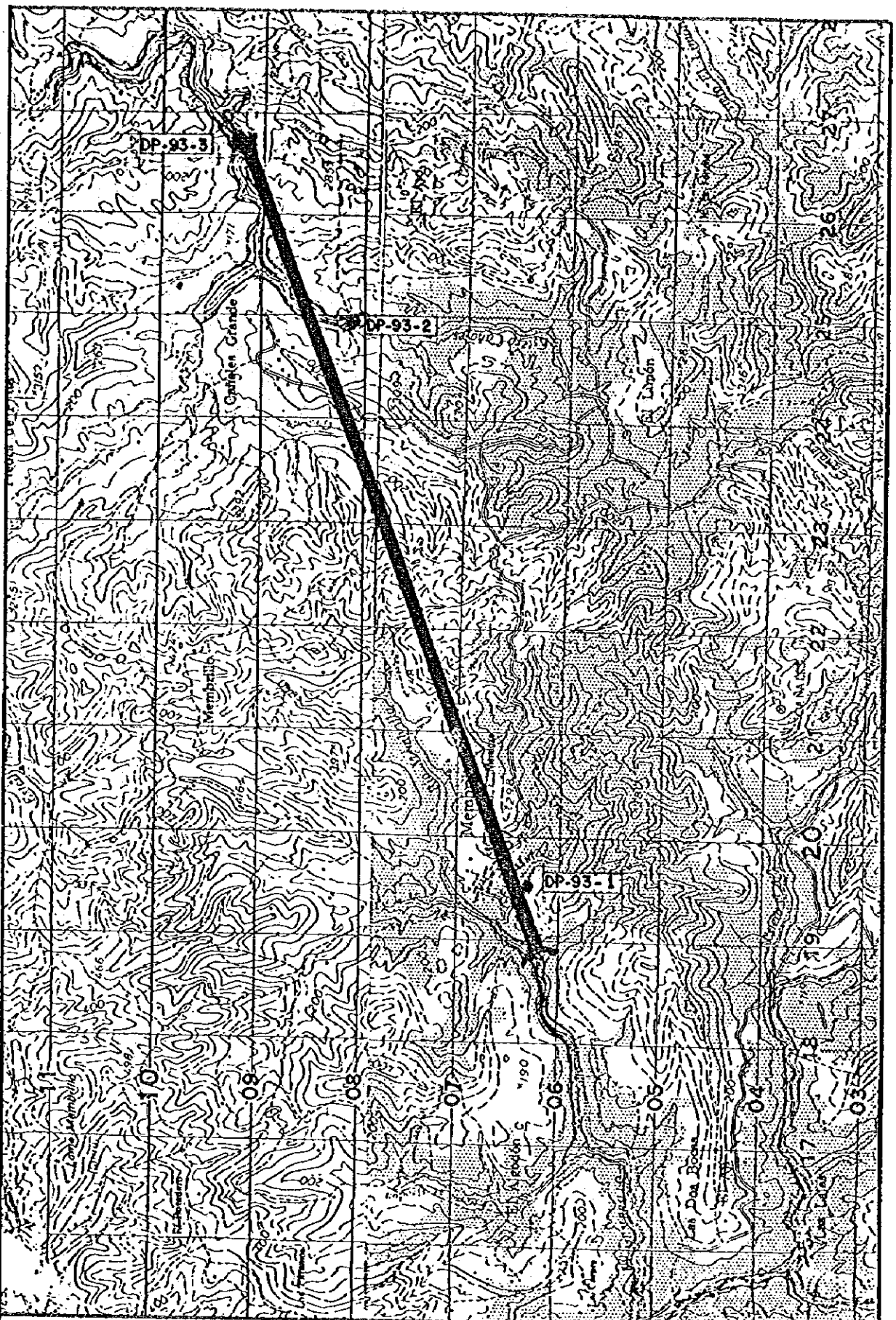


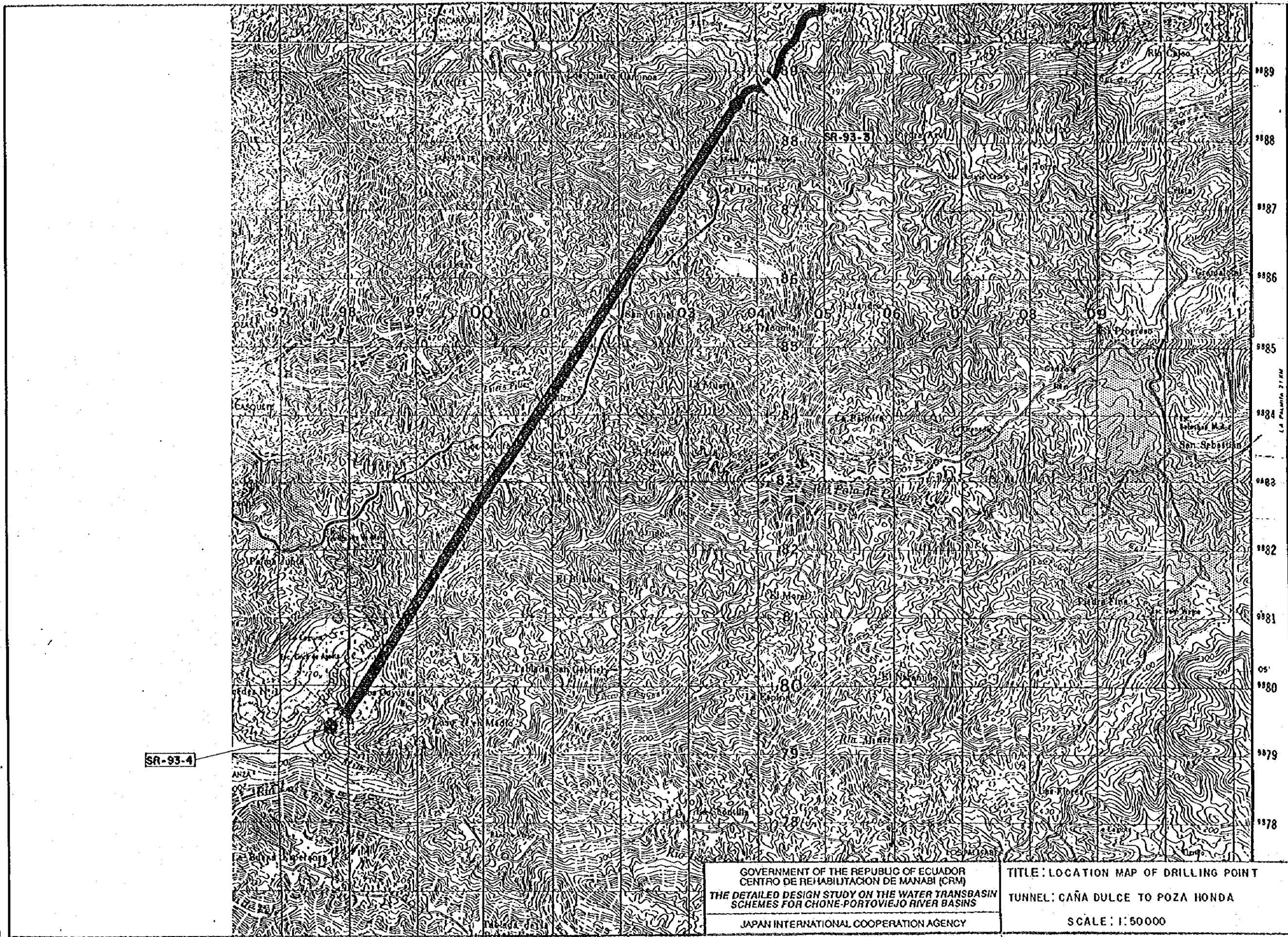


4.3 PLAN WITH LOCATION OF BOREHOLE SITES



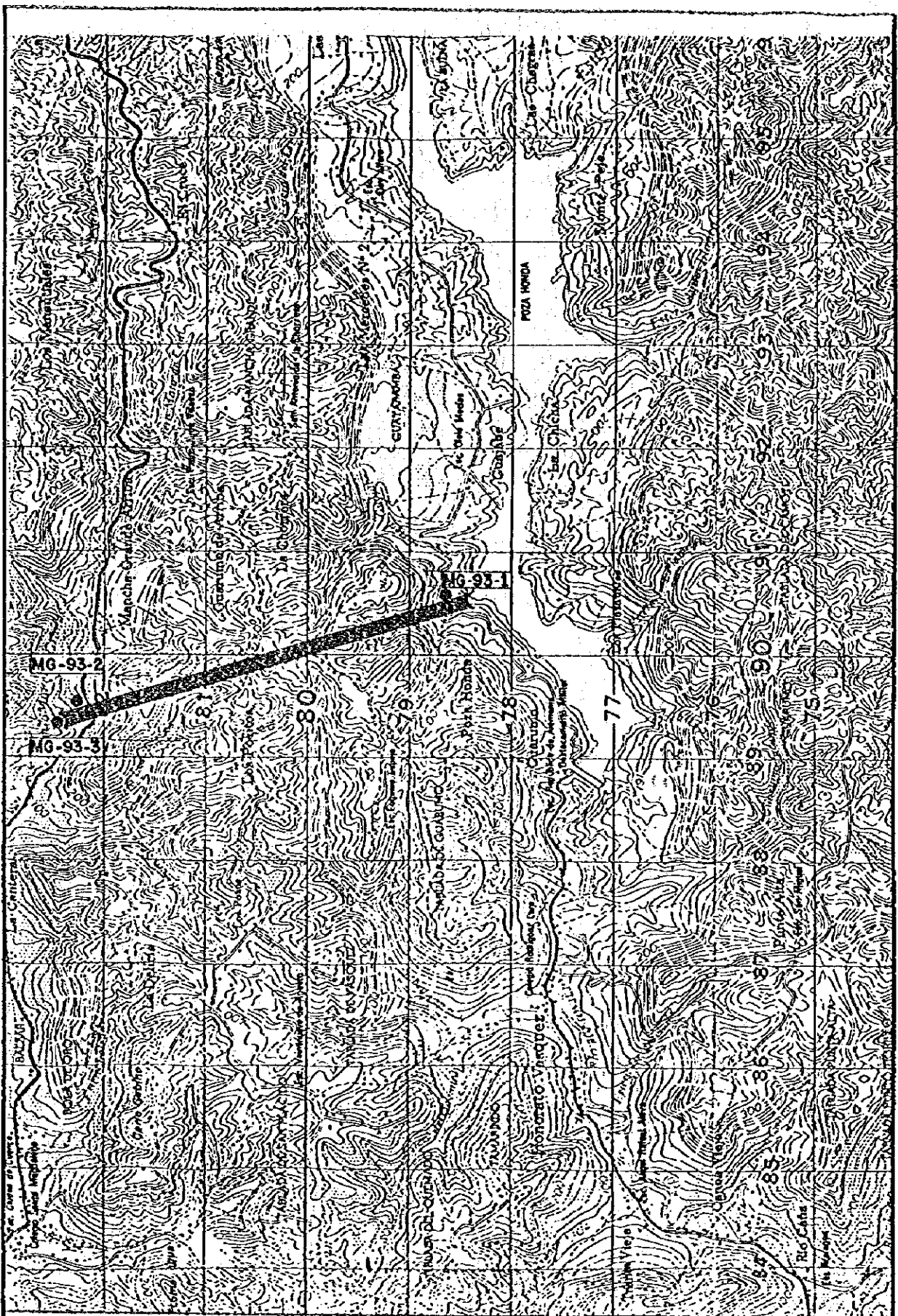
GOVERNMENT OF THE REPUBLIC OF ECUADOR
 CENTRO DE REHABILITACION DE MANABI (CRM)
 THE DETAILED DESIGN STUDY ON THE WATER TRANSBASIN
 SCHEMES FOR CHONE-PORTOVIEJO RIVER BASINS
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE: LOCATION MAP OF DRILLING POINT
 TUNNEL: DAULE PERIPA TO LA ESPERANZA
 SCALE: 1: 50 000



GOVERNMENT OF THE REPUBLIC OF ECUADOR
 CENTRO DE REHABILITACION DE MANABI (CRM)
 THE DETAILED DESIGN STUDY ON THE WATER TRANSBASIN
 SCHEMES FOR CHONE-PORTOVIEJO RIVER BASINS
 JAPAN INTERNATIONAL COOPERATION AGENCY

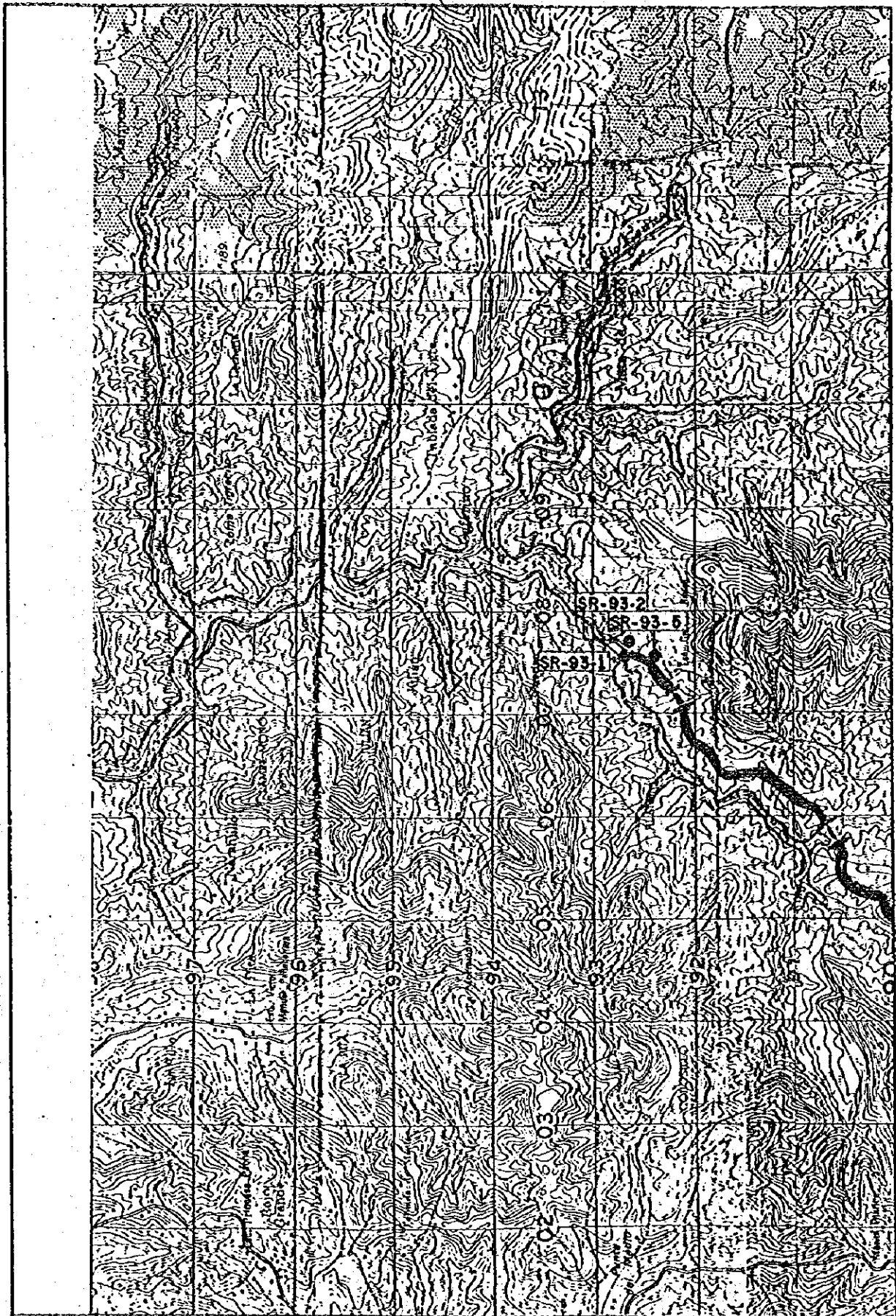
TITLE: LOCATION MAP OF DRILLING POINT
 TUNNEL: CAÑA DULCE TO POZA HONDA
 SCALE: 1:50000



GOVERNMENT OF THE REPUBLIC OF ECUADOR
 CENTRO DE REHABILITACION DE MANABI (CRM)
 THE DETAILED DESIGN STUDY ON THE WATER TRANSBASIN
 SCHEMES FOR CHONE-PORTOVIEJO RIVER BASINS
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE : LOCATION MAP OF DRILLIN POINT
 TUNNEL POZA HONDA TO MANCHA GRANDE
 SCALE : 1: 50 000

118
1



GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE DETAILED DESIGN STUDY ON THE WATER TRANSBASIN
SCHEMES FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE: LOCATION MAP OF DRILLING POINT
PUMPING STATION SUBSTATION HEAD TANK
SCALE: 1:50000

8



**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**

ANNEX - VOLUME I

FEBRUARY 1994



RESULTS OF FIELD TESTS



PERMEABILITY FIELD LEFRANC TEST

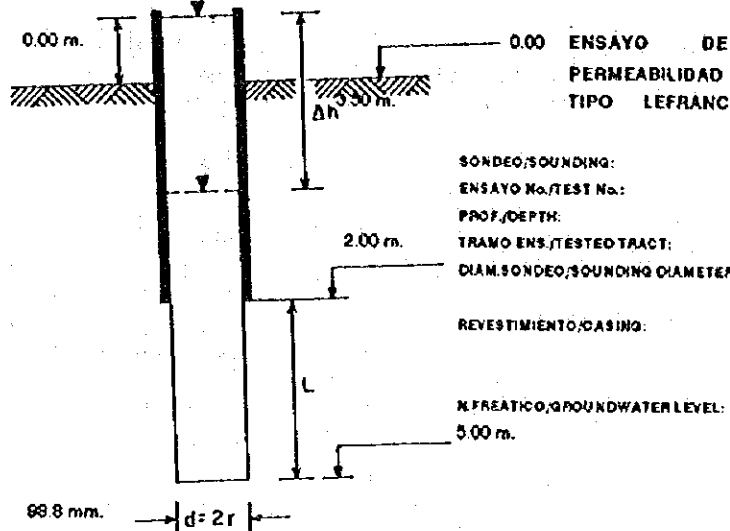


hidrosuelos Cla. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	4-01-94
PERFORM BY:	FV



PERMEABILITY FIELD TEST LEFRANC

SR-93-5
I
5.00 m.
3.00 m.
98.8 mm.
DIAM./DIAMETER: HW-101.6 mm
LONG./LENGTH: 2.00 m.
ANTES/BEFORE: 3.90 m.
DESP./AFTER: 3.60 m.

PRUEBA A NIVEL CONSTANTE TEST WITH CONSTANT LEVEL

TIEMPO/TIME (min.)	VOL. (lbs)	ACC.VOL (lbs)	Q (lbs/min)
1	1.00	1.00	1.00
2	1.20	2.20	1.20
4	2.50	4.70	1.25
6	3.00	7.70	1.50
8	3.40	11.10	1.70
10	4.50	15.60	2.25
15	14.00	29.60	2.80
20	21.00	50.60	4.20
25	34.50	85.10	6.90
30	54.25	139.35	10.85
35	77.00	216.35	15.40
40	99.00	315.35	19.80
45	110.00	425.35	22.00
50	131.00	556.35	26.20
55	152.00	708.35	30.40
60	180.00	888.35	32.00

ENSAYO DE DESCENSO DESCENT TEST

TIEMPO/TIME (min.)	h (m)
1	1.72
2	2.75
4	3.34
6	3.55
8	3.57
10	3.60
15	3.60
20	3.60
25	3.60
30	3.60

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY (nivel constante/constant level)

$$K = \frac{Q}{(2 \times 3.1415927 \times L \times x \times H)} \times \left[\frac{L_n[(2 \times L)/D]}{L} \right]$$

Q = 533.33 cm³/sec

r = 4.94 cm

H = 350.00 cm

L = 300.00 cm

K = 3.320E-03 cm/sec

NOTAS:

• K > 3.320E-03 cm/sec.

