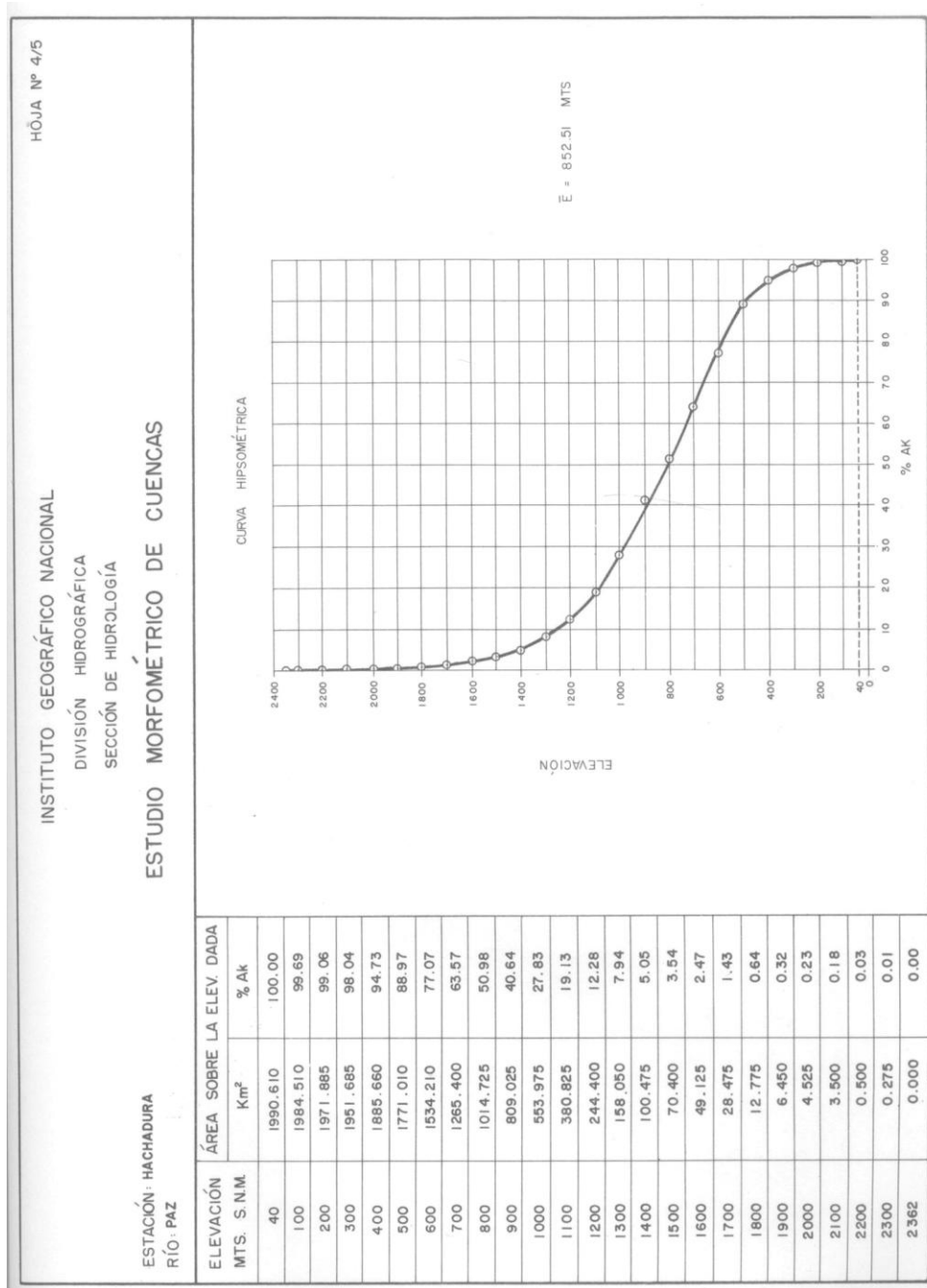


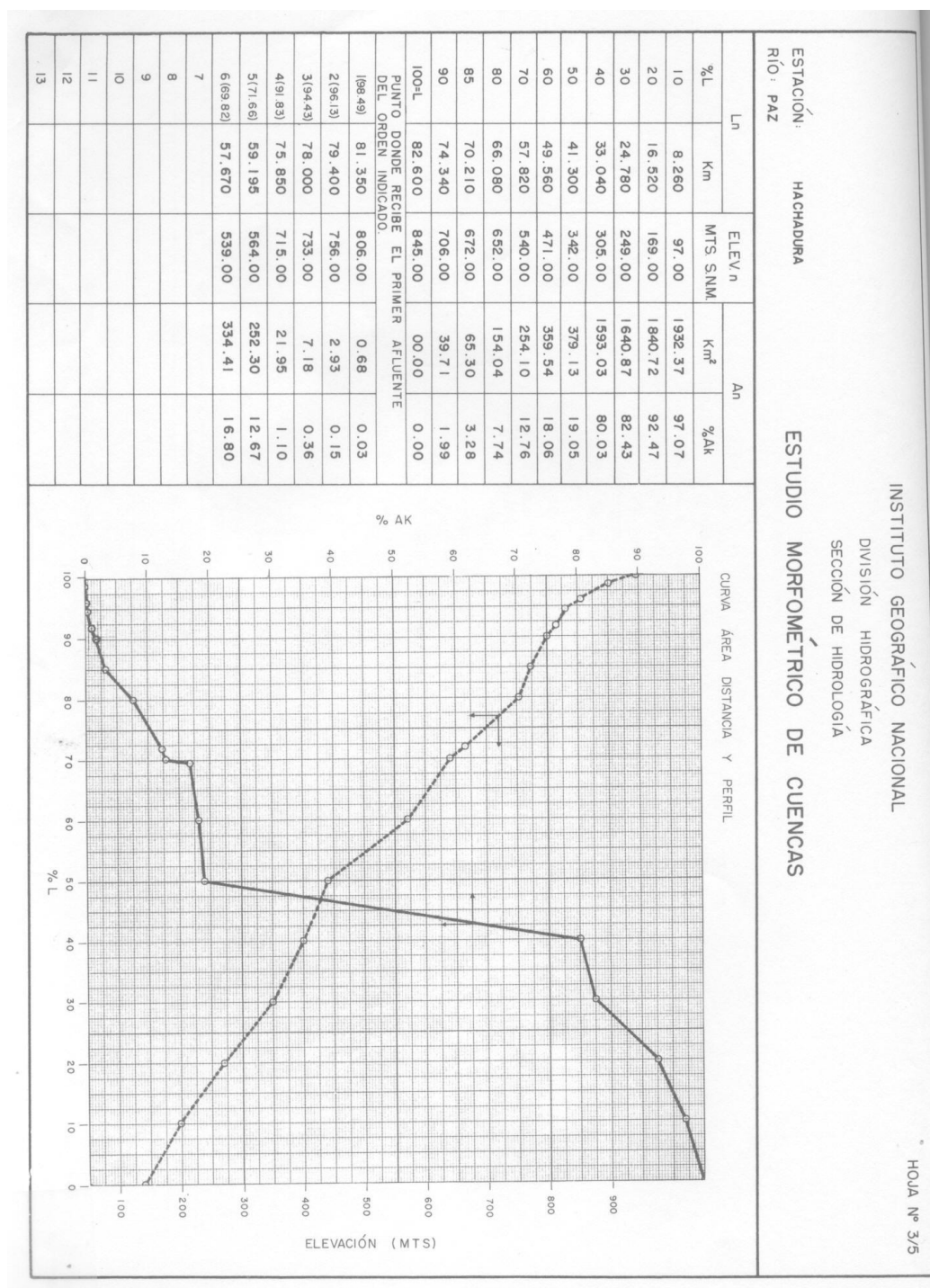


