HUMEDA	(gr/cm^3)	2.015	2.055	2.042
DENSIDAD SECA	(gr/cm^3)	1.552	1.582	1.573

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO B
OBRA	: CIMENTACION	PROFUND.	: 6,00-6,50 m
UBICACION	: PLATAFORMA B	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

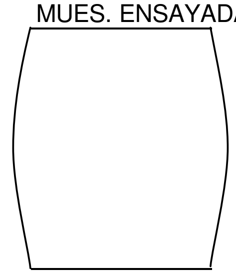
Ds	3.64	Peso inicial	143.39	
Dc	3.59	Vol. inicial	71.15	Calculado por : B.ALVAREZ
Di	3.60	δ m. inicial	2.015	Cnte.anillo Kg 0.1120
Dm	3.60	δ d . inicial	1.552	
Am	10.18			
Hm	6.99	Presión lateral	0.5 Kg/cm^2	

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	4	0.45	0.18	0.04
10	6	0.67	0.36	0.07
20	8	0.90	0.73	0.09
30	10	1.12	1.09	0.11
40	13	1.46	1.45	0.14
50	17	1.90	1.82	0.18
60	21	2.35	2.18	0.23
70	26	2.91	2.54	0.28
80	28	3.14	2.91	0.30
90	32	3.58	3.27	0.34
100	36	4.03	3.63	0.38
120	39	4.37	4.36	0.41
140	42	4.70	5.09	0.44
160	44	4.93	5.81	0.46
180	46	5.15	6.54	0.47
200	48	5.38	7.27	0.49
250	52	5.82	9.08	0.52
300	55	6.16	10.90	0.54

CONTENIDO DE HUMEDAD

CAPSULA No.	122
P. CAP.+ S HUM	162.30
P.CAP + S.SECO	129.22
P. CAPSULA	18.44
HUMEDAD %	29.86

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO B
OBRA	: CIMENTACION	PROFUND.	: 6,00-6,50 m
UBICACION	: PLATAFORMA B	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

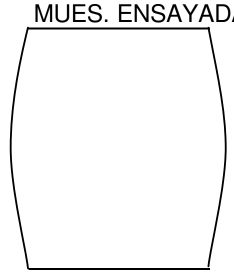
Ds	3.63	Peso inicial	143.54		
Dc	3.66	Vol. inicial	69.86	Calculado por	: B.ALVAREZ
Di	3.64	δ m. inicial	2.055	Cnte.anillo Kg	0.1120
Dm	3.65	δ d . inicial	1.582		
Am	10.47				
Hm	6.67	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	5	0.56	0.19	0.05
10	8	0.90	0.38	0.09
20	12	1.34	0.76	0.13
30	15	1.68	1.14	0.16
40	18	2.02	1.52	0.19
50	24	2.69	1.90	0.25
60	28	3.14	2.28	0.29
70	32	3.58	2.67	0.33
80	36	4.03	3.05	0.37
90	42	4.70	3.43	0.43
100	48	5.38	3.81	0.49
120	58	6.50	4.57	0.59
140	66	7.39	5.33	0.67
160	74	8.29	6.09	0.74
180	82	9.18	6.85	0.82
200	89	9.97	7.62	0.88
250	99	11.09	9.52	0.96
300	110	12.32	11.42	1.04

CONTENIDO DE HUMEDAD

CAPSULA No.	153
P. CAP.+ S HUM	160.12
P.CAP + S.SECO	127.31
P. CAPSULA	17.45
HUMEDAD %	29.87

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO B
OBRA	: CIMENTACION	PROFUND.	: 6,00-6,50 m
UBICACION	: PLATAFORMA B	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

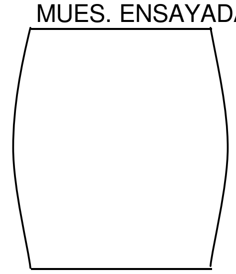
Ds	3.66	Peso inicial	144.49		
Dc	3.58	Vol. inicial	70.74	Calculado por	: B.ALVAREZ
Di	3.62	δ m. inicial	2.042	Cnte.anillo Kg	0.1120
Dm	3.60	δ d . inicial	1.573		
Am	10.18				
Hm	6.95	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	7	0.78	0.18	0.08
10	12	1.34	0.37	0.13
20	20	2.24	0.73	0.22
30	26	2.91	1.10	0.28
40	33	3.70	1.46	0.36
50	40	4.48	1.83	0.43
60	48	5.38	2.19	0.52
70	59	6.61	2.56	0.63
80	68	7.62	2.92	0.73
90	79	8.85	3.29	0.84
100	88	9.86	3.65	0.93
120	98	10.98	4.39	1.03
140	106	11.87	5.12	1.11
160	112	12.54	5.85	1.16
180	118	13.22	6.58	1.21
200	124	13.89	7.31	1.26
250	135	15.12	9.14	1.35
300	140	15.68	10.96	1.37

