



PROCTOR COMPACTION TEST



HIDROSUELOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

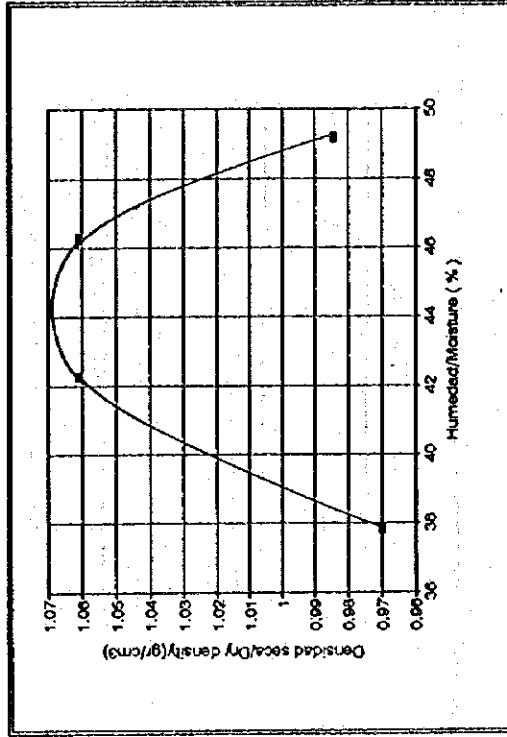
PROYECTO/PROJECT: **Trasvases/Trasbasin**
 LOCALIZACION/SITE: **Canal abierto/Open Channel**
 FECHA/DATE: **Enero-84/January-84**
 CALICATA No./PIT No.: **C-10**
 MUESTRA No./SAMPLE No.: **M-1**
 PROFUNDIDAD/DEPTH: **0.50 - 1.40 m.**

METODO DE ENSAYO/TEST METHOD: **PROCTOR ESTANDAR/Standard proctor**
 GOLPES POR CAPA/BLOWS PER LAY: **25**
 No. DE CAPA/NUMBER OF LAYERS: **3**
 PESO MARTILLO/HAMMER WEIGHT: **5.5 Lbs./Pounds**
 ALTURA DE CAIDA/FALLING HEIGHT: **12"**

MOLDE MO. DIAMETRO/DIAMETER: **4"**
 VOLUMEN/VOLUME: **944 cm³**
 PESO/WEIGHT: **4265 gr.**

ENSAYADO/PERFORMED BY: **G.S.**
 CALCULADO/CALCULATED BY: **F.V.**

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE + SUELO/CAN WEIGHT+SOI	5527	5650	5730	5651
P. MOLDE/CAN WEIGHT(gr.)	4265	4265	4265	4265
P. SUELO/SOIL WEIGHT(gr.)	1262	1425	1465	1386
Humedad prom./Average moisture(%)	37.87	42.26	46.27	49.18
Densid. Humo. hued density(gr./cm ³)	1.34	1.51	1.55	1.47
Densid. Secc./Dry density(gr./cm ³)	0.97	1.06	1.06	0.98



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara+Suelo Humo+wet soil(gr.)	60.93	61.53	61.98	61.47	58.94	65.54	62.38	51.35
Tara+Suelo S./soil+dry soil(gr.)	49.72	49.25	48.94	48.78	46.28	50.62	47.85	40.00
Peso Tara/Can weigh	19.78	17.18	18.16	18.67	18.75	18.57	18.45	16.81
Contn. de Agua/Moisture(%)	37.44	38.29	42.37	42.15	45.99	46.55	49.42	48.94
Humedad prom./Average moisture(%)	37.87		42.26		46.27		49.18	

DENS. SECA MAX./MAX. DRY DENSITY (gr/cm ³)	1.07
HUMEDAD OPTIMA/OPTIM. MOISTURE(%)	44.40



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ENSAYO DE COMPACTACION/COMPACTION TEST

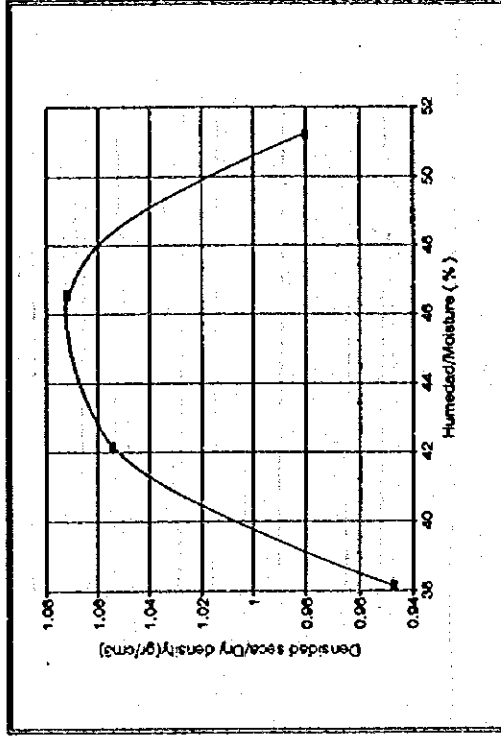
PROYECTO/PROJECT: Traveses/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January-94
 CALICATA No./PT No.: C-11
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.55 - 1.60 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard Proctor
 COLPES POR CAPA/BLOWS PER LAY: 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/NO. - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADITAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE + SUELO/CAN WEIGHT + SOI	5500	5680	5748	5664
P.MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P.SUELO/SOI WEIGHT (gr.)	1235	1415	1483	1399
Humedad prom./Average moisture(%)	38.13	42.16	46.56	51.20
Densid. Humed./wet density (gr./cm ³)	1.31	1.50	1.57	1.48
Densid. Seca/Dry density (gr./cm ³)	0.95	1.05	1.07	0.98



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tarso+Suelo H./tray+soil (gr.)	63.73	60.88	69.86	61.31	58.00	57.00	58.80	63.84
Tarso+Suelo S./soil+dry soil (gr.)	51.50	48.69	55.10	48.27	45.62	44.96	45.52	48.55
Peso Tara/Cap weight	19.51	16.64	19.98	17.44	19.08	19.05	19.59	18.68
Conte. de Agua/Moisture(%)	38.23	38.03	42.03	42.30	46.65	46.47	51.21	51.19
Humedad prom./Average moisture(%)	38.13		42.16		46.56		51.20	

DENS. SECA MAX. MAX. DRY DENSITY (gr/cm ³)	1.07
HUMEDAD OPTIMA/OPTIMAL MOISTURE(%)	45.60



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ENSAYO DE COMPACTACION/COMPACTION TEST

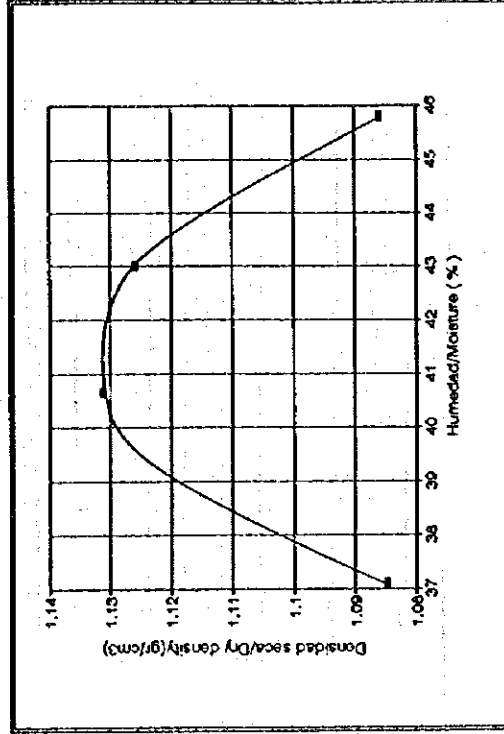
PROYECTO/PROJECT: Traveses/Tresbasin.
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-84/January=84
 CALICATA No./PIT No.: C-12
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.60 - 1.60 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPAS/BLOWS PER LAY: 25
 No. DE CAPAS/LAYERS: 3
 PESO MARTILLO/HAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE - SUELO/CAN WEIGHT-SOI	5669	5767	5785	5760
P.MOLDE/CAN WEIGHT(gr.)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT(gr.)	1404	1502	1520	1495
Humedad prom/Average moisture(%)	37.10	40.66	43.00	45.82
Densid. Humet./wet density(gr./cm ³)	1.49	1.59	1.61	1.58
Densid. Secca/Dry density(gr./cm ³)	1.08	1.13	1.13	1.09



CONTENIDO DE AGUA/MOISTURE CONTEN								
	1	2	3	4	5	6	7	8
Resistente No./Cap number	62.47	56.48	71.36	57.21	72.50	68.15	66.15	75.53
Tarea-Suelo Humet./wet soil(gr.)	51.00	46.47	56.14	45.95	56.16	53.25	51.23	57.56
Tarea-Suelo Secca-dry soil(gr.)	20.10	19.47	18.62	18.32	18.16	18.60	18.45	18.60
Peso Tarea/Cap weight	37.12	37.07	40.57	40.75	43.00	43.00	45.52	46.12
Humedad prom./Average moisture(%)	37.10		40.66		43.00		45.82	

DENS. SECA MAX./MAX.DRY DENSITY(gr/cm ³)	1.13
HUMEDAD OPTIMA/OPTIM.MOISTURE(%)	41.60



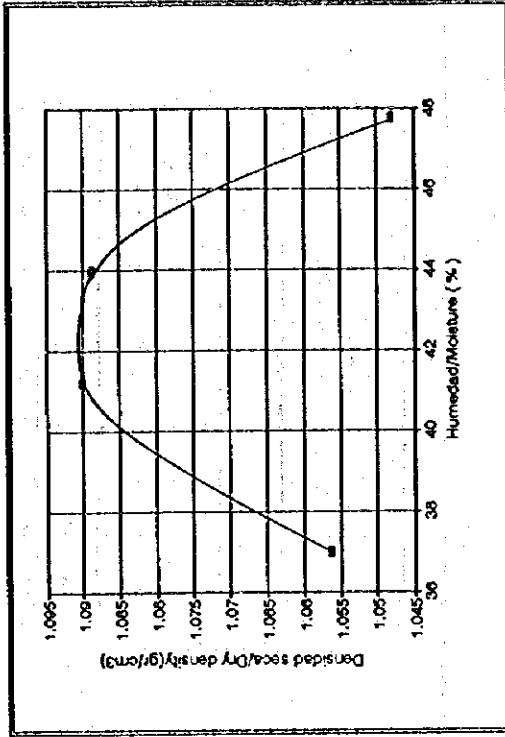
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ENSAYO DE COMPACTACION/COMPACTION TEST

PROYECTO/PROJECT: Traveses/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January=94
 CALICATA No./PIT No.: C-12
 MUESTRA No./SAMPLE No.: M-2
 PROFUNDIDAD/DEPTH: 2.00 - 3.60 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPAS/LAWS PER LAY 25
 No. DE CAPAS/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"
 MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE+SUELO/CAN WEIGHT+SOI	5631	5718	5745	5727
P.MOLDE/CAN WEIGHT(gr)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT(gr)	1366	1453	1480	1462
Humedad prom./Average moisture(%)	36.99	41.20	44.00	47.79
Densid. Humed./wet density(gr./cm ³)	1.45	1.54	1.57	1.55
Densid. Seca/Dry density(gr./cm ³)	1.06	1.09	1.09	1.05



Resistente No./Cap number	CONTENIDO DE AGUA/MOISTURE CONTEN							
	1	2	3	4	5	6	7	8
Tara+Suelo Humed+wet soil(gr)	59.87	56.40	66.83	67.41	65.09	68.34	84.67	92.10
Tara+Suelo Secc+dry soil(gr)	48.69	46.16	53.10	53.25	51.00	53.10	63.16	68.18
Peso Tara/Can weight	18.47	18.48	19.77	18.89	18.97	18.47	18.15	18.13
Conte. de Agua/Moisture(%)	37.00	36.99	41.19	41.21	43.99	44.01	47.79	47.79
Humedad prom./Average moisture(%)	36.99		41.20		44.00		47.79	

DENS. SECA MAX./MAX.DRY DENSITY (gr/cm ³)	1.09
HUMEDAD OPTIMA/OPTIM.MOISTURE(%)	42.60



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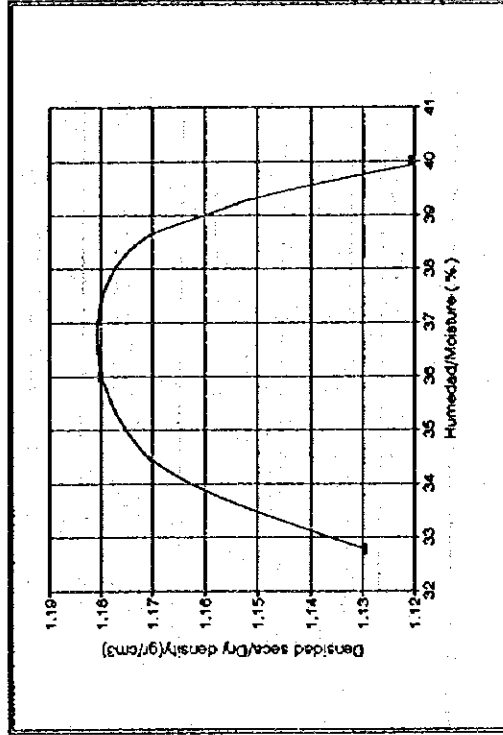
PROYECTO/PROJECT: Travesaies/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January=94
 CALICATA No./PIT No.: C-13
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.80 - 2.00 m.

MOLE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPAS/LAYS PER LAY: 25
 No. DE CAPAS/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE+SUELO/CAN WEIGHT+SOI	5681	5780	5746	5746
P. MOLDE/CAN WEIGHT(Gr)	4265	4265	4265	4265
P. SUELO/BOIL WEIGHT(Gr)	1416	1515	1481	1481
Humedad prom/Average moisture(%)	32.79	36.00	40.01	40.01
Dens. Hum. /wet density(Gr/cm ³)	1.50	1.60	1.57	1.57
Dens. Secc./Dry density(Gr/cm ³)	1.13	1.18	1.12	1.12



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara+Suelo H/hum+wet soil(Gr)	58.71	62.93	65.41	83.52	52.31	60.38	52.31	60.38
Tara+Suelo S/hum+dry soil(Gr)	48.10	52.18	53.12	66.57	42.87	48.40	42.87	48.40
Peso Tara/Cap weight	16.51	18.57	18.97	19.50	19.47	18.20	19.47	18.20
Conte. de Agua/Moisture(%)	33.59	31.98	35.99	36.01	40.34	39.67	40.34	39.67
Humedad prom/Average moisture(%)	32.79		36.00		40.01		40.01	

DENS. SECA MAX./MAX DRY DENSITY(Gr/cm ³)	1.18
HUMEDAD OPTIMA/OPTIM. MOISTURE(%)	36.30

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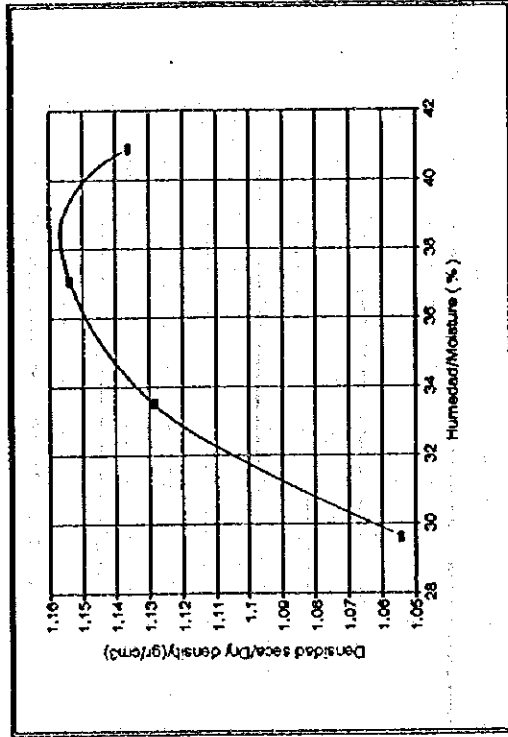
PROYECTO/PROJECT: Tresvases/Triasbasah
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-04/January=04
 CALICATA No./PIT No.: C-14
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.90 - 1.90 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDARDO/Standard proctor
 GOLPES POR CAPAS/LAYERS: 3
 PESO MARTILLO/HAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"
 MOLDE/NO. - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm3
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVA/DATAS FOR GRAPHIC

MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE + SUELO/CAN WEIGHT + SOI	5555	5687	5758	5776
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/SOIL WEIGHT (gr.)	1290	1422	1493	1511
Humedad prom/Average moisture(%)	29.62	33.52	37.05	40.89
Densid. Humo./wet density/(gr./cm3)	1.37	1.51	1.58	1.60
Densid. Secca/Dry density/(gr./cm3)	1.05	1.13	1.15	1.14



CONTENIDO DE AGUA/MOISTURE CONTEN

Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara + Suelo H/(tare+wet soil)(gr)	62.83	65.82	64.51	62.99	63.78	64.26	70.73	68.18
Tara + Suelo S/(tare+dry soil)(gr)	52.92	55.06	45.78	51.86	51.54	51.70	55.48	53.86
Peso Tara/Cap weigh	19.08	18.67	19.76	17.82	18.32	17.99	18.43	18.60
Conte. de Agua/Moisture(%)	29.67	29.57	33.55	33.48	36.85	37.26	41.16	40.61
Humedad prom/Average moisture(%)	29.62		33.52		37.05		40.89	

DENS. SECA MAX./MAX DRY DENSITY (gr/cm3): 1.16
 HUMEDAD OPTIMA/OPTIM. MOISTURE(%): 37.80



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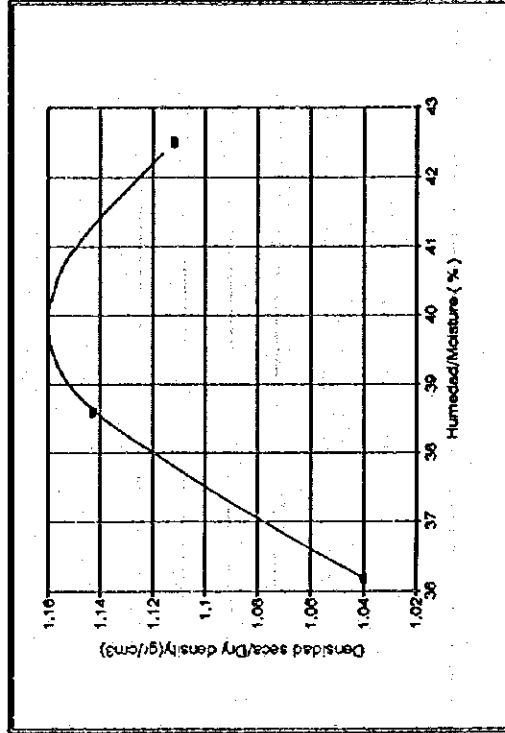
METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDARD/Standard proctor
 GOLPES POR CAPA/BLOWS PER LAY: 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

PROYECTO/PROJECT: Trásvases/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January=94
 CALICATA No./PIT No.: 4
 MUESTRA No./SAMPLE No.: M-2
 PROFUNDIDAD/DEPTH: 2.00 - 3.50 m.

MOLDE/NO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 CM³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS FOR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE+SUELO/CAN WEIGHT+SOI	5602	5760	5761	5761
P.MOLDE/CAN WEIGHT(gr.)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT(gr.)	1337	1495	1496	1496
Humedad prom./Average moisture(%)	36.19	38.59	42.50	42.50
Densid. Humo./wet density(gr./cm ³)	1.42	1.58	1.58	1.58
Densid. Secco./Dry density(gr./cm ³)	1.04	1.14	1.11	1.11



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara+Tubo H./tare+wet soil(gr.)	59.37	57.35	63.28	65.05	74.74	63.37	74.74	63.37
Tara+Tubo S./tare+dry soil(gr.)	48.16	47.06	50.98	51.94	58.26	49.90	58.26	49.90
Peso Tara/Cap weight	17.20	18.61	19.26	17.81	19.35	18.32	19.35	18.32
Conts. de Agua/Moisture(%)	36.21	36.17	38.78	38.41	42.35	42.65	42.35	42.65
Humedad prom./Average moisture(%)	36.19		38.59		42.50		42.50	

DENS. SECA MAX./MAX. DRY DENSITY (gr/cm ³)	1.16
HUMEDAD OPTIMA/OPTIM. MOISTURE(%)	40.20

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ENSAYO DE COMPACTACION/COMPACTION TEST

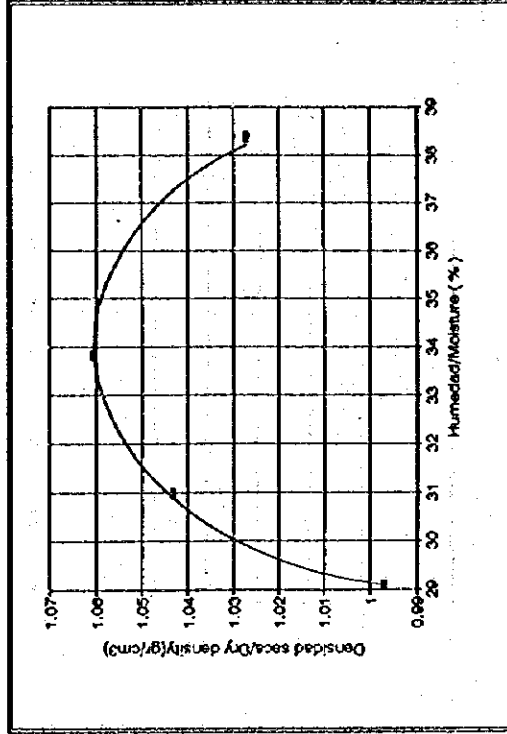
PROYECTO/PROJECT: Traasases/Traasasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHADA/DATE: Enero-84/January-84
 CALICATA No./PIT No.: C-15
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.40 - 1.00 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPABLOWS PER LAY: 25
 No. DE CAPANUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm3
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE + SUELO/CAN WEIGHT = SOI	5480	5555	5605	56.07
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/BOIL WEIGHT (gr.)	1215	1290	1340	1342
Humedad prom/Average moisture (%)	29.09	30.99	33.83	38.38
Densid. Humed./wet density (gr./cm3)	1.29	1.37	1.42	1.42
Densid. Seca/Dry density (gr./cm3)	1.00	1.04	1.06	1.03



Recipiente No./Cap number	CONTENIDO DE AGUA/MOISTURE CONTEN							
	1	2	3	4	5	6	7	8
Terra + Suelo /Moist + wet soil (gr.)	71.22	57.43	64.69	62.72	56.32	55.18	63.45	74.18
Terra + Suelo /Moist + dry soil (gr.)	59.20	48.42	53.71	52.41	46.91	46.40	51.28	58.85
Peso Terra/Cap weight	18.45	17.00	18.38	19.05	18.70	17.89	19.59	18.89
Conte. de Agua/Moisture (%)	29.50	28.68	31.08	30.91	33.36	34.30	38.40	38.36
Humedad prom/Average moisture (%)	29.09		30.99		33.83		38.38	
DENS. SECA MAX./MAX. DRY DENSITY (gr/cm3)								1.06
HUMEDAD OPTIMA/OPTIMAL MOISTURE (%)								34.60