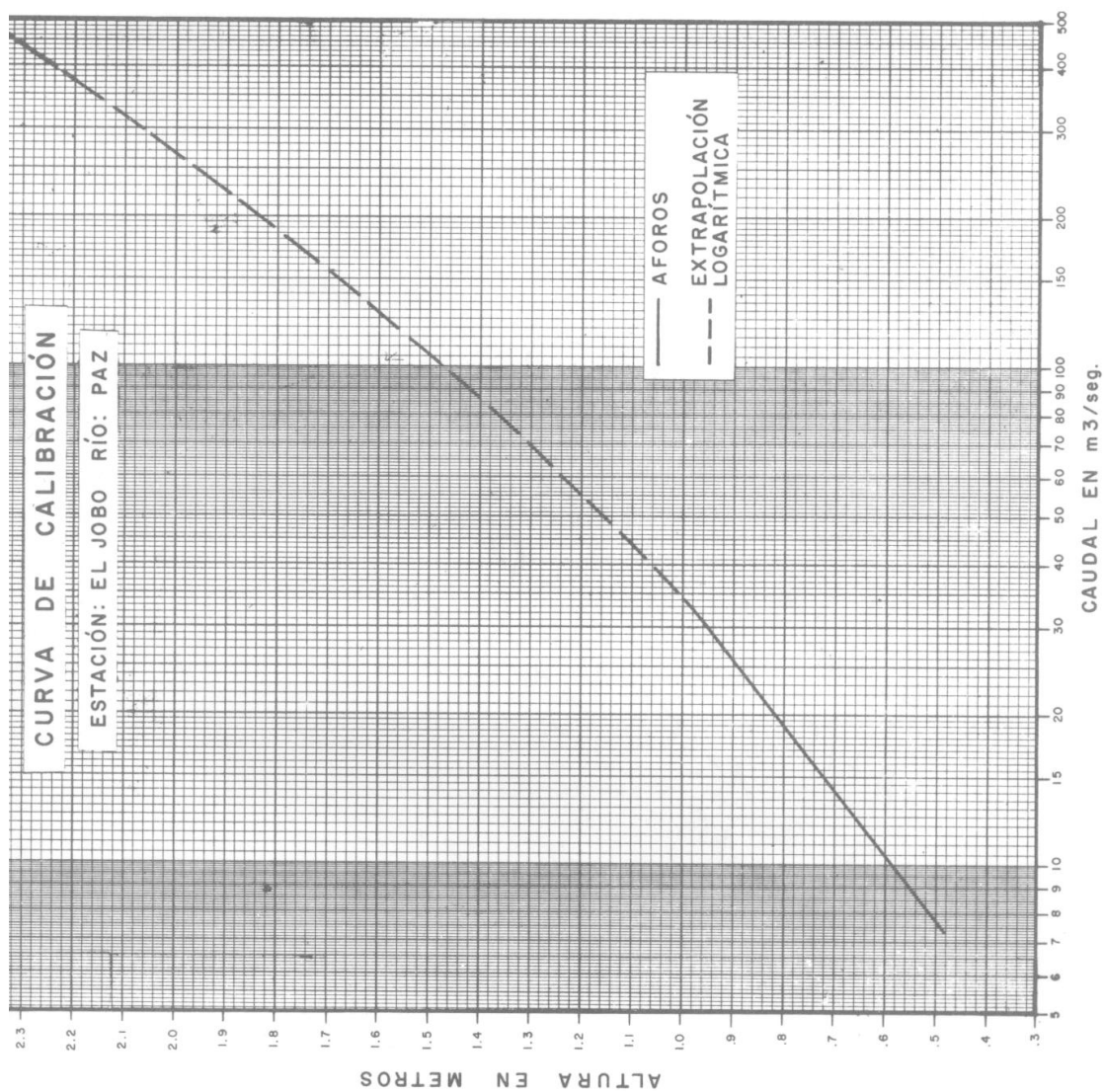
ANEXO CORRESPONDIENTE A HIDROLOGIA