• Caudal infiltrado no estabilizado debido a probable disolución de cristales de ClNa (Halita o sal)

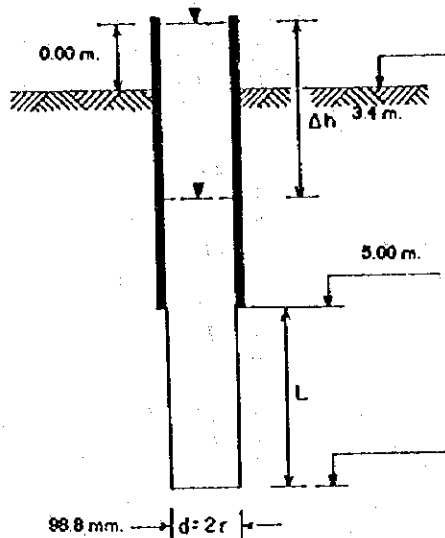


Hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOUASHEET:	1/1
FECHA/DATE:	5-01-94
PERFORM BY:	FV



0.00 ENSAYO DE PERMEABILIDAD TIPO LEFRANC

SONDEO/SOUNDING:
 ENSAYO No./TEST No.:
 PROF./DEPTH:
 TRAMO ENS./TESTED TRACT:
 DIAM.SONDEO/SOUNDING DIAMETER

REVESTIMIENTO/CASINO:

N.FREATICO/GROUNDWATER LEVEL:
 7.80 m.

PERMEABILITY FIELD TEST LEFRANC

SR 93-5
 2
 7.80 m.
 2.80 m.
 98.8 mm.

DIAM./DIAMETER: HW=101.6 mm
 LONG./LENGTH: 5.00 m.

ANTES/BEFORE: 3.40 m.

PRUEBA A NIVEL CONSTANTE TEST WITH CONSTANT LEVEL

TIEMPO/TIME (min.)	VOL. (lts)	ACC.VOL (lts)	Q (lts/min)
1	0.50	0.50	0.50
2	0.50	1.00	0.50
4	0.95	1.95	0.48
6	0.85	2.80	0.42
8	0.60	3.40	0.30
10	0.50	3.90	0.25
15	1.25	5.15	0.25
20	1.05	6.20	0.21
25	1.00	7.20	0.20
30	1.00	8.20	0.20
35	1.00	9.20	0.20
40	0.75	9.95	0.15
45	0.70	10.65	0.14
50	0.75	11.40	0.15
55	0.75	12.15	0.15
60	0.75	12.90	0.15

ENSAYO DE DESCENSO DESCENT TEST

TIEMPO/TIME (min.)	h (m)
1	0.02
2	0.04
4	0.06
6	0.14
8	0.17
10	0.21
15	0.33
20	0.45
25	0.57
30	0.74

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY (nivel constante, constant level)

$$K = \frac{Q}{(2 \times 3.1415927 \times L \times x \times H)} \times \left\{ \ln \left[\frac{(2 \times L)}{D} \right] \right\}$$

Q = 2.50 cm³/sec

r = 4.94 cm

H = 340.00 cm

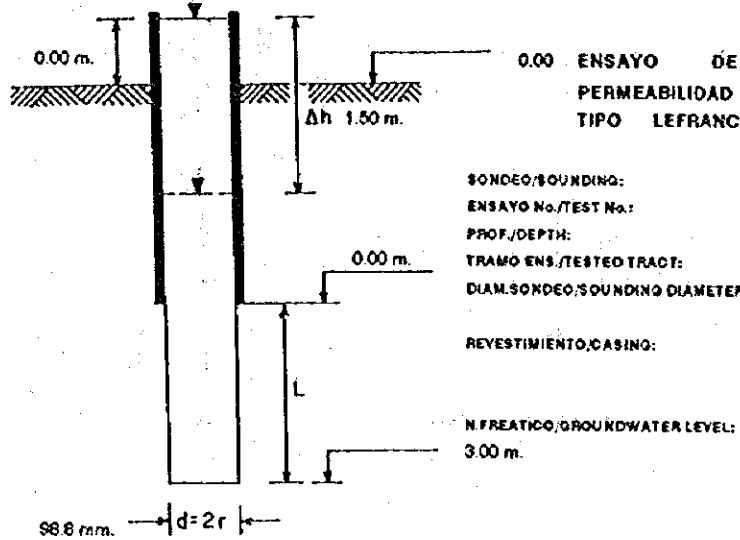
L = 280.00 cm

K = 1.687E-05 cm/sec



hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	10-12-93
PERFORM BY:	RB



**PRUEBA A NIVEL CONSTANTE
TEST WITH CONSTANT LEVEL**

TIEMPO/TIME (min.)	VOL. (lts)	ACC.VOL (lts)	Q (lts/min)
1	8.00	8.00	8.00
2	7.60	15.60	7.60
4	13.00	28.60	6.50
6	12.50	41.10	6.25
8	12.00	53.10	6.00
10	11.00	64.10	5.50
15	28.00	92.10	5.60
20	25.00	117.10	5.00
25	23.00	140.10	4.60
30	21.50	161.60	4.30
35	21.00	182.60	4.20
40	21.00	203.60	4.20
45	21.00	224.60	4.20
50	21.00	245.60	4.20
55	21.00	266.60	4.20
60	21.00	287.60	4.20

**ENSAYO DE DESCENSO
DESCENT TEST**

TIEMPO/TIME (min.)	h (m)
1	0.12
2	0.22
4	0.39
6	0.56
8	0.81
10	0.96
15	1.15
20	1.30
25	1.42
30	1.55

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

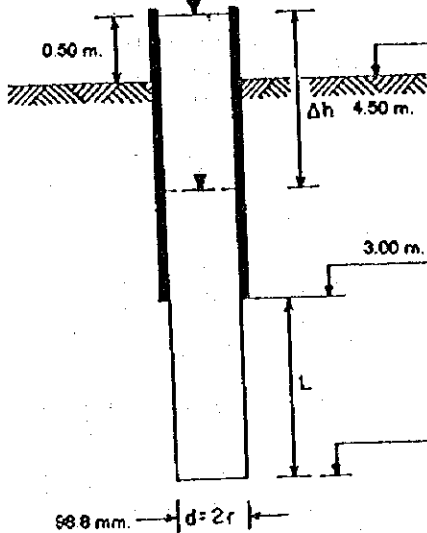
$$K = [Q / (2 \times 3.1415927 \times L \times x \times H)] \times \{Ln[(2 \times L) / D]\}$$

Q = 70.00 cm³/sec
 r = 4.94 cm
 H = 150.00 cm
 L = 300.00 cm
 K = 1.017E-03 cm/sec



Hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	10-12-93
PERFORM BY:	RS



000 ENSAYO DE PERMEABILIDAD TIPO LEFRANC

SONDEO/SOUNDING:
ENSAYO No./TEST No.:
PROF./DEPTH:
TRAMO ENS./TESTED TRACT:
DIAM.SONDEO/SOUNDING DIAMETER:
REVESTIMIENTO/CASING:
N.FREATICO/GROUNDWATER LEVEL:
5.00 m.

PERMEABILITY FIELD TEST LEFRANC

MG-93-3
2
5.00 m.
2.00 m.
60.8 mm.
DIAM./DIAMETER: HW=101.6 mm
LONG./LENGTH: 3.00 m.
ANTES/BEFORE: 420 m

**PRUEBA A NIVEL CONSTANTE
TEST WITH CONSTANT LEVEL**

TIEMPO/TIME (min.)	VOL. (lbs)	ACC.VOL. (lbs)	Q (lbs/min)
1	3.00	3.00	3.00
2	2.40	5.40	2.40
4	4.00	9.40	2.00
6	3.60	13.00	1.80
8	2.60	15.60	1.40
10	2.30	18.10	1.15
15	5.60	23.90	1.16
20	5.10	29.00	1.02
25	4.90	33.90	0.98
30	4.60	38.70	0.96
35	4.60	43.50	0.96
40	4.60	48.30	0.96
45	4.60	53.10	0.96
50	4.60	57.90	0.96
55	4.60	62.70	0.96
60	4.60	67.50	0.96

**ENSAYO DE DESCENSO
DESCENT TEST**

TIEMPO/TIME (min.)	h (m)
1	0.05
2	0.09
4	0.16
6	0.22
8	0.27
10	0.31
15	0.50
20	0.60
25	0.72
30	0.77

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD; COEFFICIENT OF PERMEABILITY:

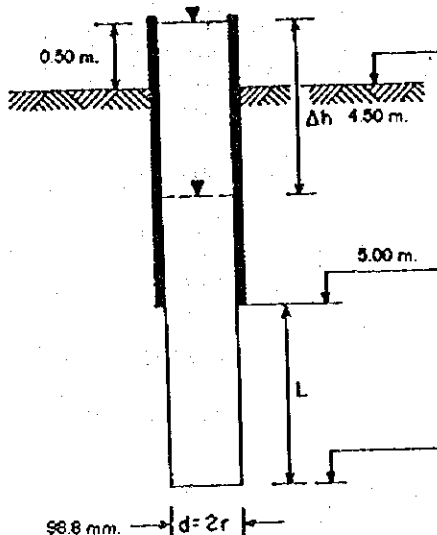
$$K = \frac{Q}{(2 \times 3.1415927 \times L \times x \times H)} \times \{ \ln \left[\frac{(2 \times L)}{D} \right] \}$$

Q = 16.00 cm³/sec
r = 4.94 cm
H = 450.00 cm
L = 200.00 cm
K = 1.047E-04 cm/sec



hidrosuelos Cia. Ltda.
QUITO ECUADOR

QUA. SHEET.	1/1
FECHA/DATE	11-12-93
PERFORM BY.	RS



0.00 ENSAYO DE PERMEABILIDAD TIPO LEFRANC

SONDEO/SOUNDING: 3
 ENSAYO No./TEST No.: 3
 PROF./DEPTH: 8.00 m.
 TRAMO ENS./TESTED TRACT: 3.00 m.
 DIAM.SONDEO/SOUNDING DIAMETER: 98.8 mm.
 REVESTIMIENTO/CASINO: DIAM./DIAMETER: HW=101.6 mm.
 LONG./LENGTH: 5.00 m.
 N.FREATICO/GROUNDWATER LEVEL: 8.00 m.
 ANTES/BEFORE: 4.00 m.

PERMEABILITY FIELD TEST LEFRANC

MG 93 3
 3
 8.00 m.
 3.00 m.
 98.8 mm.
 DIAM./DIAMETER: HW=101.6 mm.
 LONG./LENGTH: 5.00 m.
 ANTES/BEFORE: 4.00 m.

PRUEBA A NIVEL CONSTANTE
TEST WITH CONSTANT LEVEL

TIEMPO/TIME (min.)	VOL. (lts)	ACC.VOL. (lts)	Q (lts/min)
1	1.25	1.25	1.25
2	1.10	2.35	1.10
4	1.90	4.25	0.95
6	1.80	6.05	0.90
8	1.75	7.80	0.88
10	1.70	9.50	0.85
15	4.00	13.50	0.80
20	3.85	17.35	0.77
25	3.80	21.15	0.76
30	3.80	24.95	0.76
35	3.75	28.70	0.75
40	3.80	32.50	0.76
45	3.80	36.30	0.76
50	3.80	40.10	0.76
55	3.80	43.90	0.76
60	3.80	47.70	0.76

ENSAYO DE DESCENSO
DESCENT TEST

TIEMPO/TIME (min.)	h (m)
1	0.06
2	0.11
4	0.17
6	0.23
8	0.28
10	0.33
15	0.52
20	0.64
25	0.73
30	0.80

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = [Q / (2 \times 3.1415927 \times L \times x \times H)] \times \{ \ln[(2 \times L) / O] \}$$

Q= 12.67 cm³/sec
 r= 4.94 cm
 H= 450.00 cm
 L= 300.00 cm
 K= 6.132E-05 cm/sec

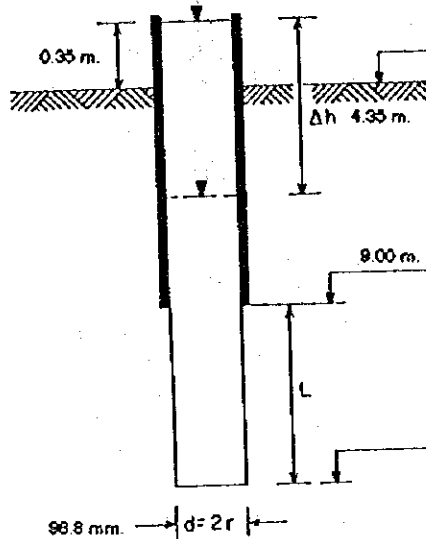


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	12-12-93
PERFORM BY:	RB



0.00 ENSAYO DE PERMEABILIDAD TIPO LEFRANC

SONDEO/SOUNDING:
 ENSAYO No./TEST No.:
 PROF./DEPTH:
 TRAMO ENS./TESTED TRACT:
 DIAM.SONDEO/SOUNDING DIAMETER
 REVESTIMIENTO/CASING:
 N.FREATICO/GROUNDWATER LEVEL:
 12.00 m.

PERMEABILITY FIELD TEST LEFRANC

MG-933
 4
 12.00 m.
 3.00 m.
 98.8 mm.
 DIAM./DIAMETER: HW=101.6 mm
 LONG./LENGTH: 9.00 m.
 ANTES/BEFORE: 4.00 m.

PRUEBA A NIVEL CONSTANTE TEST WITH CONSTANT LEVEL

TIEMPO/TIME (min.)	VOL. (lts)	ACC.VOL. (lts)	Q (lts/min)
1	1.13	1.13	1.13
2	1.00	2.13	1.00
4	1.70	3.83	0.85
6	1.60	5.43	0.80
8	1.50	6.93	0.75
10	1.50	8.43	0.75
15	3.75	12.18	0.75
20	3.75	15.93	0.75
25	3.75	19.68	0.75
30	3.75	23.43	0.75
35	3.75	27.18	0.75
40			
45			
50			
55			
60			

ENSAYO DE DESCENSO DESCENT TEST

TIEMPO/TIME (min)	h (m)
1	0.07
2	0.11
4	0.21
6	0.30
8	0.39
10	0.48
15	0.68
20	0.82
25	1.00
30	1.16

FORMULAS Y CALCULOS/FORMULAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

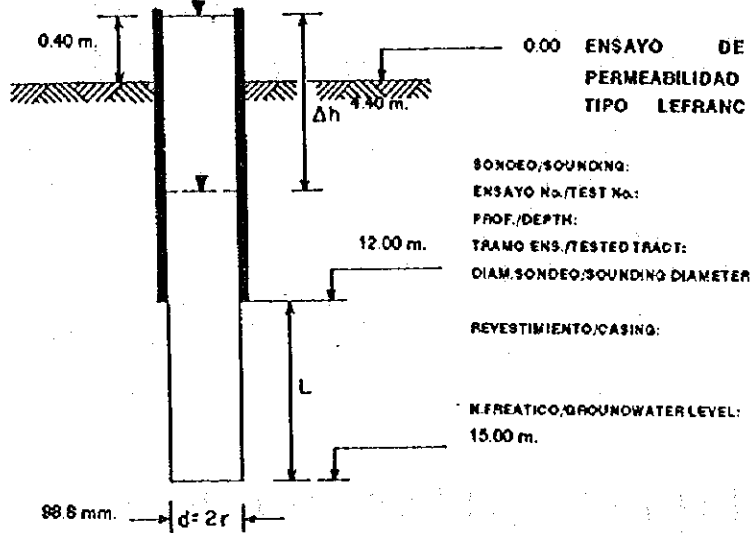
$$K = \frac{Q}{(2 \times 3.1415927 \times r \times L \times H)} \times \left[\ln\left(\frac{2 \times L}{D}\right) \right]$$

Q= 12.50 cm³/sec
 r= 4.94 cm
 H= 435.00 cm
 L= 300.00 cm
 K= 6.260E-05 cm/sec



Hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	13-12-93
PERFORM BY:	PB



**PERMEABILITY
FIELD TEST
LEFRANC**

MG 93-3
5
15.00 m.
3.00 m.
98.6 mm.
DIAM./DIAMETER: HW=101.6 mm
LONG./LENGTH: 12.40 m.
ANTES, BEFORE: 4.00 m.

**PRUEBA A NIVEL CONSTANTE
TEST WITH CONSTANT LEVEL**

TIEMPO/TIME (min.)	VOL. (lts)	ACC.VOL (lts)	Q (lts/min)
1	0.85	0.85	0.85
2	0.85	1.70	0.85
4	1.60	3.30	0.80
6	1.60	4.90	0.80
8	1.60	6.50	0.80
10	1.60	8.10	0.80
15	3.80	11.90	0.76
20	3.65	15.75	0.77
25	3.80	19.55	0.76
30	3.80	23.35	0.76
35	3.80	27.15	0.76
40			
45			
50			
55			
60			

**ENSAYO DE DESCENSO
DESCENT TEST**

TIEMPO/TIME (min.)	h (m)
1	0.09
2	0.17
4	0.32
6	0.46
8	0.59
10	0.71
15	1.02
20	1.30
25	1.55
30	1.78

FORMULAS Y CALCULOS/FORMLAS AND CALCULATIONS:

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = [Q / (2 \times 3.1415927 \times r \times x \times H)] \times \{ \ln[(2 \times L) / D] \}$$

Q=	12.87	cm ³ /sec
r=	4.94	cm
H=	440.00	cm
L=	300.00	cm
K=	6.272E-03	cm/sec

128



PERMEABILITY FIELD LUGEON TEST

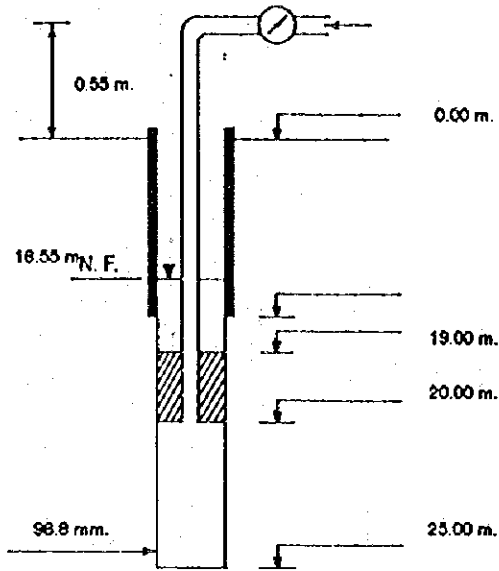


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	29-11-93
PERFORM BY:	RS



ENSAYO DE PERMEABILIDAD FIELD TEST

TIPO LUGEON LUGEON

SONDEO/SOUNDING:	OP-93-1
ENSAYO No./TEST No.:	1
PROF./DEPTH:	25.00m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	ACKER MOINO
TIPO/TYPE:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/119262
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	SW
LONGITUD/LENGTH:	19.55 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 18.55 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	8.0Kg/cm ²	4.0Kg/cm ²	1.0Kg/cm ²
1	0.00	14.00	23.00	15.00	3.
2	2.00	14.00	24.00	15.00	3.
3	1.00	14.00	23.00	15.00	3.
4	1.00	14.00	23.00	15.00	3.
5	2.00	14.00	24.00	15.00	3.
6	2.00	15.00	23.00	15.00	3.
7	2.00	15.00	23.00	15.00	3.
8	3.00	15.00	24.00	15.00	3.
9	1.00	15.00	24.00	15.00	3.
10	3.00	15.00	24.00	15.00	3.