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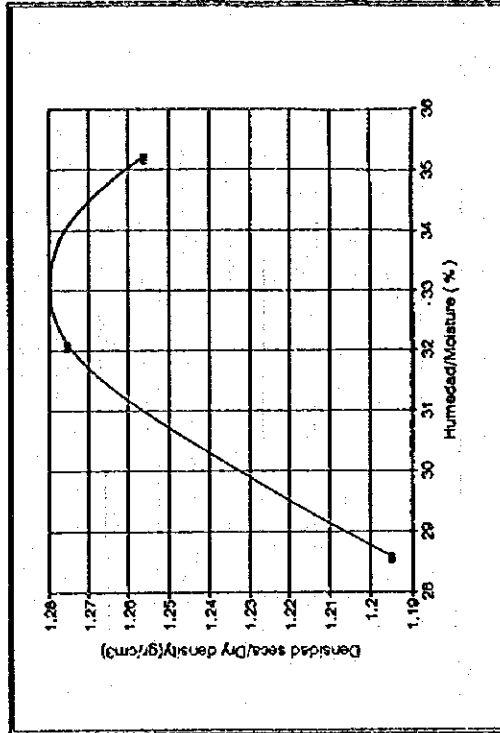
PROYECTO/PROJECT: Traszases/Trazbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January-94
 CALICATA No./PAT No.: C-16
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.85 - 1.80 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPAS/BLOWS PER LAY: 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS FOR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE + SUELO/CAN WEIGHT - 901	5715	5855	5868	5868
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/ SOIL WEIGHT (gr.)	1450	1590	1603	1603
Humedad prom./Average moisture (%)	28.56	32.06	35.18	35.18
Densid. Hume./wet density (gr./cm ³)	1.54	1.68	1.70	1.70
Densid. Seca./Dry density (gr./cm ³)	1.19	1.28	1.26	1.26



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cup number	1	2	3	4	5	6	7	8
Tara + Suelo /Tara + wet soil (gr.)	60.81	65.46	58.56	56.58	73.27	69.38	73.27	69.38
Tara + Suelo /Tara + dry soil (gr.)	51.35	55.48	49.03	47.30	58.96	56.48	58.96	56.48
Peso Tara/Cup weight	18.64	20.08	19.05	18.60	18.50	19.62	18.50	19.62
Contn. de Agua/Moisture (%)	28.92	28.19	31.79	32.33	35.37	35.00	35.37	35.00
Humedad prom./Average moisture (%)	28.56		32.06		35.18		35.18	

DENS. SECA MAX./MAX. DRY DENSITY (gr/cm ³)	1.28
HUMEDAD OPTIMA/OPTIM. MOISTURE (%)	32.80



HIDROSUEÑOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

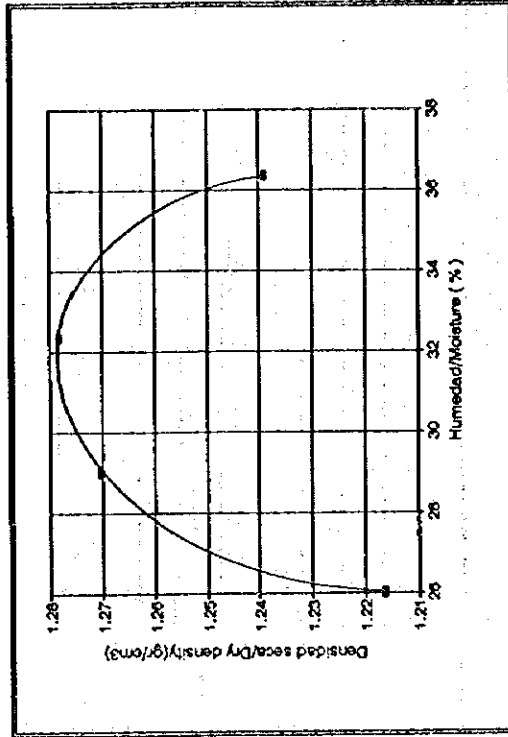
PROYECTO/PROJECT: **Trasvases/Trasbasin.**
 LOCALIZACION/SITE: **Canal abierto/Open Channel**
 FECHA/DATE: **Enero-94/January=94**
 CALICATA No./PIT No.: **C-16**
 MUESTRA No./SAMPLE No.: **M-2**
 PROFUNDIDAD/DEPTH: **2.00 - 3.50 m.**

METODO DE ENSAYO/TEST METHOD: **PROCTOR ESTANDAR/Standard proctor**
 GOLPES POR CAPA/BLOWS PER LAY: **25**
 No. DE CAPA/NUMBER OF LAYERS: **3**
 PESO MARTILLO/RAMMER WEIGHT: **5.5 Lbs./Pounds**
 ALTURA DE CAIDAFALLING HEIGHT: **12"**

MOLDE/NO - DIAMETRO/DIAMETER: **4"**
 VOLUMEN/VOLUME: **944 cm3**
 PESO/WEIGHT: **4265 gr.**

ENSAYADO/PERFORMED BY: **G.S.**
 CALCULADO/CALCULATED BY: **F.V.**

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE+SUELO/CAN WEIGHT-(gr)	5712	5812	5862	5860
P.MOLDE/CAN WEIGHT-(gr.)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT-(gr.)	1447	1547	1597	1596
Humedad prom./Average moisture(%)	26.02	29.00	32.35	36.37
Densid. Húmeda/wet density(gr./cm3)	1.53	1.64	1.69	1.69
Densid. Seca/Dry density(gr./cm3)	1.22	1.27	1.28	1.24



Recipiente No./Cap number	CONTENIDO DE AGUA/MOISTURE CONTEN							
	1	2	3	4	5	6	7	8
Tara+Suelo /Tara+wet soil(gr.)	70.80	63.66	67.76	61.98	73.51	67.83	76.08	70.71
Tara+Suelo Steno-dry soil(gr.)	60.00	54.12	56.81	52.38	60.00	55.92	60.07	57.12
Peso Tara/Cap weight	18.44	17.51	19.06	19.26	18.29	19.05	17.37	18.57
Contn. de Agua/Moisture(%)	25.99	26.06	29.01	28.99	32.39	32.30	37.49	35.25
Humedad prom./Average moisture(%)	26.02	29.00	29.00	32.35				

DENS. SECA MAX./MAX DRY DENSITY (gr/cm3)	1.28
HUMEDAD OPTIMA/OPTIM. MOISTURE (%)	31.80

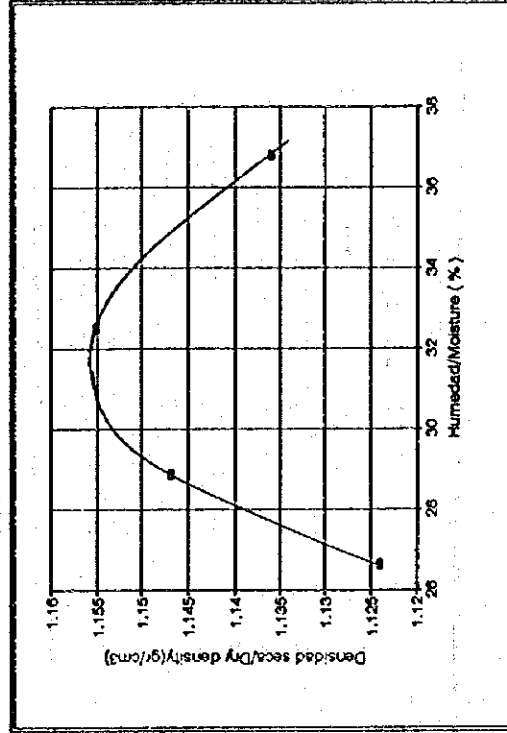


HIDROSUELOS CIA. LTDA. ENSAYO DE COMPACTACION/COMPACTION TEST

PROYECTO/PROJECT: **Trasvases/Trasbasin**
 LOCALIZACION/SITE: **Canal abierto/Open Channel**
 FECHA/DATE: **Enero-94/January=94**
 CALICATA No./PIT No.: **C-17**
 MUESTRA No./SAMPLE No.: **M-1**
 PROFUNDIDAD/DEPTH: **0.40 - 1.80 m.**

METODO DE ENSAYO/TEST METHOD: **PROCTOR ESTANDAR/Standard Proctor**
 GOLPES POR CAPA/LAWS PER LAY: **25** MOLDE/MO - DIAMETRO/DIAMETER: **4**
 No. DE CAPA/NUMBER OF LAYERS: **3** - VOLUMEN/VOLUME: **944 cm3**
 PESO MARTILLO/HAMMER WEIGHT: **5.5 Lbs./Pounds** - PESO/WEIGHT: **4265 gr.**
 ALTURA DE CAIDA/FALLING HEIGHT: **12"**

ENSAYADO/PERFORMED BY: **G.S.**
 CALCULADO/CALCULATED BY: **F.V.**



MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE+SUELO/CAN WEIGHT+SOI	5609	5660	5710	5732
P.MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT (gr.)	1344	1395	1445	1467
Humedad prom./Average moisture(%)	26.65	28.86	32.51	36.80
Densel. Humed./wet density (gr./cm3)	1.42	1.48	1.53	1.55
Densel. Secca/Dry density (gr./cm3)	1.12	1.15	1.16	1.14

Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara+Suelo H/cont+wet soil (gr.)	57.70	52.33	68.00	64.54	69.74	76.54	73.06	74.13
Tara+Suelo S/cont+dry soil (gr.)	49.56	44.98	57.00	54.60	57.06	62.40	58.50	59.22
Peso Tara/Can weigh	18.98	17.44	16.96	20.10	18.18	18.78	19.00	18.64
Conte. de Agua/Moisture(%)	26.62	26.69	26.92	28.81	32.61	32.42	36.86	36.74
Humedad prom./Average moisture(%)	26.65		28.86		32.51		36.80	

DENS.SECA MAX./MAX.DRY DENSITY (gr./cm3)	1.16
HUMEDAD OPTIMA/OPTIM.MOISTURE(%)	32.20



HIDROSUEÑOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

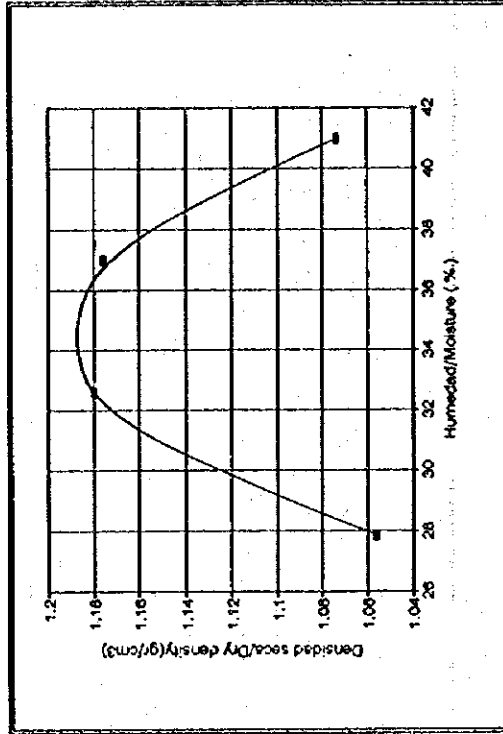
PROYECTO/PROJECT: Travesaños/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January-94
 CALICATA No./PIT No.: C-18
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.30 - 1.60 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPA/BLOWS PER LAY: 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE + SUELO/CAN WEIGHT+SOI	5540	5742	5786	5694
P.MOLDE/CAN WEIGHT(gr.)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT(gr.)	1275	1477	1521	1429
Humedad prom./Average moisture(%)	27.85	32.59	37.00	40.98
Densid. Hum./wet density(gr./cm ³)	1.35	1.56	1.61	1.51
Densid. Base/Dry density(gr./cm ³)	1.06	1.18	1.18	1.07



CONTENIDO DE AGUA/MOISTURE CONTEN								
	1	2	3	4	5	6	7	8
Recipiente No./Cup number								
Tara-Suelo H/horn+wet soil(gr.)	56.72	57.44	49.83	61.29	58.23	60.29	71.34	62.45
Tara-Suelo S/oven+dry soil(gr.)	48.61	48.58	42.10	50.82	47.84	48.82	56.27	49.61
Peso Tara/Cup weight	19.50	16.75	18.38	18.70	19.76	17.82	19.58	18.20
Conts. de Agua/Moisture(%)	27.86	27.84	32.59	32.60	37.00	37.00	41.07	40.88
Humedad prom./Average moisture(%)	27.85		32.59		37.00		40.98	

DENS. SECA MAX./MAX.DRY DENSITY(gr/cm ³)	1.19
HUMEDAD OPTIMA/OPTIM.MOISTURE(%)	34.60



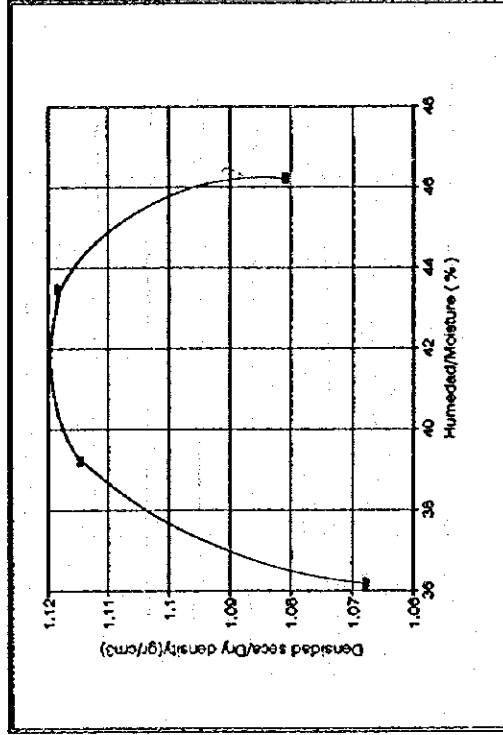
HIDROSUELOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

PROYECTO/PROJECT: Travesaños/Tresbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-84/January=84
 CALICATA No./PIT No.: C-18
 MUESTRA No./SAMPLE No.: M-2
 PROFUNDIDAD/DEPTH: 2.00 - 3.50 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDAR/Standard proctor
 GOLPES POR CAPAS/LAYERS: 3
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"
 MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVADATAS POR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE+SUELO/CAN WEIGHT+SOI	5638	5730	5780	5757
P. MOLDE/CAN WEIGHT(Gr.)	4265	4265	4265	4265
P. SUELO/BOIL WEIGHT(Gr.)	1373	1465	1515	1492
Humedad prom./Average moisture(%)	36.19	39.23	43.49	46.23
Densid. Humed./wet density(Gr./cm ³)	1.45	1.55	1.60	1.58
Densid. Sece./Dry density(Gr./cm ³)	1.07	1.11	1.12	1.08



CONTENIDO DE AGUA/MOISTURE CONTEN								
Resipiente No./Cap number	1	2	3	4	5	6	7	8
Tara+Suelo H./can+wet soil(Gr.)	61.82	58.00	61.13	70.71	70.15	70.55	74.51	67.96
Tara+Suelo S./can+dry soil(Gr.)	50.33	47.66	49.40	56.14	54.67	55.22	56.25	52.12
Peso Tara/Can weight	18.60	19.07	19.59	18.88	18.98	20.06	16.73	17.87
Conte. de Agua/Moisture(%)	36.21	36.17	39.35	39.10	43.37	43.60	46.20	46.25
Humedad prom./Average moisture(%)	36.19		39.23	43.49		46.23		

DENS. SECA MAX./MAX DRY DENSITY(Gr/cm ³)	1.12
HUMEDAD OPTIMA/OPTIM. MOISTURE(%)	41.60



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ENSAYO DE COMPACTACION/COMPACTION TEST

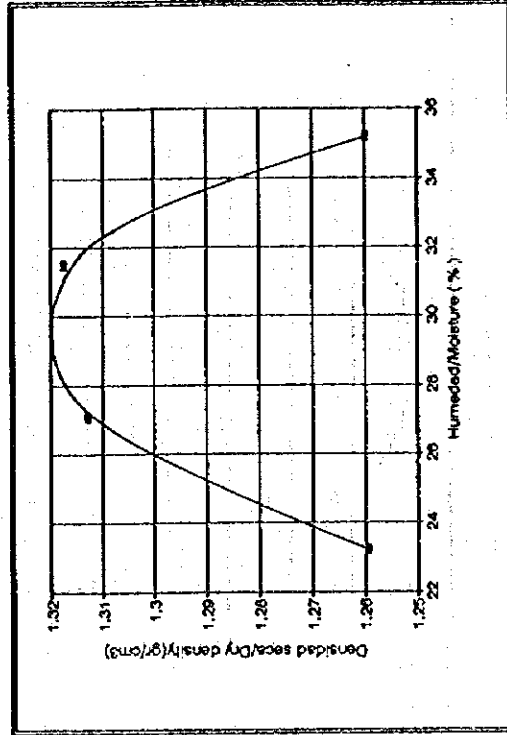
PROYECTO/PROJECT: Travesaños/Tresbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January=94
 CALICATA No./PIT No.: C-19
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 1.10 - 1.70 m.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDARDO/Standard proctor
 GOLPES POR CAPA/LAWS PER LAY 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 cm³
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVA DATAS FOR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P.MOLDE + SUELO/CAN WEIGHT + SOI	5730	5840	5900	5873
P.MOLDE/CAN WEIGHT (gr)	4265	4265	4265	4265
P.SUELO/SOIL WEIGHT (gr)	1465	1575	1635	1608
Humedad prom/Average moisture (%)	23.23	27.09	31.47	35.20
Densid. Humed./wet density (gr./cm ³)	1.55	1.67	1.73	1.70
Densid. Secc./Dry density (gr./cm ³)	1.26	1.31	1.32	1.26



Recipiente No./Cap number	CONTENIDO DE AGUA/MOISTURE CONTEN							
	1	2	3	4	5	6	7	8
Tara + Suelo Humed./wet soil (gr)	68.96	68.31	69.34	67.20	91.38	76.23	85.48	71.21
Tara + Suelo Seco/dry soil (gr)	59.42	58.50	58.84	56.95	74.25	62.16	68.05	57.62
Peso Tara/Can weight	18.13	16.64	19.78	19.39	19.77	17.48	19.58	18.16
Conte. de Agua/Moisture (%)	23.03	23.44	26.88	27.29	31.44	31.49	35.96	34.44
Humedad prom/Average moisture (%)	23.23		27.09			31.47		

DENS. SECA MAX./MAX DRY DENSITY (gr/cm ³)	1.32
HUMEDAD OPTIMA/OPTIM. MOISTURE (%)	29.60



HIDROSUELOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

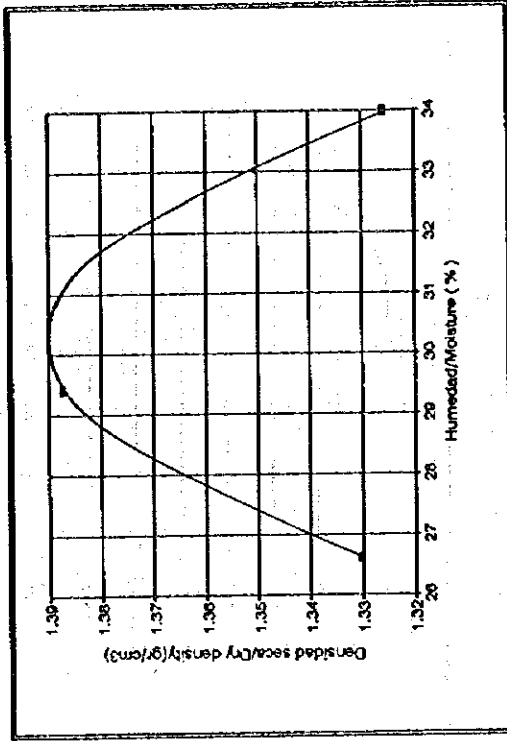
METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDARDO/Standard proctor
 COLPES POR CAPAS/LAWS PER LAY. 25
 No. DE CAPAS/NUMBER OF LAYERS: 3
 PESO MARTILLO/RAMMER WEIGHT: 5.5 Lbs./POUNDS
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

PROYECTO/PROJECT: Travases/Trasbasin
 LOCALIZACION/SITE: Canal abierto/Open Channel
 FECHA/DATE: Enero-94/January-94
 CALICATA No./PIT No.: C-19
 MUESTRA No./SAMPLE No.: M-2
 PROFUNDIDAD/DEPTH: 2.00 - 4.00 m.

MOLDE/MO - DIAMETRO/DIAMETER: 4"
 VOLUMEN/VOLUME: 944 CM3
 PESO/WEIGHT: 4265 gr.