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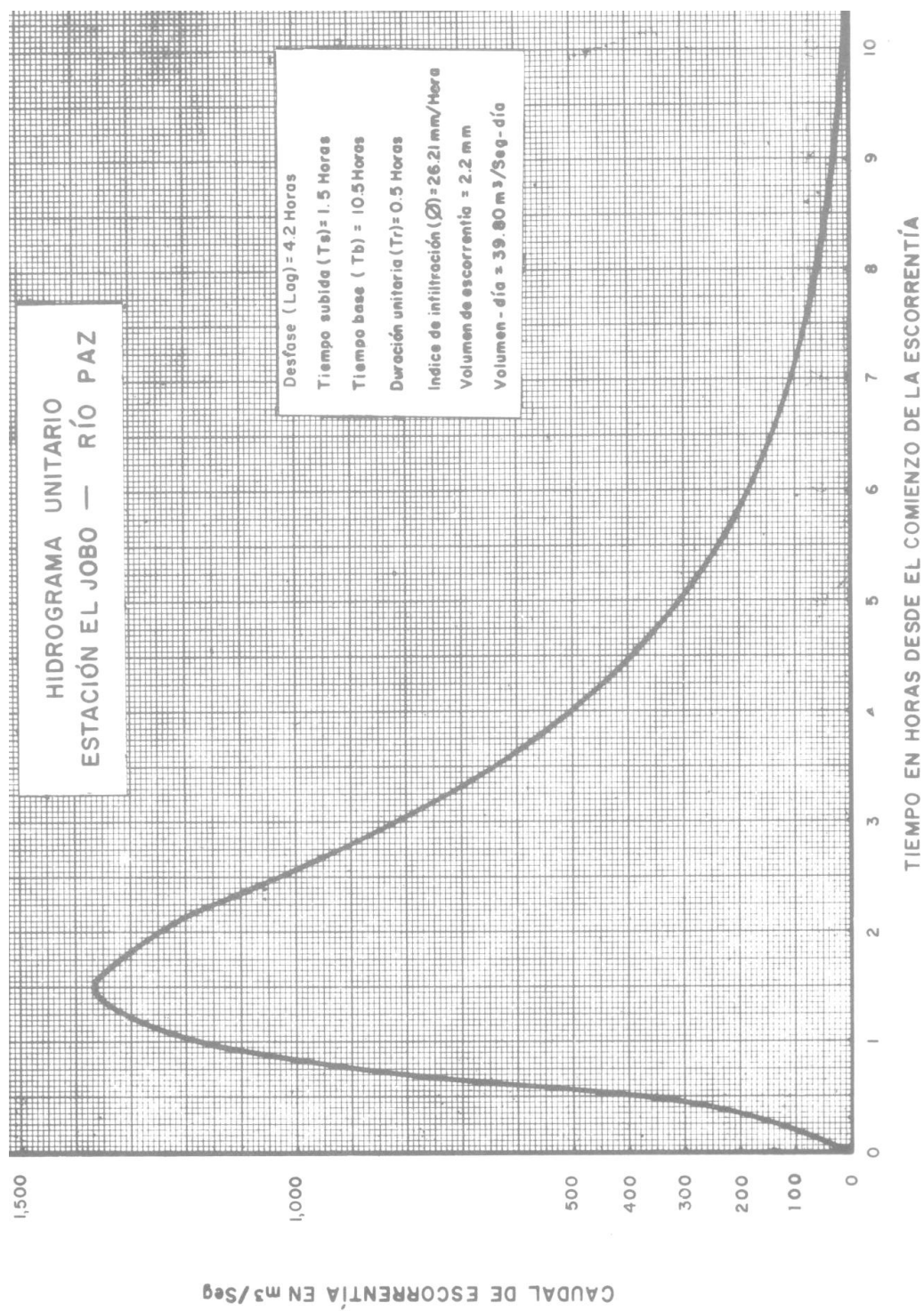