CAUDAL/FLOW (lts./min)	1.7000	14.5000	23.5000	15.0000	3.00
C. ESP./SPECIFIC FLOW (lts./min.m.)	0.3400	2.9000	4.7000	3.0000	0.60
PRESION TOTAL/TOTAL PRESSURE	2.9100	5.9100	9.9100	5.9100	2.91
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0060	0.0070	0.0060	0.00
PRESION NETA/NET PRESSURE	2.9100	5.9040	9.9030	5.9040	2.90
UNID. LUGEON/LUGEON UNIT	1.1684	4.9119	4.7460	3.0813	2.06
PERMEAS. K/K PERMEABILITY (cm/sec)	1.216E-05	5.113E-05	4.940E-05	5.289E-05	2.147E-

FORMULAS:

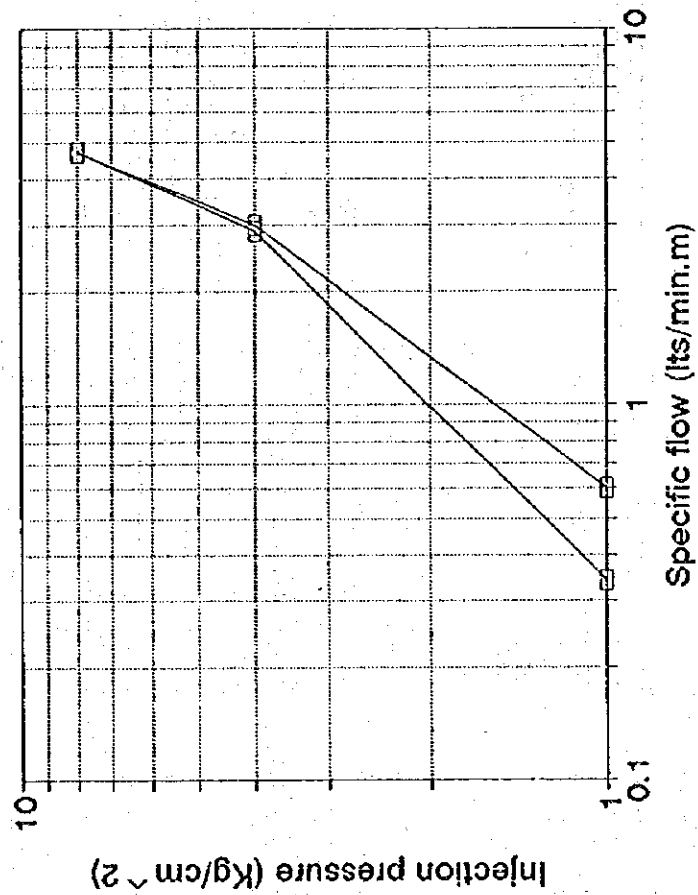
UNIDAD LUGEON/LUGEON UNIT:
 $LU = (q \times 1E6) / (L \times H)$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$
 cuando/when: $L \geq 10r$
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \text{Sinh}^{-1}(L/2r) \} \times [L/(2 \times r)]$
 cuando/when: $10r > L \geq r$



DP-93-1

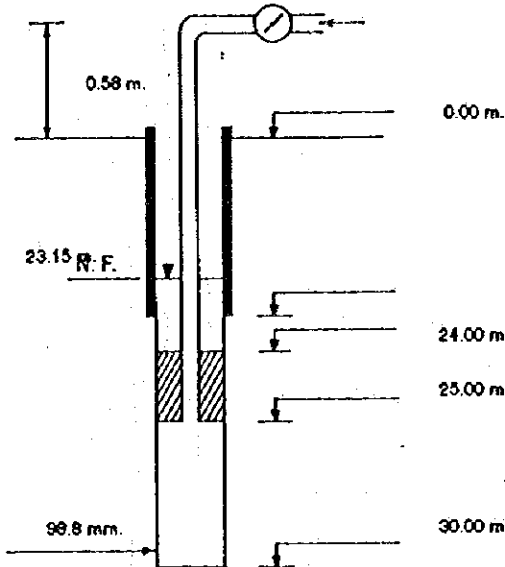
LUGEON: 20.00 - 25.00 m





hidrosuelos Cia. Ltda.
QUITO EQUADOR

FOLIO/SHEET:	1/1
FECHA/DATE:	30-11-93
PERFORM BY:	RB



ENSAYO DE PERMEABILIDAD
PERMEABILIDAD FIELD TEST
TIPO LUGEON LUGEON

SONOEO/SOUNDING: DP-93-1
 ENSAYO No./TEST No.: 2
 PROF./DEPTH: 30.00m
 TRAMO ENS./TESTED TRACT: 5.00 m.
 BOMBA/PUMP: ACKER MOINO
 TIPO/TYPE: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119262
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD/LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD/LENGTH: 24.58 m.
 N. FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 23.15 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	5.0Kg/cm ²	4.0Kg/cm ²	1.0Kg/cm ²
1	34.00	57.00	85.00	44.00	35.1
2	34.00	57.00	85.00	44.00	35.1
3	34.00	56.00	85.00	44.00	35.1
4	35.00	57.00	85.00	45.00	35.1
5	35.00	57.00	85.00	44.00	35.1
6	34.00	56.00	85.00	44.00	35.1
7	34.00	57.00	85.00	44.00	35.1
8	35.00	57.00	85.00	44.00	35.1
9	34.00	57.00	85.00	44.00	35.1
10	35.00	57.00	85.00	44.00	35.1

CAUDAL/FLOW(lts/min)	34.4000	56.8000	85.0000	44.1000	35.00
C. ESP./SPECIFIC FLOW(lts/min.m.)	6.8900	11.3600	17.0000	8.8200	7.00
PRESION TOTAL/TOTAL PRESSURE	3.3730	6.3730	7.3730	6.3730	3.37
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0175	0.0300	0.0650	0.0200	0.01
PRESION NETA/NET PRESSURE	3.3555	6.3430	7.3080	6.3530	3.35
UNID. LUGEON/LUGEON UNIT	20.5037	17.9095	23.2622	13.6832	20.86
PERMEAB. K/K PERMEABILITY (cm ² /sec)	2.134E-04	1.864E-04	2.421E-04	1.445E-04	2.171E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E3) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left(\frac{q \times 1E3}{2 \times 3.1415927 \times L \times H \times 60} \right) \times \ln(L/r)$$

cuando/when: $L > 10r$

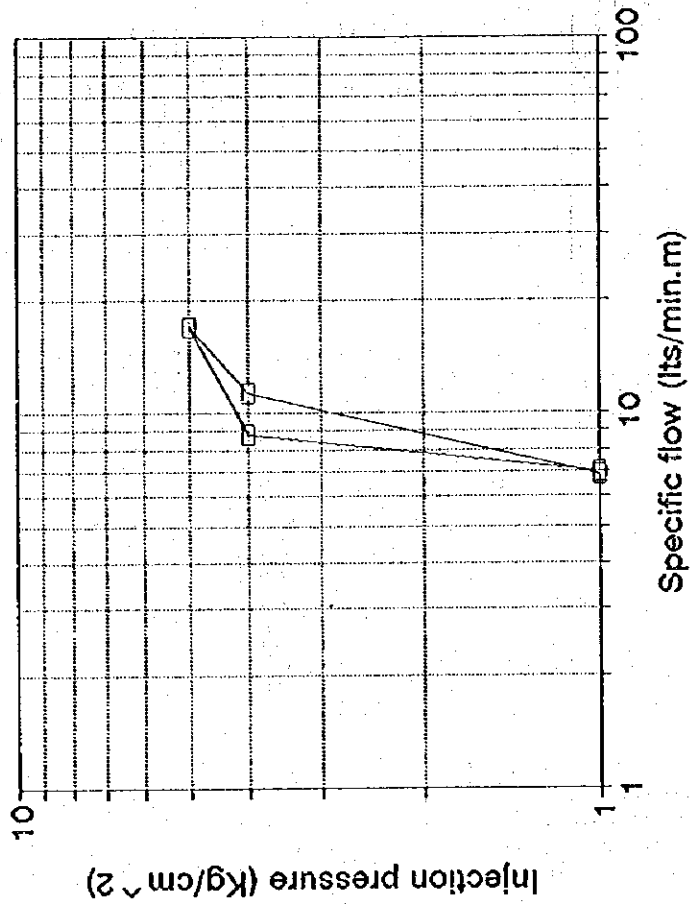
$$K = \left(\frac{q \times 1E3}{2 \times 3.1415927 \times L \times H \times 60} \right) \times \sinh^{-1}(L/2r) \times [L/(2\pi r)]$$

cuando/when: $10r > L > r$



DP-93-1

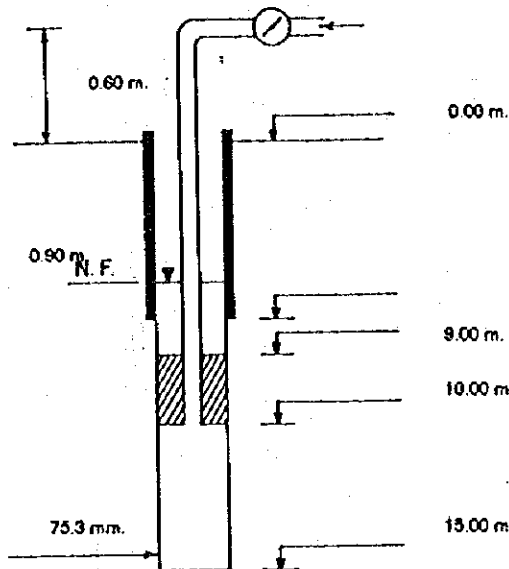
LUGEON: 25.00 - 30.00 m





hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 29-11-93
PERFORM BY: RB



ENSAYO DE PERMEABILIDAD TIPO LUGEON
DE FIELD TEST LUGEON

SONDEO/SOUNDING: DP-93-2
ENSAYO No./TEST No.: 1
PROF./DEPTH: 15.00m
TRAMO ENS./TESTED TRACT: 5.00m.
BOMBA/PUMP: AGRALE
TIPO/TYPE: PISTON
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119262
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGTH: 1.00m.
TUBERÍA/PIPE: BW
LONGITUD/LENGTH: 9.60m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 0.90m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	15.00	45.00	90.00	55.00	25.00
2	15.00	45.00	95.00	55.00	25.00
3	15.00	42.00	90.00	55.00	25.00
4	15.00	45.00	90.00	55.00	25.00
5	14.00	46.00	85.00	55.00	25.00
6	16.00	47.00	90.00	55.00	25.00
7	16.00	45.00	95.00	55.00	25.00
8	13.00	46.00	90.00	55.00	25.00
9	16.00	45.00	90.00	55.00	25.00
10	15.00	47.00	90.00	55.00	25.00

CAUDAL/FLOW (lts/min)	15.2000	45.3000	90.5000	55.0000	25.0000
C. ESP./SPECIFIC FLOW (lts./min.m.)	3.0400	9.0600	18.1000	11.0000	5.0000
PRESION TOTAL/TOTAL PRESSURE	1.1500	3.1500	5.1500	3.1500	1.1500
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0020	0.0090	0.0300	0.0100	0.0040
PRESION NETA/NET PRESSURE	1.1480	3.1420	5.1200	3.1400	1.1460
UNID. LUGEON/LUGEON UNIT	26.4806	28.8351	35.3516	35.0318	43.6300
PERMEAB. K/K PERMEABILITY (cm/sec)	2.847E-04	3.209E-04	3.934E-04	3.699E-04	4.656E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

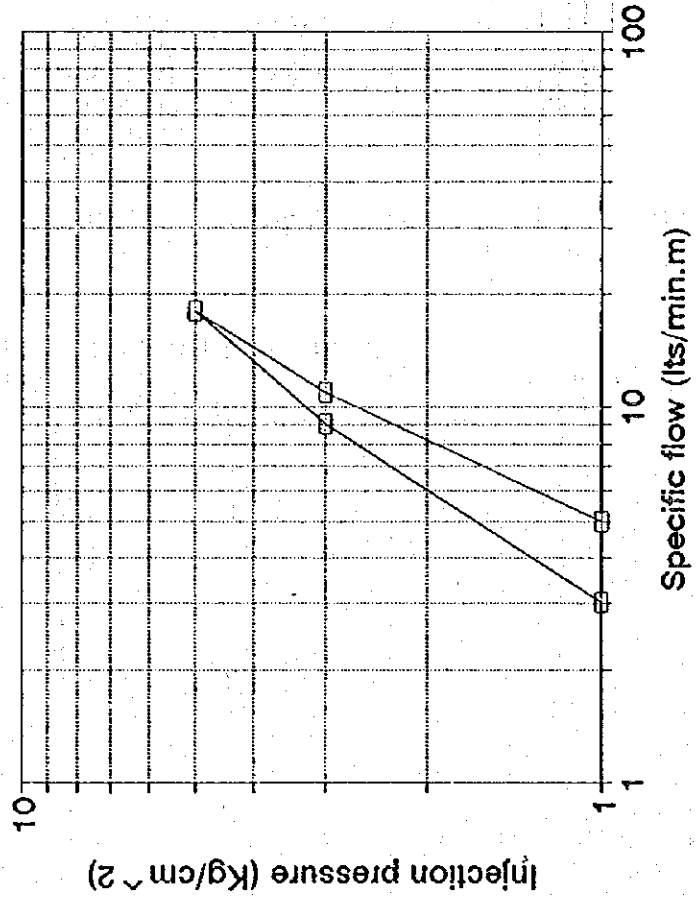
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \sinh^{-1}(L/2r) \times [L/(2 \times r)]$$

cuando/when: $10r > L > r$



DP-93-2

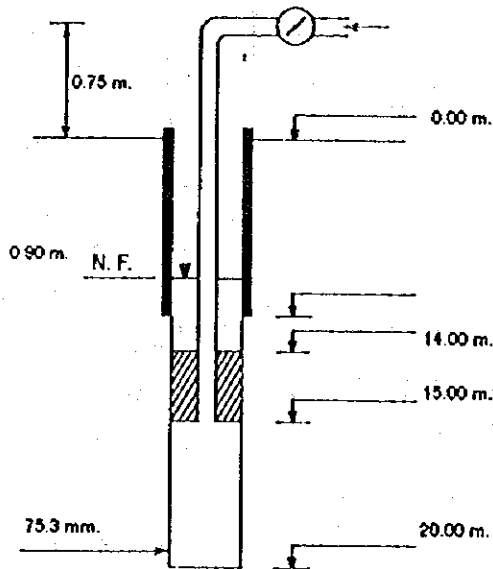
LUGEON: 10.00 - 15.00 m





hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 29-11-93
PERFORM BY: RB



ENSAYO DE PERMEABILIDAD TIPO LUGEON DE **PERMEABILITY FIELD TEST LUGEON**

SONDEO/SOUNDING: DP-93-2
ENSAYO No./TEST No.: 2
PROF./DEPTH: 20.00m
TRAMO ENS./TESTED TRACT: 5.00m.
BOMBA/PUMP: AGRALE
TIPO/TYP: PISTON
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119262
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGHT: 1.00m.
TUBERIA/PIPE: BW
LONGITUD/LENGHT: 14.75m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 0.90m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	0.00	1.00	2.00	1.00	0.00
2	1.00	1.00	2.00	0.00	0.00
3	0.00	0.00	2.00	1.00	0.00
4	0.00	1.00	2.00	0.00	0.00
5	1.00	1.00	2.00	1.00	0.00
6	0.00	1.00	1.00	0.00	0.00
7	1.00	0.00	2.00	0.00	0.00
8	0.00	1.00	1.00	1.00	0.00
9	1.00	1.00	2.00	0.00	0.00
10	1.00	1.00	1.00	1.00	0.00

CAUDAL/FLOW(lts/min)	0.5000	0.8000	1.7000	0.5000	0.0500
C. ESP./SPECIFIC FLOW(lts/min.m.)	0.1000	0.1600	0.3400	0.1000	0.0100
PRESION TOTAL/TOTAL PRESSURE	1.1650	3.1650	5.1650	3.1650	1.1650
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0020	0.0060	0.0000	0.0100	0.0040
PRESION NETA/NET PRESSURE	1.1630	3.1570	5.1350	3.1350	1.1610
UNID. LUGEON/LUGEON UNIT	0.8598	0.5068	0.6621	0.3170	0.0861
PERMEAB. K/K PERMEABILITY (cm/sec)	9.370E-06	5.611E-06	7.369E-06	3.528E-06	9.566E-07

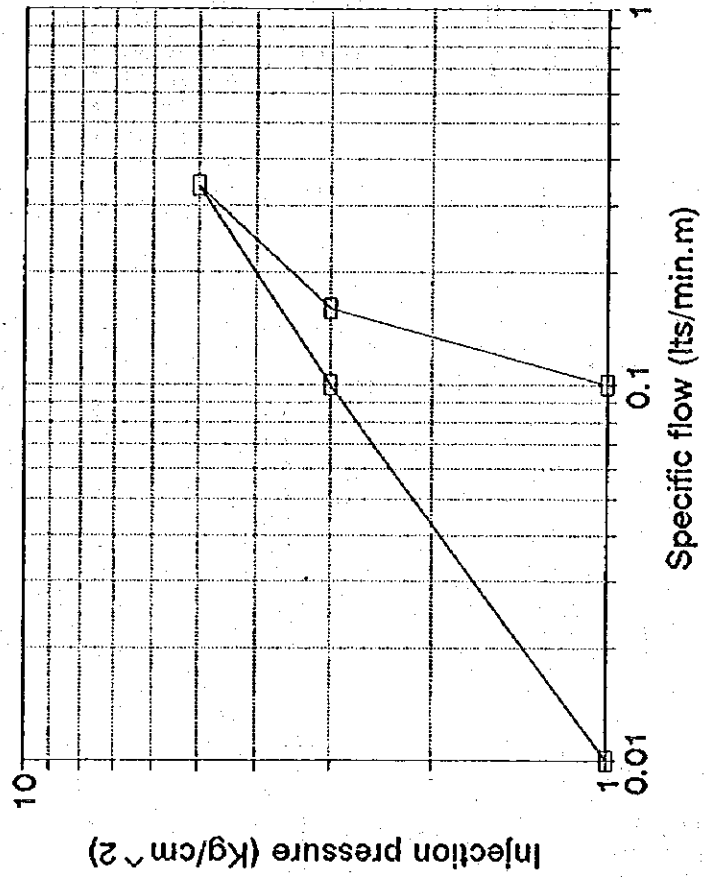
FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:
 $LU = (q \times 1E6) / (L \times H)$
 COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$
 cuando/when: $L \geq 10r$
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \text{Sinh}^{-1}(L/2r) \times [L/(2 \times r)] \}$
 cuando/when: $10r > L > r$



DP-93-2

LUGEON: 15.00 - 20.00 m



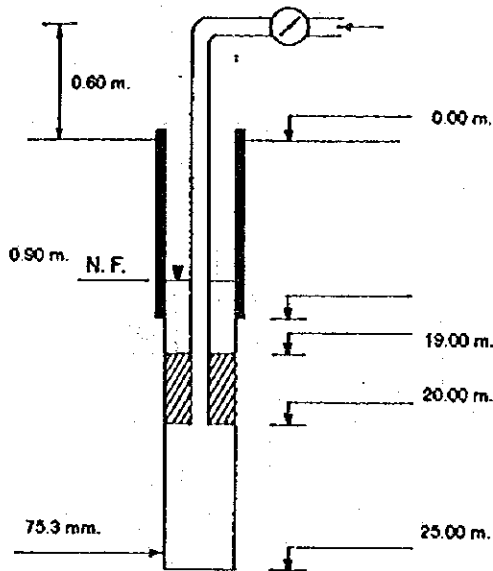


Hidrosuelos Cla. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	29-11-93
PERFORM BY:	CC



ENSAYO DE PERMEABILIDAD TIPO LUGEON

PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING:	DP-83-2
ENSAYO No./TEST No.:	3
PROF./DEPTH:	25.00m
TRAMO ENS./TESTED TRACT:	5.00m
BOMBA/PUMP:	AGRALE
TIPO/TYP:	PISTON
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/118262
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00m
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	19.80m
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 0.90m

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	6.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	0.00	4.00	12.00	6.00	0.00
2	0.00	5.00	12.00	6.00	0.00
3	0.00	5.00	12.00	6.00	0.00
4	1.00	5.00	12.00	6.00	0.00
5	0.00	5.00	12.00	6.00	0.00
6	1.00	5.00	18.00	6.00	0.00
7	0.00	5.00	18.00	6.00	0.00
8	0.00	5.00	17.00	6.00	0.00
9	1.00	5.00	17.00	6.00	0.00
10	0.00	5.00	18.00	6.00	0.50

	0	0	0	0	0
CAUDAL/FLOW (lts/min)	0.3000	4.9000	14.8000	6.0000	0.0500
C. ESP./SPECIFIC FLOW (lts/min.m)	0.0600	0.9800	2.9600	1.2000	0.0100
PRESION TOTAL/TOTAL PRESSURE	1.1500	3.1500	6.1500	3.1500	1.1500
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0010	0.0050	0.0020	0.0000
PRESION NETA/NET PRESSURE	1.1500	3.1490	6.1450	3.1480	1.1500
UNID. LUGEON/LUGEON UNIT	0.5217	3.1121	4.8169	3.8119	0.0870
PERMEAB. K/K PERMEABILITY (cm/sec)	5.607E-06	3.464E-05	5.361E-05	4.242E-05	9.678E-07

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E3) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \text{Sinh}^{-1}(L/2r) \times [L/(2r)]$$