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVA/DATAS FOR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE-SUELO/CAN WEIGHT + SOI	5855	5960	5942	5942
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/SOIL WEIGHT (gr.)	1590	1695	1677	1677
Humedad promi/Average moisture(%)	26.62	29.42	33.99	33.99
Densid. Humal./wet density(gr./cm3)	1.68	1.80	1.78	1.78
Densid. Secca/Dry density(gr./cm3)	1.33	1.39	1.33	1.33



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tara-Suelo H./can+wet soil(gr.)	77.58	56.00	63.37	71.84	77.30	70.80	77.30	70.80
Tara-Suelo S./can+dry soil(gr.)	65.21	48.03	52.71	60.00	62.64	57.46	62.64	57.46
Peso Tara/Can weight	18.61	18.18	16.64	19.58	19.39	18.32	19.39	18.32
Contn. de Agua/Moisture(%)	26.55	26.70	29.55	29.29	33.90	34.08	33.90	34.08
Humedad promi/Average moisture(%)	26.62		29.42		33.99		33.99	

DENS. SECA MAX./MAX DRY DENSITY (gr/cm3)	1.39
HUMEDAD OPTIMA/OPTIM. MOISTURE (%)	30.20



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ENSAYO DE COMPACTACION/COMPACTION TEST

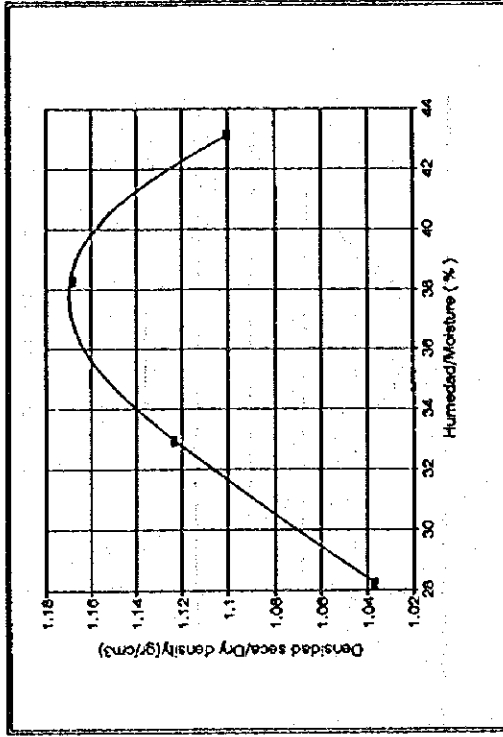
PROYECTO/PROJECT: **Trasvases/Trasbasin**
 LOCALIZACION/SITE: **L. Transm./Transmission Line**
 FECHA/DATE: **Enero-94/January-94**
 CALICATA No./PIT No.: **C-20**
 MUESTRA No./SAMPLE No.: **M-1**
 PROFUNDIDAD/DEPTH: **0.35 - 1.10 m.**

METODO DE ENSAYO/TEST METHOD: **PROCTOR ESTANDAR/Standard Proctor**
 GOLPES POR CAPAS/LAYERS: **3**
 No. DE CAPAS/NUMBER OF LAYERS: **3**
 PESO MARTILLO/HAMMER WEIGHT: **5.5 Lbs./Pounds**
 ALTURA DE CAIDA/FALLING HEIGHT: **12"**

MOLDE/NO. - DIAMETRO/DIAMETER: **4"**
 VOLUMEN/VOLUME: **944 cm³**
 PESO/WEIGHT: **4265 gr.**

ENSAYADO/PERFORMED BY: **G.S.**
 CALCULADO/CALCULATED BY: **F.V.**

DATOS PARA LA CURVADITAS POR GRAFIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE-SUELO/CAN WEIGHT+SOI	5520	5675	5730	5752
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/SOI WEIGHT (gr.)	1255	1410	1525	1487
Humedad prom/Average moisture (%)	28.22	32.98	38.27	43.14
Dens. Hum. Wet density (gr./cm ³)	1.33	1.49	1.62	1.58
Dens. Seca/Dry density (gr./cm ³)	1.04	1.12	1.17	1.10



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cap number	1	2	3	4	5	6	7	8
Tarea Suelo H (wet+wet soil) (gr.)	65.31	58.91	66.62	58.92	57.71	59.37	61.42	62.73
Tarea Suelo S (wet-dry soil) (gr.)	55.00	50.00	54.86	49.04	46.68	48.34	48.06	49.32
Peso Tarea/Can weight	18.58	18.32	19.28	18.93	17.88	19.50	17.20	18.12
Conte. de Agua/Moisture (%)	28.31	28.12	33.05	32.61	38.30	38.25	43.29	42.98
Humedad prom/Average moisture (%)	28.22		32.93		38.27		43.14	

DENS. SECA MAX. MAX. DRY DENSITY (gr/cm ³)	1.17
HUMEDAD OPTIMA/OPTIM. MOISTURE (%)	37.80



HIDROSUEÑOS CIA. LTDA.
ENSAYO DE COMPACTACION/COMPACTION TEST

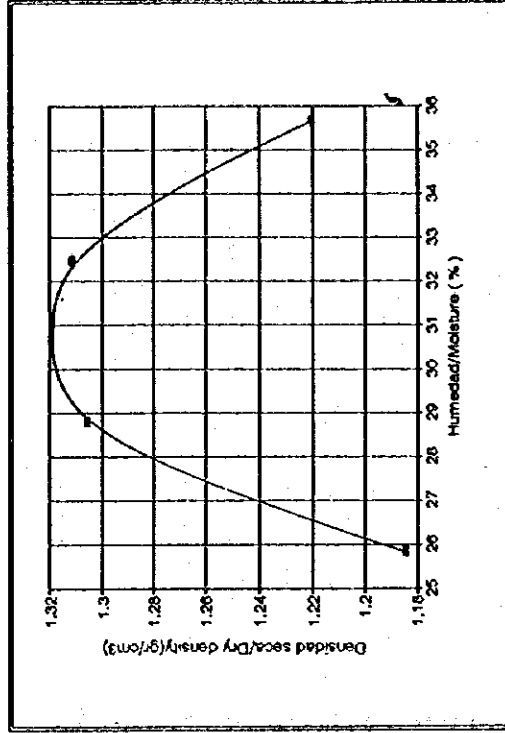
PROYECTO/PROJECT: Tresvases/Tresbeshin
 LOCALIZACION/SITE: L. Transm./Transmission Line
 FECHA/DATE: Enero-94/January-94
 CALICATA No./PIT No.: C-21
 MUESTRA No./SAMPLE No.: M-1
 PROFUNDIDAD/DEPTH: 0.40 - 1.00 m.

MOLDE/NO: 4
 DIAMETRO/DIAMETER: 44 CM3
 VOLUMEN/VOLUME: 944 CM3
 PESO/WEIGHT: 4265 gr.

METODO DE ENSAYO/TEST METHOD: PROCTOR ESTANDARD/Standard proctor
 GOLPES POR CAPA/BLOWS PER LAY: 25
 No. DE CAPA/NUMBER OF LAYERS: 3
 PESO MATTILLO/RAMMER WEIGHT: 5.5 Lbs./Pounds
 ALTURA DE CAIDA/FALLING HEIGHT: 12"

ENSAYADO/PERFORMED BY: G.S.
 CALCULADO/CALCULATED BY: F.V.

DATOS PARA LA CURVA/DATAS FOR GRAPHIC				
MUESTRA No./SPECIMEN No.	1	2	3	4
P. MOLDE + SUELO/CAN WEIGHT + SOI	5672	5853	5905	5828
P. MOLDE/CAN WEIGHT (gr.)	4265	4265	4265	4265
P. SUELO/SOIL WEIGHT (gr.)	1407	1588	1640	1563
Humedad prom./Average moisture(%)	25.86	28.81	32.46	35.67
Densid. Hume./wet density(gr./cm3)	1.49	1.68	1.74	1.66
Densid. Secc./Dry density(gr./cm3)	1.18	1.31	1.31	1.22



CONTENIDO DE AGUA/MOISTURE CONTEN								
Recipiente No./Cup number	1	2	3	4	5	6	7	8
Tara + Suelo H./can + wet soil (gr.)	68.87	68.02	67.14	78.81	73.83	46.09	62.85	72.61
Tara + Suelo S./can + dry soil (gr.)	58.71	57.85	56.00	65.51	60.32	39.15	50.68	58.50
Peso Tara/Can weight	19.35	18.60	17.38	19.28	19.06	17.58	16.53	18.99
Conte. de Agua/Moisture(%)	25.81	25.91	28.85	28.77	32.74	32.17	35.64	35.71
Humedad prom./Average moisture(%)	25.86		28.81		32.46		35.67	

DENS. SECA MAX./MAX DRY DENSITY (gr/cm3)	1.32
HUMEDAD OPTIMA/OPTIM. MOISTURE(%)	31.00



UNDISTURBED SAMPLE

ESCUELA POLITECNICA NACIONAL
FACULTAD DE INGENIERIA CIVIL
LABORATORIO DE MECANICA DE ROCAS

PROYECTO "TRASVASES MANABI"

COMPACTACION

TIPO DE ENSAYO: PROCTOR ESTANDAR

	ENVIO	2		
	SONDEO:	C-22		
	BLOQUE:	M-1		
	PROFUNDIDAD:	0.60-0.90		
MOLDE No:	2	PESO MARTILLO =	2.5	
VOLUMEN (cm ³) =	964	ALTURA CAIDA =	30	
PESO (gr) =	4960	No. CAPAS =	3	
		GOLFES POR CAPA =	25	

DATOS PARA LA CURVA

ENSAYO No.	1	2	3	4	5
PESO MOLDE + SUELO HUMEDO (gr):	6255.0	6345.0	6486.0	6535.0	6510.0
PESO SUELO HUMEDO (gr):	1295.0	1385.0	1526.0	1575.0	1550.0
HUMEDAD PROMEDIO (%):	23.54	29.90	37.21	44.73	52.53
DENSIDAD HUMEDA (gr/cm ³):	1.34	1.44	1.58	1.63	1.61
DENSIDAD SECA (gr/cm ³):	1.09	1.11	1.15	1.13	1.05

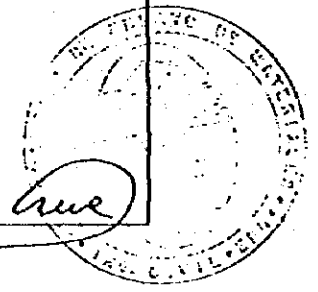
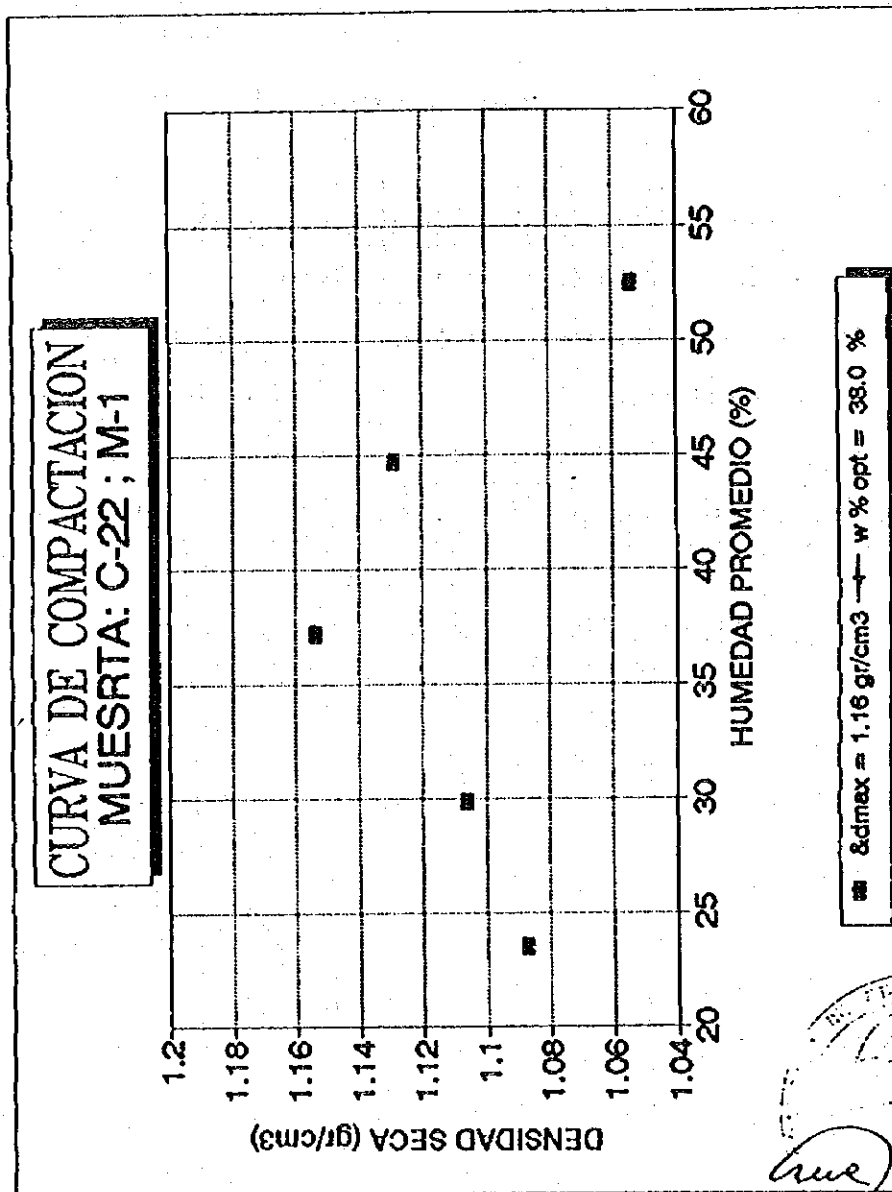
DENSIDAD SECA MAXIMA: 1.16 g/cm³
 HUMEDAD OPTIMA: 38.0 %


 Ing. GERMAN LUNA H.
 JEFE LABORATORIO

ESCUELA POLITECNICA NACIONAL
FACULTAD DE INGENIERIA CIVIL
LABORATORIO DE MECANICA DE ROCAS

PROYECTO "TRASVASES MANABI"

COMPACTACION
TIPO DE ENSAYO: PROCTOR ESTANDAR
ENVIO: 2
SONDEO: C-22
BLOQUE: M-1
PROFUNDIDAD: 0.60-0.90



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PROYECTO "TRASVASES MANABI"

COMPACTACION

TIPO DE ENSAYO: PROCTOR ESTANDAR

ENVIO 2

SONDEO: C-23

BLOQUE: M-1

PROFUNDIDAD: 1.20-1.50

MOLDE No: 2
VOLUMEN (cm³) = 964
PESO (gr) = 4960

PESO MARTILLO = 2.5
ALTURA CAIDA = 30
No. CAPAS = 3
GOLFES POR CAPA = 25

DATOS PARA LA CURVA

ENSAYO No.	1	2	3	4	5
PESO MOLDE + SUELO HUMEDO (gr)	6302.0	6375.0	6500.0	6615.0	6566.0
PESO SUELO HUMEDO (gr)	1342.0	1415.0	1540.0	1655.0	1606.0
HUMEDAD PROMEDIO (%)	26.06	31.76	40.46	47.97	51.90
DENSIDAD HUMEDA (gr/cm ³)	1.39	1.47	1.60	1.72	1.67
DENSIDAD SECA (gr/cm ³)	1.10	1.11	1.14	1.16	1.10

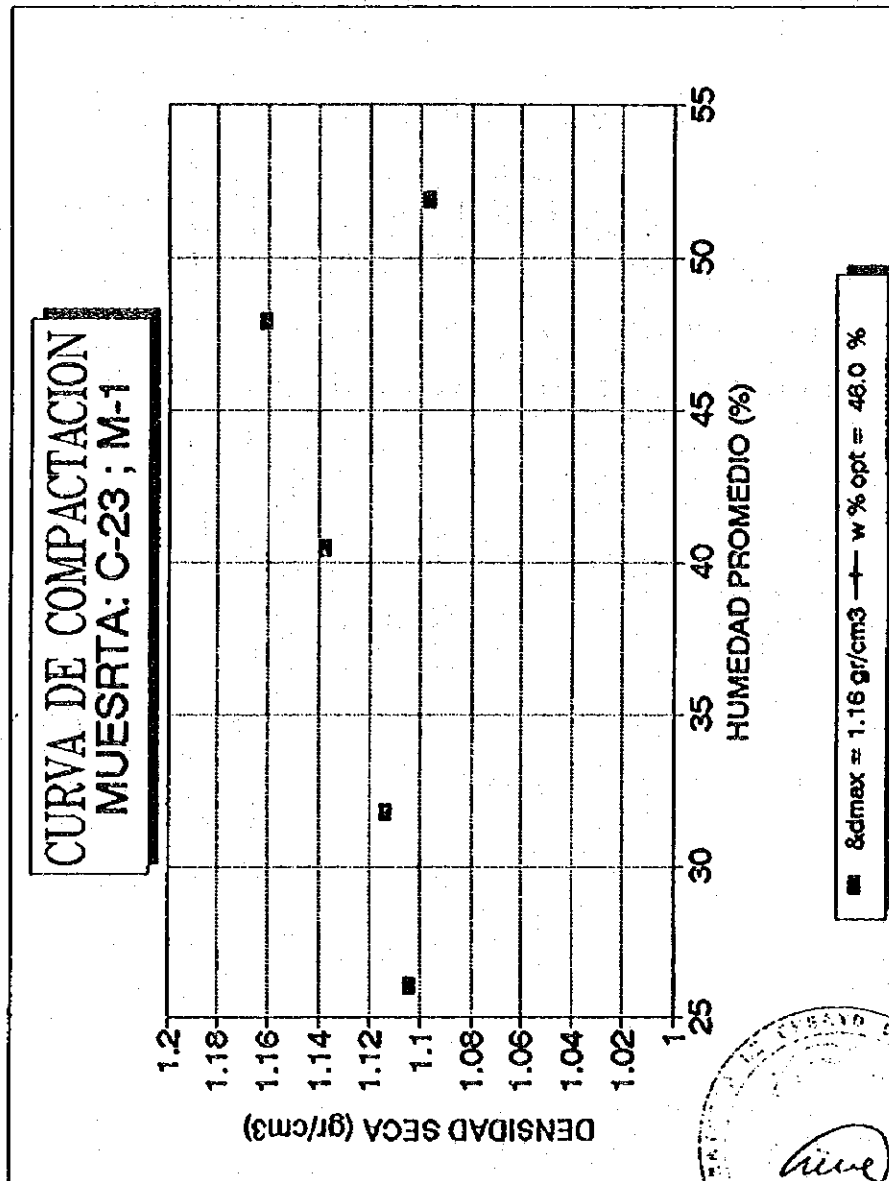
DENSIDAD SECA MAXIMA: 1.16 g/cm³
HUMEDAD OPTIMA: 46.0 %

Ing. GERMAN LUNA R.
JEFE LABORATORIO



PROYECTO "TRASVASES MANABI"

COMPACTACION
TIPO DE ENSAYO: PROCTOR ESTANDAR
ENVIO: 2
SONDEO: C-23
BLOQUE: M-1
PROFUNDIDAD: 1.20-1.50



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PROYECTO "TRASVASES MANABI"

COMPACTACION

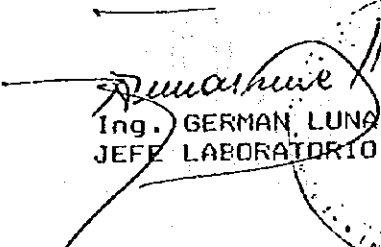
TIPO DE ENSAYO: PROCTOR ESTANDAR

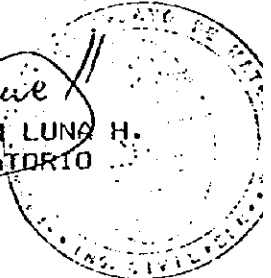
	ENVIO	2		
	SONDEO:	C-24		
	BLOQUE:	M-1		
	PROFUNDIDAD:	1.50-1.80		
MOLDE No:	2	PESO MARTILLO	=	2.5
VOLUMEN (cm ³) =	964	ALTURA CAIDA	=	30
PESO (gr) =	4960	No. CAPAS	=	3
		GOLPES POR CAPA	=	25

DATOS PARA LA CURVA

ENSAYO No.	1	2	3	4	5
PESO MOLDE + SUELO HUMEDO (gr)	6382.0	6480.0	6639.0	6643.0	6583.0
PESO SUELO HUMEDO (gr)	1422.0	1520.0	1679.0	1683.0	1623.0
HUMEDAD PROMEDIO (%)	21.53	27.42	33.98	41.61	47.52
DENSIDAD HUMEDA (gr/cm ³)	1.48	1.58	1.74	1.75	1.68
DENSIDAD SECA (gr/cm ³)	1.21	1.24	1.30	1.23	1.14

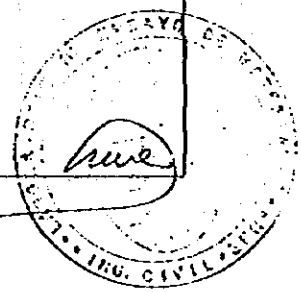
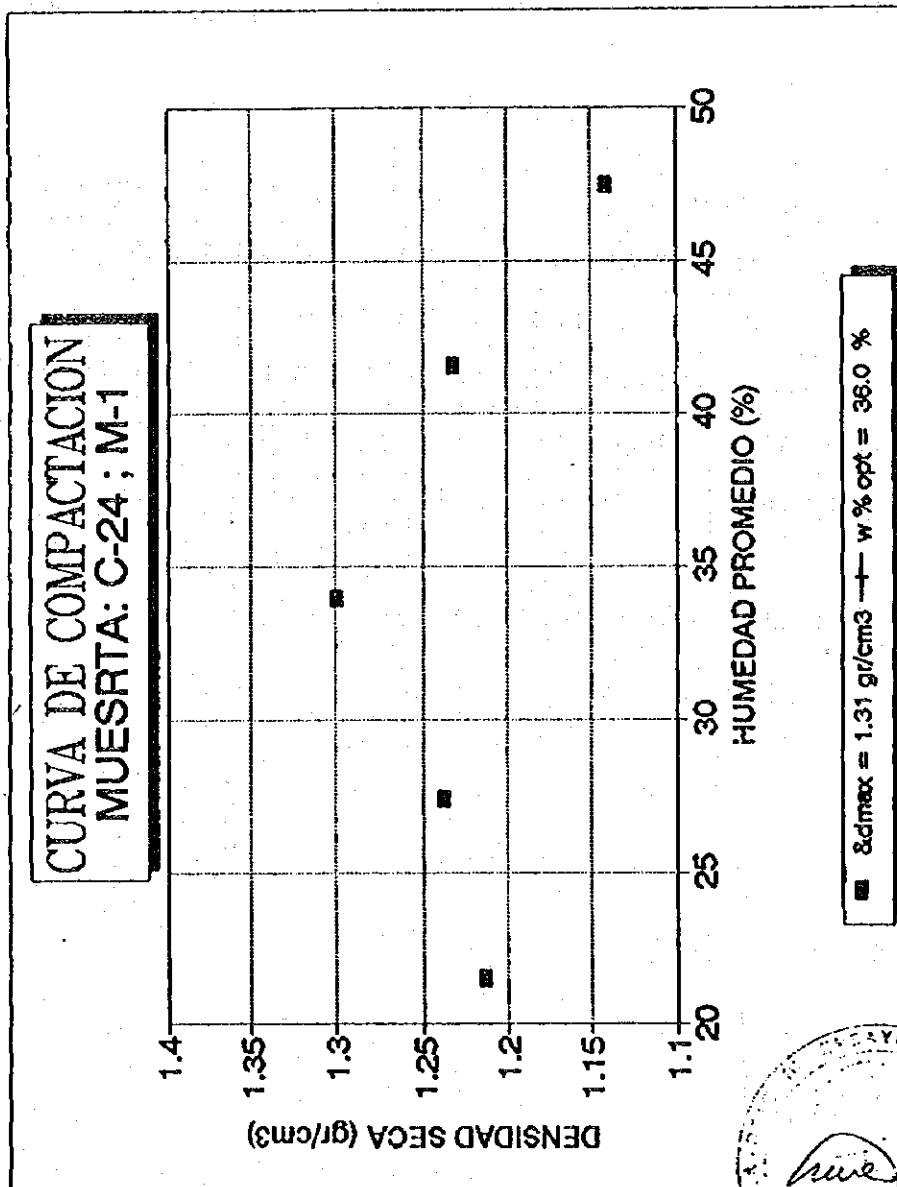
DENSIDAD SECA MAXIMA: 1.31 g/cm³
 HUMEDAD OPTIMA: 36.0 %


 Ing. GERMAN LUNA H.
 JEFE LABORATORIO



PROYECTO "TRASVASES MANABI"

COMPACTACION
TIPO DE ENSAYO: PROCTOR ESTANDAR
ENVIO: 2
SONDEO: C-24
BLOQUE: M-1
PROFUNDIDAD: 1.50-1.80





SWELLING TEST



HIDROSUELOS CIA. LTDA.