**MATERIAL EXTRAIDO DE:
ESTUDIO HIDROLOGICO BASICO DE LA CUENCA DEL RIO PAZ (Girón, 1970)**









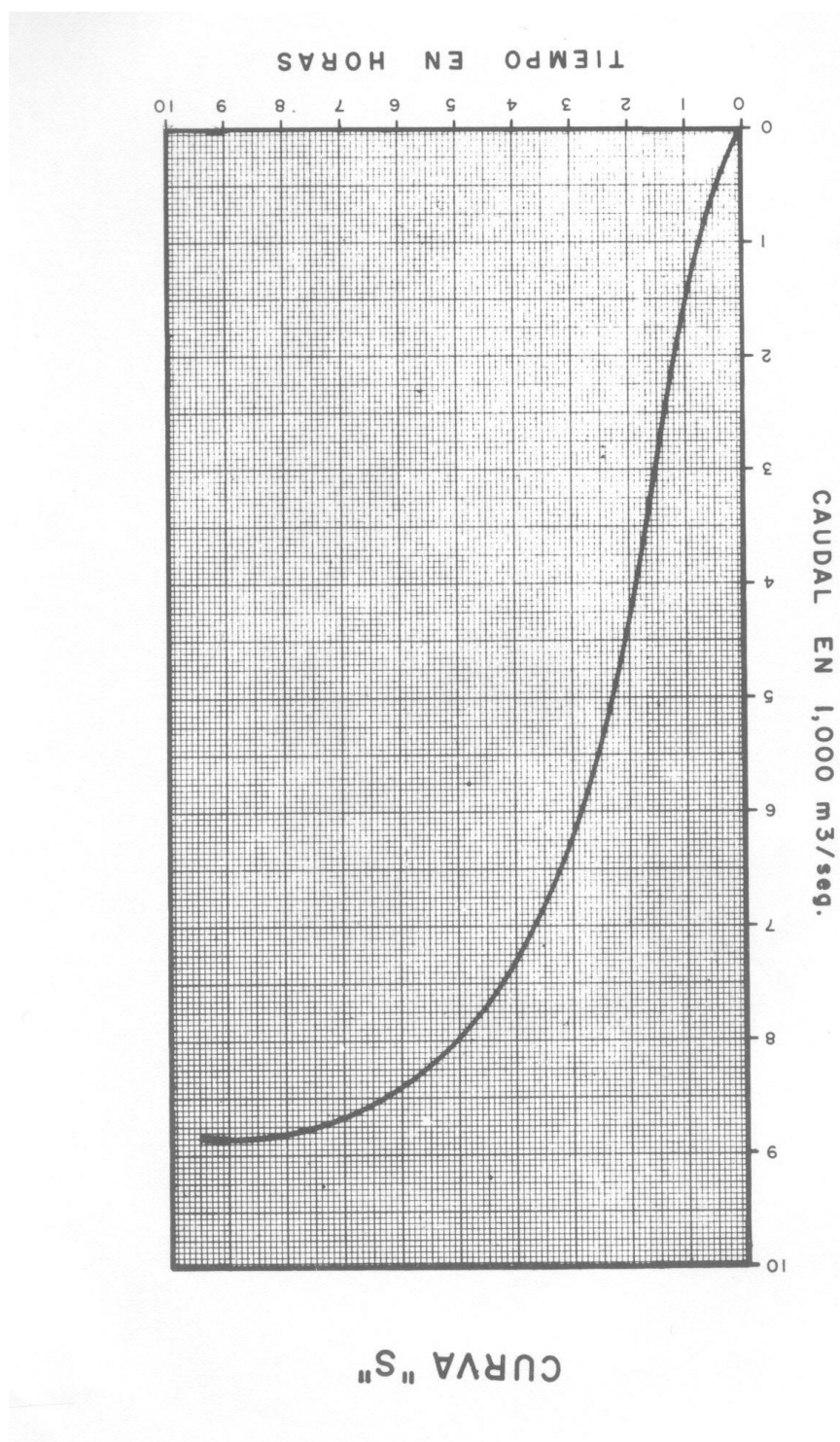
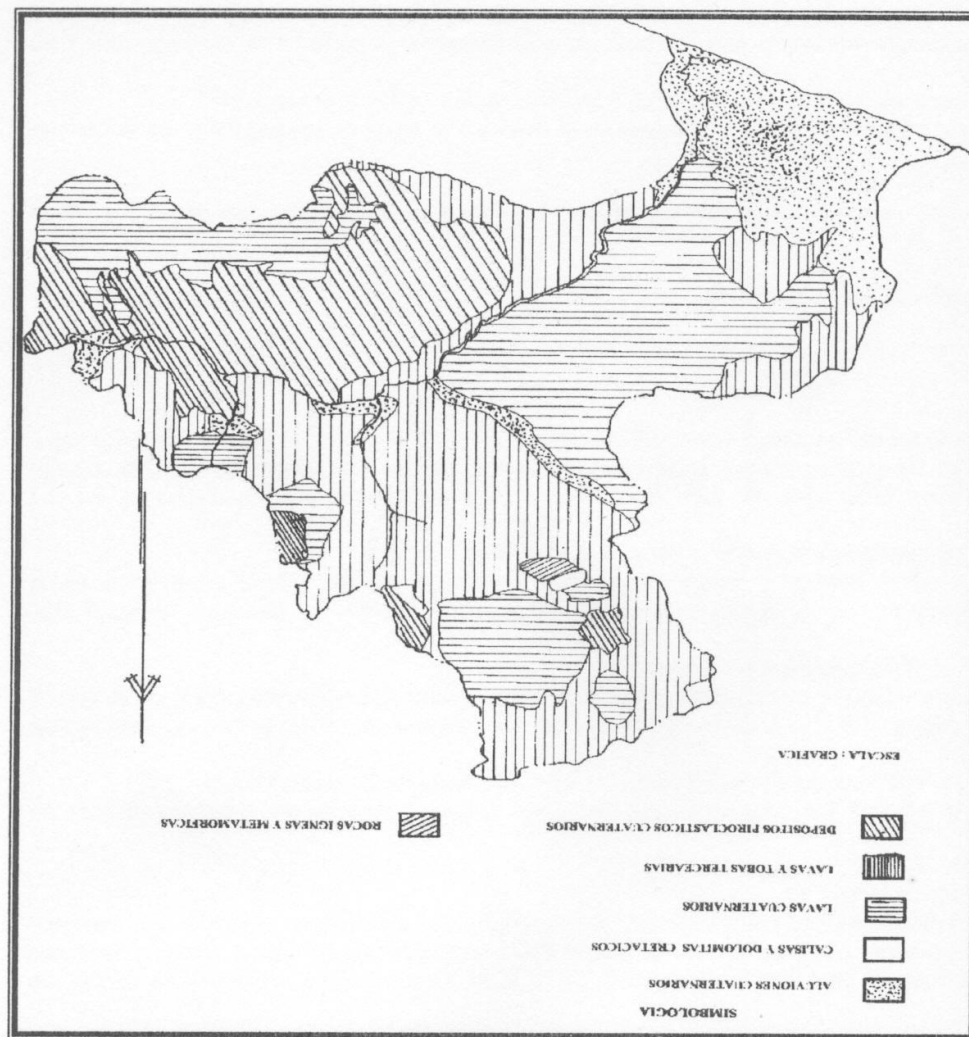