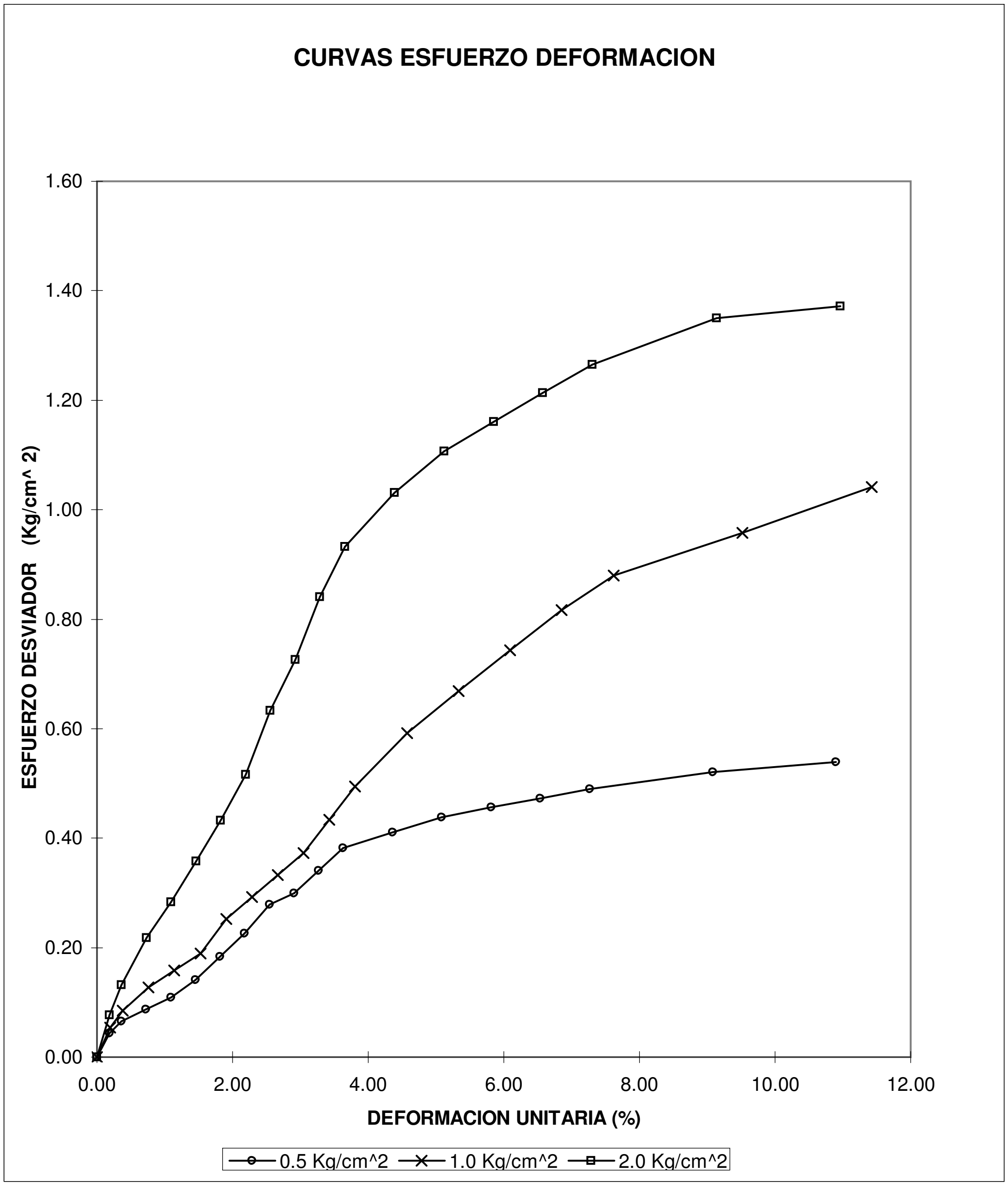
CONTENIDO DE HUMEDAD

CAPSULA No.	166
P. CAP.+ S HUM	168.79
P.CAP + S.SECO	134.22
P. CAPSULA	18.42
HUMEDAD %	29.85

GRAFICO DE LA MUES. ENSAYADA



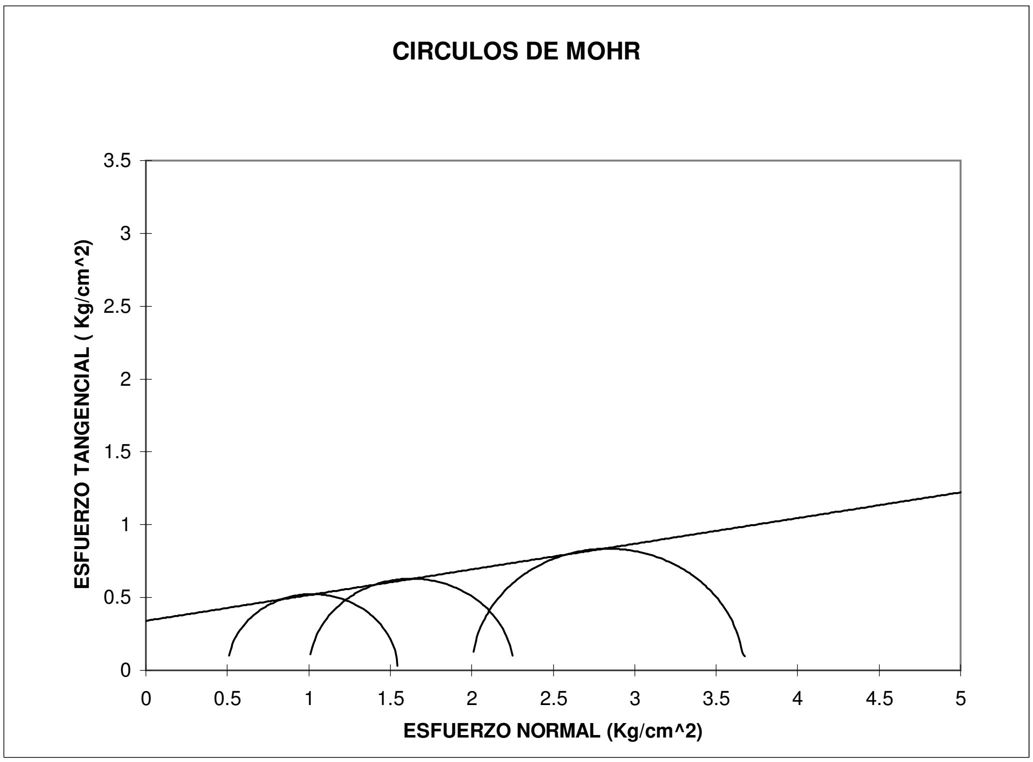
PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO B
OBRA	: CIMENTACION	PROFUND.	: 6,00-6,50 m
UBICACION	: PLATAFORMA B	FECHA	: MARZO-2005



ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO	: MILL SITE	MUESTRA No.	: BLOQUE E
OBRA	: CIMENTACION	PROFUND.	: 1,50-1,80 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	1.05	0.50	1.55	0.52	1.02
2	1.26	1.00	2.26	0.63	1.63
3	1.67	2.00	3.67	0.83	2.83



COHESION (kg/cm^2)	0.34
FRICCION (GRADOS)	10

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.65	3.67	3.58
ALTURA MEDIA	(cm)	7.06	7	7.04
HUMEDAD FINAL	(%)	39.81	39.82	39.79
DENSIDAD HUMEDA	(gr/cm^3)	1.657	1.659	1.749
DENSIDAD SECA	(gr/cm^3)	1.185	1.187	1.251

PROYECTO	: MILL SITE	MUESTRA No.	: BLOQUE E
OBRA	: CIMENTACION	PROFUND.	: 1,50-1,80 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

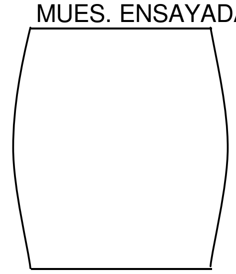
Ds	3.64	Peso inicial	122.52	
Dc	3.65	Vol. inicial	73.94	Calculado por : B.ALVAREZ
Di	3.67	δ m. inicial	1.657	Cnte.anillo Kg 0.1120
Dm	3.65	δ d . inicial	1.185	
Am	10.47			
Hm	7.06	Presión lateral	0.5 Kg/cm^2	

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	12	1.34	0.18	0.13
10	19	2.13	0.36	0.20
20	30	3.36	0.72	0.32
30	38	4.26	1.08	0.40
40	45	5.04	1.44	0.47
50	50	5.60	1.80	0.53
60	55	6.16	2.16	0.58
70	60	6.72	2.52	0.63
80	70	7.84	2.88	0.73
90	76	8.51	3.24	0.79
100	85	9.52	3.60	0.88
120	96	10.75	4.32	0.98
140	103	11.54	5.04	1.05
160	106	11.87	5.76	1.07
180	110	12.32	6.48	1.10
200	116	12.99	7.20	1.15
250	125	14.00	8.99	1.22
300	133	14.90	10.79	1.27

CONTENIDO DE HUMEDAD

CAPSULA No.	164
P. CAP.+ S HUM	141.58
P.CAP + S.SECO	106.47
P. CAPSULA	18.28
HUMEDAD %	39.81

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: BLOQUE E
OBRA	: CIMENTACION	PROFUND.	: 1,50-1,80 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

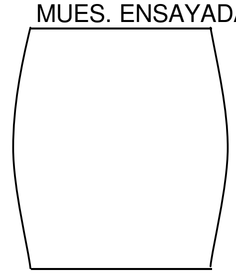
Ds	3.66	Peso inicial	122.66		
Dc	3.67	Vol. inicial	73.91	Calculado por	: B.ALVAREZ
Di	3.66	δ m. inicial	1.659	Cnte.anillo Kg	0.1120
Dm	3.67	δ d . inicial	1.187		
Am	10.56				
Hm	7.00	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	15	1.68	0.18	0.16
10	25	2.80	0.36	0.26
20	40	4.48	0.73	0.42
30	51	5.71	1.09	0.54
40	60	6.72	1.45	0.63
50	70	7.84	1.81	0.73
60	77	8.62	2.18	0.80
70	84	9.41	2.54	0.87
80	90	10.08	2.90	0.93
90	96	10.75	3.27	0.98
100	102	11.42	3.63	1.04
120	114	12.77	4.35	1.16
140	125	14.00	5.08	1.26
160	131	14.67	5.81	1.31
180	141	15.79	6.53	1.40
200	147	16.46	7.26	1.45
250	160	17.92	9.07	1.54
300	172	19.26	10.89	1.63

CONTENIDO DE HUMEDAD

CAPSULA No.	183
P. CAP.+ S HUM	140.39
P.CAP + S.SECO	105.49
P. CAPSULA	17.85
HUMEDAD %	39.82

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: BLOQUE E
OBRA	: CIMENTACION	PROFUND.	: 1,50-1,80 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

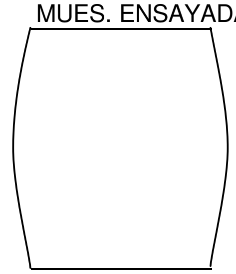
Ds	3.63	Peso inicial	123.91		
Dc	3.56	Vol. inicial	70.86	Calculado por	: B.ALVAREZ
Di	3.61	δ m. inicial	1.749	Cnte.anillo Kg	0.1120
Dm	3.58	δ d . inicial	1.251		
Am	10.07				
Hm	7.04	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	14	1.57	0.18	0.16
10	31	3.47	0.36	0.34
20	55	6.16	0.72	0.61
30	71	7.95	1.08	0.78
40	86	9.63	1.44	0.94
50	100	11.20	1.80	1.09
60	111	12.43	2.16	1.21
70	120	13.44	2.53	1.30
80	128	14.34	2.89	1.38
90	135	15.12	3.25	1.45
100	143	16.02	3.61	1.53
120	152	17.02	4.33	1.62
140	158	17.70	5.05	1.67
160	165	18.48	5.77	1.73
180	170	19.04	6.49	1.77
200	175	19.60	7.22	1.81
250	185	20.72	9.02	1.87
300	197	22.06	10.82	1.95