SWELLING PRESSURE UNDER CONDITIONS OF ZERO VOLUME CHANGE

PROJECT: **Trasbasins** TESTED BY: **G.S.**

DATE: **JANUARY-1994** CALCULATED BY: **F.V.**

SAMPLE No.	SITE	DEPTH	DIAMETER cm.	HEIGHT cm.	λ_m g/cm^3	MOISTURE %	PRESSION Kg/cm^2
C10 - M1	OPEN CHANNEL	0.50-1.40m	6.35	2.54	1.540	43.85	0.20
C10 - M2	OPEN CHANNEL	2.00-3.00m	6.35	2.54	1.538	43.12	0.40
C11 - M1	OPEN CHANNEL	0.55-1.60m	6.35	2.54	1.558	44.10	1.25
C12 - M1	OPEN CHANNEL	0.60-1.60m	6.35	2.54	1.580	40.12	1.60
C12 - M2	OPEN CHANNEL	2.00-3.60m	6.35	2.54	1.540	41.36	1.60
C13 - M1	OPEN CHANNEL	0.80-2.00m	6.35	2.54	1.566	35.50	1.35
C14 - M1	OPEN CHANNEL	0.90-1.90m	6.35	2.54	1.518	35.52	0.60
C14 - M2	OPEN CHANNEL	2.00-3.50m	6.35	2.54	1.523	37.06	0.10
C15 - M1	OPEN CHANNEL	0.40-1.00m	6.35	2.54	1.399	33.91	1.50
C15 - M2	OPEN CHANNEL	1.20-1.60m	6.35	2.54	1.400	33.19	1.60
C16 - M1	OPEN CHANNEL	0.85-1.80m	6.35	2.54	1.627	31.82	0.75
C16 - M2	OPEN CHANNEL	2.00-3.50m	6.35	2.54	1.642	31.43	1.65
C17 - M1	OPEN CHANNEL	0.40-1.60m	6.35	2.54	1.496	31.56	1.15
C17 - M2	OPEN CHANNEL	2.00-3.00m	6.35	2.54	1.496	31.82	1.10
C18 - M1	OPEN CHANNEL	0.30-1.60m	6.35	2.54	1.528	32.83	1.30
C18 - M2	OPEN CHANNEL	2.00-3.50m	6.35	2.54	1.527	40.22	1.50
C19 - M1	OPEN CHANNEL	1.10-1.70m	6.35	2.54	1.423	28.71	0.30
C19 - M2	OPEN CHANNEL	2.00-4.00m	6.35	2.54	1.423	28.61	0.30
C20 - M1	TRANSMISSION LINE	0.35-1.10m	6.35	2.54	1.541	35.52	0.15
C21 - M1	TRANSMISSION LINE	0.40-1.00m	6.35	2.54	1.668	29.96	1.10
C21 - M2	TRANSMISSION LINE	1.10-2.15m	6.35	2.54	1.670	30.10	0.26
C22 - M2	TRANSMISSION LINE	1.00-2.35m	6.35	2.54	1.660	28.16	1.25
C23 - M2	TRANSMISSION LINE	2.00-2.80m	6.35	2.54	1.670	29.80	0.75
C24 - M2	TRANSMISSION LINE	2.50-3.50m	6.35	2.54	1.660	31.12	0.76



UNDISTURBED SAMPLE

ESCUELA POLITECNICA NACIONAL
FACULTAD DE INGENIERIA CIVIL
LABORATORIO DE MECANICA DE ROCAS

PROYECTO "TRASVASES MANABI"

PROYECTO: "TRASVASES MANABI"

FECHA: ENERO 1994

SOLICITADO POR: HIDROSUELOS

HINCHAMIENTO EN SUELO

CALICATA	C - 22
MUESTRA	M-1
PROFUNDIDAD (m)	0.60 - 0.90
TIPO DE ENSAYO	CAMBIO VOL. NULO
ALTURA (cm)	1.595
DIAMETRO (cm)	6.330
AREA (cm ²)	31.470
PESO INICIAL (gr)	86.300
PESO FINAL (gr)	89.800
PESO SECO (gr)	60.600
HUMEDAD INICIAL (%)	42.409
HUMEDAD FINAL (%)	48.185
PESO UNITARIO (gr/cm ³)	1.719
PESO UNITARIO SECO (gr/cm ³)	1.207
FUERZA MAX. HINCHAMIENTO (kg)	78.600
PRESION DE HINCHAMIENTO (kg/cm ²)	2.498


ING. GERMAN LUNA H.
JEFE DE LABORATORIO

ESCUELA POLITECNICA NACIONAL
FACULTAD DE INGENIERIA CIVIL
LABORATORIO DE MECANICA DE ROCAS

PROYECTO "TRASVASES MANABI"

PROYECTO: "TRASVASES MANABI"

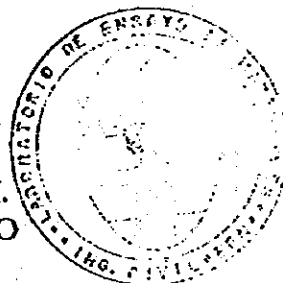
FECHA: ENERO 1994

SOLICITADO POR: HIDROSUELOS

HINCHAMIENTO EN SUELO

CALICATA	C - 23
MUESTRA	M-1
PROFUNDIDAD (m)	1.20 - 1.50
TIPO DE ENSAYO	CAMBIO VOL. NULO
ALTURA (cm)	1.671
DIAMETRO (cm)	6.330
AREA (cm ²)	31.470
PESO INICIAL (gr)	89.200
PESO FINAL (gr)	93.200
PESO SECO (gr)	61.700
HUMEDAD INICIAL (%)	44.571
HUMEDAD FINAL (%)	51.053
PESO UNITARIO (gr/cm ³)	1.696
PESO UNITARIO SECO (gr/cm ³)	1.173
FUERZA MAX. HINCHAMIENTO (kg)	43.040
PRESION DE HINCHAMIENTO (kg/cm ²)	1.368


ING. GERMAN LUNA H.
JEFE DE LABORATORIO



ESCUELA POLITECNICA NACIONAL
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PROYECTO "TRASVASES MANABI"

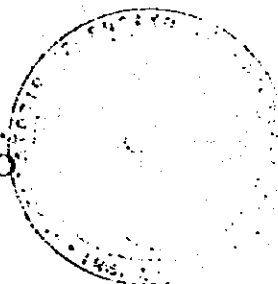
PROYECTO: "TRASVASES MANABI"

FECHA: ENERO 1994
SOLICITADO POR: HIDROSUELOS

HINCHAMIENTO EN SUELO

CALICATA	C-24
MUESTRA	M-1
PROFUNDIDAD (m)	1.50 - 1.80
TIPO DE ENSAYO	CAMBIO VOL. NULO
ALTURA (cm)	1.627
DIAMETRO (cm)	6.330
AREA (cm ²)	31.470
PESO INICIAL (gr)	86.700
PESO FINAL (gr)	90.300
PESO SECO (gr)	57.500
HUMEDAD INICIAL (%)	50.783
HUMEDAD FINAL (%)	57.043
PESO UNITARIO (gr/cm ³)	1.693
PESO UNITARIO SECO (gr/cm ³)	1.123
FUERZA MAX. HINCHAMIENTO (kg)	16.064
PRESION DE HINCHAMIENTO (kg/cm ²)	0.510


ING/GERMAN LUNA H.
JEFE DE LABORATORIO





SHRINKAGE TEST



HIDROSUELOS CIA. LTDA. SHRINKAGE LIMIT

PROJECT: Trasbasins
DATE: JANUARY/1994
TESTED BY: G.S.
CALCULATED BY: F.V.

PIT No.	SAMPLE No.	SITE	DEPTH (m)	CAN No.	CAN WEIGH (gr)	CAN VOL (cm ³)	DRY SAMP VOL (cm ³)	INITIAL MOIST. (%)	DRY SAMP WEIGHT (gr)	SHRINKAGE LIMIT (%)
C10	M1	OPEN CHANNEL	0.50-1.40m	1	19.8	15.54	8.93	59.7	15.31	16.526
C10	M2	OPEN CHANNEL	2.00-3.00m	2	19.5	15.37	8.01	62.75	14.79	12.987
C11	M1	OPEN CHANNEL	0.55-1.60m	3	19.6	15.28	8.81	57.87	15.38	15.802
C12	M1	OPEN CHANNEL	0.60-1.60m	1	19.7	16.16	10.48	58.62	16.99	25.189
C12	M2	OPEN CHANNEL	2.00-3.60m	2	19.8	15.17	8.92	63.7	14.82	21.527
C13	M1	OPEN CHANNEL	0.80-2.00m	3	19.6	16.29	6.95	90.56	13.45	21.118
C13	M2	OPEN CHANNEL	2.00-3.50m	4	19.3	16.13	9.66	61.3	16.46	21.993
C14	M1	OPEN CHANNEL	0.90-1.90m	5	25.8	15.33	11	60.55	15.69	32.953
C14	M2	OPEN CHANNEL	2.00-3.50m	6	11	14.92	10.27	62.96	14.58	31.067
C15	M1	OPEN CHANNEL	0.40-1.00m	7	11.1	14.82	6.36	86.51	11.79	14.754
C15	M2	OPEN CHANNEL	1.20-1.60m	8	11.3	14.27	6.03	83.36	11.6	12.326
C16	M1	OPEN CHANNEL	0.85-1.80m	9	11.2	14.54	8.91	53.67	15.52	17.394
C16	M2	OPEN CHANNEL	2.00-3.50m	1	19.8	15.54	9.04	55.13	16.36	15.399
C17	M1	OPEN CHANNEL	0.40-1.60m	2	19.5	15.37	8.46	62.52	14.86	16.019
C17	M2	OPEN CHANNEL	2.00-3.00m	3	19.6	15.28	8.79	59.85	15.64	18.354
C18	M1	OPEN CHANNEL	0.30-1.60m	3	19.6	15.28	8.23	67.48	14.33	18.283
C18	M2	OPEN CHANNEL	2.00-3.50m	1	19.7	16.16	7.5	71.44	14.46	11.551
C19	M1	OPEN CHANNEL	1.10-1.70m	2	19.8	15.17	9.25	48.37	17.14	13.631
C19	M2	OPEN CHANNEL	2.00-4.00m	3	19.6	16.29	11.24	44.35	19.37	18.279
C20	M1	TRANSMISSION LIN	0.35-1.10m	4	19.3	16.13	9.56	60.27	16.06	19.361
C21	M1	TRANSMISSION LIN	0.40-1.00m	5	25.8	15.33	11.25	42.23	18.35	19.996
C21	M2	TRANSMISSION LIN	1.10-2.15m	6	11	14.92	11.19	39.31	18.52	19.170
C22	M2	TRANSMISSION LIN	1.00-2.35m	7	11.1	14.82	8.9	60.22	14.68	19.693
C23	M2	TRANSMISSION LIN	2.00-2.80m	8	11.3	14.27	7.25	77.44	12.28	20.274
C24	M2	TRANSMISSION LIN	2.50-3.50m	9	11.2	14.54	8.06	64.32	13.51	16.356

FORMULAS:

$$L_c = W_o - \left\{ \left[\frac{(V_o - V_f)}{W_s} \right] \times 100 \right\}$$

Lc=SHRINKAGE LIMIT
 W_o=INITIAL MOISTURE
 V_o=INITIAL VOLUME
 V_f=FINAL VOLUME
 W_s=DRY WEIGHT



0

0

UNDISTURBED SAMPLE

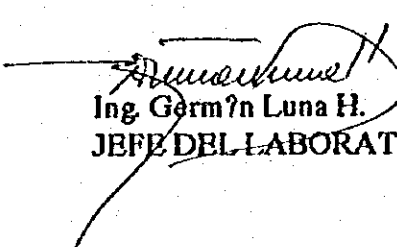
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PROYECTO "TRASVASES MANABI"

ENVIO # 2

LIMITE DE CONTRACCION						
MUESTRA	C-22;M-1		C-23;M-1		C-24;M-1	
PROF.(m)	0.60-0.90		1.20-1.50		1.50-1.80	
Peso capsula	19.95	20.57	20.00	22.25	20.15	19.23
peso cap + S humed.	43.55	45.28	43.47	42.97	44.91	42.65
peso cap + S seco	32.04	33.25	31.36	32.25	33.07	31.38
W _i %	95.20	94.87	106.60	107.20	91.64	92.76
Peso de Hg en cap	220.17	231.00	219.05	195.70	195.62	214.33
Peso Hg desaloj.	94.19	97.74	98.20	85.45	82.59	98.13
LC	18.58	17.60	28.38	26.13	27.31	22.44
PROMEDIO	18.09		27.26		24.87	


 Ing. Germán Luna H.
 JEFE DEL LABORATORIO





PIN HOLE TEST FOR DISPERSION



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
<u>PROYECTO/PROJECT:</u>		Trasvases/Trasbasins		<u>LOCALIZACION/SITE:</u>		Canal abierto/Open Channel			
<u>CALICATA No./PIT No.:</u>		C-10		<u>MUESTRA No./SAMPLE No.:</u>		M-1			
<u>PROFUNDIDAD/DEPTH:</u>		0.50 - 1.40 m.		<u>FECHA/DATE:</u>		Enero94/Jan.94			
<u>ENSAY./PERFORM.BY:</u>		G.S.		<u>CALC./CALCULATED BY:</u>		F.V.			
<u>PESO DEL ANILLO+MUESTRA/Sample+ring weight:</u>		219.3 gr		$\delta m =$		1.540		gr/cm ³	
<u>PESO ANILLO/Ring weight:</u>		171.65 gr		$W\% =$		43.12		%	
<u>PESO MUESTRA/ Sample weight:</u>		47.65 gr		NORMA: ASTM D4647-87, METHOD C					
<u>VOLUMEN MUESTRA/Sample vol:</u>		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
2-11-94 8:00h	10	39	0.26						
	10	37	0.27						
	10	38	0.26						
	25	90	0.28	42	0.60	20	1.25		
	25	92	0.27	43	0.58	21	1.19		
	25	95	0.26	45	0.56	19	1.32		
8:40h	50	173	0.29	98	0.51	41	1.22		
	50	171	0.29	94	0.53	45	1.11		
	50	167	0.30	97	0.52	45	1.11		
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIGERAMENTE TURBIO/SLIGHTLY			

CLASIFICACION:
CLASIFICATION:

NO DISPERSIVA (ND1)
NONDISPERSIVE (ND1)

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HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
<u>PROYECTO/PROJECT:</u>		Trasvases/Trasbasins		<u>LOCALIZACION/SITE:</u>		Canal abierto/Open Channel			
<u>CALICATA No./PIT No.:</u>		C-10		<u>MUESTRA No./SAMPLE No.:</u>		M-2			
<u>PROFUNDIDAD/DEPTH:</u>		2.00 - 3.00 m.		<u>FECHA/DATE:</u>		Feb.94			
<u>ENSAY./PERFORM.BY:</u>		G.S.		<u>CALC./CALCULATED BY:</u>		F.V.			
<u>PESO DEL ANILLO+MUESTRA/Sample+ring weight:</u>		218.68 gr		<u>&m=</u>		1.520 gr/cm ³			
<u>PESO ANILLO/Ring weight:</u>		171.65 gr		<u>W%=</u>		42.16 %			
<u>PESO MUESTRA/ Sample weight:</u>		47.03 gr		<u>NORMA: ASTM D4647-87, METHOD C</u>					
<u>VOLUMEN MUESTRA/Sample vol:</u>		30.94 cm ³							
HOUR	VOL. cm ³	h=2"		h=7"		h=15"		q(ml/sec)	q(ml/sec)
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)		
9:00h	10	16	0.63						
	10	15	0.67						
	10	12	0.83						
	25	37	0.68	19	1.32	15	1.67		
	25	35	0.71	17	1.47	14	1.79		
	25	31	0.81	19	1.32	15	1.67		
9:40h	50	67	0.75	36	1.39	27	1.85		
	50	64	0.78	32	1.56	27	1.85		
	50	60	0.83	37	1.35	27	1.85		
COLOR		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY	

CLASIFICACION: NO DISPERSIVA (ND2)
 CLASIFICACION: NONDISPERSIVE (ND2)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Trasvases/Trasbasins **LOCALIZACION/SITE:** Canal abierto/Open Channel
CALICATA No./PIT No.: C-11 **MUESTRA No./SAMPLE No.:** M-1
PROFUNDIDAD/DEPTH: 0.55 - 1.60 m. **FECHA/DATE:** Enero94/Jan.94
ENSAY./PERFORM.BY: G.S. **CALC./CALCULATED BY:** F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 218.09 gr **&m=** 1.501 **gr/cm³**
PESO ANILLO/Ring weight: 171.65 gr **W%=** 41.13 **%**
PESO MUESTRA/ Sample weight: 46.44 gr **NORMA:** ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
10:00h	10	47	0.21				
	10	47	0.21				
	10	46	0.22				
	25	99	0.25	54	0.46	28	0.89
	25	98	0.26	57	0.44	26	0.96
	25	97	0.26	55	0.45	25	1.00
	50	193	0.26	109	0.46	57	0.88
	50	196	0.26	103	0.49	51	0.98
10:40h	50	195	0.26	104	0.48	54	0.93
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIGERAMENTE TURBIO/SLIGHTLY	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Trasbasins
CALICATA No./PIT No.: C-12
PROFUNDIDAD/DEPTH: 0.60 - 1.60 m.
ENSAY./PERFORM.BY: G.S.
LOCALIZACION/SITE: Canal abierto/Open Channel
MUESTRA No./SAMPLE No.: M-1
FECHA/DATE: Enero 94/Jan. 94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 219.3 gr
PESO ANILLO/Ring weight: 171.65 gr
PESO MUESTRA/ Sample weight: 47.65 gr
VOLUMEN MUESTRA/Sample vol: 30.94 cm³
 $\rho = 1.540$ gr/cm³
 $W\% = 39.94$ %
NORMA: ASTM D4647-87, METHOD C

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(mi/sec)	t(sec)	q(mi/sec)	t(sec)	q(mi/sec)
2-11-94	10	18	0.56				
11:00h	10	19	0.53				
	10	20	0.50				
	25	34	0.74	20	1.25	15	1.67
	25	33	0.76	22	1.14	14	1.79
	25	32	0.78	23	1.09	17	1.47
	50	68	0.74	47	1.06	32	1.58
	50	69	0.72	46	1.09	33	1.52
11:40h	50	68	0.74	45	1.11	36	1.39
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIG.TURBIO/SLIGHTLY CLOUDY	

CLASIFICACION: NO DISPERSIVA (ND2)
CLASIFICATION: NONDISPERSIVE (ND2)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-12		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 3.60 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY/PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight		218.37 gr		&m=		1.510 gr/cm ³			
PESO ANILLO/Ring weight		171.65 gr		W%=		41.32 %			
PESO MUESTRA/ Sample weight		46.72 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"		q(ml/sec)	q(ml/sec)
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)		
12:00h	10	24	0.42						
	10	26	0.38						
	10	25	0.40						
	25	58	0.43	29	0.86	16	1.56		
	25	54	0.46	30	0.83	17	1.47		
	25	56	0.45	29	0.85	17	1.47		
12:40h	50	110	0.45	61	0.82	34	1.47		
	50	115	0.43	62	0.81	31	1.61		
	50	120	0.42	64	0.78	32	1.56		
COLOR		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY		LIG.TURBIO/SLIGHTLY CLOUDY	

CLASIFICACION: NO DISPERSIVA (ND2)
CLASIFICACION: NONDISPERSIVE (ND2)

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HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvasos/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-13		MUESTRA No./SAMPLE No.:		M-1			
PROFUNDIDAD/DEPTH:		0.80 - 2.00 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight:		220.01 gr		&m=		1.563 gr/cm ³			
PESO ANILLO/Ring weight:		171.65 gr		W%=		34.85 %			
PESO MUESTRA/ Sample weight		48.36 gr		NORMA: ASTM D4847-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL. cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
13:00h	10	50	0.20						
	10	51	0.20						
	10	50	0.20						
	25	99	0.25	49	0.51	26	0.96		
	25	98	0.26	48	0.52	27	0.93		
	25	98	0.26	47	0.53	27	0.93		
13:40h	50	186	0.27	98	0.51	53	0.94		
	50	185	0.27	99	0.51	54	0.93		
	50	190	0.26	98	0.51	55	0.91		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR			

CLASIFICACION:
CLASIFICATION:

NO DISPERSIVA (ND1)
NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-13		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 3.50 m.		FECHA/DATE:		Enero 94/Jan. 94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight		219.48 gr		&m=		1.546 gr/cm ³			
PESO ANILLO/Ring weight		171.65 gr		W%=		34.85 %			
PESO MUESTRA/ Sample weight		47.83 gr		NORMA:		ASTM D4647-87, METHOD C			
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL cm ³	h=2" t(sec)	q(ml/sec)	h=7" t(sec)	q(ml/sec)	h=15" t(sec)	q(ml/sec)		
2-11-94	10	46	0.22						
15:00h	10	45	0.22						
	10	44	0.23						
	25	94	0.27	49	0.51	25	1.00		
	25	96	0.26	48	0.52	25	1.00		
	25	95	0.26	48	0.52	24	1.04		
	50	187	0.27	99	0.51	48	1.04		
	50	189	0.26	98	0.51	44	1.14		
15:40h	50	186	0.27	95	0.53	47	1.06		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR			

CLASIFICACION:

CLASIFICACION:

NO DISPERSIVA (ND1), POTENCIALMENTE EXPANSIVA

NONDISPERSIVE (ND1), SWELLING POTENTIAL



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: <u>Trasvases/Trasbasins</u>		LOCALIZACION/SITE: <u>Canal abierto/Open Channel</u>					
CALICATA No./PIT No.: <u>C-14</u>		MUESTRA No./SAMPLE No.: <u>M-1</u>					
PROFUNDIDAD/DEPTH: <u>0.90 - 1.90 m.</u>		FECHA/DATE: <u>Enero94/Jan.94</u>					
ENSAY./PERFORM.BY: <u>G.S.</u>		CALC./CALCULATED BY: <u>F.V.</u>					
PESO DEL ANILLO+MUESTRA/Sample+ring weight: <u>219.45 gr</u>		&m= <u>1.545</u>	gr/cm³				
PESO ANILLO/Ring weight: <u>171.65 gr</u>		W%= <u>36.67</u>	%				
PESO MUESTRA/Sample weight: <u>47.8 gr</u>		NORMA: <u>ASTM D4647-87, METHOD C</u>					
VOLUMEN MUESTRA/Sample vol: <u>30.94 cm³</u>							
HOUR	VOL cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(mi/sec)	t(sec)	q(mi/sec)	t(sec)	q(mi/sec)
8:00h	10	47	0.21				
	10	48	0.21				
	10	47	0.21				
	25	94	0.27	48	0.52	24	1.04
	25	96	0.26	50	0.50	23	1.09
	25	95	0.26	49	0.51	22	1.14
8:40h	50	190	0.26	93	0.54	51	0.98
	50	189	0.26	90	0.56	55	0.91
	50	186	0.27	98	0.51	53	0.94
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIG.TURBIO/SLIGHTLY CLOUDY	

CLASIFICACION:
CLASIFICATION:

NO DISPERSIVA (ND1)
NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
<u>PROYECTO/PROJECT:</u>		Trasvases/Trasbasins		<u>LOCALIZACION/SITE:</u>		Canal abierto/Open Channel			
<u>CALICATA No./PIT No.:</u>		C-14		<u>MUESTRA No./SAMPLE No.:</u>		M-2			
<u>PROFUNDIDAD/DEPTH:</u>		2.00 - 3.50 m.		<u>FECHA/DATE:</u>		Enero94/Jan.94			
<u>ENSAY./PERFORM.BY:</u>		G.S.		<u>CALC./CALCULATED BY:</u>		F.V.			
<u>PESO DEL ANILLO+MUESTRA/Sample+ring weight:</u>		220.88 gr		<u>&m=</u>		1.591 gr/cm ³			
<u>PESO ANILLO/Ring weight:</u>		171.65 gr		<u>W%=</u>		39.4 %			
<u>PESO MUESTRA/ Sample weight:</u>		49.23 gr		<u>NORMA: ASTM D4647-87, METHOD C</u>					
<u>VOLUMEN MUESTRA/Sample vol:</u>		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
16:00h	10	54	0.19						
	10	52	0.19						
	10	53	0.19						
	25	107	0.23	55	0.45	24	1.04		
	25	110	0.23	54	0.46	20	1.25		
	25	114	0.22	54	0.46	24	1.04		
16:40h	50	220	0.23	108	0.46	69	0.72		
	50	221	0.23	107	0.47	65	0.77		
	50	223	0.22	108	0.46	60	0.83		
<u>COLOR</u>		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR			

CLASIFICACION:
 CLASIFICATION:

POTENCIALMENTE EXPANSIVA
 SWELLING POTENTIAL



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel	
CALICATA No./PIT No.:		C-15		MUESTRA No./SAMPLE No.:		M-1	
PROFUNDIDAD/DEPTH:		0.40 - 1.00 m.		FECHA/DATE:		Enero94/Jan.94	
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.	
PESO DEL ANILLO+MUESTRA/Sample+ring weight:		214.56 gr		&m=		1.387 gr/cm ³	
PESO ANILLO/Ring weight:		171.65 gr		W%=		33.57 %	
PESO MUESTRA/ Sample weight:		42.91 gr		NORMA:		ASTM D4647-87, METHOD C	
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³					

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
9:00h	10	50	0.20				
	10	51	0.20				
	10	50	0.20				
	25	104	0.24	52	0.48	25	1.00
	25	106	0.24	50	0.50	24	1.04
	25	105	0.24	56	0.45	25	1.00
9:40h	50	207	0.24	102	0.49	48	1.04
	50	210	0.24	106	0.47	47	1.06
	50	210	0.24	105	0.48	49	1.02
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
 CLASIFICACION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT: Traveses/Trasbasins		LOCALIZACION/SITE: Canal abierto/Open Channel							
CALICATA No./PIT No.: C-15		MUESTRA No./SAMPLE No.: M-2							
PROFUNDIDAD/DEPTH: 1.20 - 1.60 m.		FECHA/DATE: Enero94/Jan.94							
ENSAY./PERFORM.BY: G.S.		CALC./CALCULATED BY: F.V.							
PESO DEL ANILLO+MUESTRA/Sample+ring weight: 214.69 gr		&m= 1.391		gr/cm³ 33.89					
PESO ANILLO/Ring weight: 171.65 gr		W%= 43.04		% 30.94					
PESO MUESTRA/ Sample weight: 43.04 gr		NORMA: ASTM D4647-87, METHOD C							
VOLUMEN MUESTRA/Sample vol: 30.94 cm ³									
HOUR	VOL cm ³	h=2" t(sec)	q(ml/sec)	h=7" t(sec)	q(ml/sec)	h=15" t(sec)	q(ml/sec)		
10:00h	10	60	0.17						
	10	61	0.16						
	10	59	0.17						
	25	120	0.21	58	0.43	29	0.86		
	25	122	0.20	57	0.44	27	0.93		
	25	125	0.20	55	0.45	28	0.89		
10:40h	50	250	0.20	106	0.47	55	0.91		
	50	253	0.20	107	0.47	59	0.85		
	50	249	0.20	106	0.47	54	0.93		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
 CLASIFICACION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Trasbasins
CALICATA No./PIT No.: C-16
LOCALIZACION/SITE: Canal abierto/Open Channel
PROFUNDIDAD/DEPTH: 0.85 - 1.80 m.
ENSAY./PERFORM.BY: G.S.
MUESTRA No./SAMPLE No.: M-1
FECHA/DATE: Enero94/Jan.94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 223.03 gr &m= 1.661 gr/cm³
PESO ANILLO/Ring weight: 171.65 gr W%= 32.14 %
PESO MUESTRA/ Sample weight: 51.38 gr
VOLUMEN MUESTRA/Sample vol: 30.94 cm³
NORMA: ASTM D4647-87, METHOD C

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
11:00h	10	49	0.20				
	10	48	0.21				
	10	49	0.20				
	25	99	0.25	56	0.45	28	0.89
	25	100	0.25	57	0.44	27	0.93
11:40h	25	98	0.26	56	0.45	26	0.96
	50	190	0.26	99	0.51	56	0.89
	50	188	0.27	90	0.56	58	0.86
COLOR	50	193	0.26	98	0.51	55	0.91
		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-16		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 3.50 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight:		222.25 gr		&m=		1.635 gr/cm ³			
PESO ANILLO/Ring weight:		171.65 gr		W%=		30.85 %			
PESO MUESTRA/Sample weight		50.6 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94. cm ³							
HOUR	VOL. cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	CLARO/CLEAR	CLARO/CLEAR
12:00h	10	51	0.20						
	10	52	0.19						
	10	50	0.20						
	25	101	0.25	63	0.40	26	0.96		
	25	102	0.25	61	0.41	26	0.96		
	25	100	0.25	66	0.38	25	1.00		
12:40h	50	190	0.26	102	0.49	50	1.00		
	50	189	0.26	103	0.49	52	0.96		
	50	189	0.26	100	0.50	51	0.98		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR			

CLASIFICACION: NO DISPERSIVA (ND1)
 CLASIFICATION: NONDISPERSIVE (ND1)

HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Trasbasins
CALICATA No./PIT No.: C-17
PROFUNDIDAD/DEPTH: 0.40 - 1.40 m.
ENSAY/PERFORM.BY: G.S.

LOCALIZACION/SITE: Canal abierto/Open Channel
MUESTRA No./SAMPLE No.: M-1
FECHA/DATE: Enero94/Jan.94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 218 gr &m= 1,498 gr/cm³
PESO ANILLO/Ring weight: 171.65 gr W%= 31.56 %
PESO MUESTRA/ Sample weight: 46.35 gr NORMA: ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
13:00h	10	57	0.18				
	10	58	0.17				
	10	57	0.18				
	25	110	0.23	57	0.44	27	0.93
	25	109	0.23	56	0.45	28	0.89
	25	110	0.23	50	0.50	30	0.83
	50	210	0.24	94	0.53	50	1.00
	50	213	0.23	96	0.52	49	1.02
13:40h	50	215	0.23	98	0.51	48	1.04
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION:
 CLASIFICATION:

NO DISPERSIVA (ND1)
 NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traveses/Trasbasins. **LOCALIZACION/SITE:** Canal abierto/Open Channel
CALICATA No./PIT No.: C-17 **MUESTRA No./SAMPLE No.:** M-2
PROFUNDIDAD/DEPTH: 2.00 - 3.00 m. **FECHA/DATE:** Enero94/Jan.94
ENSAY./PERFORM.BY: G.S. **CALC./CALCULATED BY:** F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 217.04 gr **&math;=** 1.467 **gr/cm³**
PESO ANILLO/Ring weight: 171.65 gr **W%=** 31 **%**
PESO MUESTRA/ Sample weight: 45.39 gr **NORMA:** ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
15:00h	10	18	0.56				
	10	19	0.53				
	10	19	0.53				
	25	34	0.74	20	1.25	15	1.67
	25	32	0.78	22	1.14	14	1.79
	25	33	0.76	23	1.09	13	1.92
	50	67	0.75	39	1.28	29	1.72
	50	65	0.77	38	1.32	28	1.79
15:40h	50	65	0.77	39	1.28	28	1.79
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND2)
CLASIFICACION: NONDISPERSIVE (ND2)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traveses/Trasbasins
CALICATA No./PIT No.: C-18
LOCALIZACION/SITE: Canal abierto/Open Channel
PROFUNDIDAD/DEPTH: 0.30 - 1.60 m.
ENSAY./PERFORM.BY: G.S.
MUESTRA No./SAMPLE No.: M-1
FECHA/DATE: Enero94/Jan.94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 219.73 gr &m= 1.554 gr/cm³
PESO ANILLO/Ring weight: 171.65 gr W%= 33.56 %
PESO MUESTRA/ Sample weight: 48.08 gr
VOLUMEN MUESTRA/Sample vol: 30.94 cm³
NORMA: ASTM D4647-87, METHOD C

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
16:00h	10	18	0.56				
	10	15	0.67				
	10	18	0.56				
	25	46	0.54	26	0.96	17	1.47
	25	45	0.56	23	1.09	15	1.67
	25	49	0.51	22	1.14	18	1.39
16:40h	50	99	0.51	63	0.79	28	1.79
	50	98	0.51	62	0.81	27	1.85
	50	99	0.51	66	0.76	29	1.72
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIG.TURBIO/SLIGHTLY CLOUDY	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)

HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-18		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 3.50 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight:		219.82 gr		&m=		1.557 gr/cm ³			
PESO ANILLO/Ring weight:		171.65 gr		W%=		40.78 %			
PESO MUESTRA/ Sample weight:		48.17 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
8:00h	10	13	0.77						
	10	14	0.71						
	10	13	0.77						
	25	26	0.96	26	0.96	21	1.19		
	25	27	0.93	26	0.96	21	1.19		
	25	26	0.96	26	0.96	22	1.14		
8:40h	50	53	0.94	50	1.00	41	1.22		
	50	52	0.96	51	0.98	40	1.25		
	50	53	0.94	50	1.00	41	1.22		
COLOR		LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY

CLASIFICACION:

CLASIFICACION:

NO DISPERSIVA (ND2)

NONDISPERSIVE (ND2)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Trasbasins **LOCALIZACION/SITE:** Canal abierto/Open Channel
CALICATA No./PIT No.: C-19 **MUESTRA No./SAMPLE No.:** M-1
PROFUNDIDAD/DEPTH: 1.10 - 1.70 m. **FECHA/DATE:** Enero 94/Jan. 94
ENSAY./PERFORM.BY: G.S. **CALC./CALCULATED BY:** F.Y.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 222.57 gr **&m=** 1.646 **gr/cm³**
PESO ANILLO/Ring weight: 171.65 gr **W%=** 29 %
PESO MUESTRA/ Sample weight: 50.92 gr **NORMA:** ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(mi/sec)	t(sec)	q(mi/sec)	t(sec)	q(mi/sec)
9:00h	10	51	0.20				
	10	49	0.20				
	10	51	0.20				
	25	93	0.27	80	0.31	50	0.50
	25	95	0.26	82	0.30	49	0.51
	25	94	0.27	81	0.31	51	0.49
9:40h	50	172	0.29	152	0.33	102	0.49
	50	171	0.29	153	0.33	100	0.50
	50	175	0.29	152	0.33	98	0.51
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION:
 CLASIFICATION:

POTENCIALMENTE EXPANSIVO
 SWELLING POTENTIAL



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Canal abierto/Open Channel			
CALICATA No./PIT No.:		C-19		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 4.00 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight		225.7 gr		&m=		1.747		gr/cm³	
PESO ANILLO/Ring weight		171.65 gr		W%=		28.99		%	
PESO MUESTRA/ Sample weight		54.05 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
10:00h	10	41	0.24						
	10	42	0.24						
	10	42	0.24						
	25	80	0.31	52	0.48	23	1.09		
	25	79	0.32	54	0.46	23	1.09		
10:40h	25	81	0.31	57	0.44	23	1.09		
	50	148	0.34	100	0.50	45	1.11		
	50	147	0.34	99	0.51	46	1.09		
	50	146	0.34	101	0.50	44	1.14		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICACION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Trasvases/Trasbessins
CALICATA No./PIT No.: C-20
PROFUNDIDAD/DEPTH: 0.35-1.10 m.
ENSAY./PERFORM.BY: G.S.

LOCALIZACION/SITE: Linea Transmission/Transmission LI
MUESTRA No./SAMPLE No.: M-1
FECHA/DATE: Enero94/Jan.94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 220.04 gr &m= 1.564 gr/cm³
PESO ANILLO/Ring weight: 171.65 gr W%= 36.67 %
PESO MUESTRA/ Sample weight: 48.39 gr NORMA: ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
11:00h	10	38	0.26				
	10	37	0.27				
	10	35	0.29				
	25	75	0.33	38	0.66	18	1.39
	25	74	0.34	40	0.63	19	1.32
	25	75	0.33	42	0.60	18	1.39
11:40h	50	145	0.34	79	0.63	34	1.47
	50	146	0.34	77	0.65	36	1.39
	50	147	0.34	75	0.67	32	1.56
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Trasvases/Trasbasins **LOCALIZACION/SITE:** Linea Transmission/Transmission LI
CALICATA No./PIT No.: C-21 **MUESTRA No./SAMPLE No.:** M-1
PROFUNDIDAD/DEPTH: 0.40 - 1.00 m. **FECHA/DATE:** Enero 94/Jan. 94
ENSAY./PERFORM.BY: G.S. **CALC./CALCULATED BY:** F.V.

PESO DEL ANILLO + MUESTRA/Sample + ring weight: 223.38 gr **&m=** 1.672 **gr/cm³**
PESO ANILLO/Ring weight: 171.65 gr **W%=** 30.07 **%**
PESO MUESTRA/ Sample weight: 51.73 gr **NORMA:** ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
12:00h	10	53	0.19				
	10	53	0.19				
	10	52	0.19				
	25	86	0.29	54	0.46	26	0.96
	25	83	0.30	53	0.47	27	0.93
	25	87	0.29	54	0.46	26	0.96
12:40h	50	174	0.29	97	0.52	53	0.94
	50	172	0.29	99	0.51	52	0.96
	50	178	0.28	98	0.51	54	0.93
COLOR		CLARO/CLEAR		CLARO/CLEAR		LIGERAMENTE TURBIO/SLIGHTLY	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)

HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Traszbasins
CALICATA No./PIT No.: C-21
PROFUNDIDAD/DEPTH: 1.10 - 2.15 m.
ENSAY./PERFORM.BY: G.S.

LOCALIZACION/SITE: Linea Transmission/Transmission L1
MUESTRA No./SAMPLE No.: M-2
FECHA/DATE: Enero94/Jan.94
CALC./CALCULATED BY: F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 223.32 gr &m= 1.670 gr/cm³
PESO ANILLO/Ring weight: 171.65 gr W%= 30.67 %
PESO MUESTRA/ Sample weight: 51.67 gr NORMA: ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm³

HOUR	VOL. cm ³	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
13:00h	10	12	0.83				
	10	13	0.77				
	10	14	0.71				
	25	27	0.93	25	1.00	21	1.19
	25	28	0.89	26	0.96	22	1.14
	25	27	0.93	26	0.96	21	1.19
13:40h	50	56	0.89	49	1.02	40	1.25
	50	57	0.88	50	1.00	39	1.28
	50	58	0.86	51	0.98	41	1.22
COLOR		LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICACION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST

PROYECTO/PROJECT: Traszases/Trasbasins LOCALIZACION/SITE: Linea Transmission/Transmission LI
CALICATA No./PIT No.: C-22 **MUESTRA No./SAMPLE No.:** M-2
PROFUNDIDAD/DEPTH: 1.00 - 2.35 m. **FECHA/DATE:** Enero 94/Jan. 94
ENSAY./PERFORM.BY: G.S. **CALC./CALCULATED BY:** F.V.

PESO DEL ANILLO+MUESTRA/Sample+ring weight: 223.47 gr $\rho_m =$ 1.675 gr/cm^3
PESO ANILLO/Ring weight: 171.65 gr $W\% =$ 31.28 %
PESO MUESTRA/ Sample weight: 51.82 gr **NORMA:** ASTM D4647-87, METHOD C
VOLUMEN MUESTRA/Sample vol: 30.94 cm^3

HOUR	VOL. cm^3	h=2"		h=7"		h=15"	
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
8:00h	10	47	0.21				
	10	46	0.22				
	10	45	0.22				
	25	90	0.28	60	0.42	25	1.00
	25	90	0.28	62	0.40	24	1.04
	25	89	0.28	62	0.40	23	1.09
8:40h	50	145	0.34	120	0.42	46	1.09
	50	148	0.34	117	0.43	44	1.14
	50	147	0.34	112	0.45	42	1.19
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION: NO DISPERSIVA (ND1)
CLASIFICATION: NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Linea Transmission/Transmission LI			
CALICATA No./PIT No.:		C-23		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.00 - 2.80 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight:		221.56 gr		&m=		1.613		gr/cm ³	
PESO ANILLO/Ring weight:		171.65 gr		W%=		32.16		%	
PESO MUESTRA/ Sample weight:		49.91 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL cm ³	h=2"		h=7"		h=15"			
		t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)	t(sec)	q(ml/sec)
9:00h	10	50	0.20						
	10	53	0.19						
	10	52	0.19						
	25	83	0.30	52	0.48	29	0.86		
	25	85	0.29	56	0.45	28	0.89		
	25	94	0.27	53	0.47	27	0.93		
	50	174	0.29	98	0.51	57	0.88		
	50	176	0.28	99	0.51	58	0.86		
9:40h	50	172	0.29	97	0.52	56	0.89		
COLOR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR		CLARO/CLEAR	

CLASIFICACION:

NO DISPERSIVA (ND1)

CLASIFICACION:

NONDISPERSIVE (ND1)



HIDROSUELOS CIA. LTDA.

ENSAYO PIN HOLE / PIN HOLE TEST									
PROYECTO/PROJECT:		Trasvases/Trasbasins		LOCALIZACION/SITE:		Linea Transmission/Transmission Li			
CALICATA No./PIT No.:		C-24		MUESTRA No./SAMPLE No.:		M-2			
PROFUNDIDAD/DEPTH:		2.50 - 3.50 m.		FECHA/DATE:		Enero94/Jan.94			
ENSAY./PERFORM.BY:		G.S.		CALC./CALCULATED BY:		F.V.			
PESO DEL ANILLO+MUESTRA/Sample+ring weight		220.04 gr		&m=		1.564 gr/cm ³			
PESO ANILLO/Ring weight		171.65 gr		W%=		36 %			
PESO MUESTRA/ Sample weight:		48.39 gr		NORMA: ASTM D4647-87, METHOD C					
VOLUMEN MUESTRA/Sample vol:		30.94 cm ³							
HOUR	VOL. cm ³	h=2"		h=7"		h=15"		q (ml/sec)	q (ml/sec)
		t(sec)	q (ml/sec)	t(sec)	q (ml/sec)	t(sec)	q (ml/sec)		
10:00h	10	15	0.67						
	10	16	0.63						
	10	15	0.67						
	25	32	0.78	24	1.04	18	1.39		
	25	32	0.78	23	1.09	17	1.47		
	25	32	0.78	24	1.04	18	1.39		
10:40h	50	54	0.93	48	1.04	34	1.47		
	50	54	0.93	47	1.06	36	1.39		
	50	55	0.91	46	1.09	33	1.52		
COLOR		LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY	LIG.TURBIO/SLIGHTLY CLOUDY

CLASIFICACION: NO DISPERSIVA (ND2)
 CLASIFICACION: NONDISPERSIVE (ND2)



0

0

UNDISTURBED SAMPLE

0

4350

ESCUELA POLITÉCNICA NACIONAL
LABORATORIO DE ENSAYO DE MATERIALES, MECÁNICA DE SUELOS Y ROCAS

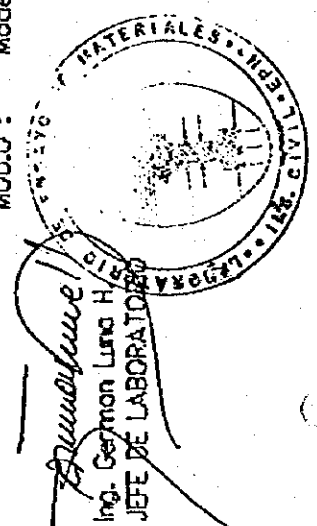
PRUEBA PINDICP

SOLICITA: HIDROSUELOS ENVID: 2 NORMA: ASTM D 4647
 MUESTRA: C-22M-1 DIAM.(cm) = 3.40 HUMEDAD (%) = 40.98
 PROF.(m): 0.60-0.90 LONG.(cm) = 3.99 P.UNIT (gr/cm³) = 1.601
 FECHA: 94-02-10 PESO (gr) = 58.01

CARGA (kg)	FLUID (ml)	TIEMPO (seg)	CALIDAD (m/seg)	TURBIDEZ DE EFUEXIE					COMP.C
				MO	O	MOD.O	LC	C	
5.0	10	302	0.033						X
	10	306	0.033						X
	25	748	0.033						X
	25	746	0.034						X
18.0	25	148	0.169						X
	25	148	0.169						X
	25	146	0.171						X
	25	146	0.171						X
38.0	50	122	0.410						X
	50	120	0.417						X
	50	122	0.410						X
	50	122	0.410						X

NOMENCLATURA: MO: Muy oscura LC: Ligeramente clara
 O: Oscura C: Clara
 MOD.O: Moderadamente oscura COMP.C: Completamente clara

CLASIFICACION: ND (No dispersivo)



ESCUELA POLITECNICA NACIONAL
LABORATORIO DE ENSAYO DE MATERIALES. MECANICA DE SUELOS Y ROCAS

PRUEBA: PINHOLE

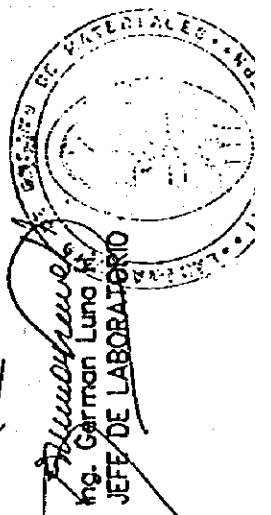
SOLICITA: HIDROSUELOS ENVI: 2 NORMA: ASTM D 4647
 MUESTRA : C-23M-1 DIAM.(cm) = 3.40 HUMEDAD (%) = 43.56
 PROF.(m): 1.20-1.50 LONG.(cm) = 3.68 P.UNIT (gr/cm³) = 1.632
 FECHA: 94-02-10 PESO (gr) = 54.54

CARGA (cm)	FLUJO (ml)	TIEMPO (seg)	CAUDAL (ml/seg)	TURBIDAD DE EFUENTE					
				MO	O	MOD.O	LC	C	COMP.C
5.0	10	36	0.278						X
	10	34	0.294						X
	25	88	0.284						X
	25	90	0.278						X
18.0	25	38	0.658						X
	25	39	0.641						X
	25	38	0.658						X
	25	40	0.625						X
38.0	50	51	0.980						X
	50	54	0.926						X
	50	53	0.943						X
	50	54	0.926						X

NOMENCLATURA: MO: Muy oscura LC: Ligeramente clara
 O: Oscura C: Clara
 MOD.O: Moderadamente oscura COMP.C: Completamente clara

CLASIFICACION: ND (No dispersiva)

Garman Luna M.
 Ing. Garman Luna M.
 JEFE DE LABORATORIO



ESCUELA POLITECNICA NACIONAL
LABORATORIO DE ENSAYO DE MATERIALES. MECANICA DE SUELOS Y ROCAS

PRUEBA "PINHOLE"

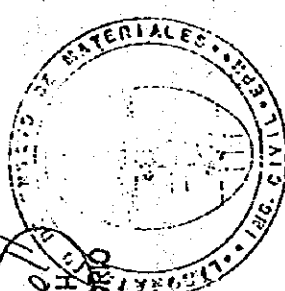
SOLICITA: HIDROSUELOS ENVIÓ: 2 NORMA: ASTM D 4647
 MUESTRA : C-24-M-1 DIAM.(cm) = 3.40 HUMEDAD (%) = 14.54
 PROF.(m): 1.50-1.80 LONG.(cm) = 4.10 P.UNIT (gr/cm3) = 1.542
 FECHA: 94-02-10 PESO (gr) = 57.4

CARGA (cm)	TIEMPO (seg)				CAUDAL (ml/seg)	TURBIDIDAD DE ERLENMEYER			
	FLUJO (ml)	MO	O	MOD.O		LC	C	COMP.C	
5.0	10	42	0.238					X	
	10	43	0.233					X	
	25	120	0.208					X	
	25	122	0.205					X	
18.0	25	46	0.543					X	
	25	48	0.521					X	
	25	47	0.532					X	
	25	48	0.521					X	
38.0	50	59	0.847					X	
	50	60	0.833					X	
	50	61	0.820					X	
	50	60	0.833					X	

NOMENCLATURA: MO: Muy oscuro LC: Ligeramente clara
 O: Oscura C: Clara
 MOD.O: Moderadamente oscuro COMP.C: Completamente clara

CLASIFICACION: ND (No dispersivo)

German Luna H
 Ing. German Luna H
 JEFE DE LABORATORIO





**JAPAN INTERNATIONAL
COOPERATION AGENCY
J I C A**

**THE DETAILED DESIGN STUDY ON THE WATER
TRANSBASIN SCHEMES FOR CHONE-PORTOVIEJO
RIVER BASINS**

**GEOLOGICAL - GEOTECHNICAL
INVESTIGATIONS REPORT**

VOLUME III

FEBRUARY 1994



JAPAN INTERNATIONAL COOPERATION AGENCY
J I C A

DETAILED DESIGN STUDY ON THE TRANSBASIN WATER
PROJECT FOR THE CHONE-PORTOVIEJO RIVER BASINS

REPORT ON GEOLOGICAL-GEOTECHNICAL RESEARCH

VOLUME III

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JAPAN INTERNATIONAL COOPERATION AGENCY
J I C A

DETAILED DESIGN STUDY ON THE TRANSBASIN WATER
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REPORT ON GEOLOGICAL-GEOTECHNICAL RESEARCH

8. GEOLOGICAL MAPPING

8.1 PURPOSE AND SCOPE

This study describes the project's geological conditions for the purpose of designing a water transbasin system for taking, first of all, waters from the Daule Peripa Transbasin towards the La Esperanza Dam which are then transferred to the Poza Honda Reservoir and finally transferred towards the Mancha Grande River. This is achieved by connection to the current Daule Peripa Reservoir on the Daule River through a tunnel with the La Esperanza Dam which is under construction and in turn sequentially connected via open channel from Severino to Caña Dulce and with a tunnel from Caña Dulce to Poza Honda.