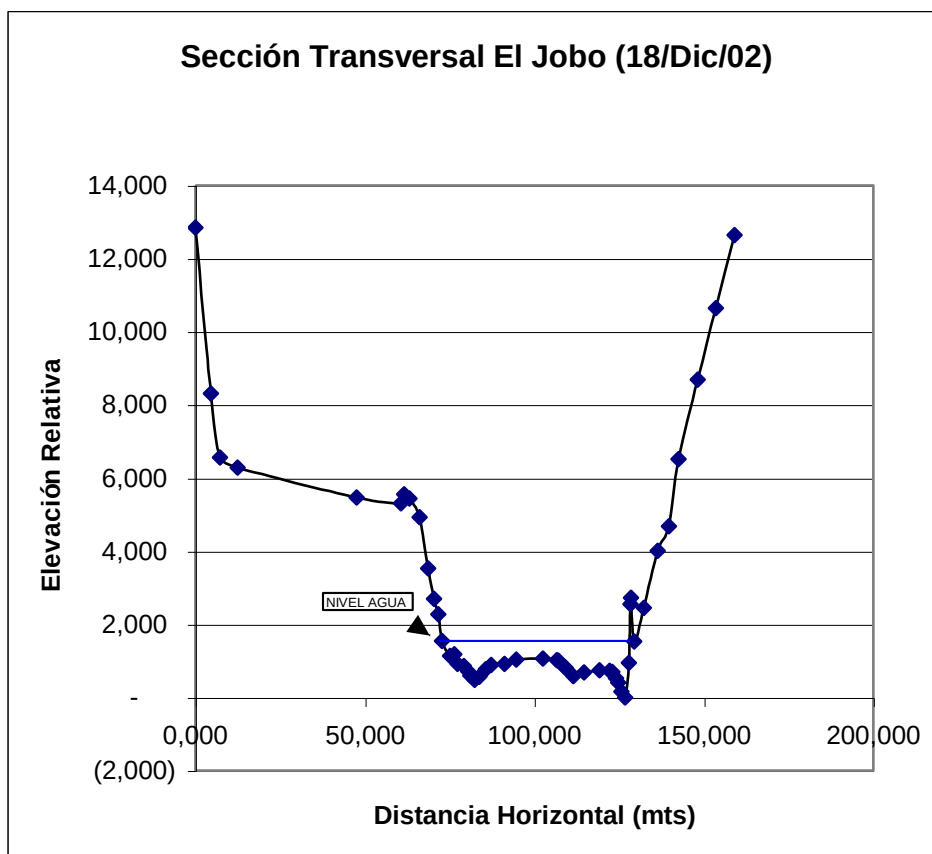


Figura 2 Mapa de Unidades Hidrogeológicas



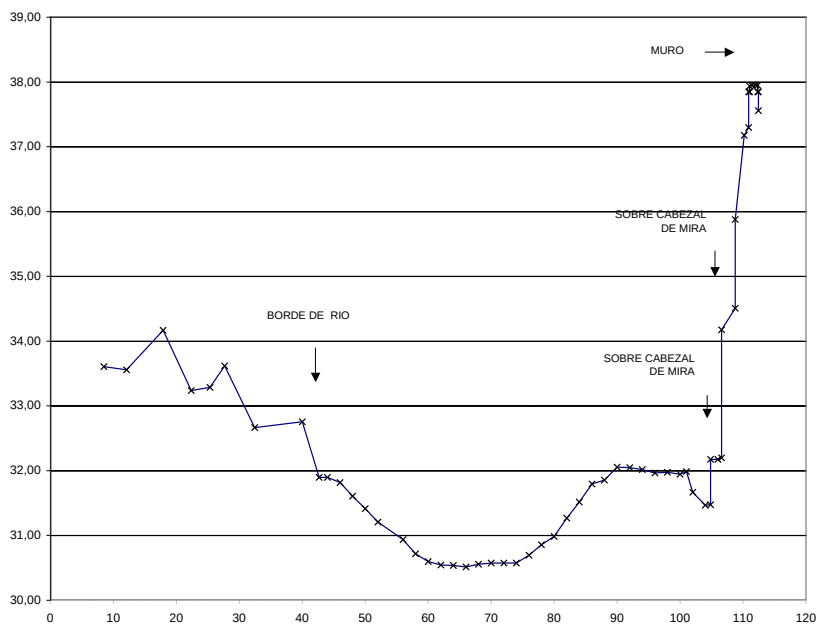


MATERIAL CEDIDO POR SNET- EL SALVADOR

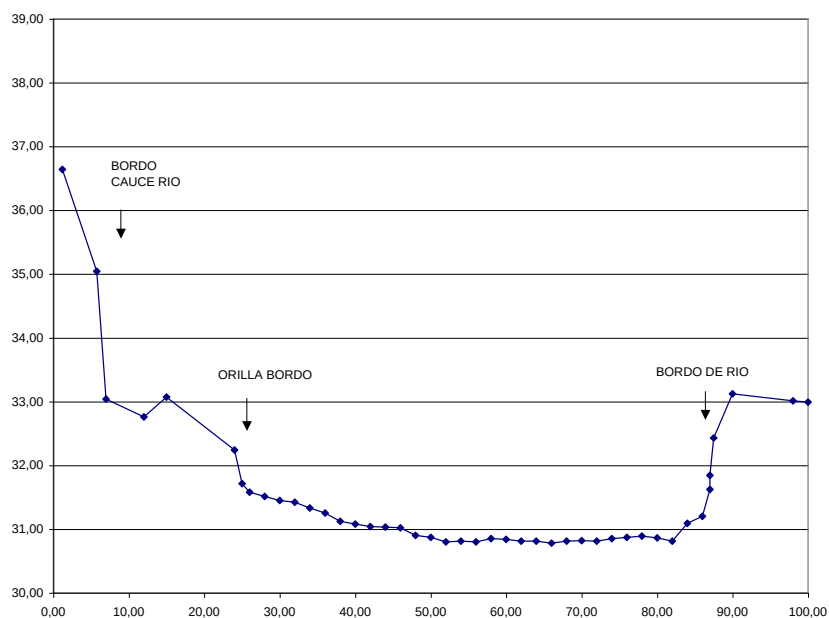




ESTACION PAZ HACHADURA
SECCION ESTACION HIDROMETRICA



ESTACION PAZ HACHADURA
SECCION DE AFORO



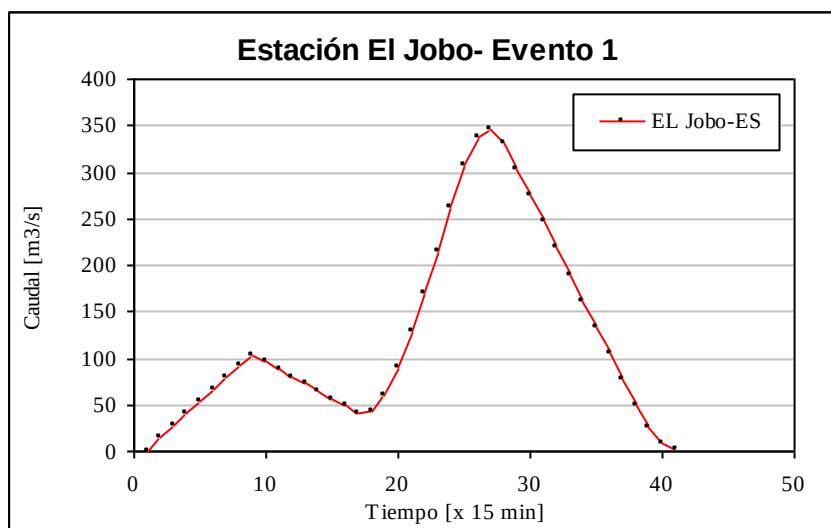
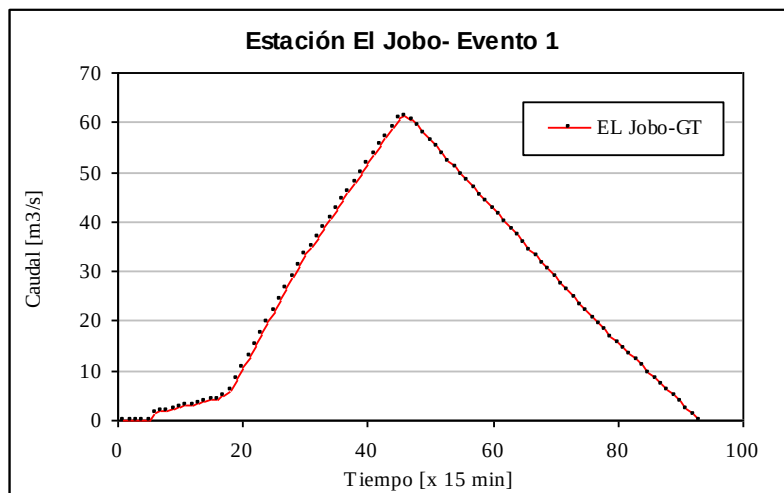