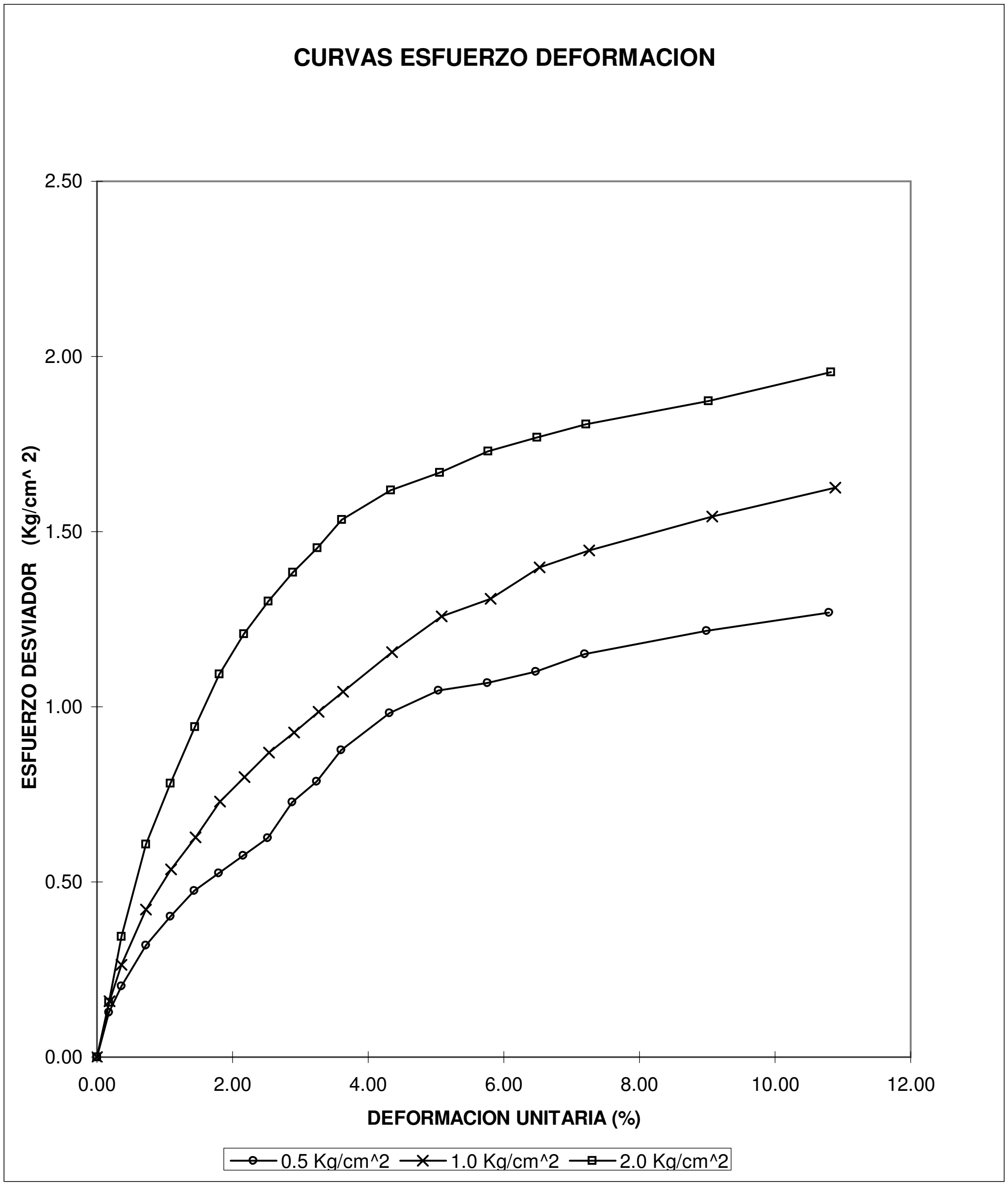
CONTENIDO DE HUMEDAD

CAPSULA No.	177
P. CAP.+ S HUM	143.98
P.CAP + S.SECO	108.69
P. CAPSULA	20.00
HUMEDAD %	39.79

GRAFICO DE LA
MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: BLOQUE E
OBRA	: CIMENTACION	PROFUND.	: 1,50-1,80 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

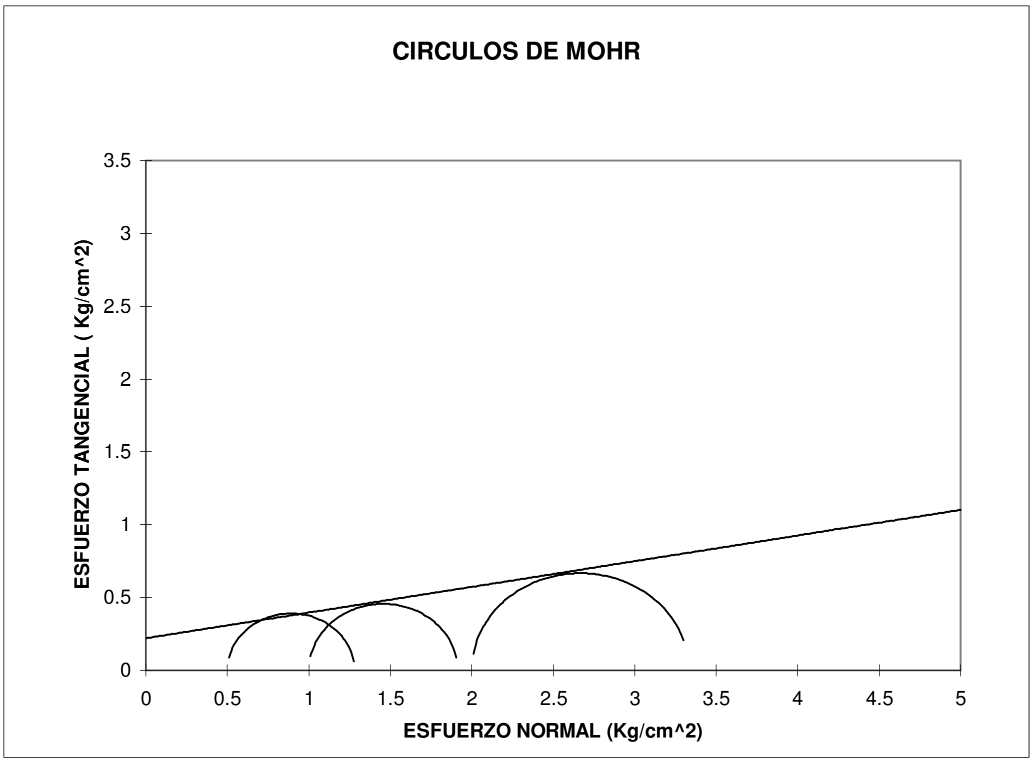


ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO : MILL SITE
OBRA : CIMENTACION
UBICACION : PLATAFORMA J

MUESTRA No. : SONDEO J
PROFUND. : 2,00-2,50 m
FECHA : MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	0.78	0.50	1.28	0.39	0.89
2	0.91	1.00	1.91	0.46	1.46
3	1.33	2.00	3.33	0.67	2.67



COHESION (kg/cm^2)	0.22
FRICCION (GRADOS)	10

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.54	3.59	3.61
ALTURA MEDIA	(cm)	7.03	6.92	7
HUMEDAD FINAL	(%)	19.19	19.17	19.18
DENSIDAD HUMEDA	(gr/cm^3)	1.999	1.948	1.907
DENSIDAD SECA	(gr/cm^3)	1.677	1.635	1.600

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO J
OBRA	: CIMENTACION	PROFUND.	: 2,00-2,50 m
UBICACION	: PLATAFORMA J	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