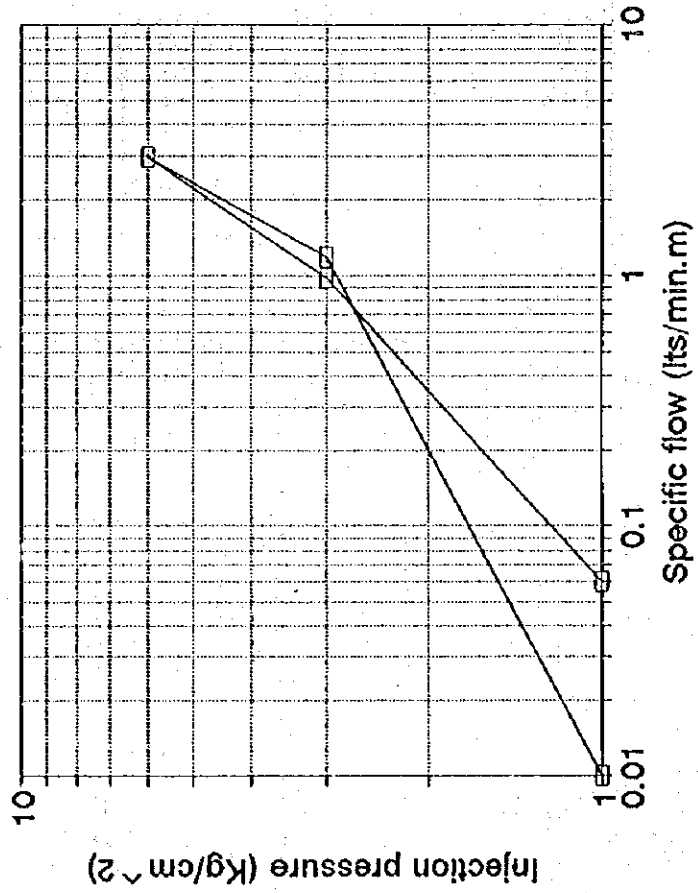
cuando/when: $10r > L > r$

13



DP-93-2

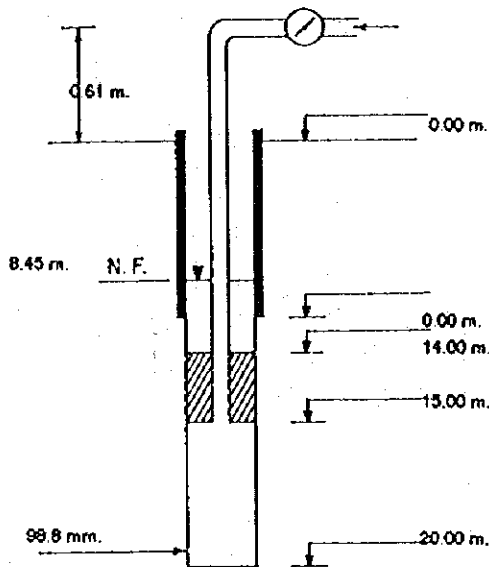
LUGEON: 20.00 - 25.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 21-11-93
PERFORM.BY: CC



ENSAYO DE PERMEABILIDAD TIPO LUGEON DE FIELD TEST LUGEON

SONDEO/SOUNDING: DP-93-3
ENSAYO No./TEST No.: 1
PROF./DEPTH: 20.00 m
TRAMO ENS./TESTED TRACT: 5.00 m
BOMBA/PUMP: ACKER MOINO
TIPO/TYPE: CENTRIFUGA
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119261
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGTH: 1.00 m
TUBERIA/PIPE: BW
LONGITUD/LENGTH: 14.61 m
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 8.45 m

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	2.0Kg/cm ²	4.0Kg/cm ²	2.0Kg/cm ²	1.0Kg/cm ²
1	50.00	68.00	120.00	83.00	62.00
2	60.00	87.00	125.00	84.00	68.00
3	70.00	87.00	125.00	88.00	70.00
4	62.00	88.00	123.00	85.00	65.00
5	69.00	85.00	128.00	89.00	69.00
6	71.00	87.00	124.00	87.00	68.00
7	75.00	90.00	125.00	89.00	68.00
8	63.00	88.00	120.00	87.00	73.00
9	70.00	83.00	116.00	86.00	67.00
10	70.00	86.00	115.00	94.00	70.00

CAUDAL/ FLOW (lbs/min)	68.0000	86.9000	122.1000	87.0000	69.0000
C. ESP./SPECIFIC FLOW (lbs./min.m.)	13.2000	17.3800	24.4200	17.4000	13.6000
PRESION TOTAL/TOTAL PRESSURE	1.9060	2.9060	4.9060	2.9060	1.9060
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0250	0.0400	0.0750	0.0400	0.0250
PRESION NETA/NET PRESSURE	1.8810	2.8660	4.8310	2.8660	1.8810
UNID. LUGEON/LUGEON UNIT	70.1754	60.8420	50.5485	60.7118	72.3020
PERMEAB. K/K PERMEABILITY (cm/sec)	7.305E-04	6.312E-04	5.262E-04	6.319E-04	7.526E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD. COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$$

cuando/when: $L \geq 10r$

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \text{Sinh}^{-1}(L/2r) \} \times [L/(2r)]$$

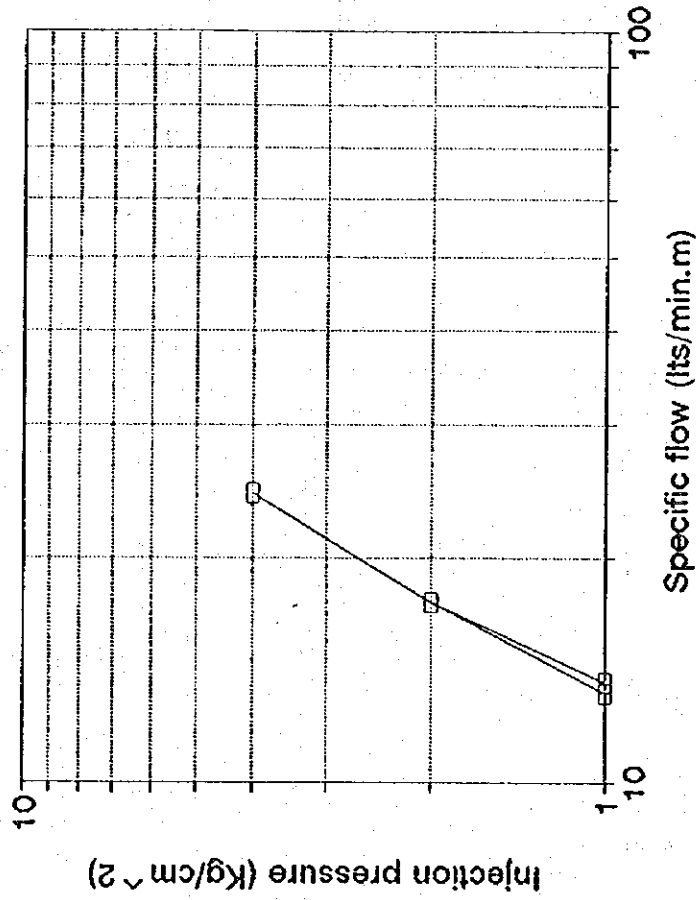
cuando/when: $10r > L \geq r$

141



DP-93-3

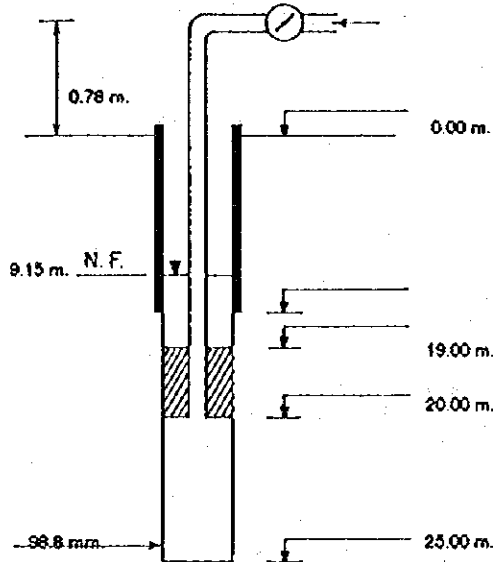
LUGEON: 15.00 - 20.00 m





hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 22-11-93
PERFORM BY: CC



ENSAYO DE PERMEABILIDAD
TIPO LUGEON

PERMEABILITY
FIELD TEST
LUGEON

SONDEO/SOUNDING: DP-93-3
ENSAYO No./TEST No.: 2
PROF./DEPTH: 23.00m
TRAMO ENS./TESTED TRACT: 5.00 m.
BOMBA/PUMP: ACKER MOINO
TIPO/TYP: CENTRIFUGA
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/118261
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGTH: 1.00 m.
TUBERIA/PIPE: BW
LONGITUD/LENGTH: 19.78 m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 9.15 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	6.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	23.00	28.00	47.00	15.00	4.00
2	23.00	31.00	47.00	18.00	5.00
3	11.00	30.00	47.00	15.00	3.00
4	16.00	28.00	49.00	16.00	4.00
5	22.00	29.00	48.00	14.00	2.00
6	21.00	30.00	49.00	10.00	3.00
7	24.00	29.00	49.00	14.00	3.00
8	24.00	30.00	49.00	13.00	2.00
9	22.00	32.00	47.00	11.00	1.00
10	22.00	27.00	42.00	11.00	1.00

CAUDAL/FLOW(lts/min)	21.0000	28.2000	47.4000	13.7000	2.8000
C. ESP./SPECIFIC FLOW(lts/min.m.)	4.2000	5.8400	9.4800	2.7400	0.5600
PRESION TOTAL/TOTAL PRESSURE	1.9930	3.9930	6.9930	3.9930	1.9930
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0060	0.0100	0.0170	0.0060	0.0000
PRESION NETA/NET PRESSURE	1.9850	3.9830	6.9760	3.9870	1.9930
UNID. LUGEON/LUGEON UNIT	21.1587	14.6823	13.5894	6.8723	2.8098
PERMEAB. K/K PERMEABILITY (cm/sec)	2.202E-04	1.526E-04	1.415E-04	7.153E-05	2.925E-05

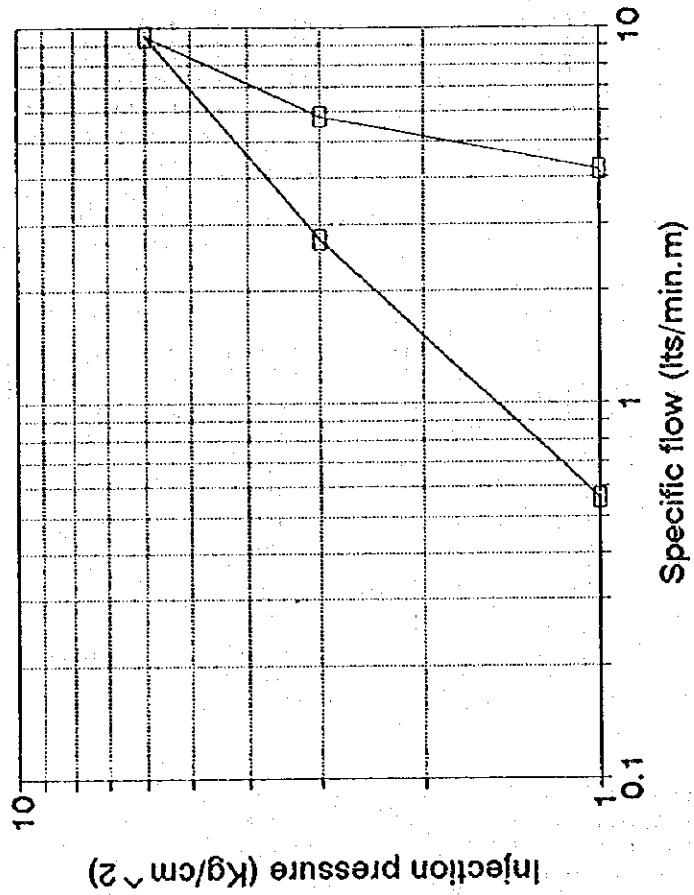
FORMULAS:

UNIDAD LUGEON, LUGEON UNIT:
 $LU = (q \times 1E6) / (L \times H)$
 COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:
 $K = [\{ (q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60) \} \times \ln(L/r)]$
 cuando/when: $L \geq 10r$
 $K = [\{ (q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60) \} \times \text{Sinh}^{-1}(L/2r) \times [L/(2 \times r)]]$
 cuando/when: $10r > L > r$



DP-93-3

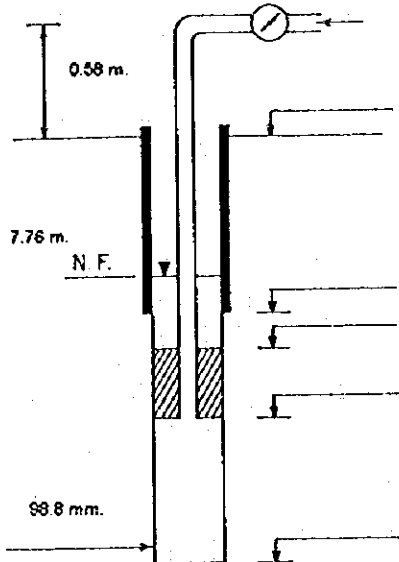
LUGEON: 20.00 - 25.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	23-11-90
PERFORM BY:	CC



ENSAYO DE PERMEABILIDAD
TIPO LUGEON

SONDEO/SOUNDING:	DP-93-3
ENSAYO No./TEST No.:	3
PROF./DEPTH:	30.00m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	ACKER MOINO
TIPO/TYP:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/119
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	24.58 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES, BEFORE:

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE (Kg/cm ²)							
	1.0	4.0	7.0	10.0	7.0	4.0	1.0	
1	0.00	0.00	4.00	4.00	1.00	0.00	0.00	
2	0.00	0.00	3.00	3.00	0.00	0.00	0.00	
3	0.00	0.00	2.00	3.00	0.00	0.00	0.00	
4	0.00	0.00	2.00	3.00	0.00	0.00	0.00	
5	0.00	0.00	2.00	3.00	0.00	0.00	0.00	
6	0.00	0.00	1.00	3.00	0.00	0.00	0.00	
7	0.00	0.00	2.00	3.00	0.00	0.00	0.00	
8	0.00	0.00	2.00	3.00	0.00	0.00	0.00	
9	0.00	0.00	1.00	3.00	0.00	0.00	0.00	
10	0.01	0.01	2.00	3.00	0.00	0.01	0.01	

CAUDAL/FLOW (lts./min)	0.001	0.001	2.100	3.100	0.100	0.001	0.001
C. ESP./SPECIFIC FLOW (lts./min.m.)	0.000	0.000	0.420	0.620	0.020	0.000	0.000
PRESION TOTAL/TOTAL PRESSURE	1.834	4.834	7.834	10.834	7.834	4.834	1.834
PERD. CARGA/LOST LOAD (kg/cm ²)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PRESION NETA/NET PRESSURE	1.834	4.834	7.834	10.834	7.834	4.834	1.834
UNID. LUGEON/LUGEON UNIT	0.001	0.000	0.536	0.572	0.026	0.000	0.001
PERMEAB. K/K PERMEABILITY (cm/sec)	1.135E-08	4.307E-09	5.58E-06	5.937E-06	2.66E-07	4.31E-09	1.135E-08

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$$

cuando/when: $L \geq 10r$

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \sinh^{-1}(L/2r) \} \times [L/(2r)]$$

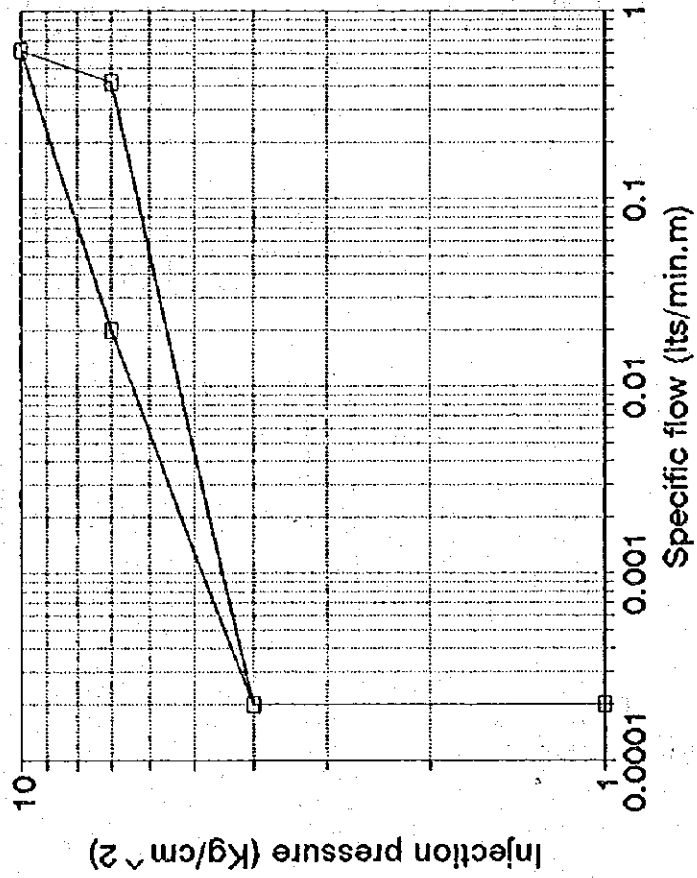
cuando/when: $10r > L \geq r$

145



DP-93-3

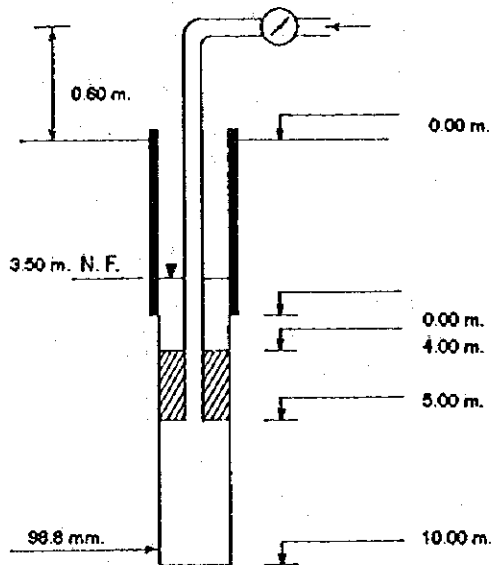
LUGEON: 25.00 - 30.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	19-12-93
PERFORM BY:	FV



ENSAYO DE PERMEABILIDAD
PERMEABILIDAD FIELD TEST
TIPO LUGEON LUGEON

SONDEO/SOUNDING:	SR 93-2
ENSAYO No./TEST No.:	1.
PROF., DEPTH:	10.00m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	ACKER MOINO APS727
TIPO/TYPE:	CENTRIFUGA,
MANOMETRO/MANOMETER:	1-A
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER.:	007N001
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGHT:	1.00 m.
TUBERIA/PIPE.:	BW
LONGITUD/LENGHT:	4.60 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 3.50 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	0.5Kg/cm ²	1.0Kg/cm ²	1.5Kg/cm ²	1.0Kg/cm ²	0.5Kg/cm ²
1	50.00	68.00	84.00	71.00	51.00
2	50.00	70.00	84.00	79.00	51.00
3	48.00	70.00	85.00	74.00	50.00
4	50.00	66.00	87.00	75.00	50.00
5	47.00	69.00	88.00	73.00	49.00
6	53.00	72.00	87.00	73.00	49.00
7	47.00	65.00	89.00	73.00	51.00
8	49.00	70.00	90.00	71.00	50.00
9	48.00	69.00	89.00	74.00	49.00
10	50.00	69.00	90.00	72.00	48.00

CAUDAL/ FLOW (lts./min)	49.0000	68.8000	87.3000	73.5000	49.8000
C. ESP./ SPECIFIC FLOW (lts./min.m.)	9.8000	13.7600	17.4600	14.7000	9.9600
PRESION TOTAL/TOTAL PRESSURE	0.9100	1.4100	1.9100	1.4100	0.9100
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0050	0.0100	0.0150	0.0130	0.0050
PRESION NETA/NET PRESSURE	0.9050	1.4000	1.8950	1.3970	0.9050
UNID. LUGEON LUGEON UNIT	108.2873	98.2857	92.1372	105.2255	110.0552
PERMEAB. K/K PERMEABILITY (cm/Sec)	1.127E-03	1.023E-03	9.591E-04	1.055E-03	1.146E-03

FORMULAS:

UNIDAD LUGEON LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

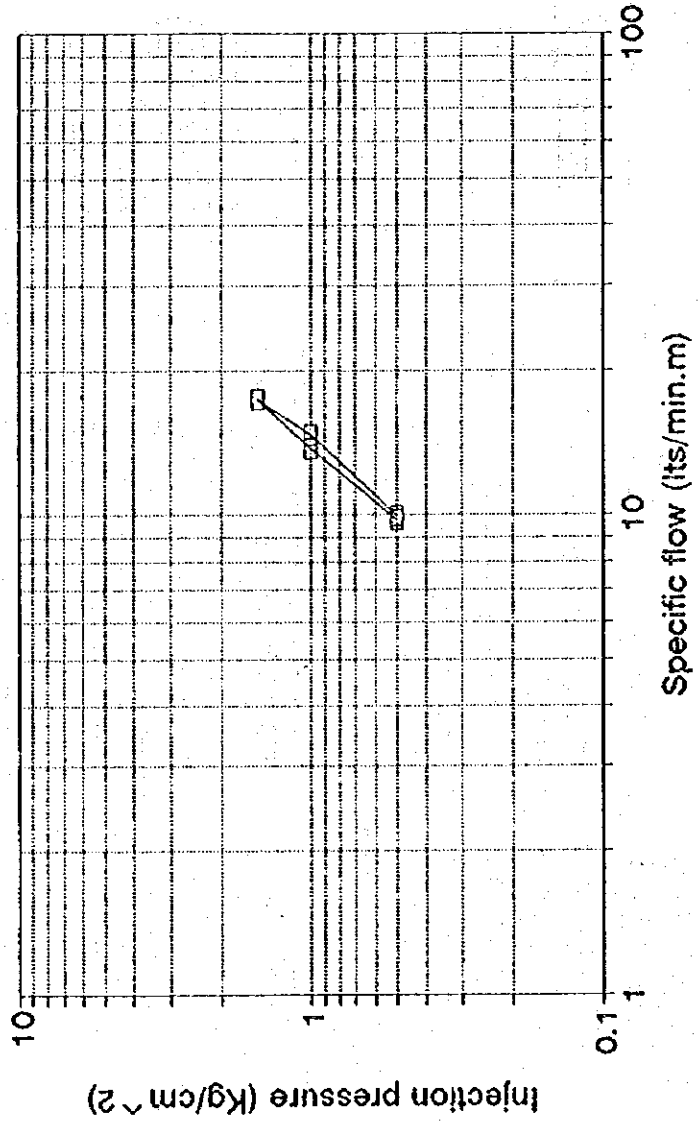
cuando/when: $L >= 10r$

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \text{Sinh}^{-1}(L/2r) \times [L/(2xr)]$$

cuando/when: $10r > L >= r$



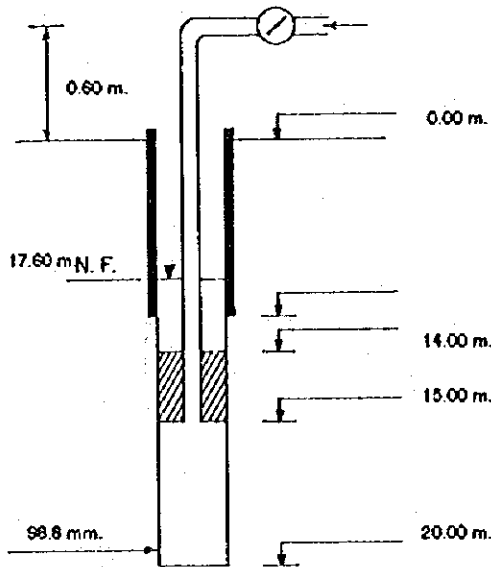
SR-93-2
LUGEON: 5.00 - 10.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	05-01-94
PERFORM BY:	RB



ENSAYO DE PERMEABILIDAD
PERMEABILIDAD FIELD TEST
TIPO LUGEON LUGEON

SONDEO/SOUNDING: SR-93-3
 ENSAYO No./TEST No.: 1
 PROF./DEPTH: 20.00m
 TRAMO ENS./TESTEO TRACT.: 5.00 m.
 BOMBA/PUMP: ACKER MOINO APS325
 TIPO/TYPER: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/1192621
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD./LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD./LENGTH: 14.60 m.
 NIVEL FREATICO/GROUNDWATER LEVEL: ANTES, BEFORE: 17.60 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	2.0Kg/cm ²	3.0Kg/cm ²	2.0Kg/cm ²	1.0Kg/cm ²
1	11.00	35.00	100.00	62.00	21.00
2	11.00	35.00	95.00	63.00	21.00
3	11.00	35.00	95.00	65.00	22.00
4	11.00	35.00	95.00	65.00	21.00
5	11.00	35.00	95.00	65.00	22.00
6	11.00	35.00	95.00	65.00	22.00
7	12.00	35.00	95.00	65.00	21.00
8	12.00	35.00	95.00	63.00	21.00
9	11.00	35.00	95.00	65.00	21.00
10	11.00	35.00	95.00	65.00	21.00

CAUDAL/FLOW(lts/min)	11.2000	35.0000	95.5000	64.7000	21.3000
C. ESP./SPECIFIC FLOW(lts/min.m.)	2.2400	7.0000	19.1000	12.9400	4.2600
PRESION TOTAL/TOTAL PRESSURE	2.8200	3.8200	4.8200	3.8200	2.8200
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0020	0.0090	0.0500	0.0250	0.0030
PRESION NETA/NET PRESSURE	2.8180	3.8110	4.7700	3.7950	2.8170
UNID. LUGEON/LUGEON UNIT	7.9469	18.3879	40.0419	34.0975	15.1221
PERMEAB. K/K PERMEABILITY (cm/sec)	8.274E-05	1.912E-04	4.168E-04	3.549E-04	1.574E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY:

$$K = \left\{ \frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right\} \times \ln(L/r)$$

cuando/when: $L >= 10r$

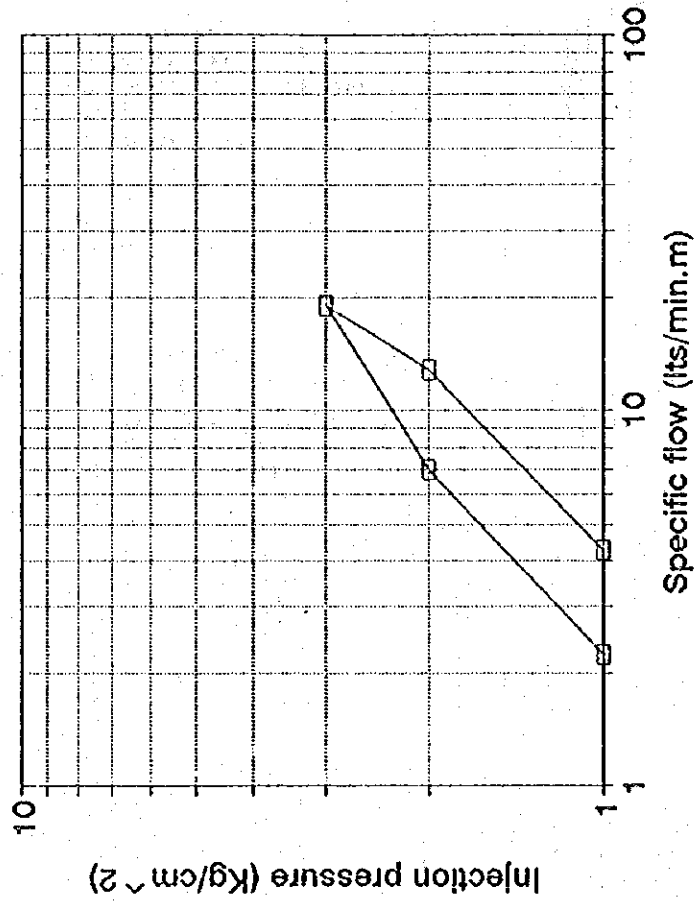
$$K = \left\{ \frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right\} \times \sinh^{-1}(L/2r) \times [L/(2 \times r)]$$

cuando/when: $10r > L >= r$



SR-93-3

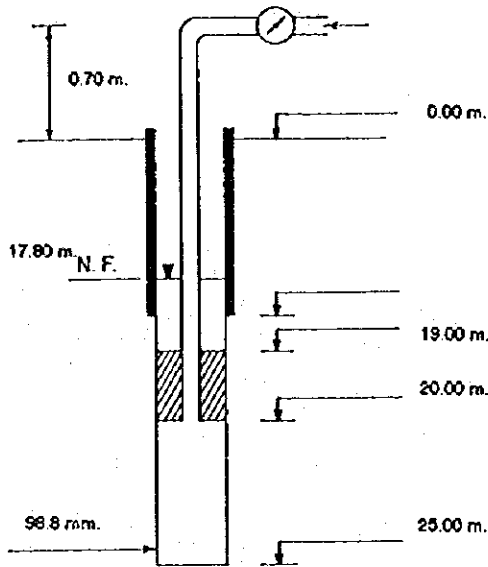
LUGEON: 15.00 - 20.00 m





hidrosuelos Cia. Ltda.
QUITO EQUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 05-01-94
PERFORM BY: cc



ENSAYO DE PERMEABILIDAD TIPO LUGEON DE PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING: SR-93-3
ENSAYO No./TEST No.: 2
PROF./DEPTH: 25.00m
TRAMO ENS./TESTED TRACT: 5.00 m.
BOMBA/PUMP: ACKER MOINO AFS525
TIPO/TYPE: CENTRIFUGA
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 61/1192621
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGTH: 1.00 m.
TUBERIA/PIPE: BW
LONGITUD/LENGTH: 19.70 m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 17.80 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	1.00	2.00	59.00	31.00	7.00
2	0.00	1.00	71.00	31.00	7.00
3	0.00	1.00	68.00	32.00	5.00
4	0.00	2.00	70.00	30.00	5.00
5	0.00	1.00	66.00	30.00	5.00
6	0.00	1.00	66.00	31.00	5.00
7	0.00	1.00	67.00	24.00	5.00
8	0.00	1.00	73.00	31.00	5.00
9	0.00	1.00	70.00	32.00	5.00
10	0.00	1.00	69.00	31.00	5.00

CAUDAL/FLOW(lts/min)	0.1000	1.2000	67.6000	30.3000	5.4000
C. ESP./SPECIFIC FLOW(lts/min.m.)	0.0200	0.2400	13.5600	6.0600	1.0600
PRESION TOTAL/TOTAL PRESSURE	2.8500	4.8500	6.8500	4.8500	2.8500
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0000	0.0350	0.0100	0.0010
PRESION NETA/NET PRESSURE	2.8500	4.8500	6.8150	4.8400	2.8490
UNID. LUGEON/LUGEON UNIT	0.0702	0.4948	19.6973	12.5207	3.7908
PERMEAB. K/K PERMEABILITY (cm/sec)	8.565E-07	6.061E-06	2.437E-04	1.533E-04	4.643E-05

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \} \times \ln(L/r)$$

cuando/when: $L \geq 10r$

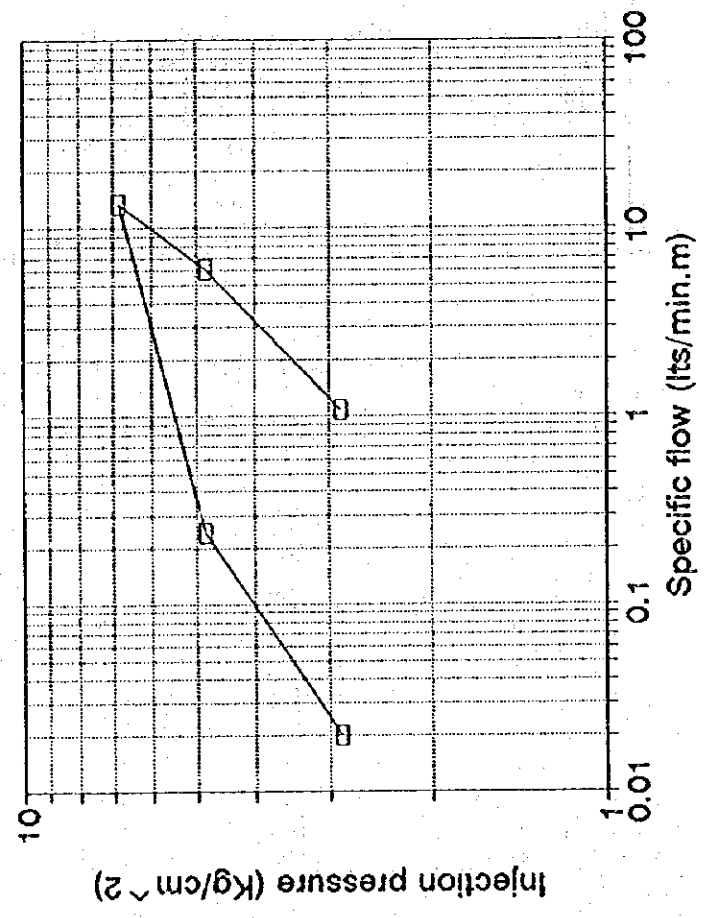
$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \} \times \sinh^{-1}(L/2r) \times [L/(2\pi r)]$$

cuando/when: $10r > L > r$



SR-93-3

LUGEON: 20.00 - 25.00 m



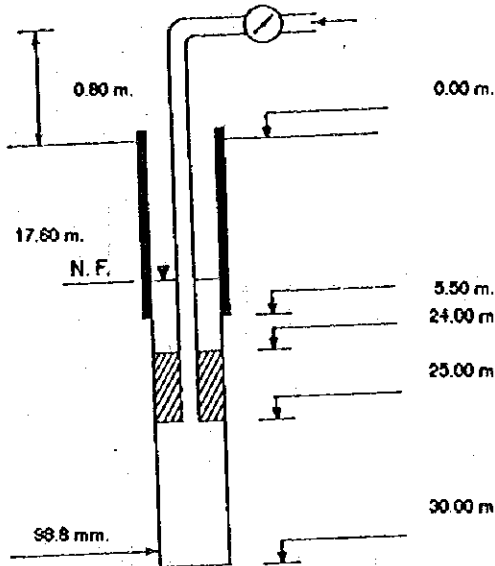


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	07-01-94
PERFORM BY:	CC



ENSAYO DE PERMEABILIDAD TIPO LUGEON
DE PERMEABILIDAD FIELD TEST LUGEON

SONDEO/SOUNDING:	SR-933
ENSAYO No./TEST No.:	3
PROF./DEPTH:	30.00m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	ACKER MOINO APS525
TIPO/TYPE:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/1192621
OBSTUPADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	24.80 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES, BEFORE: 17.60 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	2.0Kg/cm ²	4.0Kg/cm ²	6.0Kg/cm ²	7.0Kg/cm ²
1	1.00	1.00	1.00	1.00	125.00
2	0.00	0.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.00	1.00
4	1.00	0.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	0.00	1.00	1.00
7	0.00	1.00	1.00	1.00	1.00
8	1.00	1.00	0.00	1.00	1.00
9	0.00	1.00	0.00	1.00	1.00
10	1.00	0.00	0.00	1.00	1.00

CAUDAL FLOW (lts/min)	0.7000	0.7000	0.6000	1.0000	125.0000
C. ESP./SPECIFIC FLOW (lts/min m.)	0.1400	0.1400	0.1200	0.2000	25.0000
PRESION TOTAL/TOTAL PRESSURE	2.8400	3.8400	5.8400	7.8400	8.8400
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0000	0.0000	0.0000	0.0350
PRESION NETA/NET PRESSURE	2.8400	3.8400	5.8400	7.8400	8.7650
UNID. LUGEON/LUGEON UNIT	0.4930	0.3646	0.2053	0.2531	28.4576
PERMEAB. K/K PERMEABILITY (cm/sec)	6.038E-06	4.465E-06	2.517E-06	3.124E-06	3.485E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

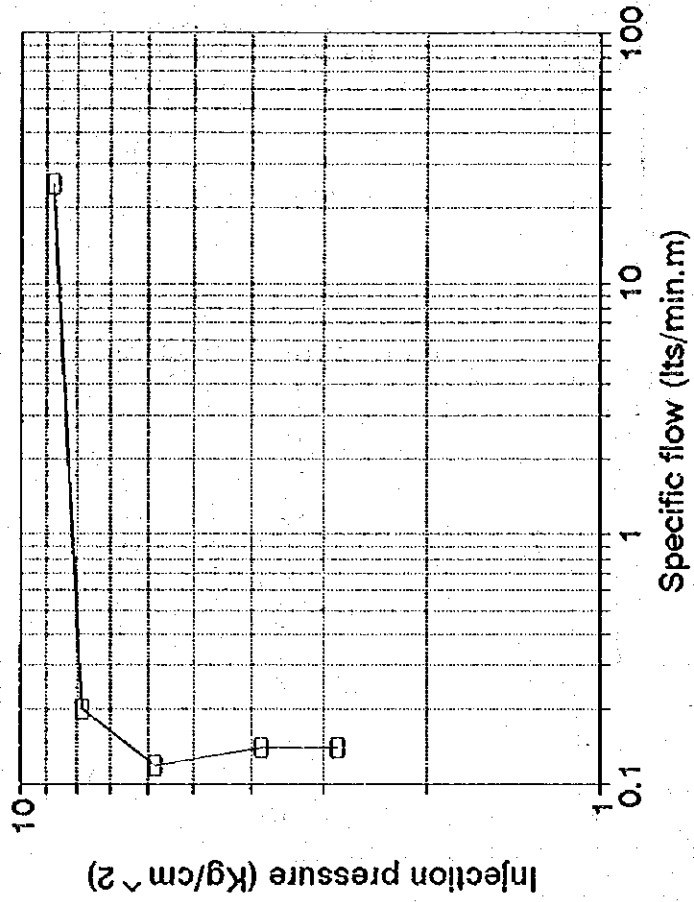
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \sinh^{-1}(L/2r) \times [L/(2 \times r)]$$

cuando/when: $10r > L \geq r$



SR-93-3

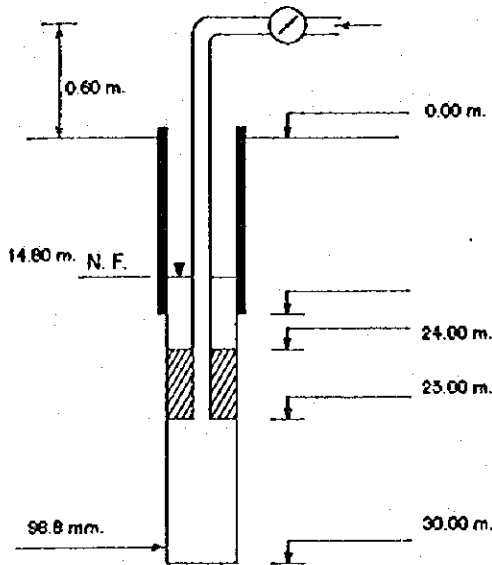
LUGEON: 25.00 - 30.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 03-12-9
PERFORM BY: RB



ENSAYO DE PERMEABILIDAD TIPO LUGEON

PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING: SR-93-4
 ENSAYO No./TEST No.: 1
 PROF./DEPTH: 30.00m
 TRAMO ENS./TESTED TRACT: 5.00 m.
 BOMBA/PUMP: LOMBARDINNI
 TIPO/TYP: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/1192622
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD/LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD/LENGTH: 24.60 m.
 NIVEL AGUA/GROUNDWATER LEVEL: ANTES/BEFORE: 14.60 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE					
	1.0Kg/cm ²	3.0Kg/cm ²	6.0Kg/cm ²	10.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	0.00	0.00	0.00	65.00	116.00	40.00
2	0.00	0.00	0.00	180.00	114.00	40.00
3	0.00	0.00	0.00	0.00	115.00	40.00
4	0.01	0.00	0.00	0.00	116.00	38.00
5	0.00	0.00	0.00	0.00	114.00	42.00
6	0.00	0.00	0.00	0.00	115.00	40.00
7	0.00	0.00	0.00	0.00	115.00	40.00
8	0.00	0.00	0.00	0.00	117.00	41.00
9	0.00	0.00	0.00	0.00	113.00	39.00
10	0.00	0.10	0.10	0.00	115.00	42.00