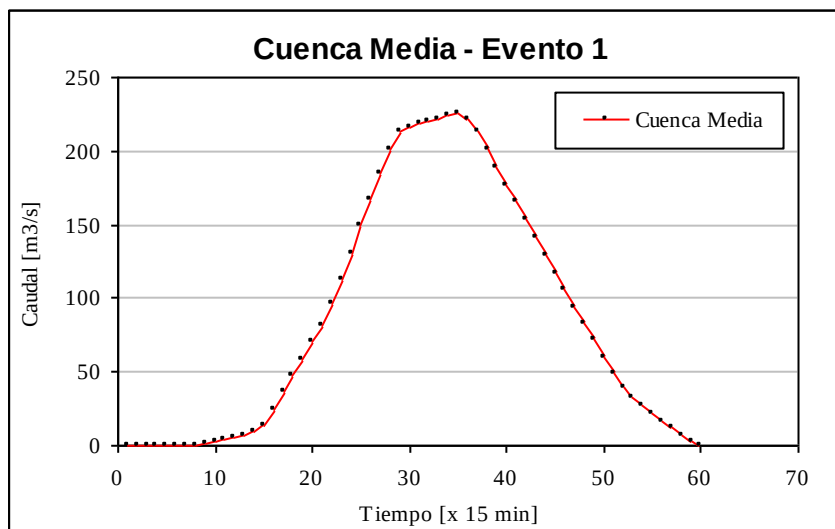
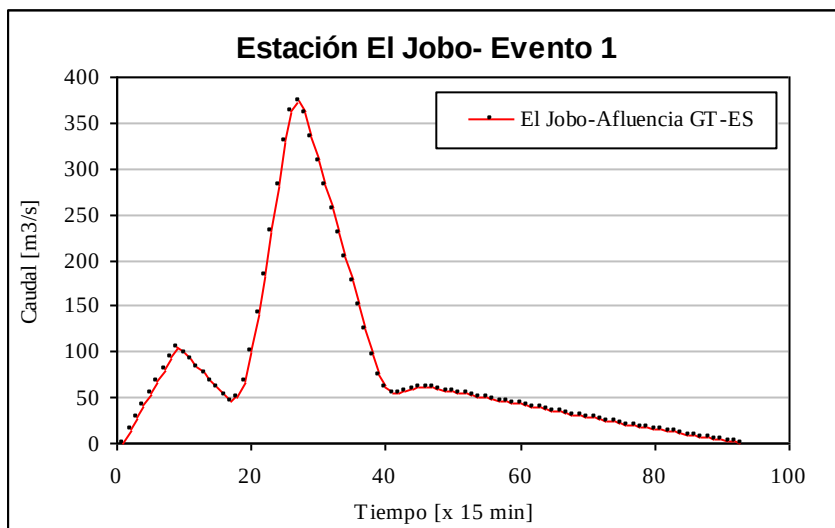
**SIMULACIÓN DE EVENTOS EN LA CUENCA
PROGRAMA HIDROLOGIA V.1.0**

EVENTO 1 (01-SET-2002)



GRAFICOS CORRESPONDIENTES A LAS SIMULACIONES REALIZADAS







PROGRAMA HIDROLOGIA-V.1.0
Desarrollado por el Prof. Juan Carlos BERTONI
Simula el comportamiento de Sistemas Hidrologicos
UNCordoba, ARGENTINA. Mail:jcbertoni@arnet.com.ar

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Transf.P-Q CUENCA ALTA (Estacion EL JOBO) GT.Ev:01-SET-2002/1:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 939.0000 [Km2]
Tiempo de Concentración de la Cuenca = 11.5895 [Hrs]
Intervalo de Cálculo Seleccionado = 0.2500 [Hrs]
Condición de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duración [horas]	Lámina [%P]	i	Duración [horas]	Lámina [%P]	i	Duración [horas]	Lámina [%P]
1	0.250	0.450	9	2.250	0.000	17	4.250	0.050
2	0.500	0.200	10	2.500	0.000	18	4.500	0.150
3	0.750	0.000	11	2.750	0.000	19	4.750	0.150
4	1.000	0.000	12	3.000	0.000	20	5.000	0.000
5	1.250	0.000	13	3.250	0.000	21	5.250	0.000
6	1.500	0.000	14	3.500	0.000	22	5.500	0.000
7	1.750	0.000	15	3.750	0.000	23	5.750	0.000
8	2.000	0.000	16	4.000	0.000	24	6.000	0.000

DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN								
	1	2	3	4	5	6	7	8
Area Parcial [%] :	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN :	79.00	82.00	0.00	0.00	0.00	0.00	0.00	0.00

COEFICIENTES DE REDUCCION AREAL DE LA LLUVIA PARA CADA DURACION (Método del U.S. National Weather Service)								
i	Duración [hrs]	Coef. [adim]	i	Duración [hrs]	Coef. [adim]	i	Duración [hrs]	Coef. [adim]
1	0.2500	1.0000	9	2.2500	1.0000	17	4.2500	1.0000
2	0.5000	1.0000	10	2.5000	1.0000	18	4.5000	1.0000
3	0.7500	1.0000	11	2.7500	1.0000	19	4.7500	1.0000
4	1.0000	1.0000	12	3.0000	1.0000	20	5.0000	1.0000
5	1.2500	1.0000	13	3.2500	1.0000	21	5.2500	1.0000
6	1.5000	1.0000	14	3.5000	1.0000	22	5.5000	1.0000
7	1.7500	1.0000	15	3.7500	1.0000	23	5.7500	1.0000
8	2.0000	1.0000	16	4.0000	1.0000	24	6.0000	1.0000