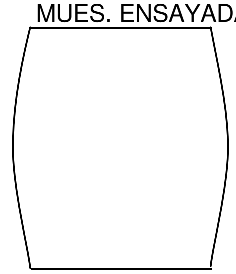
Ds	3.66	Peso inicial	137.94		
Dc	3.47	Vol. inicial	69.00	Calculado por	: B.ALVAREZ
Di	3.67	δ m. inicial	1.999	Cnte.anillo Kg	0.1120
Dm	3.54	δ d . inicial	1.677		
Am	9.81				
Hm	7.03	Presión lateral	0.5 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	10	1.12	0.18	0.11
10	17	1.90	0.36	0.19
20	25	2.80	0.72	0.28
30	32	3.58	1.08	0.36
40	38	4.26	1.45	0.43
50	43	4.82	1.81	0.48
60	48	5.38	2.17	0.54
70	50	5.60	2.53	0.56
80	54	6.05	2.89	0.60
90	56	6.27	3.25	0.62
100	60	6.72	3.61	0.66
120	66	7.39	4.34	0.72
140	72	8.06	5.06	0.78
160	77	8.62	5.78	0.83
180	81	9.07	6.50	0.86
200	84	9.41	7.23	0.89
250	89	9.97	9.03	0.92
300	91	10.19	10.84	0.93

CONTENIDO DE HUMEDAD

CAPSULA No.	606
P. CAP.+ S HUM	158.22
P.CAP + S.SECO	136.05
P. CAPSULA	20.51
HUMEDAD %	19.19

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO J
OBRA	: CIMENTACION	PROFUND.	: 2,00-2,50 m
UBICACION	: PLATAFORMA J	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

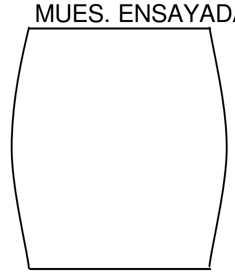
Ds	3.50	Peso inicial	136.45		
Dc	3.59	Vol. inicial	70.05	Calculado por	: B.ALVAREZ
Di	3.68	δ m. inicial	1.948	Cnte.anillo Kg	0.1120
Dm	3.59	δ d . inicial	1.635		
Am	10.12				
Hm	6.92	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	10	1.12	0.18	0.11
10	18	2.02	0.37	0.20
20	29	3.25	0.73	0.32
30	40	4.48	1.10	0.44
40	46	5.15	1.47	0.50
50	52	5.82	1.84	0.56
60	58	6.50	2.20	0.63
70	63	7.06	2.57	0.68
80	69	7.73	2.94	0.74
90	74	8.29	3.30	0.79
100	78	8.74	3.67	0.83
120	83	9.30	4.40	0.88
140	87	9.74	5.14	0.91
160	92	10.30	5.87	0.96
180	96	10.75	6.61	0.99
200	99	11.09	7.34	1.01
250	105	11.76	9.18	1.06
300	112	12.54	11.01	1.10

CONTENIDO DE HUMEDAD

CAPSULA No.	644
P. CAP.+ S HUM	170.37
P.CAP + S.SECO	146.24
P. CAPSULA	20.36
HUMEDAD %	19.17

GRAFICO DE LA MUES. ENSAYADA



PROYECTO : MILL SITE
OBRA : CIMENTACION
UBICACION : PLATAFORMA J

MUESTRA No. : SONDEO J
PROFUND. : 2,00-2,50 m
FECHA : MARZO-2005

RESISTENCIA AL CORTE

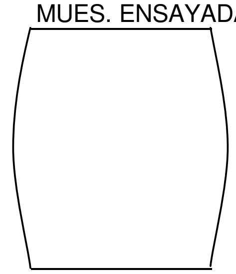
Ds	3.62	Peso inicial	136.25		
Dc	3.60	Vol. inicial	71.45	Calculado por	: B.ALVAREZ
Di	3.61	δ m. inicial	1.907	Cnte.anillo Kg	0.1120
Dm	3.61	δ d . inicial	1.600		
Am	10.21				
Hm	7	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	15	1.68	0.18	0.16
10	22	2.46	0.36	0.24
20	36	4.03	0.73	0.39
30	53	5.94	1.09	0.58
40	66	7.39	1.45	0.71
50	75	8.40	1.81	0.81
60	85	9.52	2.18	0.91
70	92	10.30	2.54	0.98
80	98	10.98	2.90	1.04
90	103	11.54	3.27	1.09
100	108	12.10	3.63	1.14
120	120	13.44	4.35	1.26
140	128	14.34	5.08	1.33
160	136	15.23	5.81	1.41
180	142	15.90	6.53	1.46
200	149	16.69	7.26	1.52
250	163	18.26	9.07	1.63
300	172	19.26	10.89	1.68