CAUDAL/FLOW (lts./min)	0.0010	0.0100	0.0100	160.0000	115.0000	40.2000
C. ESP./SPECIFIC FLOW (lts./min.m.)	0.0002	0.0020	0.0020	36.0000	23.0000	8.0400
PRESION TOTAL/TOTAL PRESSURE	2.5400	4.5400	7.5400	11.5400	4.5400	2.5400
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0000	0.0000	0.2500	0.1100	0.0180
PRESION NETA/NET PRESSURE	2.5400	4.5400	7.5400	11.2900	4.4300	2.5220
UNID. LUGEON/LUGEON UNIT	0.0006	0.0044	0.0027	31.8866	51.9187	31.8785
PERMEAB. K/K PERMEABILITY (cm/sec)	9.644E-09	5.395E-08	3.249E-08	3.905E-04	6.359E-04	3.904E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:
 $LU = (q \times 1E6) / (L \times H)$
 COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$
 cuando/when: $L \geq 10r$
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \sinh^{-1}(L/2r) \} \times [L/(2 \times r)]$
 cuando/when: $10r > L > r$

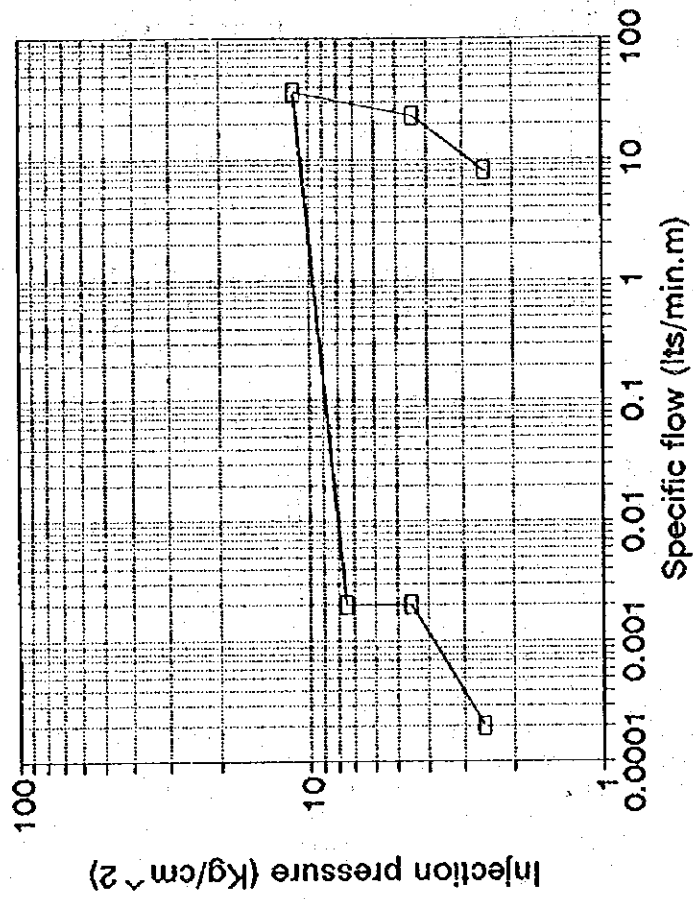
OBSERVACIONES/NOTES:

The rock is broken at 10.0 Kg/cm²



SR-93-4

LUGEON: 25.00 - 30.00 m



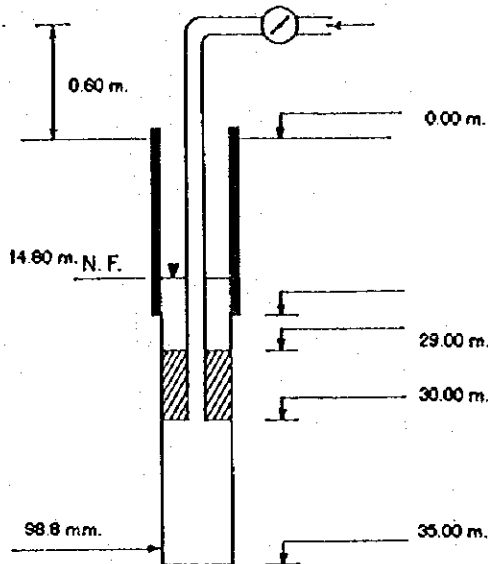


hidrosuelos Cla. Ltda.

QUITO

ECUADOR

H-OJA/SHEET:	1/1
FECHA/DATE:	06-12-93
PERFORM BY:	PS



ENSAYO DE PERMEABILIDAD FIELD TEST
TIPO LUGEON LUGEON

SONDEO/SOUNDING: SR-93-4
 ENSAYO No./TEST No.: 2
 PROF./DEPTH: 35.00m
 TRAMO ENS./TESTED TRACT: 5.00 m.
 BOMBA/PUMP: LOMBARDINI
 TIPO/TYPER: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/1192622
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD/LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD/LENGTH: 29.60 m.
 N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 14.60 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	2.0Kg/cm ²	3.0Kg/cm ²	2.0Kg/cm ²	1.0Kg/cm ²
1	90.00	120.00	135.00	122.00	95.00
2	90.00	115.00	135.00	123.00	95.00
3	90.00	115.00	135.00	120.00	95.00
4	95.00	120.00	135.00	120.00	95.00
5	90.00	115.00	140.00	127.00	95.00
6	90.00	115.00	140.00	123.00	95.00
7	95.00	120.00	140.00	120.00	95.00
8	90.00	120.00	140.00	120.00	95.00
9	90.00	115.00	140.00	120.00	95.00
10	95.00	115.00	140.00	115.00	95.00

CAUDAL/FLOW(lts/min)	91.5000	117.0000	138.0000	121.0000	95.0000
C. ESP./SPECIFIC FLOW(lts/min.m.)	18.3000	23.4000	27.6000	24.2000	19.0000
PRESION TOTAL/TOTAL PRESSURE	2.5400	3.5400	4.5400	3.5400	2.5400
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0700	0.1150	0.1500	0.1160	0.0750
PRESION NETA/NET PRESSURE	2.4700	3.4250	4.3900	3.4240	2.4650
UNID. LUGEON/LUGEON UNIT	74.0691	68.3212	62.8702	70.8776	77.0791
PERMEAB. K/K PERMEABILITY (cm/sec)	9.074E-04	8.368E-04	7.700E-04	8.636E-04	9.440E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

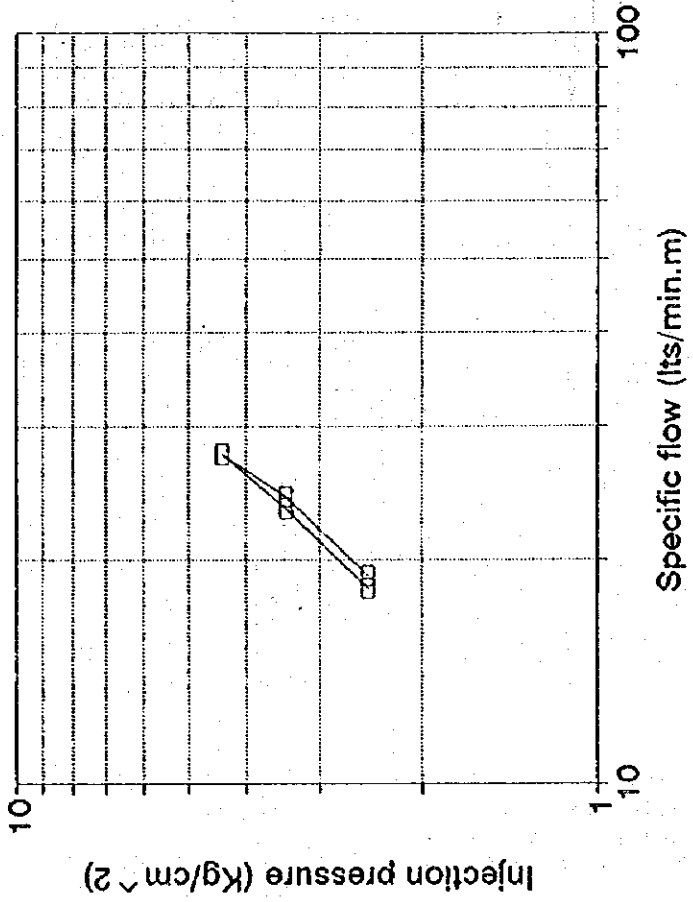
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \sinh^{-1}(L/2r) \times [L/(2 \times r)]$$

cuando/when: $10r > L \geq r$



SR-93-4

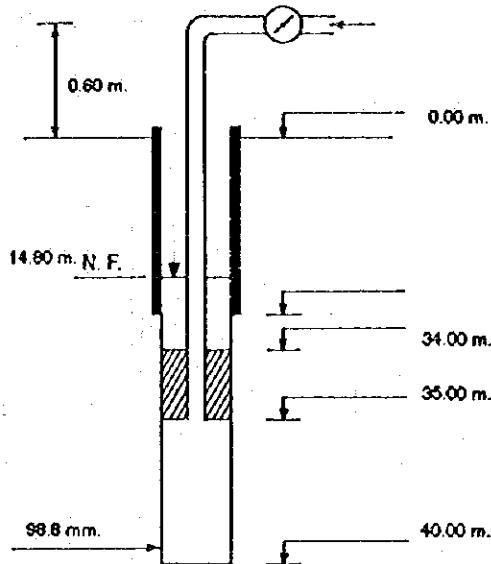
LUGEON: 30.00 - 35.00 m





hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 07-12-93
PERFORM BY: RB



ENSAYO DE PERMEABILIDAD TIPO LUGEON
DE PERMEABILIDAD FIELD TEST
LUGEON

SONDEO/SOUNDING: SR 93-1
ENSAYO No./TEST No.: 3
PROF./DEPTH: 40.00m
TRAMO ENS./TESTED TRACT: 5.00 m.
BOMBA/PUMP: LOMBARDINI
TIPO/TYPE: CENTRIFUGA
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/1192822
OBTURADOR/OBTURATOR: MECANICO
LONGITUD/LENGTH: 1.00 m.
TUBERIA/PIPE: BW
LONGITUD/LENGTH: 34.60 m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 14.80 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	55.00	90.00	132.00	95.00	96.00
2	55.00	90.00	137.00	95.00	25.00
3	55.00	90.00	130.00	95.00	46.00
4	57.00	90.00	135.00	90.00	46.00
5	55.00	90.00	136.00	90.00	48.00
6	55.00	90.00	135.00	90.00	46.00
7	57.00	95.00	135.00	90.00	45.00
8	55.00	90.00	135.00	90.00	46.00
9	56.00	95.00	135.00	95.00	45.00
10	55.00	95.00	135.00	90.00	48.00

CAUDAL/FLOW (lts/min)	55.5000	91.5000	134.5000	92.0000	48.7000
C. ESP./SPECIFIC FLOW (lts/min.m)	11.1000	18.3000	26.9000	18.4000	9.7400
PRESION TOTAL/TOTAL PRESSURE	2.5400	4.5400	6.5400	4.5400	2.5400
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0450	0.1050	0.1900	0.1050	0.0350
PRESION NETA/NET PRESSURE	2.4950	4.4350	6.3500	4.4350	2.5050
UNID. LUGEON/LUGEON UNIT	44.4890	41.2627	42.3622	41.4882	39.6822
PERMEAB. K/K PERMEABILITY (cm/sec)	5.449E-04	5.054E-04	5.188E-04	5.081E-04	4.762E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$$

cuando/when: $L \geq 10r$

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \sinh^{-1}(L/2r) \} \times [L / (2 \times r)]$$

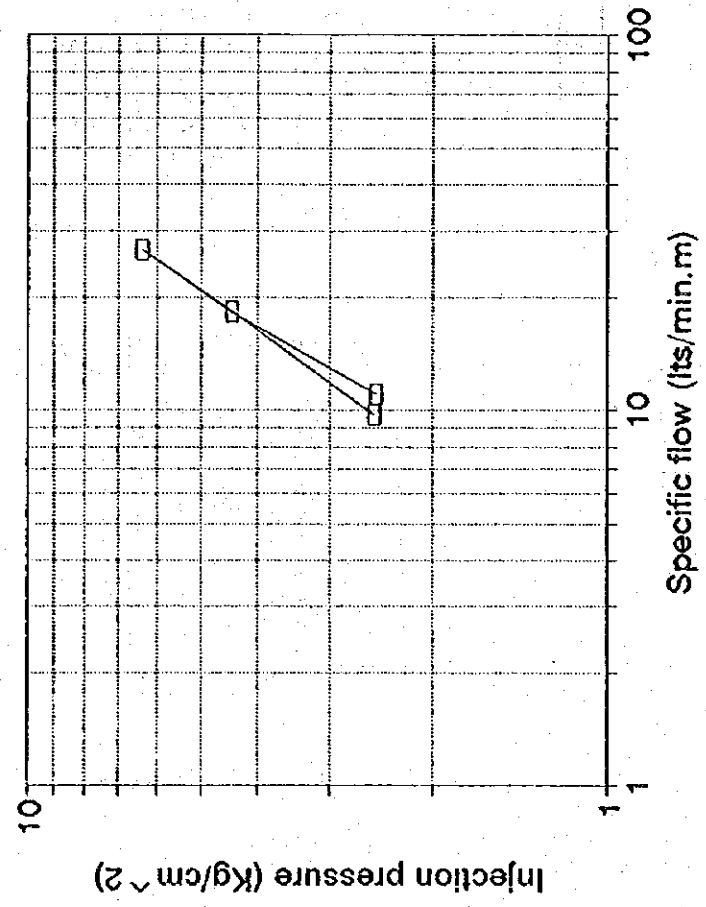
cuando/when: $10r > L \geq r$

157



SR-93-4

LUGEON: 35.00 - 40.00 m



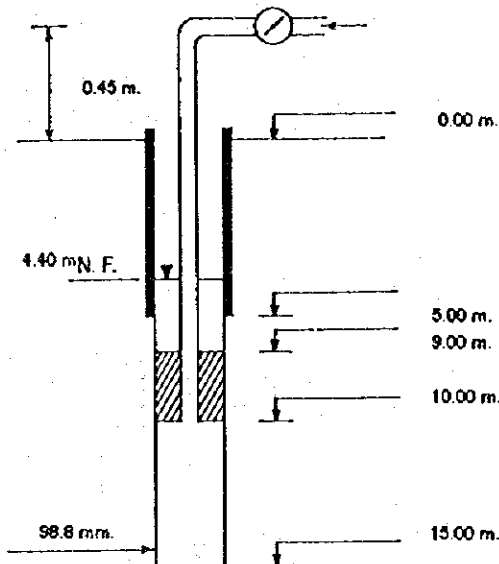


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	06-01-94
PERFORM. BY:	FV



ENSAYO DE PERMEABILIDAD
TIPO LUGEON

PERMEABILITY
FIELD TEST
LUGEON

SONDEO/SOUNDING: SR 93-5
 ENSAYO No./TEST No.: 1
 PROF./DEPTH: 15.00m
 TRAMO ENS./TESTED TRACT: 5.00 m.
 BOMBA/PUMP: ACKER MOINO APS 727
 TIPO/TYPER: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: 007NOO1
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD./LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD./LENGTH: 9.45 m.
 N. FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 4.40 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	6.0Kg/cm ²	4.0Kg/cm ²	1.0Kg/cm ²
1	0.00	83.00	122.00	104.00	42.00
2	0.00	82.00	123.00	97.00	42.00
3	0.00	83.00	122.00	95.00	42.00
4	0.00	84.00	123.00	93.00	42.00
5	0.00	84.00	124.00	97.00	40.00
6	0.00	84.00	122.00	91.00	40.00
7	0.00	85.00	124.00	85.00	41.00
8	0.00	83.00	123.00	98.00	40.00
9	0.00	87.00	123.00	92.00	39.00
10	0.10	86.00	122.00	90.00	39.00

CAUDAL/FLOW(lts./min)	0.0100	84.3000	122.8000	95.4000	40.7000
C. ESP./SPECIFIC FLOW(lts./min.m.)	0.0020	16.8600	24.5600	19.0800	8.1400
PRESION TOTAL/TOTAL PRESSURE	1.4850	4.4850	6.4850	4.4850	1.4850
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0250	0.0500	0.0300	0.0080
PRESION NETA/NET PRESSURE	1.4850	4.4600	6.4350	4.4550	1.4770
UNID. LUGEON/LUGEON UNIT	0.0135	37.8027	38.1663	42.8280	55.1117
PERMEAB. K/K PERMEABILITY (cm/sec)	1.650E-07	4.630E-04	4.674E-04	5.245E-04	6.750E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

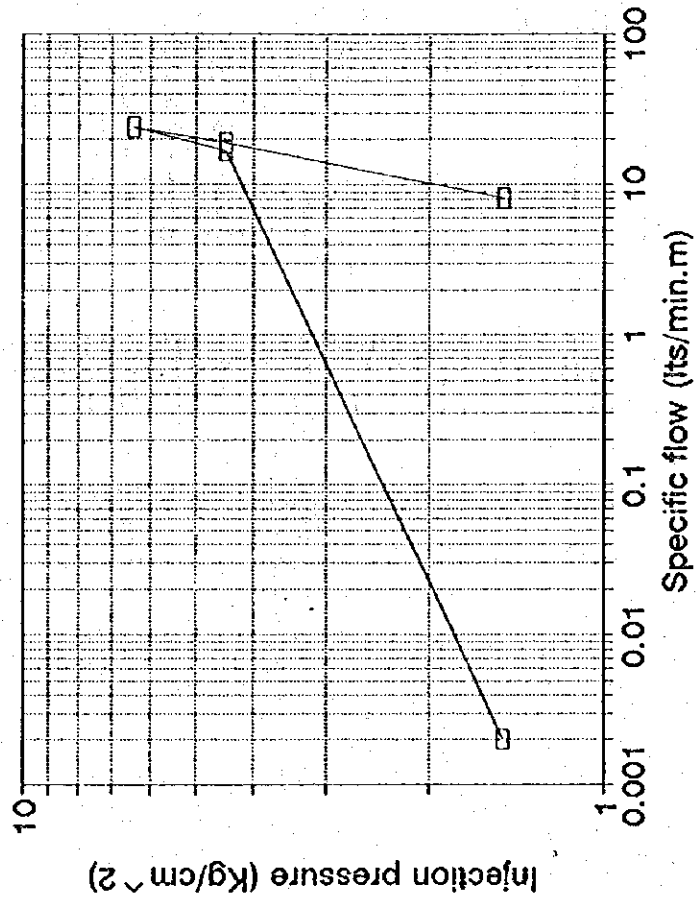
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \sinh^{-1}(L/2r) \times [L/(2r)]$$

cuando/when: $10r > L > r$



SR-93-5

LUGEON: 10.00 - 15.00 m



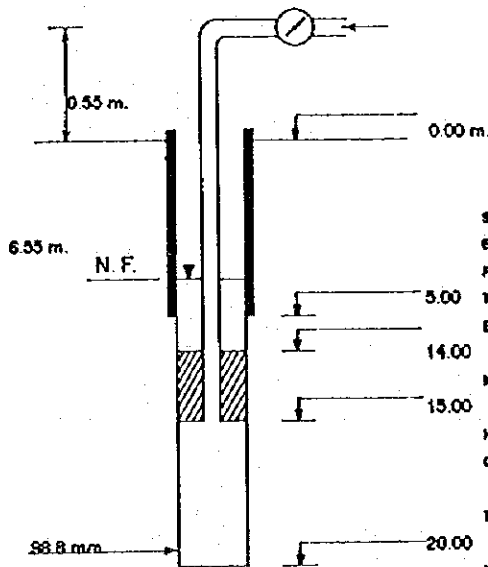


Hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET.	1/1
FECHA/DATE	08-01-94
PERFORM BY:	FY



ENSAYO DE
PERMEABILIDAD
TIPO LUGEON

PERMEABILITY
FIELD TEST
LUGEON

SONDEO/SOUNDING:
ENSAYO No./TEST No.:
PROF./DEPTH:
TRAMO ENS./TESTED TRACT:
BOMBA PUMP:
TIPO/TYPE:
MANOMETRO/MANOMETER:
CAPACIDAD/CAPACITY:
HIDROMETRO/HYDROMETER:
OBTURADOR/OBTURATOR:
LONGITUD/LENGTH:
TUBERIA/PIPE:
LONGITUD/LENGTH:
N.FREATICO/GROUNDWATER LEVEL:

SR 83-5
2
20.00m
5.00m.
ACKER MOINO APS 727
CENTRIFUGA
WIKA
10 Kg/cm²
007N001
MECANICO
1.00 m.
8W
14.55 m.
ANTES/BEFORE: 6.70 m.
DESPUES/AFTER: 6.40 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE (Kg/cm ²)						
	1.0	2.0	4.0	6.0	4.0	2.0	1.0
1	0.00	0.00	0.00	95.00	51.00	34.00	0.00
2	0.00	0.00	0.00	97.00	48.00	26.00	0.00
3	0.00	0.00	0.00	95.00	51.00	35.00	0.00
4	0.00	0.00	0.00	102.00	47.00	30.00	0.00
5	0.00	0.00	0.00	103.00	52.00	33.00	0.00
6	0.00	0.00	0.00	111.00	55.00	33.00	0.00
7	0.00	0.00	0.00	109.00	57.00	33.00	0.00
8	0.00	0.00	0.00	106.00	55.00	29.00	0.00
9	0.00	0.00	0.00	108.00	56.00	27.00	0.00
10	0.10	0.10	0.10	110.00	56.00	26.00	0.10

CAUDAL/FLOW(lts/min)	0.0100	0.0100	0.0100	103.2000	52.8000	30.6000	0.0100
C. ESP./SPECIFIC FLOW(lts/min.m)	0.0020	0.0020	0.0020	20.6400	10.5600	6.1200	0.0020
PRESION TOTAL/TOTAL PRESSURE	1.7100	2.7100	4.7100	6.7100	4.7100	2.7100	1.7100
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0000	0.0000	0.0310	0.0150	0.0090	0.0000
PRESION NETA/NET PRESSURE	1.7100	2.7100	4.7100	6.6590	4.6950	2.7010	1.7100
UNID. LUGEON/LUGEON UNIT	0.0117	0.0074	0.0042	30.9956	22.4920	22.6583	0.0117
PERMEAB. K/K PERMEABILITY (cm/sec)	1.432E-07	9.039E-08	5.201E-08	3.796E-04	2.755E-04	2.775E-04	1.432E-07

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E3) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

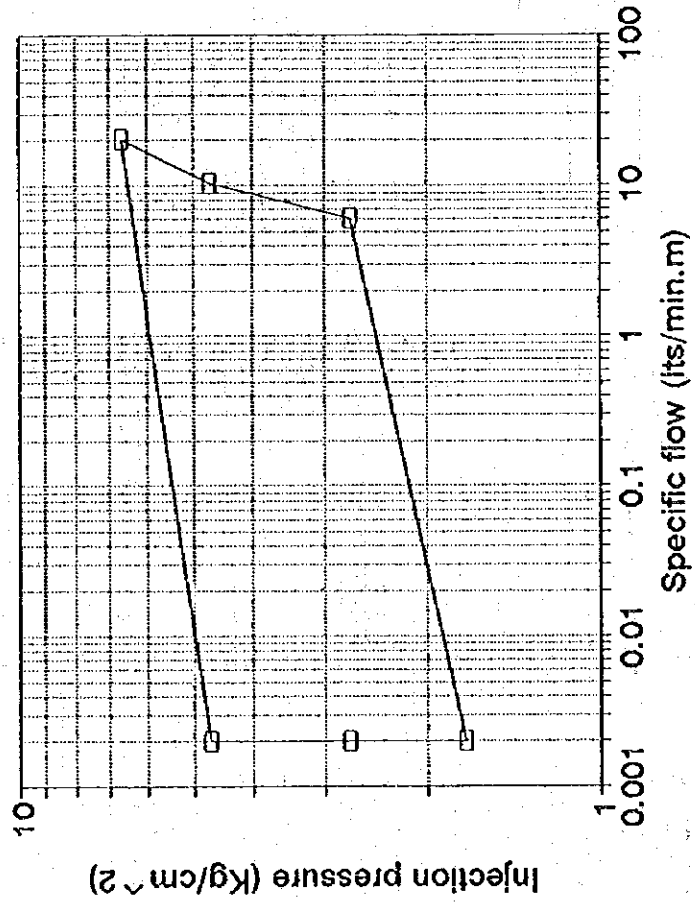
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \text{Sinh}^{-1}(L/2r) \times [L/(2\pi r)]$$

cuando/when: $10r > L \geq r$



SR-93-5

LUGEON: 15.00 - 20.00 m



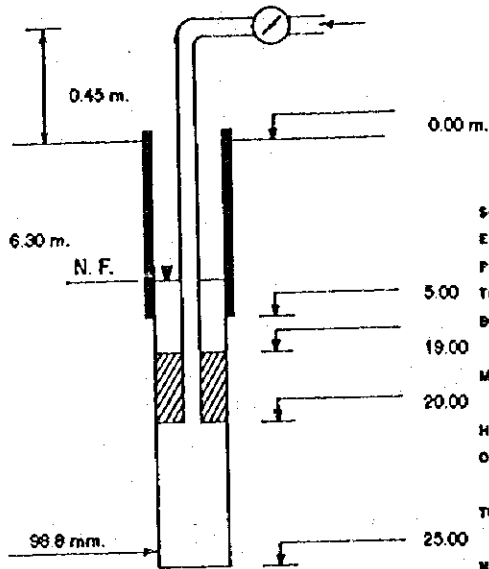


hidrosuelos Cla. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	08-01-94
PERFORM BY:	FY



ENSAYO DE PERMEABILIDAD TIPO LUGEON

PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING:	SR-93-5
ENSAYO No./TEST No.:	3
PROF./DEPTH:	25.00m
TRAMO ENS./TESTED TRACT:	5.00m.
BOMBA/PUMP:	ACKERMOINO APS 727
TIPO/TYPE:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	007NOO1
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	19.45 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 6.30 m.
	DESPUES/AFTER: 6.30 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE (Kg./cm ²)						
	1.0	2.0	4.0	7.0	4.0	2.0	1.0
1	0.00	0.00	0.00	94.00	74.00	63.00	50.00
2	0.00	0.00	0.00	95.00	75.00	62.00	51.00
3	0.00	0.00	0.00	93.00	78.00	63.00	54.00
4	0.00	0.00	0.00	95.00	83.00	63.00	55.00
5	0.00	0.00	0.00	94.00	77.00	60.00	55.00
6	0.00	0.00	0.00	96.00	79.00	62.00	55.00
7	0.00	0.00	0.00	98.00	79.00	63.00	55.00
8	0.00	0.00	0.00	99.00	78.00	62.00	55.00
9	0.00	0.00	0.00	99.00	80.00	60.00	55.00
10	0.10	0.10	0.10	99.00	79.00	62.00	55.00

CAUDAL, FLOW (lts./min)	0.0100	0.0100	0.0100	96.2000	78.2000	62.0000	54.0000
C. ESP./SPECIFIC FLOW (lts./min.m.)	0.0020	0.0020	0.0020	19.2400	15.6400	12.4000	10.8000
PRESION TOTAL/TOTAL PRESSURE	1.6750	2.6750	4.6750	7.6750	4.6750	2.6750	1.6750
PERD. CARGA/LOST LOAD (kg/cm ²)	0.0000	0.0000	0.0000	0.0612	0.0400	0.0250	0.0200
PRESION NETA/NET PRESSURE	1.6750	2.6750	4.6750	7.6138	4.6350	2.6500	1.6550
UNID. LUGEON, LUGEON UNIT	0.0119	0.0075	0.0043	25.2699	33.7439	46.7925	65.2568
PERMEAB. K, K PERMEABILITY (cm/sec)	1.462E-07	9.157E-08	5.240E-08	3.095E-04	4.133E-04	5.731E-04	7.992E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$$

cuando/when: $L \geq 10r$

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \sinh^{-1}(L/2r) \times L / (2 \times r) \}$$

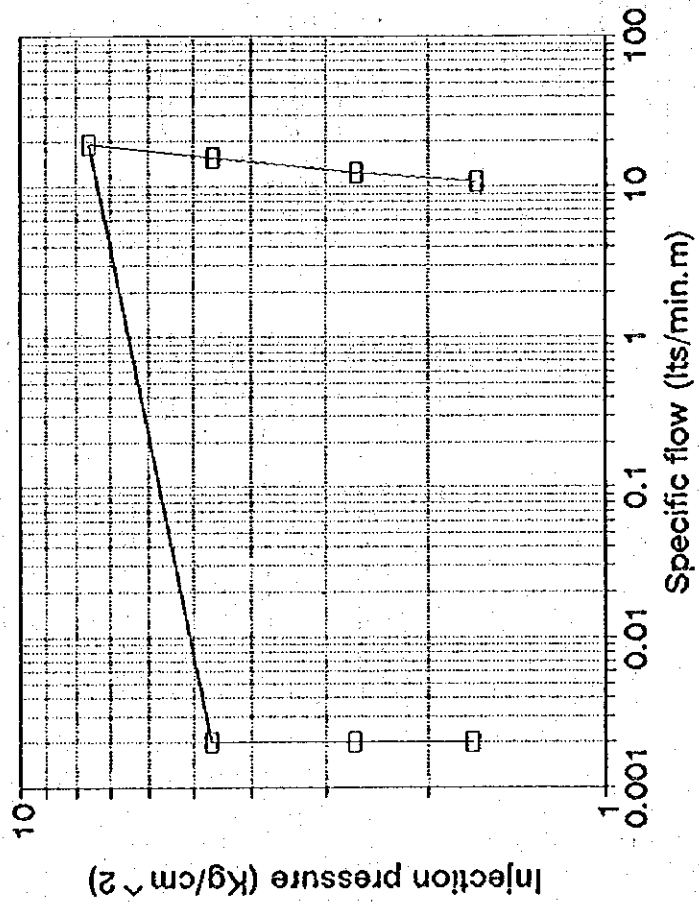
cuando/when: $10r > L \geq r$

OBSERVACIONES/OBSERVATIONS: The rock was broken at 7.0 Kg/cm²



SR-93-5

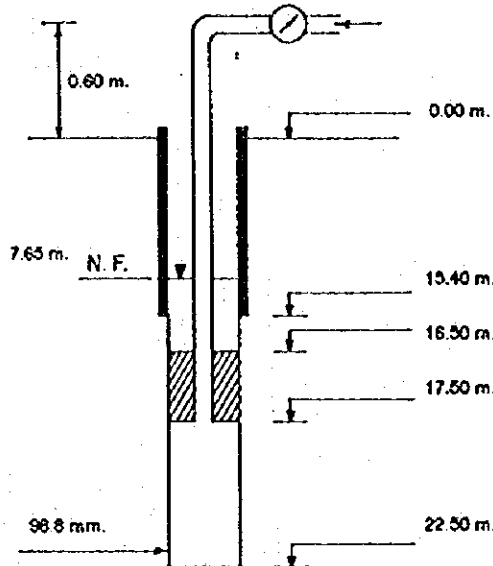
LUGEON: 20.00 - 25.00 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET	1/1
FECHA/DATE	23-11-93
PERFORM BY:	AB



ENSAYO DE PERMEABILIDAD TIPO LUGION DE PERMEABILIDAD FIELD TEST LUGION

SONDEO/BOUINDING: MQ 93-1
 ENSAYO No./TEST No.: 1
 PROF./DEPTH: 22.50m
 TRAMO ENS./TESTED TRACT: 5.00m
 BOMBA/PUMP: LOMBARDINI
 TIPO/TYPE: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119261
 OBTURADOR/OBTURATOR: MECANICO
 LONGITUD/LENGHT: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD/LENGHT: 17.10 m.
 N.FREÁTICO/GROUNDWATER LEVEL: ANTES/BEFORE: 7.65 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	6.0Kg/cm ²	4.0Kg/cm ²	1.0Kg/cm ²
1	0.00	2.00	102.00	85.00	12.00
2	0.00	2.00	113.00	85.00	12.00
3	0.00	3.00	120.00	85.00	12.00
4	0.00	5.00	120.00	85.00	12.00
5	0.00	6.00	125.00	85.00	12.00
6	1.00	10.00	128.00	85.00	12.00
7	0.00	11.00	122.00	85.00	12.00
8	0.00	9.00	125.00	85.00	12.00
9	0.00	11.00	125.00	85.00	12.00
10	0.00	11.00	125.00	85.00	12.00

CAUDAL/FLOW(lts/min)	0.100	7.000	120.500	85.000	12.000
C. ESP./SPECIFIC FLOW(lts/min.m)	0.020	1.400	24.100	17.000	2.400
PRESION TOTAL/TOTAL PRESSURE	1.825	4.825	6.825	4.825	1.825
PERD. CARGA/LOST LOAD (kg/cm ²)	0.000	0.002	0.070	0.040	0.003
PRESION NETA/NET PRESSURE	1.825	4.823	6.755	4.785	1.822
UNID. LUGION/LUGION UNIT	0.110	2.903	35.877	35.528	13.172
PERMEAB. K/K PERMEABILITY (cm/sec)	1.141E-06	3.021E-05	3.714E-04	3.698E-04	1.371E-04

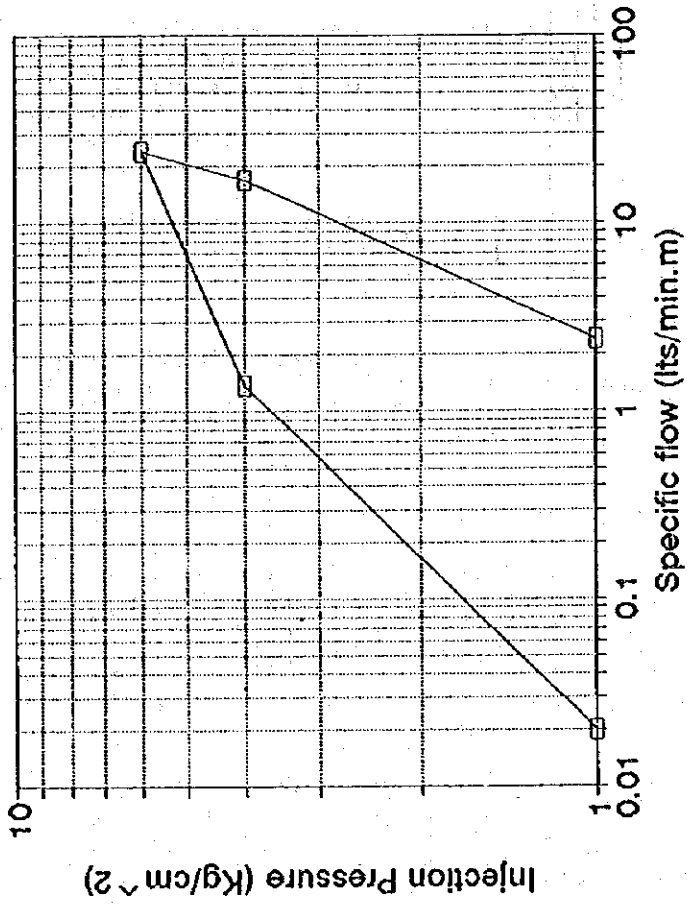
FORMULAS:

UNIDAD LUGION/LUGION UNIT:
 $LU = (q \times 1E6) / (L \times H)$
 COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$
 cuando/when: $L \geq 10r$
 $K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \text{Sinh}^{-1}(L/2r) \} \times [L/(2 \times r)]$
 cuando/when: $10r > L > r$



MG-93-1

LUGEON: 17.50 -22.50 m



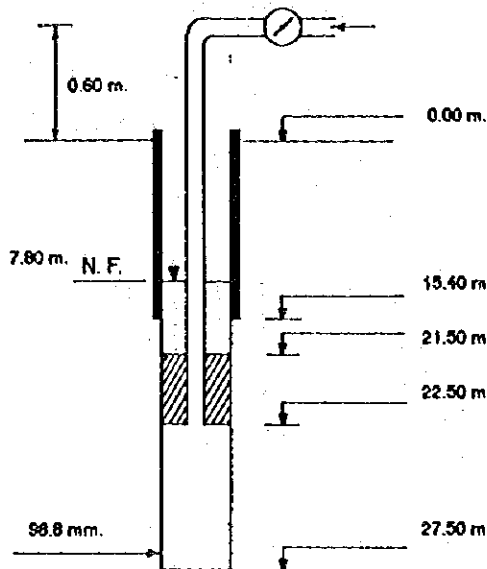


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	25-11-93
PERFORM BY:	RB



ENSAYO DE PERMEABILIDAD TIPO LUGEOON

PERMEABILITY FIELD TEST LUGEOON

SONDOO/SOUNDING:	MG-93-1
ENSAYO No./TEST No.:	2
PROF./DEPTH:	27.50m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	LOMBARDINI
TIPO/TYP:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/118261
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	22.10 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 7.80 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	0.00	65.00	130.00	100.00	9.00
2	0.00	68.00	140.00	110.00	8.00
3	0.00	80.00	145.00	110.00	10.00
4	0.00	85.00	155.00	105.00	9.00
5	0.00	95.00	140.00	105.00	9.00
6	0.00	85.00	145.00	105.00	9.00
7	0.00	85.00	145.00	105.00	9.00
8	0.00	93.00	140.00	105.00	8.00
9	0.00	95.00	140.00	105.00	9.00
10	0.50	95.00	140.00	105.00	9.00

CAUDAL/FLOW (lt./min)	0.050	86.800	142.000	105.500	8.900
C. ESP./ESPECIFIC FLOW (lt./min.m.)	0.010	17.360	28.400	21.100	1.780
PRESION TOTAL/TOTAL PRESSURE	1.840	4.840	5.840	3.840	1.840
PERD. CARGA/LOST LOAD (kg/cm ²)	0.000	0.055	0.139	0.080	0.000
PRESION NETA/NET PRESSURE	1.840	4.785	5.701	3.760	1.840
UNID. LUGEOON/LUGEOON UNIT	0.054	99.290	49.816	56.117	9.694
PERMEAB. K/K PERMEABILITY (cm/sec)	5.657E-07	3.776E-04	5.185E-04	5.841E-04	1.008E-04

FORMULAS:

UNIDAD LUGEOON/LUGEOON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E9) / (2 \times 3.1415927 \times L \times H \times 60)] \} \times \ln(L/r)$$

cuando/when: $L > = 10r$

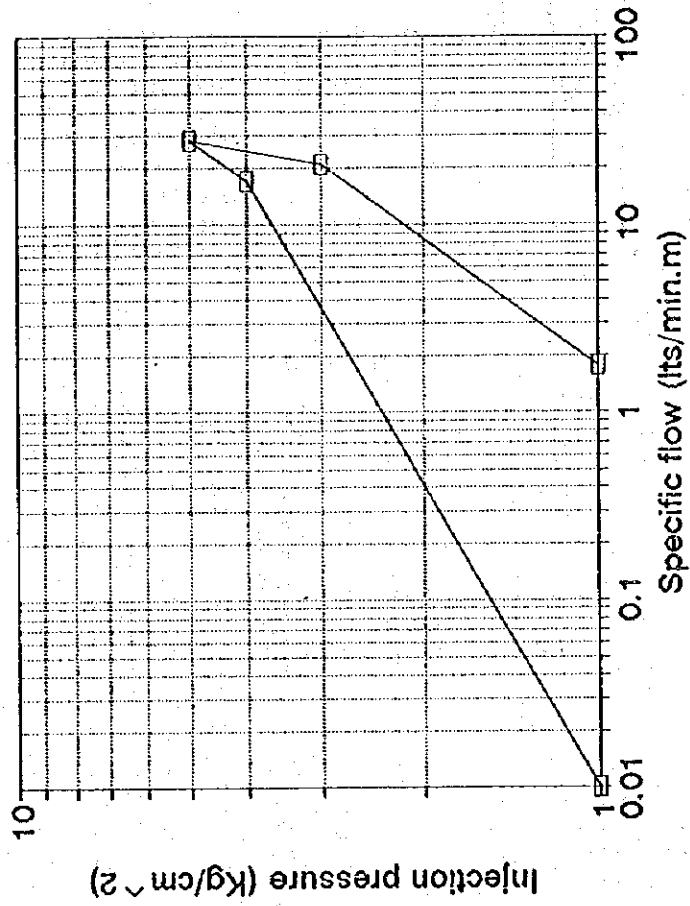
$$K = \{ [(q \times 1E9) / (2 \times 3.1415927 \times L \times H \times 60)] \} \times \text{Sinh}^{-1}(L/2r) \times [L/(2 \times r)]$$

cuando/when: $10r > L > = r$



MG-93-1

LUGEON: 22.50 - 27.50 m



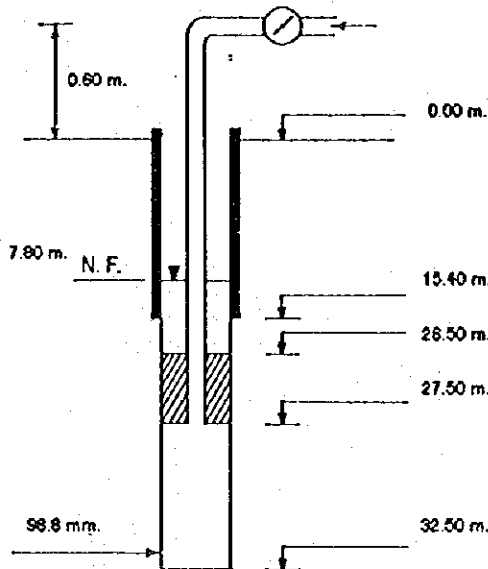


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HOJA/SHEET:	1/1
FECHA/DATE:	26-11-93
PERFORM BY:	PD