The tunnel from the Daule Peripa reservoir to the La Esperanza Reservoir is 8.3 Km long and functions with gravity. The entrance portal is on the banks of the Conguillo River and the exit on the banks of the Membrillo River near the town of the same name.

The transbasin from the La Esperanza Reservoir to Poza Honda is made up of a section of open channel starting at the banks of the Severino River where the water intake and pumping station are located, to the structure at the entrance to the tunnel at Caña Dulce with a length of 6.5 km. The tunnel is 11.5 km long and the exit portal is located at final of the Poza Honda reservoir at the Pata de Pajaro River.

The transbasin from the Poza Honda Reservoir towards the Mancha Grande River is made up of a tunnel using gravity whose entrance portal is located at the Poza Honda Reservoir on the right bank of the Guajabito River and exit at the Mancha Grande River with an approximate length of 4 km.



8.2 GENERAL GEOLOGY

8.2.1 Topography and Geomorphology

In the area considered for the project three types of relief may be clearly discerned related to the lithological characteristics of the existing formations. They are: Flat Areas, wavy or moderate relief areas and areas with strong or solid mountainous relief.

Flat Areas:

They correspond essentially to Quaternary alluvial sediments which extend along the courses of the rivers and adjacent areas, forming small valleys within topographical elevations from 30 to 80 meters above sea level.

Wavy or Moderate Relief Areas

Formed by a colluvial layer caused by the erosion of the high sections and deposited at the foot of the slopes between elevations of 60 and 150 meters above sea level.

Strong or Solid Mountainous Relief Areas

Located at elevations 150 and 420 meters above sea level and characteristic for the zones where the Borbon formation, of great competence, presents its greatest development.

From the analysis of aerial photographs and visits to the field, the existence of zones which are approximately flat and graded cut by rivers and streams originating narrow V-shaped valleys stand out. This type of morphology corresponds mainly to the open channel section.

The presence of the Onzole formation in a noticeably horizontal position is responsible for the flat-high morphology which, through less intense erosion processes, has modeled the surface with a padded look that is homogenous over large areas.



The long and sharp form with slopes that are steeper and with a morphology that is more complex, is a product of the presence of the Borbon formation at the elevation of 170-175 meters above sea level.

8.2.2 Stratigraphy

The areas of interest for the Project are included in the regional geological environment called "Tertiary coastal basins" and includes sedimentary geological formations which vary in age from the Oligocene (Tertiary) to recent (Quaternary).

The outcropping sedimentary formations in the areas of the Project from the most ancient to the newest are as follows: Onzole Formation and Borbon Formation.

Recent materials (Quaternary) correspond to colluvial, alluvial and terracing deposits.

The different formations are described herebelow in chronological order of sedimentation:

A. Tertiary

Onzole Formation

The Onzole Formation rests in harmony over the Angostura Formation, traditionally considered in geological literature as a soft formation composed mainly of mudstone, siltstone and fine greenish gray colored sandstone.

The Onzole formation presents slightly calcareous and locally micaceous levels.

The siltstones are a greenish gray to brown color, and are frequently tufaceous.



Sandstones are predominantly fine and very fine grained with calcareous cement under a specific weight and quite fossiliferous in the upper part of the sequence.

In the upper part of the formation, at times there are some detrital facies (coarse to fine grained sandstones), especially in the Conguillo-Membrillo zone, thus making it quite difficult to establish, lithologically speaking, the separation between this formation and the more recent Borbon formation. Only geomorphological criteria permit a certain difference.

We observe that the most resistant levels of the Onzole Formation originate a series of platforms that are quite marked and stepped, the last of which corresponds to contact with the Borbon Formation. Likewise, we can note that each resistant section (calcareous sandstone) usually has strong grades (banks of the Severino River) quite often affected by small slides, undermining the softest part, decompression according to the fracturing and fall of several cubic meters of blocks.

Borbon Formation

The Borbon Formation appears above the 170 meters above sea level elevation and is found in a horizontal position. It is made up of coarse or fine grain sandstone, generally well cemented, of a whitish-yellowish color. This formation is identified perfectly both by its lithological characteristics as well as its peculiar morphology. Regarding the latter aspect, it causes hilly topography with narrow outcroppings and steep grades, frequently with little vegetation and covering.

B. Recent Land - Quaternary

The following Quaternary land may be identified: formations on banks (colluvial), piedmont, rocky dips, sludge soils and alluvial deposits.

In the line of the tunnels, specifically at their portals and the line of the channel, only the bank formations are important with a thickness of 2.0 m to 13.0 m and made up of clayey or silty material with centimetric debris with fine, decomposed stones, siltstones and sandstones.



8.2.3 Structures

Tertiary formations are visibly horizontal and with a great lateral continuity of the facies which are satisfactorily correlated with the entire zone.

Regarding the Quaternary morphology, we can observe that in the central zone of the valleys of the Mineral and Pata de Pajaro Rivers near the Poza Honda Reservoir as well as the Cañales and Severino Rivers, at their headwaters there is a spectacular accumulation of waste from the piedmont (colluvials) with important strength.

The colluvial covering of the work sites makes observation of the structures difficult, and we can only view some diaclases at outcroppings in the main valleys.

Regional examination, on the other hand, permits visualizing through aerial photographs the existence of two fracturing systems oriented N 40° to 50°E, represented by the orientation of the main drainage systems.

Regarding the diaclases and considering the outcroppings found, it can be established that the orientations are similar with the values exposed at the fractures with dips preferably greater than 50°.

8.3 LOCAL GEOLOGICAL AND GEOTECHNICAL DESCRIPTION

The geological and geotechnical aspects for each one of the works are analyzed herebelow.

8.3.1 Daule Peripa-La Esperanza Transbasin

The Daule Peripa-La Esperanza Tunnel is approximately 8.3 km long in an east-west direction. The portal of the entrance is located on the right bank of the Conguillo River, 1 km downstream from the site of Piedra de Plata, at an elevation of 66.0 meters above sea level and the portal of the exit is found on the left bank of the Membrillo River at an elevation of 60.6 meters above sea level.



8.3.1.1 Investigations Performed

Important information exists obtained from geological mapping, the interpretation of the aerial photographs and the mechanical sounding performed.

In addition, from the information obtained from the investigation campaign through soundings DP-93-1, DP-93-2 and DP-93-3 we have collected and analyzed the soundings performed in other phases of the study such as: SRM-1, 2, 3 and 4; SRC-1 and 2 and SRLE-2 and 3 (See Map No. 1).

8.3.1.2 Geological and Geomorphological Aspects

Along the axis of the tunnel we observe geomorphology of the predominantly strong relief type going from an elevation of 60 to 300 meters above sea level, lithologically made up of the Onzole and Borbon formations. Practically, the entire area of the study is covered by Quaternary soils of the colluvial type with a strength of 3 to 5 m and a scarce amount of colluvial soils in the beds of the Conguillo and Membrillo Rivers and the Cañales, Mulato and Loza Estuaries. The outcroppings of the Onzole formation detected are found on the lateral slopes of these rivers and estuaries.

The covering above the tunnel is quite strong except at the intersection of the axis of the tunnel with the Cañales and Mulato Estuaries where the covering above the elevation of the tunnel is less than 20 m.

The entrance (Conguillo) and exit (Membrillo) sites have slopes which are generally stable with graded relieve of a moderate grade.

8.3.1.3 Geotechnical Aspects

Using the soundings performed and the data obtained "de visu" we prepared the longitudinal geological profile shown in Map No. 1. In it two formations may be distinguished:



a) Soils

They are made up of colluvial deposits which form a covering along the length of the axis and consist of weathered debris of sandstone, siltstone and mudstone encased in a mud-clay matrix.

These soils have little or poor influence on the work since even their strength at the portals is 2-3 cm.

b) Rock

Rock up to an elevation of 175 meters above sea level is made up of strong strata of coarse to fine grain, well cemented sandstone belonging to the Borbon formation. Below this elevation is the Onzole formation, characterized in this project zone by a detrital facies (coarse to fine grain sandstone) and with the predominance in the bedding cut of the sandstones above the mudstones or siltstones.

From the soundings performed, it can be observed that the bedding is made up fundamentally of fine and medium grain sandstone with intercalations of siltstones or mudstones, presenting towards the surface a slightly weathered and oxidized surface, improving its geotechnical parameters with depth.

Generally, from the cuts detected we can observe the predominance of rock with a III quality level (medium) and only the first meters with a IV quality level.

Considering the elevation of the tunnel, at the line we are interested in, we can observe that the rock is characterized by a fine to medium mudstone like sandstone. with medium level cementing and a weathering grade of II, with some zones with grade III towards the portals and in the areas near the Mulatos and Cañales Estuaries, with a resistance to simple compression index between 60 and 100 kg/cm², with a general fracturing grade of III and some zones with IV, and a RQD varying between 30% and 80%. The Bieniawsky quality index, calculated from the above parameters is grade III (medium rock) for most of the tunnel although it is thought that a line of the tunnel may be excavated on rock with a II quality index (good rock).



The phreatic level, once stabilized, has been determined at the following depths:

DP-93-1	=	19,00 m
DP-93-2	=	4,00 m
DP-93-3	=	9,15 m

The permeability of the rock has been calculated through Lugeon type tests. We cannot discuss the Lugeon units themselves because the tests did not reach 10 kg/cm² of pressure, due to hydraulic breakdown or the great influx of water, product of the fracturing, permeability coefficients vary for the line of interest in the tunnel between 10⁻⁴ and 10⁻⁵ cm/second.

8.3.2 Severino River-Poza Honda Transbasin

The Transbasin Project between the Severino River (reservoir of the La Esperanza Dam) and Poza Honda includes the planning of the following works:

- Pumping station, located on the right bank of the Severino River at 1.3 km from the mouth of the Carrizal River.
- Electric power substation
- Open channel with respective spillways from Severino to Caña Dulce, with an approximate length of 7.0 km
- Gravity tunnel from Caña Dulce to the Poza Honda reservoir.

8.3.2.1 Investigations Performed

The works performed in the investigation campaign from the field and office include: Geological Mapping, Mechanical Sounding, Manual Sounding, Test Pits, Laboratory Sampling and Tests.



- Pumping Station, Substation and Loading Tank

Three rotary mechanical soundings were performed: SR-93-1, SR-93-2 and SR-93-5, and they were correlated with information from sounding B-1 of the feasibility phase and geological mapping of the zone was performed.

- Open Channel

Ten test pits were excavated, with soil sampling for the purposes of use as building materials and 54 manual soundings were performed. In addition, the investigations of the feasibility phase were analyzed and detailed geological mapping was performed along the length of the channel.

- Cafia Dulce-Poza Honda Tunnel:

Two mechanical rotary soundings were performed, SR-93-3 and SR-93-4, and they were correlated with those performed in the feasibility phase of B-1 and B-3 and the respective geological mapping was performed.

8.3.2.2 Geological and Geomorphological Aspects

- Intake Site, Pumping Station, Substation and Loading Tank:

The site is located on the right bank of the Severino River and in the geomorphological aspect belongs to the moderate or softly waved relief.

Lithologically, it consists of medium cemented or cemented sandstones belonging to the Onzole Formation which are outcroppings at the back of the pumping station intake site on the river bank. On the top, it is covered by a colluvial with 2 m to 5 m strength. The site is characterized by its good stability.

- Open Channel

The section of the open channel is characterized by geomorphology with moderate to smoothly waved relief cut by streams which come down from the Severino River forming narrow V-shaped valleys, e. g. the La Chontilla and Capilla Estuaries.



Most of the section of the channel is covered by Quaternary soils with definite strength along the channel through test pits and manual sounding, from 2 m - 5 m. (See map no. 2).

Under the colluvial covering are siltstones, mudstones and fine sandstones which are quite weathered at the top of the Onzole formation which outcrops in the bottom of most of the streams of estuaries.

Caña Dulce-Poza Honda Tunnel

Along the axis of the tunnel, we can observe predominant geomorphology with strong relief, from an elevation of 80 to 420 meters above sea level, lithologically constituted by the Onzole and Borbon formations with a colluvial soil covering from 2 m to 5 m strong.

The covering above the elevation of the tunnel is quite strong along the axis and in the areas near the exit portal at the Pata de Pajaro River alone it is close to 20 m.

The slope at the portal of the Poza Honda exit as well as at the entrance is stable with its greatest strength from colluvial soils.

8.3.2.3 Geotechnical Aspects

Pumping Station, Substation and Loading Tank

The study area is covered with colluvial with a strength of 1.5 m (sounding SR-93-1) to 5.0 m (sounding SR-93-5), made up of decayed debris from mudstone and siltstone encased in a hard silty and clayey matrix.

The rocky substratum is made up basically of fine and medium grain sandstones, half cemented, with hard levels (cemented) and mudstone intercalations.

On the top, the substratum is quite weathered, approximately to a depth of 10 m with a IV fracturing index and resistance "al visu" of approximately 60 kg/cm² which defines it as rock with a Bieniawsky IV quality index (bad rock). From 10 m, the geotechnical characteristics improve. The degree of weathering is II, the fracturing index III and II, resistance to



simple compression from 60 to 150 kg/cm² and RQD varies between 50 to 80%, meaning that the rock has a III Bieniawsky quality index (medium quality rock) with levels of rock with a II quality index (good rock).

Permeability of the soils is determined by "Lefranc" infiltration tests yielding amounts for the permeability coefficient of 10^{-3} to 10^{-5} cm/second although the amount obtained in test no. 1 of Sounding SR-93-5 is not very representative since it was influenced by the cracks within the colluvial soils. We recommend utilizing for design estimates an amount of the order of 10^{-5} cm/second for colluvial deposits.

For the permeability of the rock Lugeon permeability tests were performed obtaining values for the permeability coefficient of 3.9×10^{-4} to 9.6×10^{-4} cm/second. This permeability is fundamentally due to the fracturing of the upper sandstones.

Open Channel

Most of the section of the Open Channel is covered by colluvial soils constituted by levels of silty clay and towards the contact with the rocky substratum by decayed mudstone and siltstone debris in the muddy-clayey matrix.

The consistency of these soils is hard in their dry state. These colluvial soils are classified as MH and some as CM as per the unified classification since the soft debris breaks down producing a fine soil which is highly plastic. According to the dispersion tests, they are not dispersive, characterized by their high expansion capability.

The permeability of these soils is on the order of 10^{-5} to 10^{-6} cm/second for the permeability coefficient.

The rock substratum under the colluvial covering is constituted by mudstones/siltstones which are highly weathered and oxidized and classified as V and IV index quality rocks (very bad and bad).

At the lower elevations, between 80 and 100 meters above sea level in the bottoms of the streams there are very fine sandstone outcroppings with a IV and III quality index (bad and medium rock).



Caña Dulce-Poza Honda Tunnel

The colluvial soil covering is made up of hard clayey-lime with weathered debris, with a 2 m to 5 m strength and little influence on the execution of the tunnel.

Up to the elevation of 170 meters above sea level the rock is made up of coarse to fine grain cemented sandstones from the Borbon formation.

Under the Borbon formation is the Onzole formation made up fundamentally of fine greenish gray siltstones, mudstones and sandstones.

From the soundings performed, we observe that the bedding is made up fundamentally of highly weathered siltstones or mudstones on the upper levels with V and IV quality indexes (very bad and bad rock), improving their geotechnical characteristics with depth.

Considering the elevation of the tunnel, in the section we are interested in, we observe that the rock is made up of mudstones with a weathering grade of II, II resistance index (approximately 50 to 60 kg/cm²), fracturing grade of IV and II, RQD from 30% to 80%, which determine a III to VI quality index (very bad). These parameters should be considered especially for the portals of the entrance and exit when the investigations have been performed. It is expected that towards the inside of the tunnel the geomechanical characteristics of the rock improve, and we can predict for sections of the tunnel of the rocks quality indexes of III and even II (good) where the rock is healthy and massive.

Permeability has been determined through Lugeon tests obtaining values for the permeability coefficient of the order of 10⁻⁴ cm/second. This coefficient, relatively high for mudstones, is caused by hydraulic damage from performing the tests with manometric pressures greater than 6 kg/cm².

With pressures less than 6 k/cm² the rock is impermeable with permeability coefficients of the order of 10⁻⁶ cm/second.



8.3.3 Poza Honda-Mancha Grande Transbasin

The Poza Honda-Mancha Grande Transbasin is made up of a tunnel in the south-north direction with a length of 4 km. The entrance portal is located on the left bank of the Guajabito Estuary at an elevation of 90.00 meters above sea level some 2 km from the site of the closing of the Poza Honda Reservoir. The exit Portal is located on the left bank of the Mancha Grande River at an elevation of 86.00 meters above sea level next to the main Portoviejo-Pichincha Highway.

8.3.3.1 Investigations Performed

Three rotary mechanical soundings were performed: MG-93-1, MG-93-2 and MG-93-3, Geological Mapping, laboratory and field tests and collecting of information from the phases of prior studies which yielded important information for the tunnel design.

8.3.3.2 Geological and Geomorphological Aspects

Along the axis of the tunnel, we observed a predominant geomorphology with strong relief from 90 to 400 meters above sea level, causing mountainous zones with steep grade.

Lithologically, it is made up of the Onzole and Borbon formations covered with Quaternary soils of a colluvial origin with a strength of 2 m to 7 m.

The entrance sites in Guajabito and exits at Mancha Grande are characterized by wavy or moderate relief between elevations of 80 and 140 meters above sea level, with soft grades characteristic of the zones with ancient slide.

The covering of the elevation of the tunnel is quite strong and with competent rocks, except for at that entry and exit portals, especially at Mancha Grande where the feasibility of a false tunnel should be analyzed.



8.3.3.3 Geotechnical Aspects

Through the soundings performed and the data obtained "de visu" we prepared a longitudinal geological profile which is shown in map no. 4. We can differentiate two formations on it:

a) Soils

Constituted by colluvial deposits which make up the covering along the axis and are silty-clayey with decayed debris with mudstones and siltstones.

Greatest strength is obtained in sounding MG-93-3 in which a depth of up to 19 m is reached. The median strength of the portals is 7 m along the axis of the tunnel from 3 m - 5 m.

b) Rock

The rocky substratum up to an elevation of 175 meters above sea level is made up of coarse to fine cemented sandstones from the Borbon formation.

Under the elevation of 175 meters above sea level is the Onzole formation with a clear change in slip in the relief and made up of very fine greenish gray siltstones, mudstones and sandstones.

From the soundings performed we can observe that under the colluvial soils, especially at the portals, the rocky substratum is quite altered at considerable depths (20 m - 30 m), and these mudstones are characterized by V and IV degree weathering, a resistance index of IV (from 20 to 60 kg/cm²), fracturing grade of IV, RCD (0-30%) which determine a quality index of V and IV (very bad and bad) for the rock.

Considering the elevation of the tunnel at the section of interest, we observe that the geotechnical characteristics of the rock improve, being made up of greenish gray mudstones with a sandstone character and with a high fossil content. Towards the entrance portal in Guajabito, the sandstone characteristics of the mudstone change to somewhat brittle or soft. The geotechnical characteristics of the rocky mass for the section of



the tunnel are: weathering grade II, resistance grade IV (approximately 50 kg/cm²), fracturing index of IV, RQD 30% - 60%, which determine a rock with a quality index of III to IV (medium to bad rock).

It should be indicated that the characteristics listed are exclusively for the entry and exit portals which are affected by ancient slides. We expect that towards the inside of the mass, the rock properties improve and the excavation of the tunnel is made on rock with a quality index of III (median rock) and even sections of good, healthy and massive rock.

The greatest problem of this Transbasin is the exit of the Mancha Grande, especially the mouth of the river where the strength of the soils reaches 20 m and the grade of the tunnel is found at an approximate depth of 7 m to 10 m making it necessary to have a false tunnel at the site.

The permeability of the rock has been determined through Lugeon tests obtaining a permeability coefficient between 1.6 and 5.2 x 10⁻⁴ cm/second, relatively high for the type of rock but it is directly related with the fracturing and weathering grades at the sites of the portals.