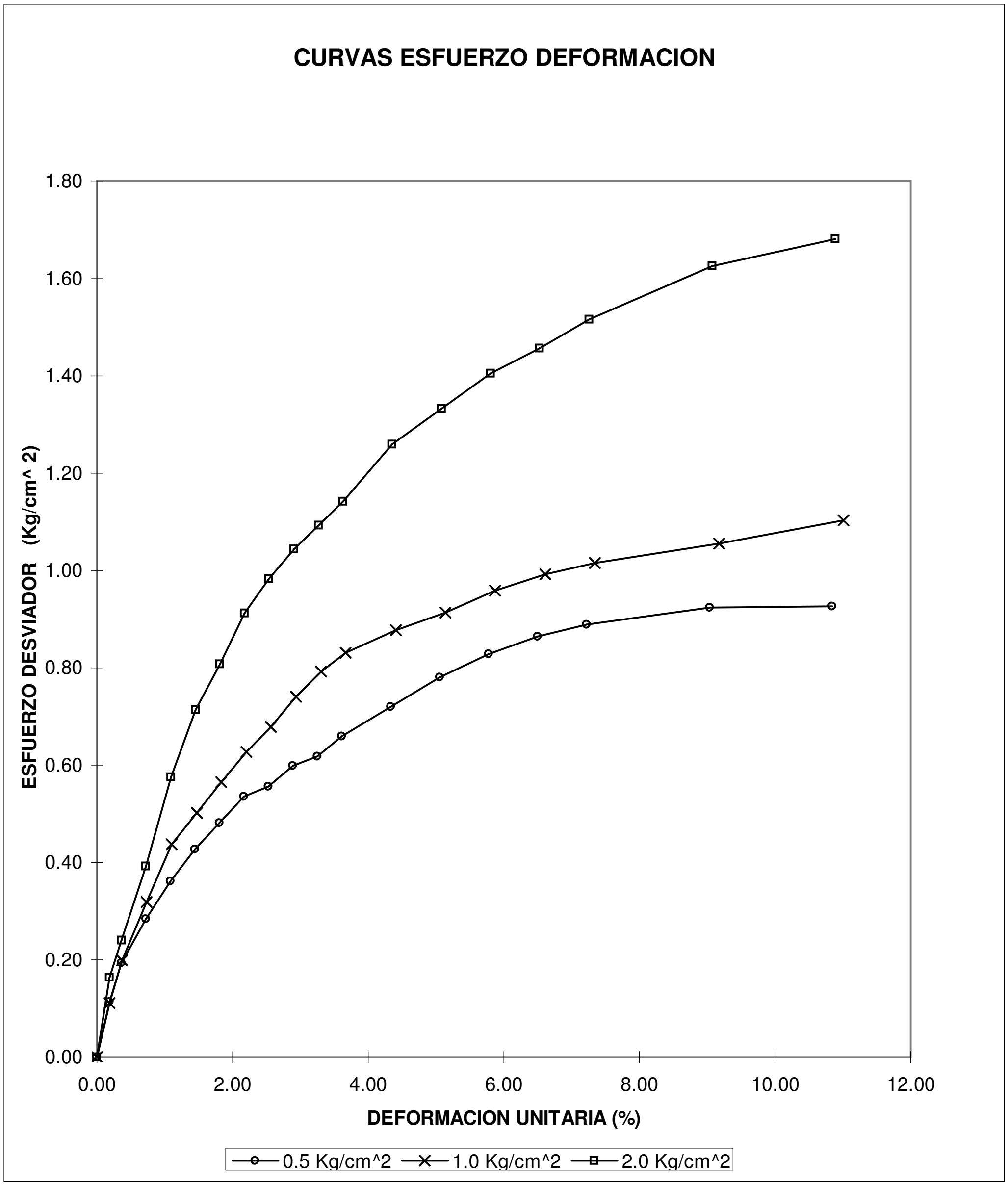
CONTENIDO DE HUMEDAD

CAPSULA No.	628
P. CAP.+ S HUM	173.12
P.CAP + S.SECO	148.39
P. CAPSULA	19.44
HUMEDAD %	19.18

GRAFICO DE LA MUES. ENSAYADA



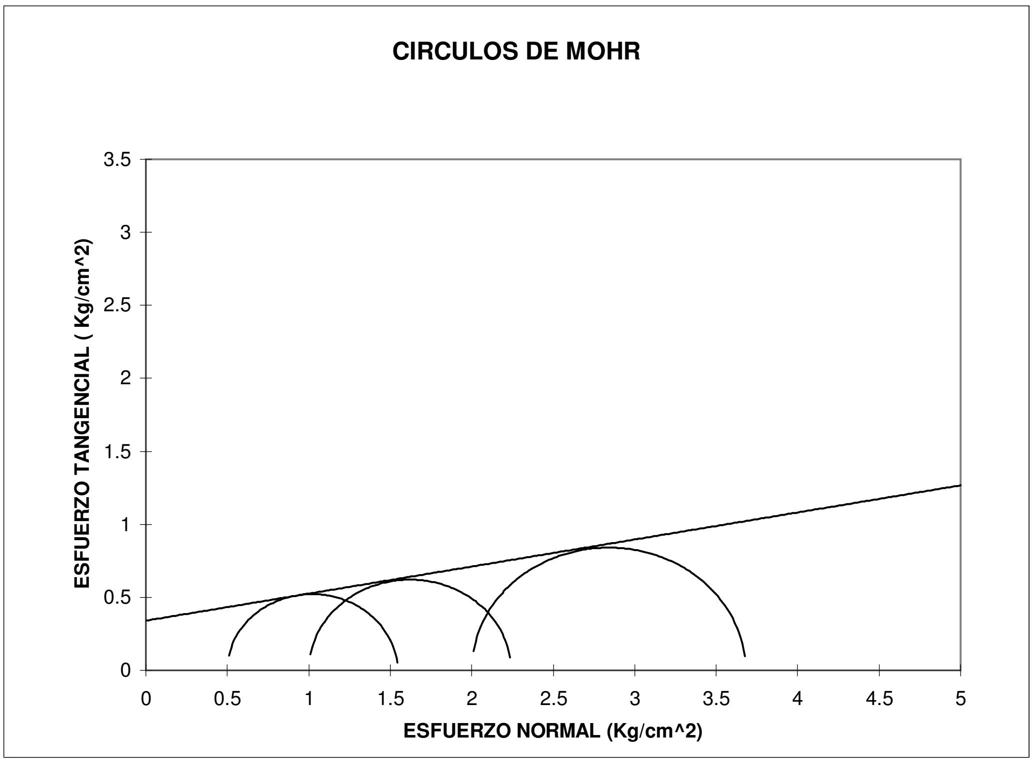
PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO J
OBRA	: CIMENTACION	PROFUND.	: 2,00-2,50 m
UBICACION	: PLATAFORMA J	FECHA	: MARZO-2005



ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO D
OBRA	:	PROFUND.	: 4,00-4,50 m
UBICACION	: PLATAFORMA D	FECHA	: MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	1.04	0.50	1.54	0.52	1.02
2	1.24	1.00	2.24	0.62	1.62
3	1.68	2.00	3.68	0.84	2.84



COHESION (kg/cm^2)	0.34
FRICCION (GRADOS)	10.5

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.62	3.65	3.65
ALTURA MEDIA	(cm)	6.89	6.96	6.96
HUMEDAD FINAL	(%)	28.44	28.48	28.00
DENSIDAD HUMEDA	(gr/cm^3)	1.909	1.986	1.999
DENSIDAD SECA	(gr/cm^3)	1.486	1.546	1.561

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO D
OBRA	:	PROFUND.	: 4,00-4,50 m
UBICACION	: PLATAFORMA D	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

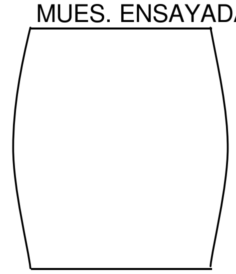
Ds	3.65	Peso inicial	135.35		
Dc	3.60	Vol. inicial	70.91	Calculado por	: B.ALVAREZ
Di	3.67	δ m. inicial	1.909	Cnte.anillo Kg	0.1120
Dm	3.62	δ d . inicial	1.486		
Am	10.29				
Hm	6.89	Presión lateral	0.5 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	12	1.34	0.18	0.13
10	20	2.24	0.37	0.22
20	28	3.14	0.74	0.30
30	37	4.14	1.11	0.40
40	41	4.59	1.47	0.44
50	48	5.38	1.84	0.51
60	56	6.27	2.21	0.60
70	64	7.17	2.58	0.68
80	73	8.18	2.95	0.77
90	80	8.96	3.32	0.84
100	86	9.63	3.69	0.90
120	94	10.53	4.42	0.98
140	101	11.31	5.16	1.04
160	105	11.76	5.90	1.08
180	108	12.10	6.64	1.10
200	112	12.54	7.37	1.13
250	114	12.77	9.22	1.13
300	116	12.99	11.06	1.12

CONTENIDO DE HUMEDAD

CAPSULA No.	620
P. CAP.+ S HUM	150.31
P.CAP + S.SECO	121.54
P. CAPSULA	20.39
HUMEDAD %	28.44

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO D
OBRA	:	PROFUND.	: 4,00-4,50 m
UBICACION	: PLATAFORMA D	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

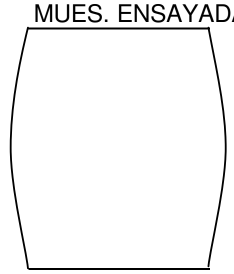
Ds	3.62	Peso inicial	144.40		
Dc	3.65	Vol. inicial	72.69	Calculado por	: B.ALVAREZ
Di	3.66	δ m. inicial	1.986	Cnte.anillo Kg	0.1120
Dm	3.65	δ d . inicial	1.546		
Am	10.44				
Hm	6.96	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	18	2.02	0.18	0.19
10	31	3.47	0.36	0.33
20	43	4.82	0.73	0.46
30	52	5.82	1.09	0.55
40	63	7.06	1.46	0.67
50	72	8.06	1.82	0.76
60	80	8.96	2.19	0.84
70	86	9.63	2.55	0.90
80	92	10.30	2.92	0.96
90	98	10.98	3.28	1.02
100	102	11.42	3.65	1.05
120	114	12.77	4.38	1.17
140	122	13.66	5.11	1.24
160	130	14.56	5.84	1.31
180	138	15.46	6.57	1.38
200	145	16.24	7.30	1.44
250	160	17.92	9.12	1.56
300	170	19.04	10.95	1.62

CONTENIDO DE HUMEDAD

CAPSULA No.	665
P. CAP.+ S HUM	158.62
P.CAP + S.SECO	127.98
P. CAPSULA	20.41
HUMEDAD %	28.48

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO D
OBRA	:	PROFUND.	: 4,00-4,50 m
UBICACION	: PLATAFORMA D	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

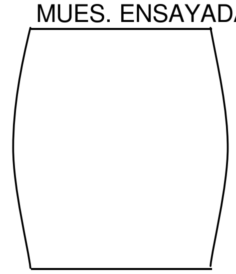
Ds	3.66	Peso inicial	145.15		
Dc	3.64	Vol. inicial	72.63	Calculado por	: B.ALVAREZ
Di	3.65	δ m. inicial	1.999	Cnte.anillo Kg	0.1120
Dm	3.65	δ d . inicial	1.561		
Am	10.43				
Hm	6.96	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	22	2.46	0.18	0.24
10	36	4.03	0.36	0.38
20	52	5.82	0.73	0.55
30	67	7.50	1.09	0.71
40	82	9.18	1.46	0.87
50	95	10.64	1.82	1.00
60	108	12.10	2.19	1.13
70	118	13.22	2.55	1.23
80	125	14.00	2.92	1.30
90	132	14.78	3.28	1.37
100	140	15.68	3.65	1.45
120	154	17.25	4.38	1.58
140	165	18.48	5.11	1.68
160	175	19.60	5.84	1.77
180	182	20.38	6.57	1.83
200	187	20.94	7.30	1.86
250	202	22.62	9.12	1.97
300	215	24.08	10.95	2.06