HIETOGRAMAS TOTAL Y EFECTIVO (NETO)								
i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	11.250	0.000	9	0.000	0.000	17	1.250	0.185
2	5.000	0.295	10	0.000	0.000	18	3.750	0.787
3	0.000	0.000	11	0.000	0.000	19	3.750	1.093
4	0.000	0.000	12	0.000	0.000	20	0.000	0.000
5	0.000	0.000	13	0.000	0.000	21	0.000	0.000
6	0.000	0.000	14	0.000	0.000	22	0.000	0.000
7	0.000	0.000	15	0.000	0.000	23	0.000	0.000
8	0.000	0.000	16	0.000	0.000	24	0.000	0.000

Coeficiente CN Promedio en la Cuenca = 81.010 [adim]
 Lluvia Total Sobre la Cuenca = 25.000 [mm]
 Lámina Efectiva (Neta) Total = 2.360 [mm]
 Coeficiente de Escurrimiento Global = 0.094 [adim]
 Volumen Escurrido Superficialmente = 2215756.000 [m3]

Parámetros del HU Triangular utilizado:

Tiempo al Pico = 7.08 [horas]
 Caudal Pico = 275.91 [m3/s/mm]
 Tiempo Base = 18.90 [horas]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Transf.P-Q CUENCA ALTA (Estacion EL JOBO).ES- Ev:01-SET-2002/1:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 680.0000 [Km2]
 Tiempo de Concentraci n de la Cuenca = 3.1142 [Hrs]
 Intervalo de C lculo Seleccionado = 0.2500 [Hrs]
 Condici n de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]
1	0.250	0.450	9	2.250	0.000	17	4.250	0.000
2	0.500	0.200	10	2.500	0.000	18	4.500	0.100
3	0.750	0.000	11	2.750	0.000	19	4.750	0.100
4	1.000	0.000	12	3.000	0.000	20	5.000	0.100
5	1.250	0.000	13	3.250	0.000	21	5.250	0.050
6	1.500	0.000	14	3.500	0.000	22	5.500	0.000
7	1.750	0.000	15	3.750	0.000	23	5.750	0.000
8	2.000	0.000	16	4.000	0.000	24	6.000	0.000



DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN

	1	2	3	4	5	6	7	8
Area Parcial [%] :	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN :	74.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00

HIETOGRAMAS TOTAL Y EFECTIVO (NETO)

i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	20.250	0.102	9	0.000	0.000	17	0.000	0.000
2	9.000	1.369	10	0.000	0.000	18	4.500	1.186
3	0.000	0.000	11	0.000	0.000	19	4.500	1.464
4	0.000	0.000	12	0.000	0.000	20	4.500	1.709
5	0.000	0.000	13	0.000	0.000	21	2.250	0.937
6	0.000	0.000	14	0.000	0.000	22	0.000	0.000
7	0.000	0.000	15	0.000	0.000	23	0.000	0.000
8	0.000	0.000	16	0.000	0.000	24	0.000	0.000

Coeficiente CN Promedio en la Cuenca = 74.670 [adim]
Lluvia Total Sobre la Cuenca = 45.000 [mm]
L mina Efectiva (Neta) Total = 6.767 [mm]
Coeficiente de Escurrimiento Global = 0.150 [adim]
Volumen Escurrido Superficialmente = 4601888.000 [m3]

Par metros del HU Triangular utilizado:

Tiempo al Pico = 1.99 [horas]
Caudal Pico = 709.50 [m3/s/mm]
Tiempo Base = 5.32 [horas]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Hidrograma estimado p/Estacion EL JOBO. (Sum:1+2).Ev:01-SET-2002/1:30AM

PUNTO DE AFLUENCIAS
HIDROGRAMAS AFLUENTES:

1 2

HIDROGRAMA RESULTANTE:

I	Q(I,IS) [M3/S]	VS(I) [M3]
1	0.91	817.49
2	14.28	13672.57
3	27.66	38565.24
4	41.03	75495.50
5	54.41	124463.30
6	67.78	185468.80



7	81.16	258511.80
8	94.50	343558.50
9	105.91	438881.80
10	98.37	527410.70
11	90.82	609145.20
12	83.27	684085.30
13	75.72	752231.00
14	68.17	813582.30
15	60.62	868139.30
16	53.07	915901.80
17	45.70	957032.10
18	49.65	1001718.00
19	67.70	1062645.00
20	100.95	1153496.00
21	142.54	1281778.00
22	184.51	1447837.00
23	231.81	1656470.00
24	281.24	1909586.00
25	330.23	2206792.00
26	362.24	2532810.00
27	373.34	2868812.00
28	360.40	3193173.00
29	334.48	3494207.00
30	308.25	3771629.00
31	281.87	4025309.00
32	255.49	4255248.00
33	229.11	4461445.00
34	202.73	4643900.00
35	176.35	4802613.00
36	149.97	4937585.00
37	123.59	5048815.00
38	97.21	5136304.00
39	75.31	5204084.00
40	60.78	5258789.00
41	54.98	5308273.00
42	55.37	5358105.00
43	57.21	5409594.00
44	59.05	5462738.00
45	60.69	5517360.00
46	61.40	5572622.00
47	60.56	5627128.00
48	59.19	5680395.00
49	57.81	5732422.00
50	56.43	5783211.00
51	55.05	5832760.00
52	53.68	5881070.00
53	52.30	5928140.00
54	50.92	5973972.00
55	49.55	6018564.00
56	48.17	6061917.00
57	46.79	6104031.00
58	45.42	6144906.00



PROGRAMA HIDROLOGIA-V.1.0

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estacion EL JOBO.Ev:01-SET-2002/1:30AM