ENSAYO DE PERMEABILIDAD TIPO LUGEON PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING:	MG-93-1
ENSAYO No./TEST No.:	3
PROF./DEPTH:	32.50m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	LOMBARD/NNI
TIPO/TYP:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/119261
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	27.10 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTES/BEFORE: 7.80 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	4.0Kg/cm ²	6.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	10.00	95.00	150.00	90.00	45.00
2	10.00	100.00	140.00	90.00	45.00
3	9.00	91.00	125.00	90.00	45.00
4	9.00	94.00	125.00	90.00	45.00
5	10.00	95.00	125.00	90.00	45.00
6	11.00	95.00	125.00	90.00	45.00
7	11.00	95.00	125.00	90.00	45.00
8	11.00	98.00	125.00	90.00	45.00
9	10.00	97.00	125.00	90.00	45.00
10	12.00	100.00	125.00	90.00	45.00

CAUDAL/FLOW (lt./min)	10.300	95.000	129.500	90.000	45.000
C. ESP./SPECIFIC FLOW (lt./min.m.)	2.060	19.200	23.900	18.000	9.000
PRESION TOTAL/TOTAL PRESSURE	1.840	4.840	6.840	3.840	1.840
PERD. CARGA/LOST LOAD (kg/cm ²)	0.003	0.065	0.150	0.075	0.025
PRESION NETA/NET PRESSURE	1.837	4.755	6.690	3.765	1.815
UNID. LUGEON/LUGEON UNIT	11.214	40.379	38.714	47.809	49.587
PERMEAB. K/K PERMEABILITY (cm/sec)	1.167E-04	4.203E-04	4.030E-04	4.976E-04	5.161E-04

FORMULAS:

UNIDAD LUGEON, LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

cuando/when: $L \geq 10r$

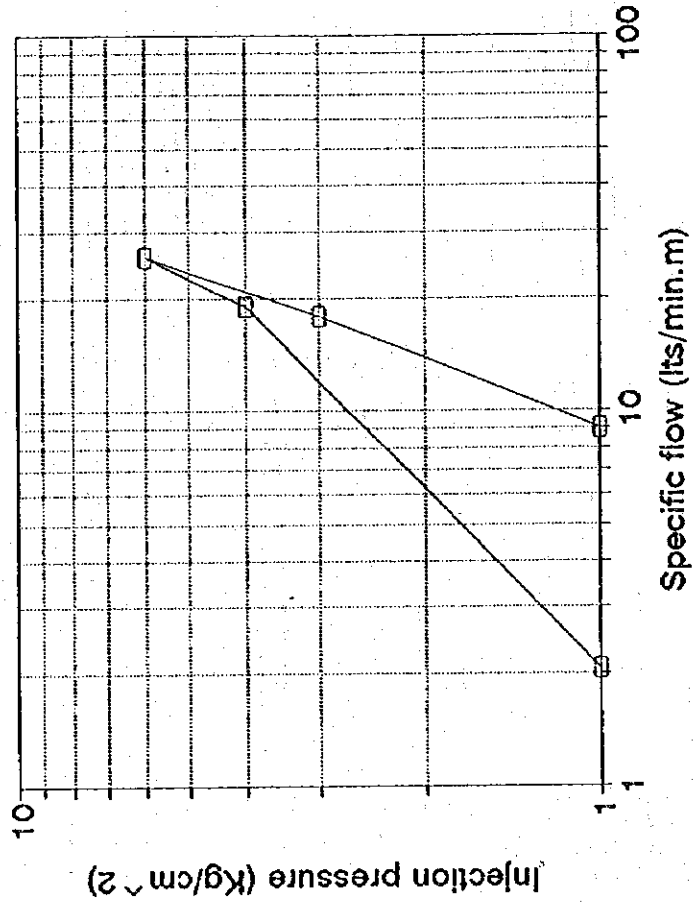
$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \frac{\sinh^{-1}(L/2r)}{L/2r}$$

cuando/when: $10r > L > r$



MG-93-1

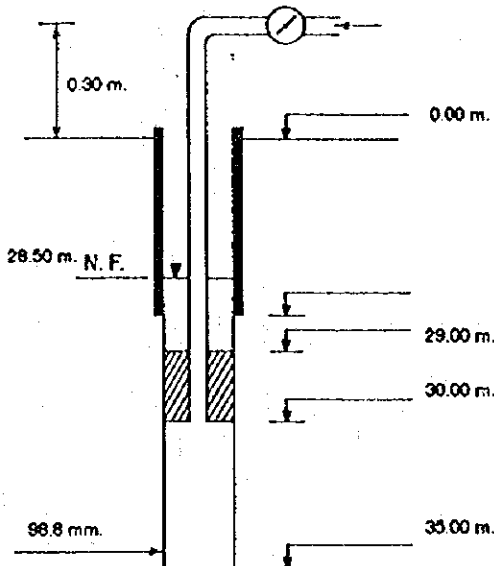
LUGEON: 27.50 - 32.50 m





hidrosuelos Cia. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 06-01-94
PERFORM BY: CC



ENSAYO DE PERMEABILIDAD TIPO LUGEON | PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING: MG-93.2
 ENSAYO No./TEST No.: 1
 PROF./DEPTH: 35.00m
 TRAMO ENS./TESTED TRACT: 5.00 m.
 BOMBA/PUMP: LOMBARDINI
 TIPO/TYPE: CENTRIFUGA
 MANOMETRO/MANOMETER: WIKA
 CAPACIDAD/CAPACITY: 10 Kg/cm²
 HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119261
 OBTURADO/OBTURATOR: MECANICO
 LONGITUD/LENGTH: 1.00 m.
 TUBERIA/PIPE: BW
 LONGITUD/LENGTH: 29.30 m.
 N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE: 28.50 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	2.0Kg/cm ²	3.0Kg/cm ²	2.0Kg/cm ²	1.0Kg/cm ²
1	86.00	83.00	100.00	85.00	77.0
2	80.00	85.00	100.00	88.00	75.0
3	80.00	80.00	100.00	90.00	76.0
4	82.00	85.00	99.00	90.00	76.0
5	83.00	85.00	97.00	91.00	80.0
6	80.00	85.00	89.00	89.00	73.0
7	82.00	86.00	100.00	89.00	75.0
8	82.00	89.00	105.00	89.00	74.0
9	80.00	89.00	101.00	92.00	70.0
10	82.00	83.00	89.00	88.00	74.0

CAUDAL/FLOW(lts/min)	61.700	88.000	100.000	89.500	75.00
C. ESP./SPECIFIC FLOW(lts/min.m.)	16.340	17.600	20.000	17.900	15.00
PRESION TOTAL/TOTAL PRESSURE	3.880	4.880	5.880	4.880	3.88
PERD. CARGA/LOST LOAD (kg/cm ²)	0.003	0.065	0.150	0.075	0.02
PRESION NETA/NET PRESSURE	3.877	4.795	5.730	4.805	3.85
UNID. LUGEON/LUGEON UNIT	42.146	36.705	34.904	37.253	38.91
PERMEAB. K/K PERMEABILITY (cm/sec)	4.397E-04	3.821E-04	3.630E-04	3.878E-04	4.050E-04

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD/COEFFICIENT OF PERMEABILITY:

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \ln(L/r)$$

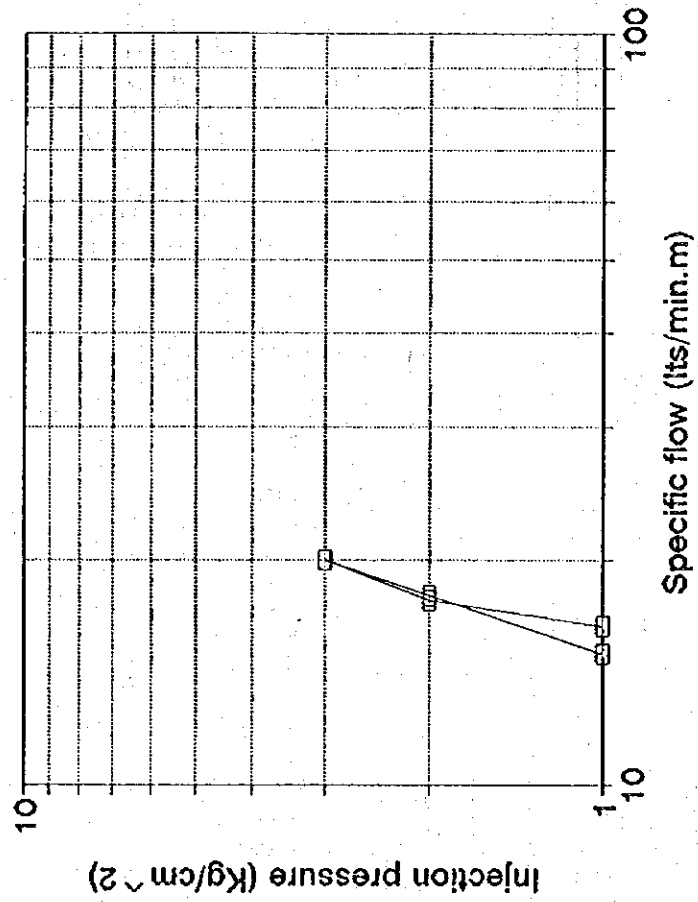
cuando/when: $L \geq 10r$

$$K = \left[\frac{(q \times 1E3)}{(2 \times 3.1415927 \times L \times H \times 60)} \right] \times \sinh^{-1}(L/2r) \times [L/(2\pi r)]$$

cuando/when: $10r > L \geq r$



MG-93-2
LUGEON: 30.00 - 35.00 m



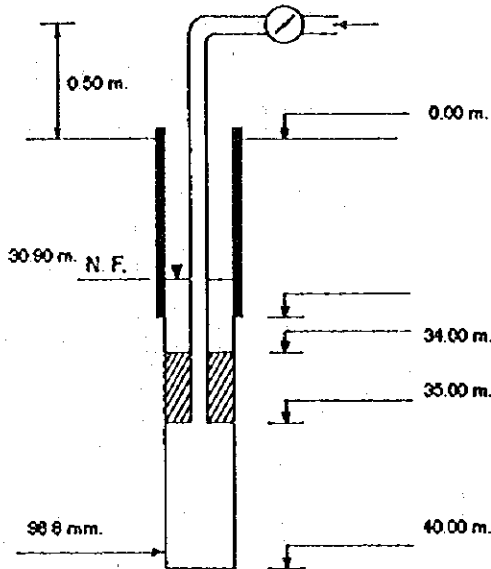


hidrosuelos Cia. Ltda.

QUITO

ECUADOR

HUASHEET:	1/1
FECHA/DATE:	07-01-94
PERFORM BY:	CC



ENSAYO DE PERMEABILIDAD
PERMEABILIDAD FIELD TEST
TIPO LUGEON LUGEON

SONDEO/SOUNDING:	MG-932
ENSAYO No./TEST No.:	2
PROF./DEPTH:	40.00m
TRAMO ENS./TESTED TRACT:	5.00 m.
BOMBA/PUMP:	LOMBARDINI
TIPO/TYP:	CENTRIFUGA
MANOMETRO/MANOMETER:	WIKA
CAPACIDAD/CAPACITY:	10 Kg/cm ²
HIDROMETRO/HYDROMETER:	SCHLUMBERGER 81/119261
OBTURADOR/OBTURATOR:	MECANICO
LONGITUD/LENGTH:	1.00 m.
TUBERIA/PIPE:	BW
LONGITUD/LENGTH:	34.50 m.
N.FREATICO/GROUNDWATER LEVEL:	ANTE/BEFORE: 30.90 m.

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE				
	1.0Kg/cm ²	3.0Kg/cm ²	5.0Kg/cm ²	3.0Kg/cm ²	1.0Kg/cm ²
1	10.00	28.00	61.00	47.00	40.00
2	11.00	29.00	67.00	48.00	38.00
3	11.00	30.00	65.00	46.00	36.00
4	10.00	30.00	63.00	45.00	40.00
5	11.00	28.00	67.00	45.00	37.00
6	12.00	29.00	64.00	45.00	37.00
7	12.00	29.00	66.00	47.00	38.00
8	11.00	29.00	65.00	42.00	36.00
9	13.00	29.00	65.00	46.00	35.00
10	13.00	29.00	64.00	48.00	36.00

CAUDAL/FLOW(lts/min)	11.400	28.600	64.700	45.500	37.300
C. ESP./SPECIFIC FLOW(lts/min.m.)	2.280	9.720	12.940	9.100	7.460
PRESION TOTAL/TOTAL PRESSURE	4.140	6.140	8.140	6.140	4.140
PERD. CARGA/LOST LOAD (kg/cm ²)	0.005	0.013	0.045	0.033	0.017
PRESION NETA/NET PRESSURE	4.135	6.127	8.095	6.107	4.123
UNID. LUGEON/LUGEON UNIT	5.514	9.336	15.985	14.901	16.094
PERMEAB. K/K PERMEABILITY (cm/sec)	5.739E-05	9.718E-05	1.664E-04	1.551E-04	1.683E-04

FORMULAS:

UNIDAD LUGEON, LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY:

$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r) \}$$

cuando/when: $L \geq 10r$

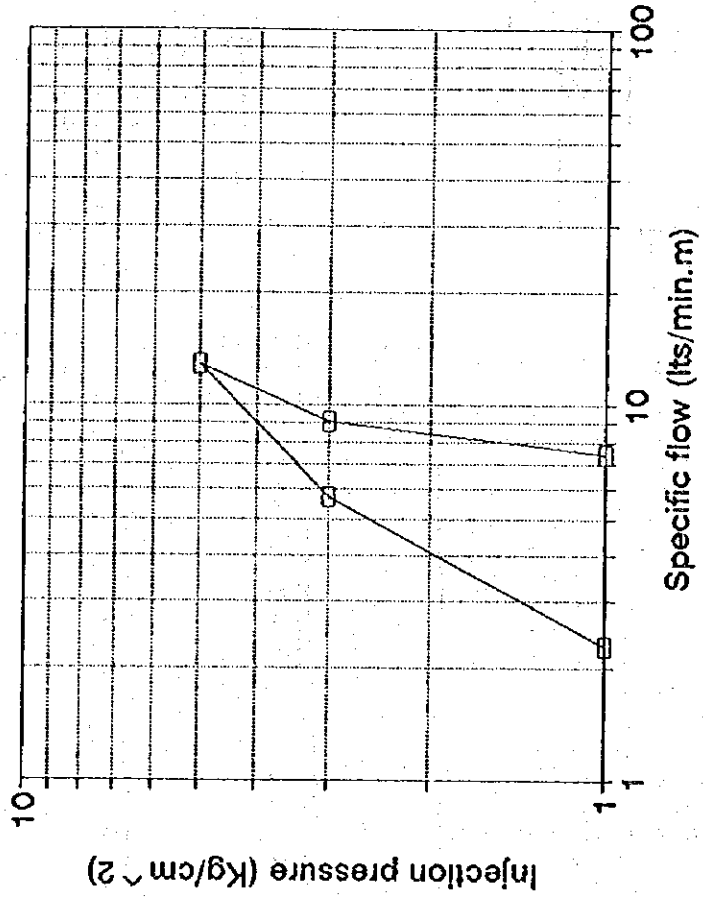
$$K = \{ [(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \sinh^{-1}(L/2r) \times [L/(2\pi r)] \}$$

cuando/when: $10r > L > r$



MG-93-2

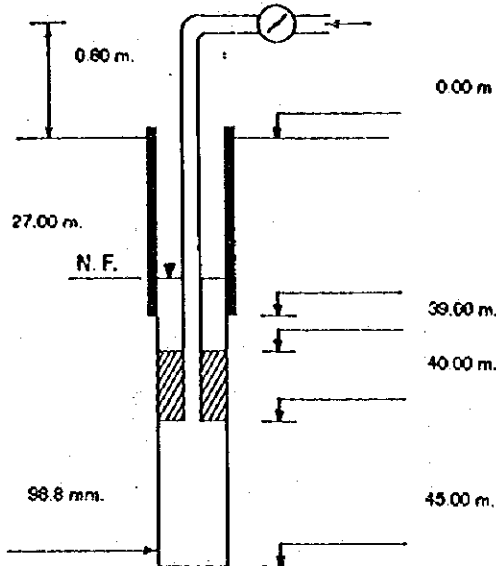
LUGEON: 35.00 - 40.00 m





hidrosuelos Cla. Ltda.
QUITO ECUADOR

HOJA/SHEET: 1/1
FECHA/DATE: 10-01-94
PERFORM BY: CC



ENSAYO DE PERMEABILIDAD
TIPO LUGEON

PERMEABILITY FIELD TEST LUGEON

SONDEO/SOUNDING: MG-93-2
ENSAYO No./TEST No.: 3
PROF./DEPTH: 45.00m
TRAMO ENS./TESTED TRACT: 5.00m
BOMBA/PUMP: LOMBARDINI
TIPO/TYPE: CENTRIFUGA
MANOMETRO/MANOMETER: WIKA
CAPACIDAD/CAPACITY: 10 Kg/cm²
HIDROMETRO/HYDROMETER: SCHLUMBERGER 81/119
OBSTURADOR/OBSTURATOR: MECANICO
LONGITUD/LENGTH: 1.00 m.
TUBERIA/PIPE: BW
LONGITUD/LENGTH: 39.80 m.
N.FREATICO/GROUNDWATER LEVEL: ANTES/BEFORE:

LECTURAS DEL HIDROMETRO (litros)/HYDROMETER READING (liters)

TIEMPO/TIME (min.)	PRESION MANOMETRICA/MANOMETER PRESSURE (Kg/cm ²)						
	1.0	4.0	7.0	10.0	7.0	4.0	1.0
1	1.00	11.00	53.00	101.00	63.00	36.00	18.00
2	0.00	11.00	53.00	101.00	62.00	36.00	18.00
3	0.00	11.00	52.00	100.00	63.00	36.00	18.00
4	2.00	12.00	53.00	98.00	63.00	36.00	18.00
5	2.00	11.00	53.00	100.00	62.00	36.00	18.00
6	4.00	11.00	52.00	98.00	62.00	36.00	18.00
7	4.00	11.00	51.00	98.00	63.00	36.00	18.00
8	4.00	11.00	51.00	97.00	62.00	36.00	18.00
9	4.00	11.00	52.00	95.00	60.00	36.00	18.00
10	4.00	10.00	52.00	95.00	63.00	36.00	18.00

CAUDAL/FLOW (lts/min)	2.500	11.000	52.200	98.300	62.300	36.000	18.000
C. ESP./SPECIFIC FLOW (lts/min.m)	0.500	2.200	10.440	19.660	12.460	7.200	3.600
PRESION TOTAL/TOTAL PRESSURE	3.780	6.780	9.780	12.780	8.780	6.780	3.780
PERD. CARGA/LOST LOAD (kg/cm ²)	0.001	0.010	0.032	0.113	0.05	0.02	0.010
PRESION NETA/NET PRESSURE	3.779	6.770	9.748	12.667	9.733	6.760	3.770
UNID. LUGEON/LUGEON UNIT	1.323	3.250	10.710	15.521	12.802	10.651	9.549
PERMEAB. K/K PERMEABILITY (cm/sec)	1.377E-05	3.383E-05	1.11E-04	1.616E-04	1.33E-04	1.11E-04	9.940E-05

FORMULAS:

UNIDAD LUGEON/LUGEON UNIT:

$$LU = (q \times 1E6) / (L \times H)$$

COEFICIENTE DE PERMEABILIDAD, COEFFICIENT OF PERMEABILITY:

$$K = \frac{[(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \ln(L/r)}$$

cuando/when: $L \geq 10r$

$$K = \frac{[(q \times 1E3) / (2 \times 3.1415927 \times L \times H \times 60)] \times \text{Sinh}^{-1}(L/2r) \times [L/(2\pi r)]}$$

cuando/when: $10r > L > r$



MG-93-2
LUGEON: 40.00 - 45.00 m