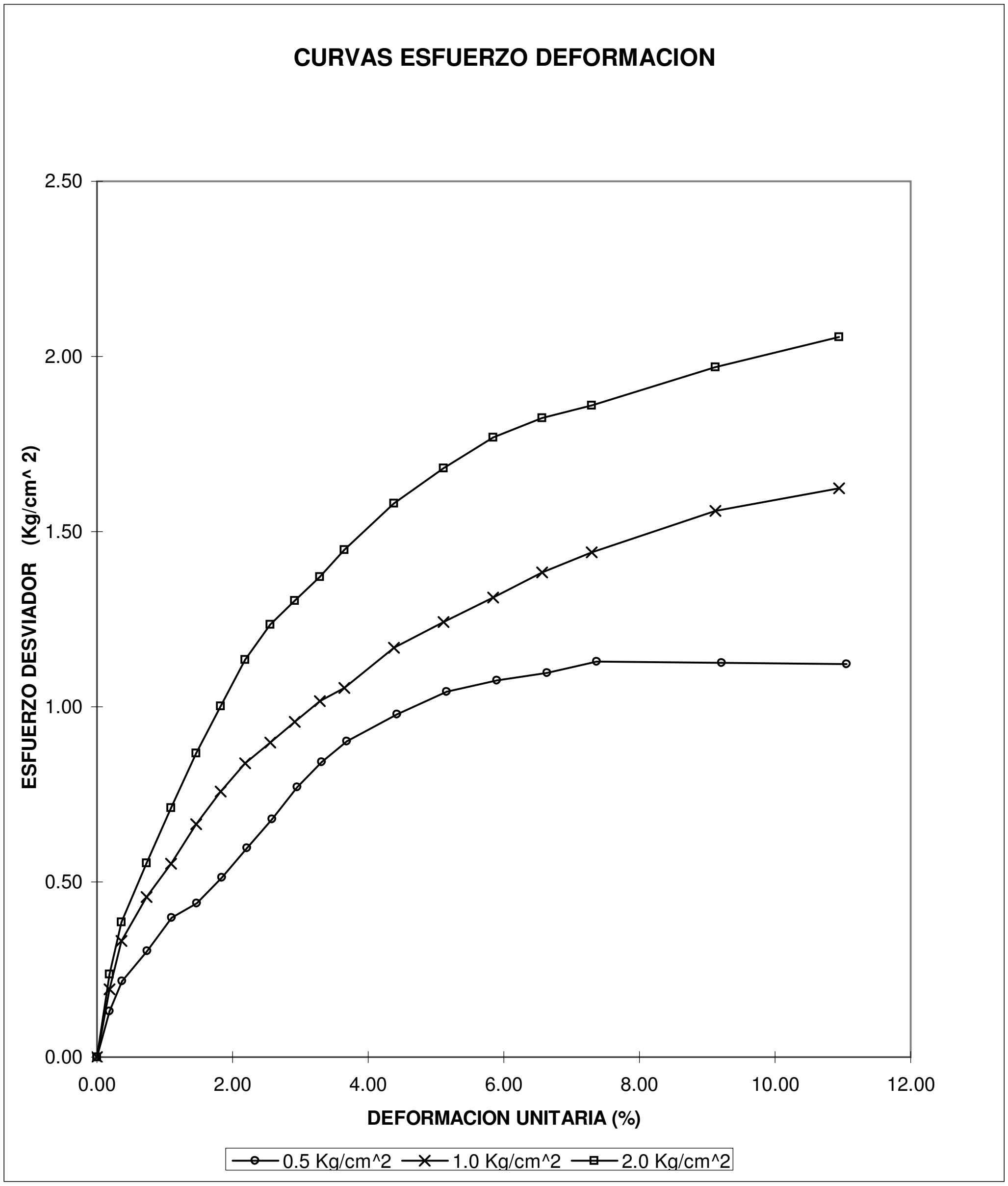
CONTENIDO DE HUMEDAD

CAPSULA No.	655
P. CAP.+ S HUM	159.72
P.CAP + S.SECO	129.16
P. CAPSULA	20.02
HUMEDAD %	28.00

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO D
OBRA	:	PROFUND.	: 4,00-4,50 m
UBICACION	: PLATAFORMA D	FECHA	: MARZO-2005

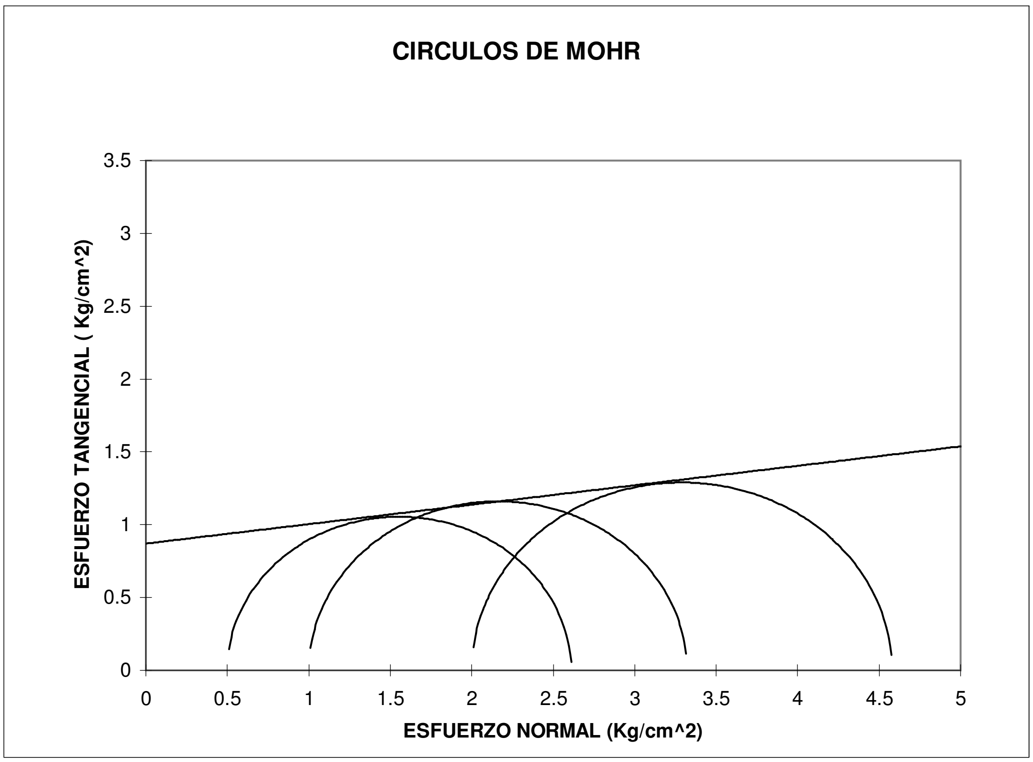


ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO : MILL SITE
OBRA : CIMENTACION
UBICACION : PLATAFORMA E

MUESTRA No. : SONDEO E
PROFUND. : 3,00-3,50 m
FECHA : MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	2.11	0.50	2.61	1.05	1.55
2	2.32	1.00	3.32	1.16	2.16
3	2.58	2.00	4.58	1.29	3.29



COHESION (kg/cm^2)	0.87
FRICCION (GRADOS)	7.6

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.66	3.66	3.67
ALTURA MEDIA	(cm)	7.06	7.04	6.97
HUMEDAD FINAL	(%)	26.39	26.45	26.42
DENSIDAD HUMEDA	(gr/cm^3)	1.955	1.947	1.979
DENSIDAD SECA	(gr/cm^3)	1.547	1.540	1.565

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO E
OBRA	: CIMENTACION	PROFUND.	: 3,00-3,50 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

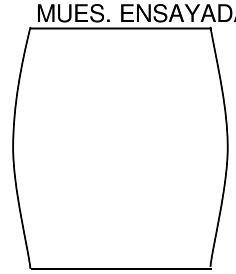
Ds	3.64	Peso inicial	144.82		
Dc	3.67	Vol. inicial	74.07	Calculado por	: B.ALVAREZ
Di	3.61	δ m. inicial	1.955	Cnte.anillo Kg	0.1120
Dm	3.66	δ d . inicial	1.547		
Am	10.49				
Hm	7.06	Presión lateral	0.5 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	18	2.02	0.18	0.19
10	32	3.58	0.36	0.34
20	49	5.49	0.72	0.52
30	64	7.17	1.08	0.68
40	78	8.74	1.44	0.82
50	95	10.64	1.80	1.00
60	112	12.54	2.16	1.17
70	127	14.22	2.52	1.32
80	140	15.68	2.88	1.45
90	156	17.47	3.24	1.61
100	169	18.93	3.60	1.74
120	191	21.39	4.32	1.95
140	208	23.30	5.04	2.11
160	222	24.86	5.76	2.23
180	232	25.98	6.48	2.32
200	242	27.10	7.20	2.40
250	260	29.12	8.99	2.53
300	277	31.02	10.79	2.64