It is expected that inside the mass, on healthy and massive rock, the permeability will be in the order of 10⁻⁶ cm/second.

8.4 SUMMARY AND CONCLUSIONS

The main conditions for the design of the tunnel are: quality of the rock and the dimensions and depth of same.

This report is aimed at obtaining the properties of the rock based on which the different estimates must be made whether with Bieniawsky, Barton or other calculation methods.

The rocks involved in the lines of the tunnels are:

- Fine and medium grain half-cemented sandstones, with a Bieniawsky quality index of II at the Daule Peripa-La Esperanza Tunnel.
- Greenish gray mudstones with a Bieniawsky quality index of III-IV (median to bad) at the Caña Daule-Poza Honda Tunnel.



- Sandstones and mudstones with a Bieniawsky quality index of II-IV (median to bad) at the Poza Honda-Mancha Grande Tunnel.

Based on the results obtained we can make the following observations:

- The tunnels themselves must be made with minimum coverings of 20 m and for smaller coverings it is recommended that a false tunnel be made.
- On the lines of the false tunnel, the expansion properties of the rock and colluvial deposits should be considered, recommending a slope of 2H : 3 V on rock and 1H : 1V on colluvial soil. The excavations should be uncovered as little time as possible due to the highly weatherable character of the rock and the expansive nature of the rock and colluvial.
- For the tunnels it is considered best to use the conventional excavation method, using friction.
- The nature of the rock, especially mudstone and its susceptibility to weathering, force the gunite to the surface of the excavation in order to avoid drying the rock which would cause on the one hand cracking of the mudstone and on the other moving of the expansion process due to later increases in humidity.
- The supports of the tunnels may be:
 - . Projected concrete (3-5 cm) on all excavated surfaces
 - . Mesh on the dome and front wall
 - . Projected concrete (3-5 cm) on the dome and front wall
 - . On temporary portals and lines, anchoring ribs and bolts.

Regarding the line of the Open Channel, the soils found are fundamentally MH and some CH, not dispersive and highly expansive with permeability of the order of 10^{-6} cm/second.

For the excavation we recommend slips of 1H : IV.



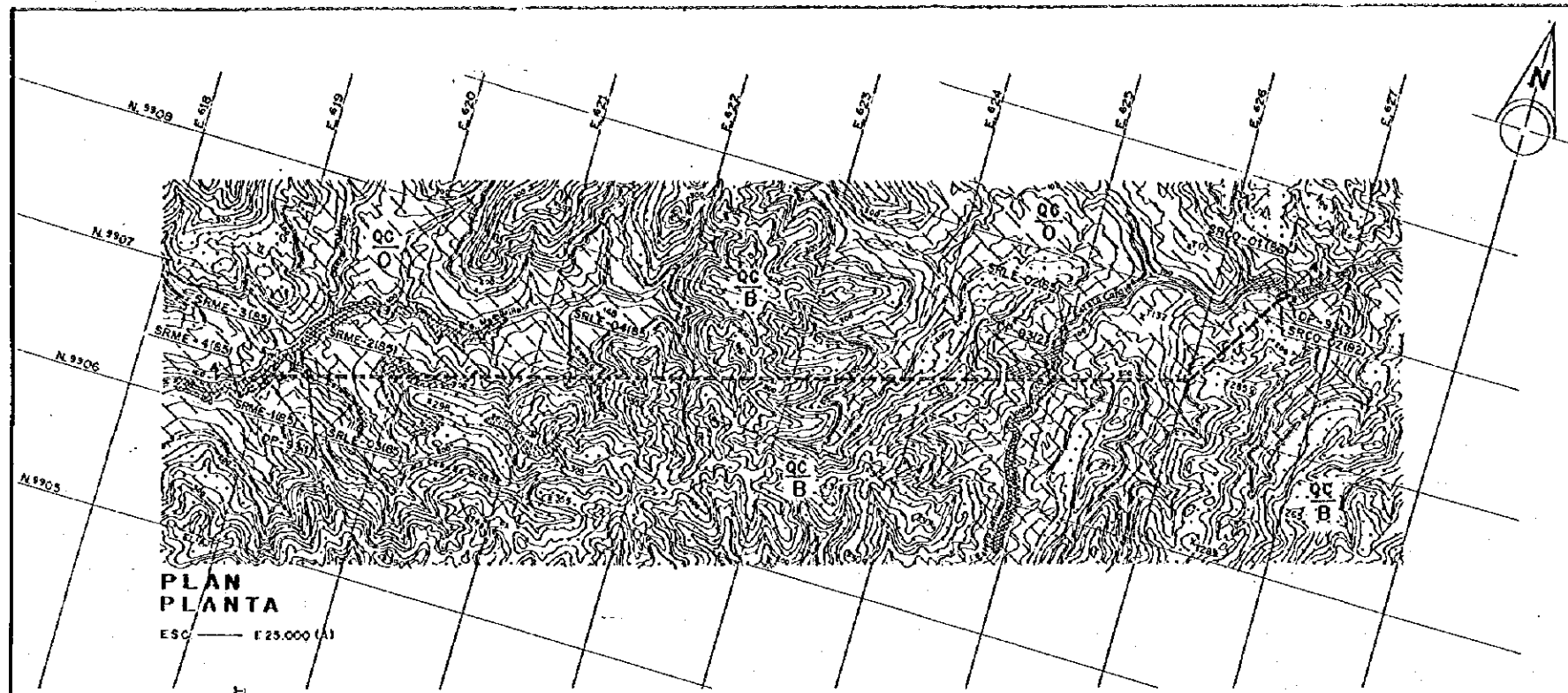
All considerations are approximate and must be confirmed through more precise calculations.



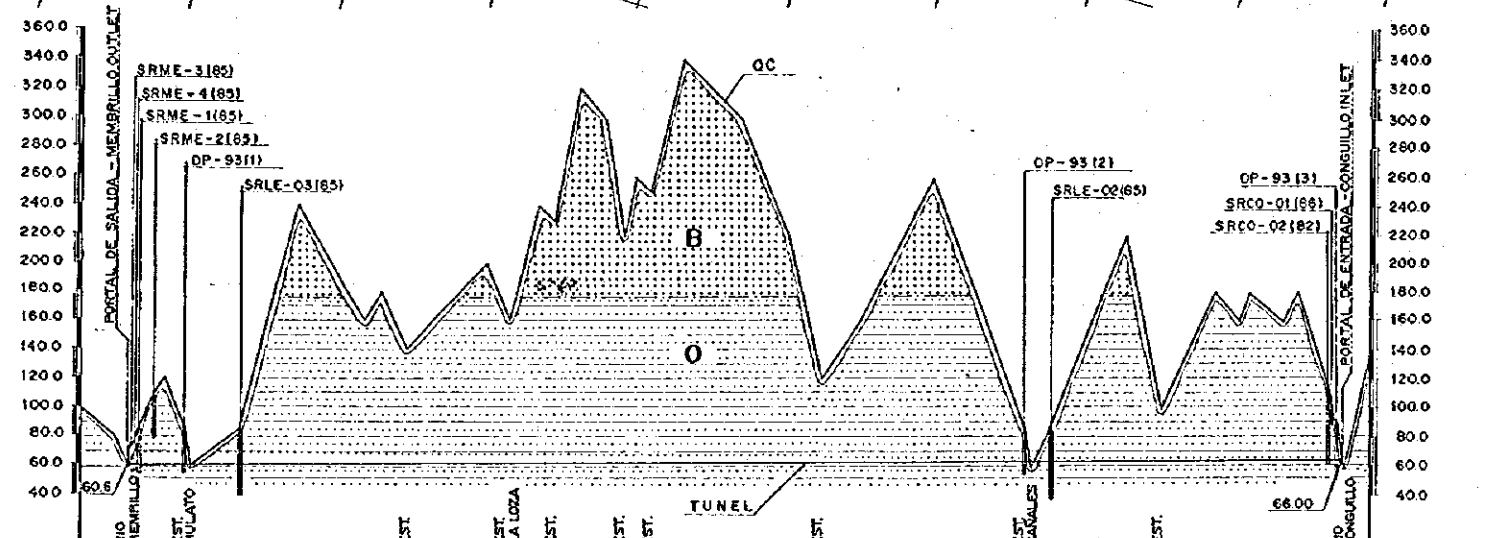
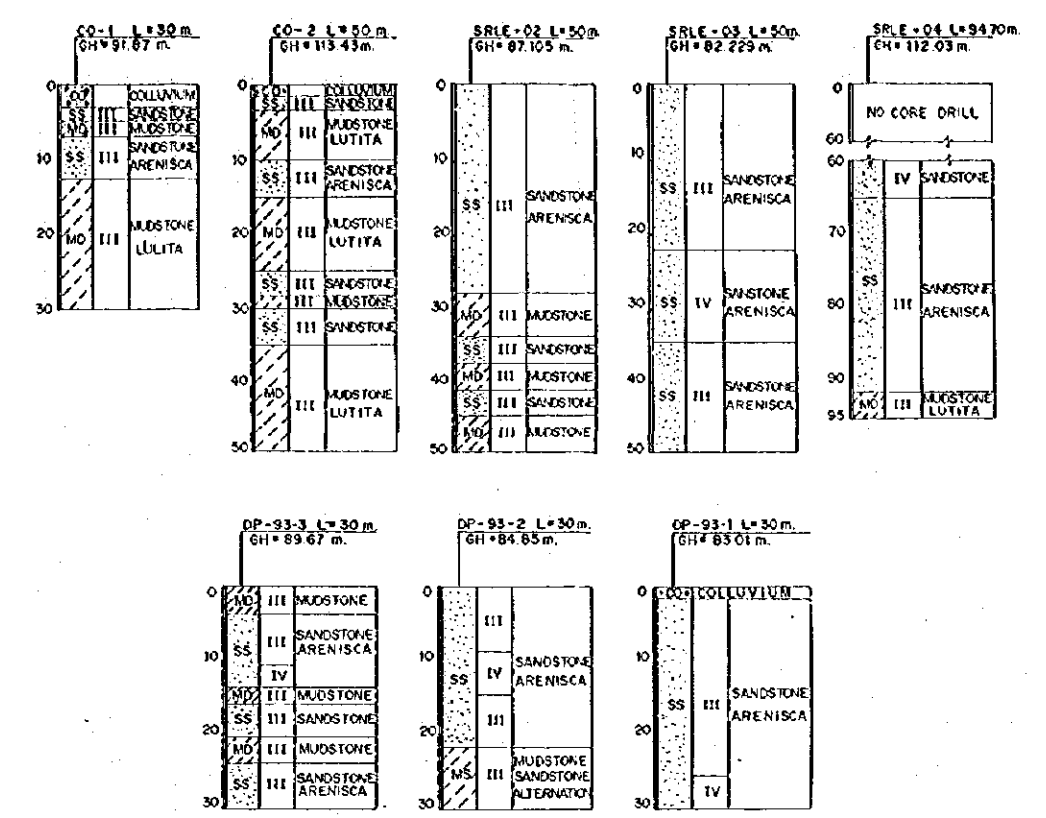
9. APPENDIXES



9.1 GEOLOGICAL DRAWINGS AND PROFILES



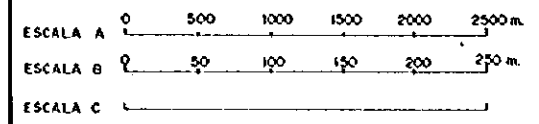
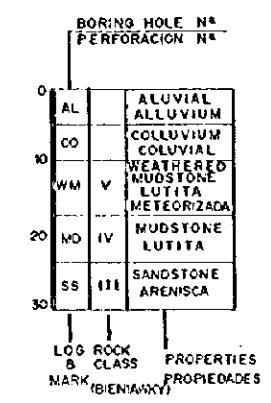
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PERFIL LONGITUDINAL
ESC H: 1:25,000 (A)
V: 1:2,500 (B)

SIMBOLOGIA	FORMACION	LITOLOGIA	LEYENDA
Qc	ALLUVIUM ALUVIAL	SANDY-MUD-SH ARENA - AROLLA-LIMO	ALLUVIUM ALUVIAL
QAL	COLLUVIUM COLUVIAL	MUD WITH BOULDER ANGULAR BOULDER CLASTOS ANGULARES EN MATRIZ LIMO-AROLLOSA-ARENA	COLLUVIUM (COLUVIAL) - SURFACE BORON FORMATION - BASE ROCK
B	BORON	SANDSTONE MEDIUM TO COARSE SANDSTONE VOLCANIC ASH ARENISCA DE GRANO MEDIO A GRUESO	COLLUVIUM (COLUVIAL) - SURFACE ONZOLE FORMATION - BASE ROCK
O	ONZOLE	MUDSTONE LUTITA/LIMOLITA SANDSTONE ARENISCA	OUT CROPS AFLORAMIENTOS
			GEOLOGICAL CONTACT CONTACTO GEOLOGICO

	GEO TIME FORMATION	ROCK TYPE	PROPERTIES
A1	QUATERNARY ALLUVIAL	FINE SOIL	RIVER AND TRIBUTARY DEPOSIT. SILTY SOIL WITH SOME GRAVELS
CO	QUATERNARY COLUVIAL	FINE SOIL	TALUS DEPOSIT. SILTY SOIL WITH A LITTLE AMOUNT OF BOULDERS.
OMO	TERTIARY ONSOLE FORMATION	MUDSTONE	MAINLY MUDSTONE. STRATIFIED WITH VERY FINE SANDSTONE. HORIZONTAL BEDDING. SOFT ROCK.
OSM	TERTIARY ONSOLE FORMATION	SANDY MUDSTONE	MAINLY SANDY MUDSTONE INTERLAID WITH FINE SANDSTONE SOFT ROCK



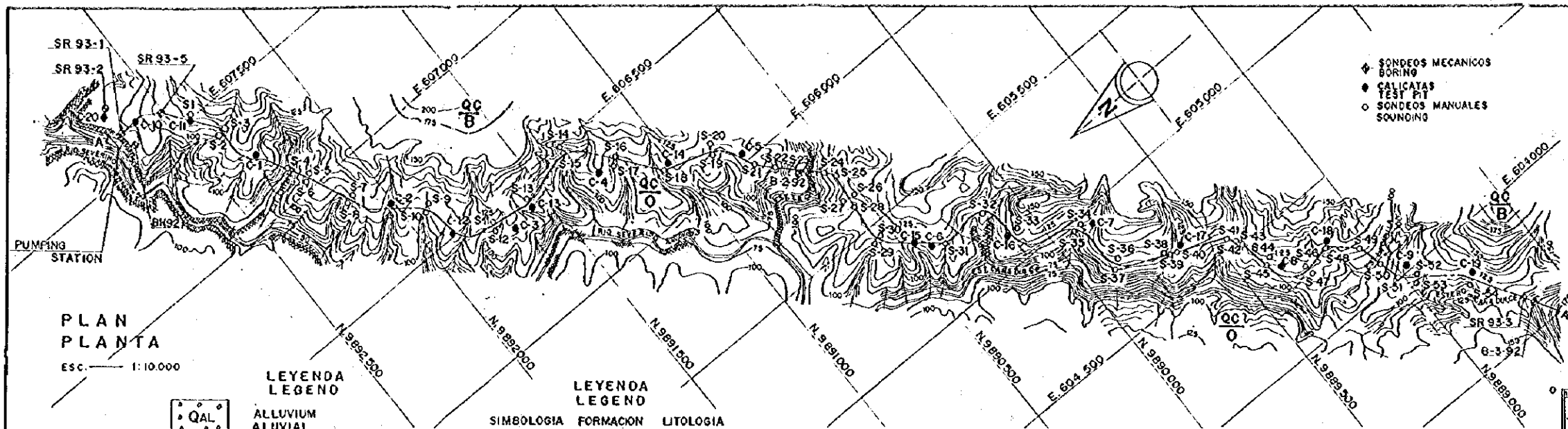
REV. N°	REVISADO	APROBADO	FECHA

CRM
CENTRO DE REHABILITACION DE MANABI

Estudio de Diseño Detallado de los Trasvases de Agua para las Cuencas de los Rios Chone-Portoviejo
The Detailed Design Study on the Water Transbasin Schemes for Chone-Portoviejo River Basins

TITULO:	LEVANTO:	APROBADO:
REPUBLICA DEL ECUADOR	DIBUJO:	FECHA:
	DISEÑO:	OIBUJO N°
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	ENTREGO:	
	FECHA:	

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GEO. TIME FORMATION	ROCK TYPE	PROPERTIES
AI	FINE SOIL	RIVER AND TRIBUTARY DEPOSIT. SILTY SOIL WITH SOME GRAVELS
CO	FINE SOIL	TALUS DEPOSIT. SILTY SOIL WITH A LITTLE AMOUNT OF SOULDERS.
OMD	MUDSTONE	MAINLY MUDSTONE STRATIFIED WITH VERY FINE SANDSTONE. HORIZONTAL BEDDING. SOFT ROCK
OSM	SANDY MUDSTONE	MAINLY SANDY MUDSTONE INTERLAID WITH FINE SANDSTONE. SOFT ROCK

PLAN PLANTA

ESC. 1:10,000

LEYENDA LEGEND

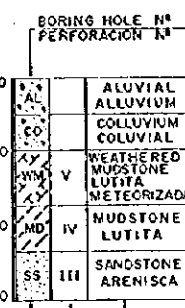
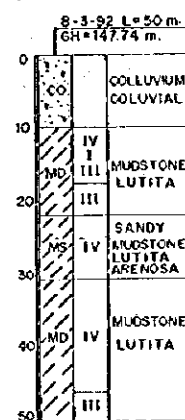
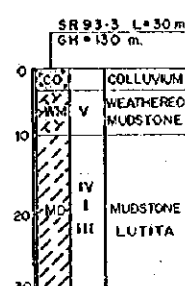
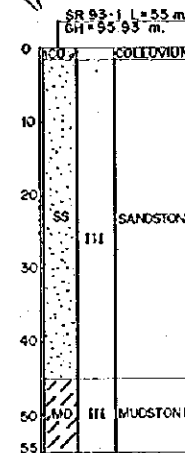
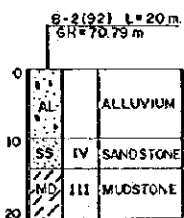
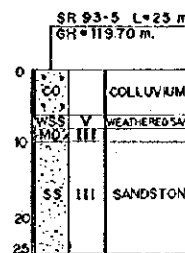
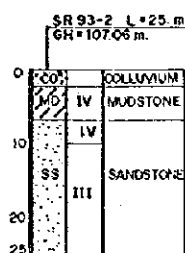
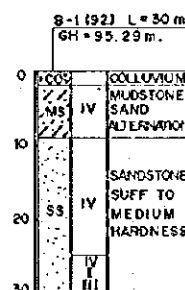
- ALLUVIUM ALUVIAL
- COLLUVIUM (COLUVIAL) - SURFACE BORBON FORMATION - BASE ROCK
- COLLUVIUM (COLUVIAL) - SURFACE ONZOLE FORMATION - BASE ROCK
- OUT CROPS AFLORAMIENTOS
- GEOLOGICAL CONTACT CONTACTO GEOLOGICO

LEYENDA LEGEND

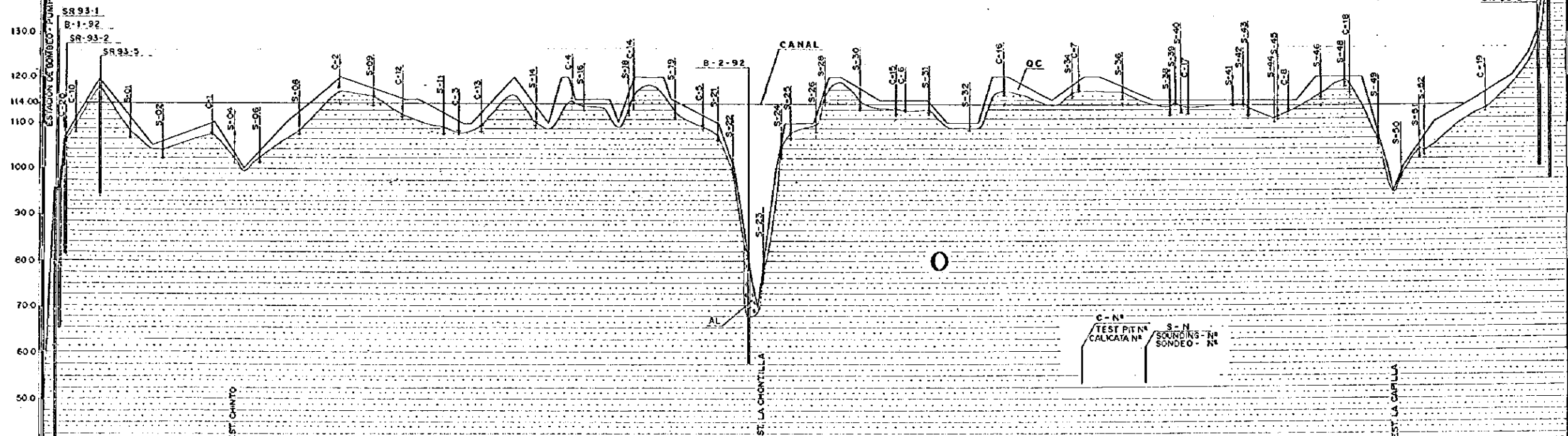
- SIMBOLOGIA FORMACION COLUMN SECTION FORMATION**
- ALLUVIUM ALUVIAL
 - COLLUVIUM COLUVIAL
 - BORBON
 - ONZOLE
- LITOLOGIA LITHOLOGY**
- SANDY-MUD-SH ARENA-ARCILLA-LIMO
 - MUD WITH BOULDER ANGULAR BOULDER CLASTOS ANGULARES EN MATRIZ LIMO-ARCILLOSA-ARENA
 - SANDSTONE MEDIUM TO COARSE SAND VOLCANIC ASH ARENISCA DE GRANO MEDIO A GRUESO
 - MUDSTONE LUTITA/LIMOLITA SANDSTONE ARENISCA

QUATERNARY
CUATERNARIO

TERTIARY (PLIOCENE)
TERCIARIO (MIOCENO)



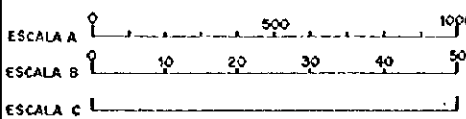
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500