CONTENIDO DE HUMEDAD

CAPSULA No.	625
P. CAP.+ S HUM	153.62
P.CAP + S.SECO	125.62
P. CAPSULA	19.51
HUMEDAD %	26.39

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO E
OBRA	: CIMENTACION	PROFUND.	: 3,00-3,50 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

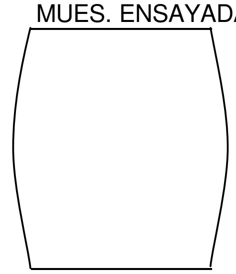
Ds	3.64	Peso inicial	144.49		
Dc	3.67	Vol. inicial	74.20	Calculado por	: B.ALVAREZ
Di	3.66	δ m. inicial	1.947	Cnte.anillo Kg	0.1120
Dm	3.66	δ d . inicial	1.540		
Am	10.54				
Hm	7.04	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	18	2.02	0.18	0.19
10	34	3.81	0.36	0.36
20	55	6.16	0.72	0.58
30	74	8.29	1.08	0.78
40	94	10.53	1.44	0.98
50	115	12.88	1.80	1.20
60	131	14.67	2.16	1.36
70	147	16.46	2.53	1.52
80	165	18.48	2.89	1.70
90	179	20.05	3.25	1.84
100	195	21.84	3.61	2.00
120	218	24.42	4.33	2.22
140	230	25.76	5.05	2.32
160	241	26.99	5.77	2.41
180	253	28.34	6.49	2.51
200	262	29.34	7.22	2.58
250	281	31.47	9.02	2.72
300	290	32.48	10.82	2.75

CONTENIDO DE HUMEDAD

CAPSULA No.	615
P. CAP.+ S HUM	153.64
P.CAP + S.SECO	125.64
P. CAPSULA	19.78
HUMEDAD %	26.45

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO E
OBRA	: CIMENTACION	PROFUND.	: 3,00-3,50 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

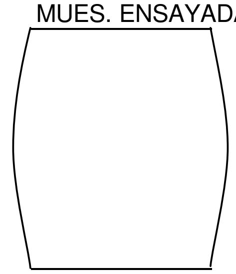
Ds	3.66	Peso inicial	145.5		
Dc	3.67	Vol. inicial	73.53	Calculado por	: B.ALVAREZ
Di	3.65	δ m. inicial	1.979	Cnte.anillo Kg	0.1120
Dm	3.67	δ d . inicial	1.565		
Am	10.55				
Hm	6.97	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	28	3.14	0.18	0.30
10	38	4.26	0.36	0.40
20	64	7.17	0.73	0.67
30	83	9.30	1.09	0.87
40	105	11.76	1.46	1.10
50	124	13.89	1.82	1.29
60	142	15.90	2.19	1.47
70	156	17.47	2.55	1.61
80	175	19.60	2.92	1.80
90	190	21.28	3.28	1.95
100	205	22.96	3.64	2.10
120	232	25.98	4.37	2.36
140	256	28.67	5.10	2.58
160	277	31.02	5.83	2.77
180	294	32.93	6.56	2.92
200	305	34.16	7.29	3.00
250	334	37.41	9.11	3.22
300	350	39.20	10.93	3.31