COTAS DE TERRENO	ABSCISAS	GROUND HEIGHT	DISTANCE
50.00	0+000	50.00	0+000
119.70	0+250	119.70	0+250
115.00	0+480	115.00	0+480
110.00	0+745	110.00	0+745
80.00	0+835	80.00	0+835
100.00	0+880	100.00	0+880
110.00	1+060	110.00	1+060
120.00	1+310	120.00	1+310
115.00	1+495	115.00	1+495
115.00	1+655	115.00	1+655
110.00	1+855	110.00	1+855
110.00	1+885	110.00	1+885
120.00	2+075	120.00	2+075
110.00	2+225	110.00	2+225
120.00	2+285	120.00	2+285
115.00	2+315	115.00	2+315
115.00	2+435	115.00	2+435
115.00	2+485	115.00	2+485
110.00	2+535	110.00	2+535
120.00	2+605	120.00	2+605
120.00	2+735	120.00	2+735
115.00	2+765	115.00	2+765
110.00	2+865	110.00	2+865
100.00	3+045	100.00	3+045
70.00	3+175	70.00	3+175
110.00	3+220	110.00	3+220
110.00	3+255	110.00	3+255
110.00	3+385	110.00	3+385
120.00	3+465	120.00	3+465
120.00	3+515	120.00	3+515
115.00	3+685	115.00	3+685
115.00	3+785	115.00	3+785
115.00	3+890	115.00	3+890
110.00	3+975	110.00	3+975
110.00	4+075	110.00	4+075
110.00	4+115	110.00	4+115
120.00	4+175	120.00	4+175
120.00	4+245	120.00	4+245
115.00	4+440	115.00	4+440
115.00	4+560	115.00	4+560
120.00	4+580	120.00	4+580
120.00	4+640	120.00	4+640
115.00	4+690	115.00	4+690
115.00	4+880	115.00	4+880
115.00	4+980	115.00	4+980
115.00	5+100	115.00	5+100
115.00	5+305	115.00	5+305
120.00	5+595	120.00	5+595
120.00	5+645	120.00	5+645
120.00	5+800	120.00	5+800
100.00	5+915	100.00	5+915
90.00	5+935	90.00	5+935
100.00	5+975	100.00	5+975
110.00	6+140	110.00	6+140
120.00	6+460	120.00	6+460
125.00	6+540	125.00	6+540
130.00	6+580	130.00	6+580
147.74	6+620	147.74	6+620
175.00	6+700	175.00	6+700

PROFILE PERFIL LONGITUDINAL

ESC. H: 1:10,000 (A)
V: 1: 500 (B)



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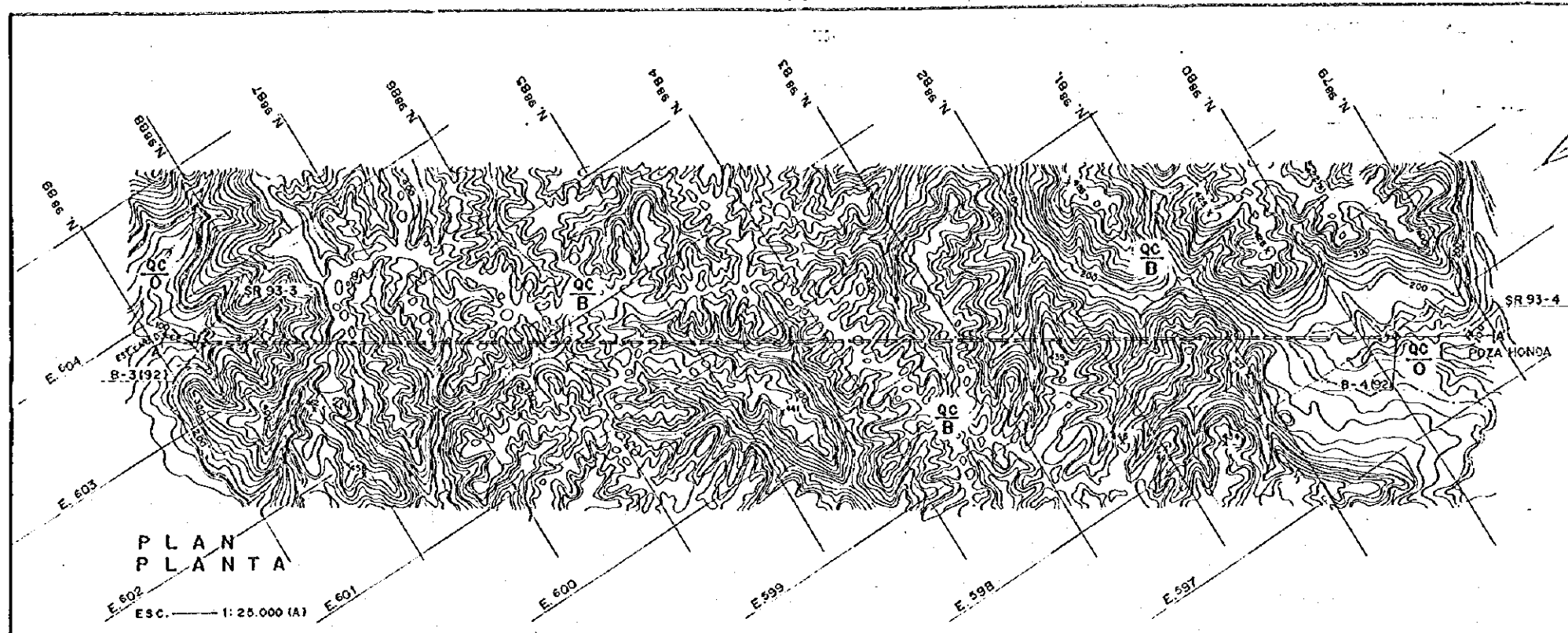
Estudio de Diseño Detallado de los Traspases de Agua para los Cuencas de los Rios Chone Portoviejo
The Detailed Design Study on the Water Transbasin Schemes for Chone-Portoviejo River Basins

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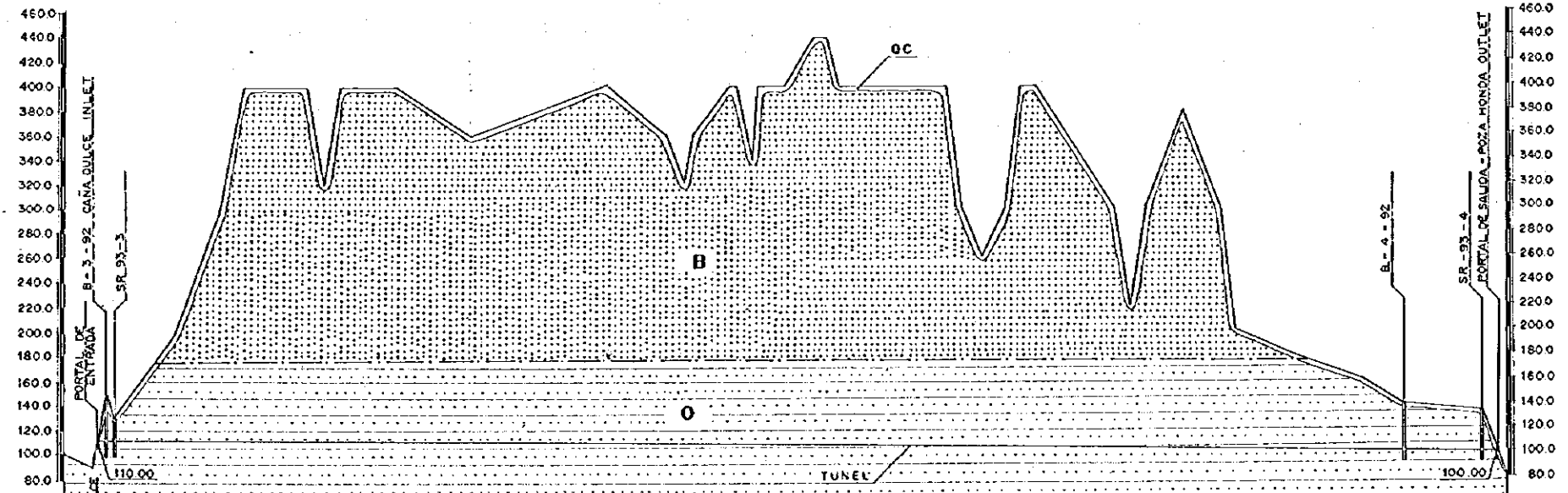
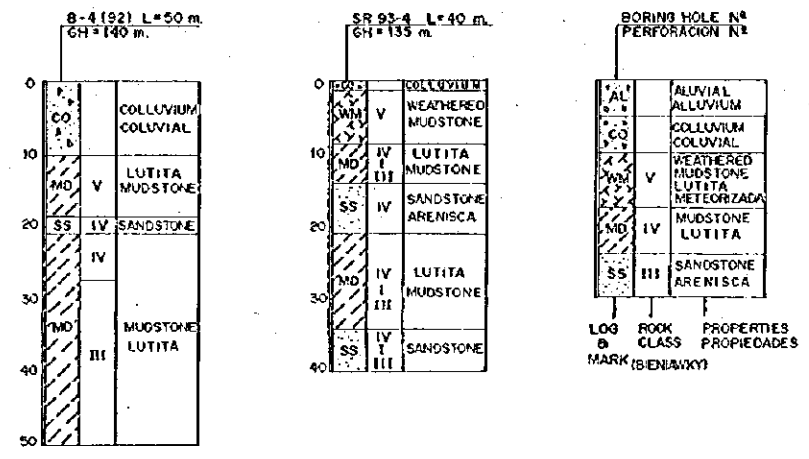
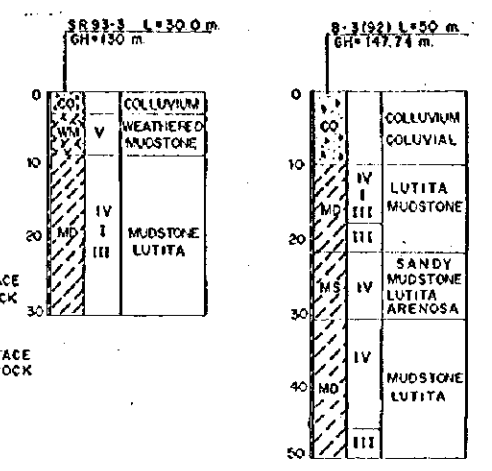
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DISEÑO:	DIBUJO N°:
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- LEYENDA LEGEND**
- ALLUVIUM ALUVIAL
 - COLUVIUM (COLUVIAL)-SURFACE BORBON FORMATION - BASE ROCK
 - COLUVIUM (COLUVIAL)-SURFACE ONZOLE FORMATION - BASE ROCK
 - OUT CROPS AFLORESCIENTOS
 - GEOLOGICAL CONTACT CONTACTO GEOLOGICO

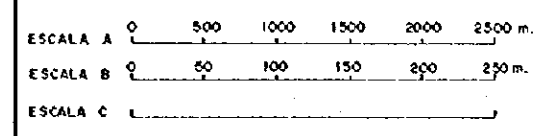


COTAS DE TERRENO	100.00	150.00	130.00	200.00	300.00	400.00	320.00	400.00	400.00	360.00	400.00	360.00	380.00	400.00	440.00	440.00	440.00	440.00	400.00	300.00	200.00	180.00	150.00	140.00	135.00	80.00	GROUND HEIGHT														
ABSCISAS	0+000	0+120	0+400	0+900	0+260	1+490	1+940	2+100	2+290	2+400	2+700	3+300	4+400	4+520	5+040	5+400	5+450	5+540	5+860	6+100	6+200	6+300	6+760	7+180	7+300	7+460	7+660	7+780	7+920	8+250	8+360	8+600	9+100	9+400	9+540	10+000	10+600	10+900	11+240	11+740	DISTANCE

PROFILE PERFIL LONGITUDINAL
 ESC. H=1:25.000 (A)
 V=1:2.500 (B)

- LEYENDA LEGEND**
- | | | | |
|-------------------------------------|---|---|-------------------------------------|
| ALLUVIUM ALUVIAL | COLLUVIUM COLUVIAL | BORBOM | ONZOLE |
| SANDY-MUD-SH ARENA - ARCILLA - LIMO | MUD WITH BOULDER ANGULAR BOULDER CLASTOS ANGULARES EN MATRIZ LIMO - ARCILLOSA-ARENA | SANDSTONE MEDIUM TO COARSE SAME VOLCANIC ASH ARENISCA DE GRANO MEDIO A GRUESO | MUDSTONE LUTITA / LIMOLITA ARENISCA |
| QUATERNARY CUATERNARIO | | TERTIARY (PLIOCENE) TERCARIO (MIOCENE) | |

	GEO TIME FORMATION	ROCK TYPE	PROPERTIES
A1	QUATERNARY ALLUVIAL	FINE SOIL	RIVER AND TRIBUTARY DEPOSIT. SILTY SOIL WITH SOME GRAVELS
Co	QUATERNARY COLLUVIAL	FINE SOIL	TALUS DEPOSIT. SILTY SOIL WITH A LITTLE AMOUNT OF BOULDERS.
OND	TERTIARY FORMATION MUDSTONE	MUDSTONE	MAINLY MUDSTONE STRATIFIED WITH VERY FINE SANDSTONE. HORIZONTAL BEDDING. SOFT ROCK.
OSM	TERTIARY FORMATION SANDY MUDSTONE	SANDY MUDSTONE	MAINLY SANDY MUDSTONE INTERLAID WITH FINE SANDSTONE SOFT ROCK



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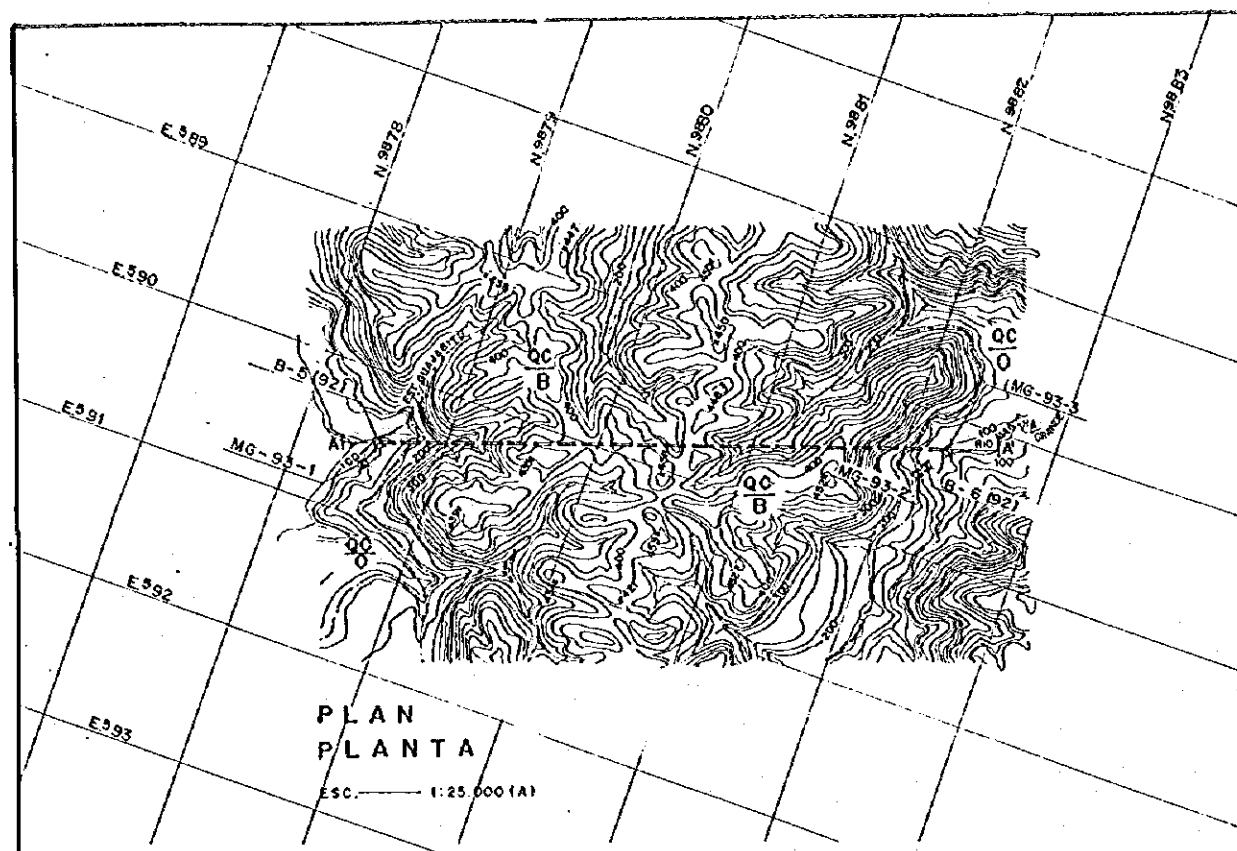
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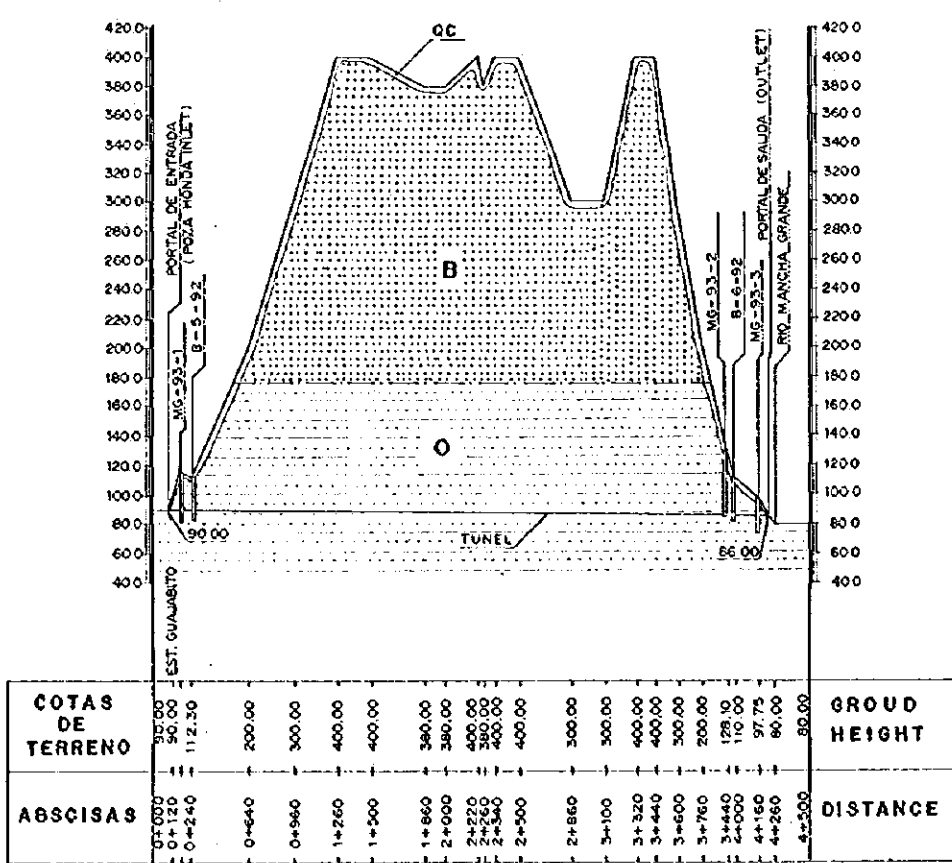
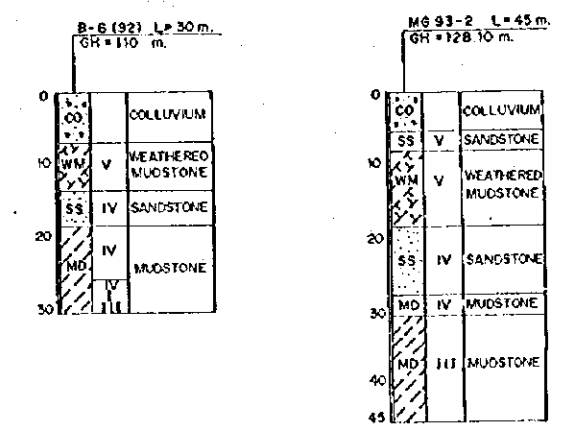
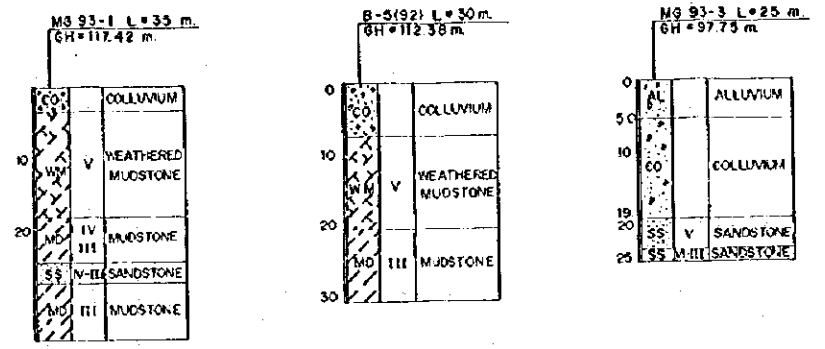
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	DIBUJO:	FECHA:
	DISEÑO:	DIBUJO N°
	REVISO:	
	ENTREGO:	
	FECHA:	3

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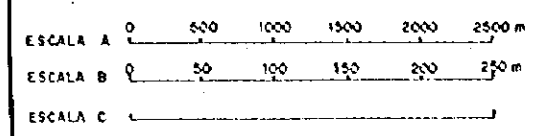
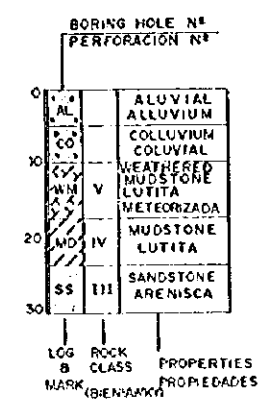


- LEYENDA LEGEND**
- ALLUVIUM ALUVIAL
 - COLLUVIUM (COLUVIAL) - SURFACE BORBON FORMATION - BASE ROCK
 - COLLUVIUM (COLUVIAL) - SURFACE ONZOLE FORMATION - BASE ROCK
 - OUT CROPS AFLORAMIENTOS
 - GEOLOGICAL CONTACT CONTACTO GEOLOGICO



- LEYENDA LEGEND**
- | SIMBOLOGIA | FORMACION | LITOLOGIA |
|------------|--------------------|---|
| | ALLUVIUM ALUVIAL | SANDY AND-SH ARENA - ARCILLA-LIMO |
| | COLLUVIUM COLUVIAL | MUD WITH BOULDER ANGULAR BOULDER CLASTOS ANGULARES EN MATRIZ LIMO - ARCILLOSA - ARENA |
| | BORBON | SANDSTONE MEDIUM TO COARSE SAND VOLCANIC ASH ARENISCA DE GRAVO MEDIO A GRISES |
| | ONZOLE | MUDSTONE LUTITA/LIMOLITA SANDSTONE ARENISCA |
- QUATERNARY CUATERNARIO
TERTIARY (PLIOCENE) TERCARIO (MIOCENE)

AL	CO	OMD	OSM
QUATERNARY	QUATERNARY	TERTIARY	TERTIARY
ALLUVIAL	COLLUVIAL	ONZOLE FORMATION	ONZOLE FORMATION
FINE SOIL	FINE SOIL	MUDSTONE	SANDY MUDSTONE
RIVER AND TRIBUTARY DEPOSIT. SILTY SOIL WITH SOME GRAVELS	TALUS DEPOSIT. SILTY SOIL WITH A LITTLE AMOUNT OF BOULDERS.	MAINLY MUDSTONE. STRATIFIED WITH VERY FINE SANDSTONE. HORIZONTAL BEDDING. SOFT ROCK.	MAINLY SANDY MUDSTONE INTERLAID WITH FINE SANDSTONE SOFT ROCK



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 REVISO: _____
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 FECHA: _____

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