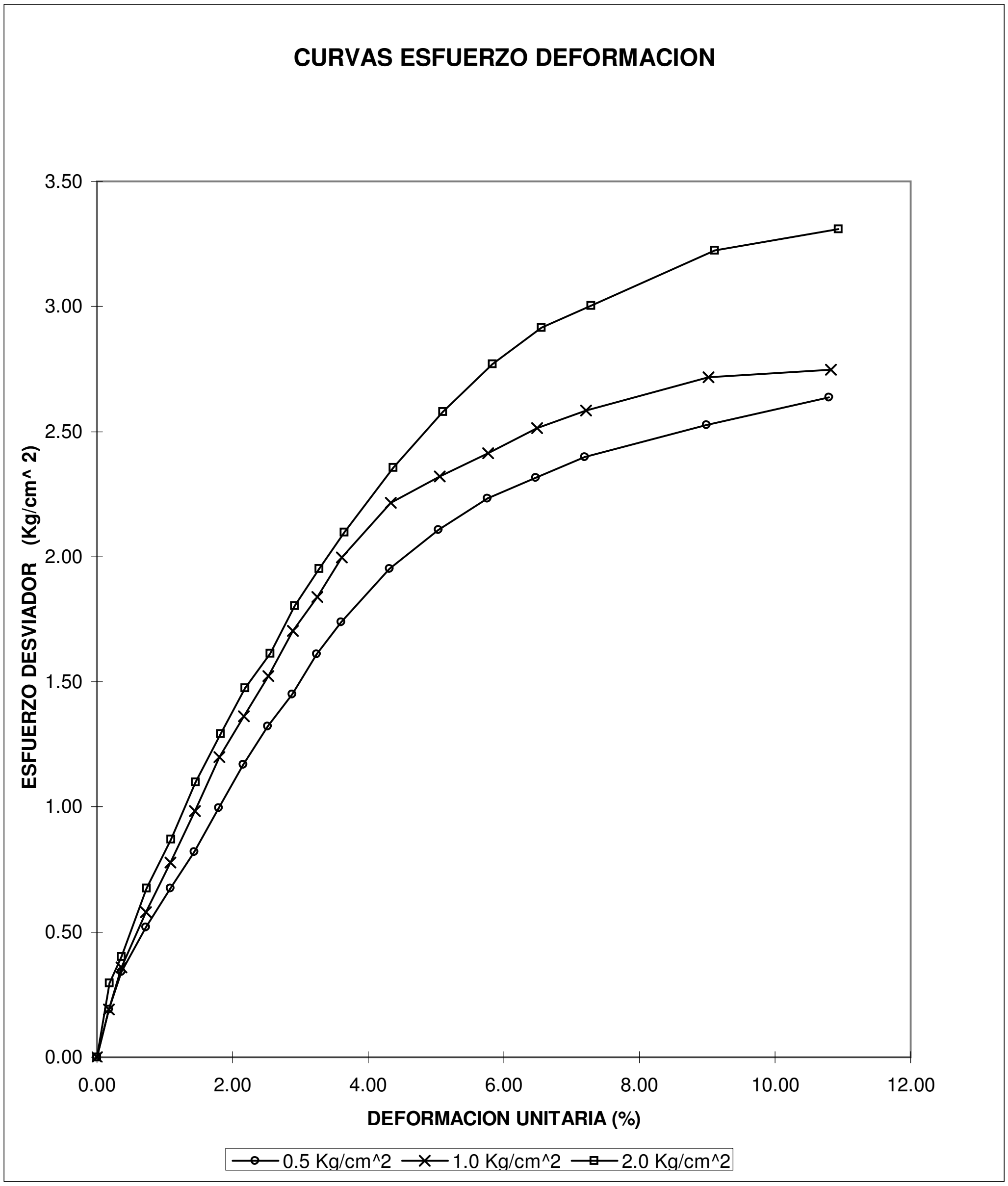
CONTENIDO DE HUMEDAD

CAPSULA No.	616
P. CAP.+ S HUM	153.66
P.CAP + S.SECO	125.81
P. CAPSULA	20.41
HUMEDAD %	26.42

GRAFICO DE LA
MUES. ENSAYADA



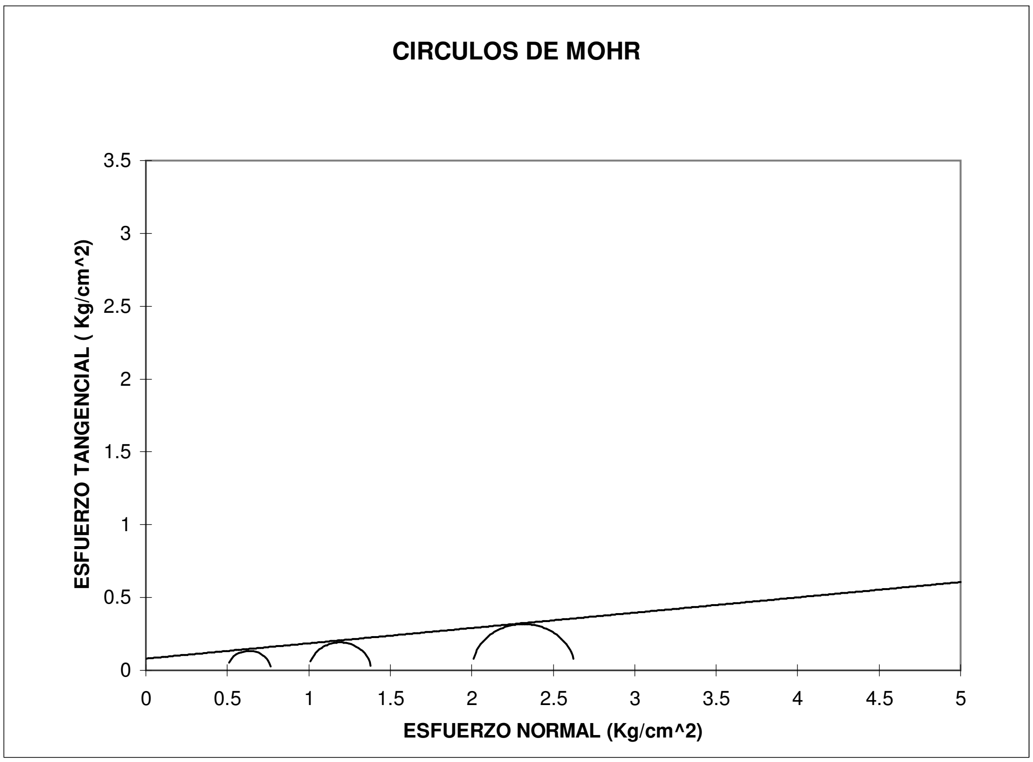
PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO E
OBRA	: CIMENTACION	PROFUND.	: 3,00-3,50 m
UBICACION	: PLATAFORMA E	FECHA	: MARZO-2005



ENSAYO TRIAXIAL NO CONSOLIDADO NO DRENADO

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO L
OBRA	: CIMENTACION	PROFUND.	: 7,00-7,50 m
UBICACION	: PLATAFORMA L	FECHA	: MARZO-2005

No	σ desv. Kg/cm^2	σ 3 Kg/cm^2	σ 1 Kg/cm^2	(σ1−σ3)/2 Kg/cm^2	(σ1+σ3)/2 Kg/cm^2
1	0.27	0.50	0.77	0.13	0.63
2	0.38	1.00	1.38	0.19	1.19
3	0.63	2.00	2.63	0.32	2.32



COHESION (kg/cm^2)	0.08
FRICCION (GRADOS)	6

DATOS DE ENSAYO		PROBETA No. 1	PROBETA No. 2	PROBETA No. 3
DIAMETRO MEDIO	(cm)	3.63	3.67	3.64
ALTURA MEDIA	(cm)	6.92	6.95	6.95
HUMEDAD FINAL	(%)	29.51	30.13	29.48
DENSIDAD HUMEDA	(gr/cm^3)	1.918	1.963	1.999
DENSIDAD SECA	(gr/cm^3)	1.481	1.509	1.544

PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO L
OBRA	: CIMENTACION	PROFUND.	: 7,00-7,50 m
UBICACION	: PLATAFORMA L	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

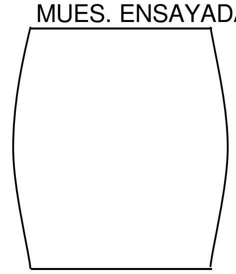
Ds	3.66	Peso inicial	137.12		
Dc	3.61	Vol. inicial	71.48	Calculado por	: B.ALVAREZ
Di	3.66	δ m. inicial	1.918	Cnte.anillo Kg	0.1120
Dm	3.63	δ d . inicial	1.481		
Am	10.33				
Hm	6.92	Presión lateral	0.5 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	5	0.56	0.18	0.05
10	8	0.90	0.37	0.09
20	10	1.12	0.73	0.11
30	12	1.34	1.10	0.13
40	13	1.46	1.47	0.14
50	15	1.68	1.84	0.16
60	16	1.79	2.20	0.17
70	18	2.02	2.57	0.19
80	19	2.13	2.94	0.20
90	20	2.24	3.30	0.21
100	21	2.35	3.67	0.22
120	23	2.58	4.40	0.24
140	26	2.91	5.14	0.27
160	28	3.14	5.87	0.29
180	30	3.36	6.61	0.30
200	31	3.47	7.34	0.31
250	34	3.81	9.18	0.33
300	38	4.26	11.01	0.37

CONTENIDO DE HUMEDAD

CAPSULA No.	648
P. CAP.+ S HUM	147.68
P.CAP + S.SECO	118.75
P. CAPSULA	20.71
HUMEDAD %	29.51

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO L
OBRA	: CIMENTACION	PROFUND.	: 7,00-7,50 m
UBICACION	: PLATAFORMA L	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

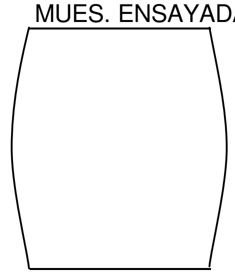
Ds	3.67	Peso inicial	143.96		
Dc	3.67	Vol. inicial	73.32	Calculado por	: B.ALVAREZ
Di	3.64	δ m. inicial	1.963	Cnte.anillo Kg	0.1120
Dm	3.67	δ d . inicial	1.509		
Am	10.55				
Hm	6.95	Presión lateral	1.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	10	1.12	0.18	0.11
10	12	1.34	0.37	0.13
20	16	1.79	0.73	0.17
30	18	2.02	1.10	0.19
40	20	2.24	1.46	0.21
50	22	2.46	1.83	0.23
60	24	2.69	2.19	0.25
70	26	2.91	2.56	0.27
80	28	3.14	2.92	0.29
90	30	3.36	3.29	0.31
100	32	3.58	3.65	0.33
120	35	3.92	4.39	0.36
140	38	4.26	5.12	0.38
160	40	4.48	5.85	0.40
180	42	4.70	6.58	0.42
200	44	4.93	7.31	0.43
250	48	5.38	9.14	0.46
300	52	5.82	10.96	0.49

CONTENIDO DE HUMEDAD

CAPSULA No.	624
P. CAP.+ S HUM	160.32
P.CAP + S.SECO	127.88
P. CAPSULA	20.21
HUMEDAD %	30.13

GRAFICO DE LA MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO L
OBRA	: CIMENTACION	PROFUND.	: 7,00-7,50 m
UBICACION	: PLATAFORMA L	FECHA	: MARZO-2005

RESISTENCIA AL CORTE

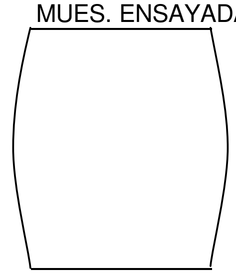
Ds	3.68	Peso inicial	144.17		
Dc	3.62	Vol. inicial	72.12	Calculado por	: B.ALVAREZ
Di	3.65	δ m. inicial	1.999	Cnte.anillo Kg	0.1120
Dm	3.64	δ d . inicial	1.544		
Am	10.38				
Hm	6.95	Presión lateral	2.0 Kg/cm^2		

DEFORMACION pulg x 10^ -3	DIAL DE CARGA pulg x 10^ -4	CARGA Kg	DEFOR. UNITARIA %	ESFUER.DESV. Kg/cm^2
0	0	0.00	0.00	0.00
5	12	1.34	0.18	0.13
10	15	1.68	0.37	0.16
20	21	2.35	0.73	0.22
30	27	3.02	1.10	0.29
40	31	3.47	1.46	0.33
50	36	4.03	1.83	0.38
60	38	4.26	2.19	0.40
70	42	4.70	2.56	0.44
80	45	5.04	2.92	0.47
90	49	5.49	3.29	0.51
100	52	5.82	3.65	0.54
120	57	6.38	4.39	0.59
140	62	6.94	5.12	0.63
160	69	7.73	5.85	0.70
180	74	8.29	6.58	0.75
200	80	8.96	7.31	0.80
250	90	10.08	9.14	0.88
300	98	10.98	10.96	0.94

CONTENIDO DE HUMEDAD

CAPSULA No.	632
P. CAP.+ S HUM	161.16
P.CAP + S.SECO	128.79
P. CAPSULA	19.00
HUMEDAD %	29.48

GRAFICO DE LA
MUES. ENSAYADA



PROYECTO	: MILL SITE	MUESTRA No.	: SONDEO L
OBRA	: CIMENTACION	PROFUND.	: 7,00-7,50 m
UBICACION	: PLATAFORMA L	FECHA	: MARZO-2005