I	Q (I, IS) [M3/S]	VS (I) [M3]
1	10.09	9081.00
2	10.51	18540.00
3	10.94	28386.00
4	33.88	58878.00
5	56.94	110124.00
6	105.54	205110.00
7	136.25	327735.00
8	148.99	461826.00
9	152.27	598869.00
10	137.81	722898.00
11	121.13	831915.00
12	106.91	928134.00
13	98.81	1017063.00
14	89.76	1097847.00
15	83.56	1173051.00
16	78.43	1243638.00
17	69.61	1306287.00
18	64.17	1364040.00
19	59.99	1418031.00
20	55.94	1468377.00
21	53.00	1516077.00
22	53.97	1564650.00
23	75.27	1632393.00
24	147.37	1765026.00
25	236.46	1977840.00
26	303.39	2250891.00
27	344.32	2560779.00
28	367.05	2891124.00
29	344.32	3201012.00
30	327.15	3495447.00
31	303.39	3768498.00
32	252.16	3995442.00
33	236.46	4208256.00
34	201.89	4389957.00
35	185.17	4556610.00
36	164.01	4704219.00
37	157.25	4845744.00
38	137.81	4969773.00
39	128.58	5085495.00
40	118.22	5191893.00
41	106.91	5288112.00
42	101.47	5379435.00
43	93.58	5463657.00



44	89.78	5544459.00
45	83.56	5619663.00
46	81.15	5692698.00
47	76.43	5761485.00
48	72.98	5827167.00
49	70.72	5890815.00
50	67.41	5951484.00
51	64.17	6009237.00
52	63.11	6066036.00
53	59.99	6120027.00
54	57.95	6172182.00
55	55.94	6222528.00
56	53.97	6271101.00
57	53.00	6318801.00
58	52.04	6365637.00
59	49.20	6409917.00
60	48.28	6453369.00
61	47.36	6495993.00
62	45.55	6536988.00
63	44.66	6577182.00
64	43.78	6616584.00
65	42.90	6655194.00
66	42.04	6693030.00
67	41.18	6730092.00
68	41.18	6767154.00
69	40.34	6803460.00
70	39.50	6839010.00
71	38.67	6873813.00
72	37.85	6907878.00
73	37.85	6941943.00
74	37.04	6975279.00



PROGRAMA HIDROLOGIA-V.1.0
Desarrollado por el Prof. Juan Carlos BERTONI
Simula el comportamiento de Sistemas Hidrologicos
UNCordoba, ARGENTINA. Mail:jcbertoni@arnet.com.ar

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ-Transf.P-Q CUENCA MEDIA (Estac.JOBO a HACHADURA).Ev:01-SET-2002/1:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 421.0000 [Km2]
Tiempo de Concentraci n de la Cuenca = 5.6303 [Hrs]
Intervalo de C lculo Seleccionado = 0.2500 [Hrs]
Condici n de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]
1	0.250	0.025	9	2.250	0.050	17	4.250	0.000
2	0.500	0.050	10	2.500	0.025	18	4.500	0.000
3	0.750	0.025	11	2.750	0.000	19	4.750	0.000
4	1.000	0.025	12	3.000	0.000	20	5.000	0.000
5	1.250	0.025	13	3.250	0.025	21	5.250	0.000
6	1.500	0.025	14	3.500	0.025	22	5.500	0.100
7	1.750	0.100	15	3.750	0.100	23	5.750	0.050
8	2.000	0.100	16	4.000	0.200	24	6.000	0.050

DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN								
	1	2	3	4	5	6	7	8
Area Parcial [%] :	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN :	72.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00

COEFICIENTES DE REDUCCION AREAL DE LA LLUVIA PARA CADA DURACION
(M,todo del U.S. National Weather Service)

i	Duraci�n [hrs]	Coef. [adim]	i	Duraci�n [hrs]	Coef. [adim]	i	Duraci�n [hrs]	Coef. [adim]
1	0.2500	1.0000	9	2.2500	1.0000	17	4.2500	1.0000
2	0.5000	1.0000	10	2.5000	1.0000	18	4.5000	1.0000
3	0.7500	1.0000	11	2.7500	1.0000	19	4.7500	1.0000
4	1.0000	1.0000	12	3.0000	1.0000	20	5.0000	1.0000
5	1.2500	1.0000	13	3.2500	1.0000	21	5.2500	1.0000
6	1.5000	1.0000	14	3.5000	1.0000	22	5.5000	1.0000
7	1.7500	1.0000	15	3.7500	1.0000	23	5.7500	1.0000
8	2.0000	1.0000	16	4.0000	1.0000	24	6.0000	1.0000



HIETOGRAMAS TOTAL Y EFECTIVO (NETO)								
i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	1.250	0.000	9	2.500	0.312	17	0.000	0.000
2	2.500	0.000	10	1.250	0.206	18	0.000	0.000
3	1.250	0.000	11	0.000	0.000	19	0.000	0.000
4	1.250	0.000	12	0.000	0.000	20	0.000	0.000
5	1.250	0.000	13	1.250	0.237	21	0.000	0.000
6	1.250	0.000	14	1.250	0.267	22	5.000	2.341
7	5.000	0.000	15	5.000	1.344	23	2.500	1.264
8	5.000	0.193	16	10.000	3.791	24	2.500	1.320

Coeficiente CN Promedio en la Cuenca = 77.360 [adim]
 Lluvia Total Sobre la Cuenca = 50.000 [mm]
 L mina Efectiva (Neta) Total = 11.276 [mm]
 Coeficiente de Escurrimiento Global = 0.226 [adim]
 Volumen Escurrido Superficialmente = 4747062.000 [m3]

Parámetros del HU Triangular utilizado:

Tiempo al Pico = 3.50 [horas]
 Caudal Pico = 249.97 [m3/s/mm]
 Tiempo Base = 9.35 [horas]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ-Transito de crecidas. De Estac. JOBO a HACHADURA.Ev:01-SET-2002/1:30AM

PROPAGACIÓN CAUDAL-CAUDAL: MUSKINGUM-CUNGE

PARAMETROS ADOPTADOS:

DX = 3411.60 RUG = 0.035 B = 65.00
 S0 = 0.0100 DTCAL = 900.00 NTRECH = 10

NRO. DE LOS HIDROGRAMAS DE AGUAS ARRIBA (MONTANTE) Y ABAJO (JUSANTE):

3 6

HIDROGRAMA DE APOORTE DISTRIBUIDO: 5

HIDROGRAMAS RESULTANTES:

I	MONTANTE		JUSANTE		
	Q	VOL	Q	VOL	H
	[M3/S]	[M3]	[M3/S]	[M3]	[M]
1	0.91	817.49	0.91	817.49	0.04
2	14.28	13672.57	0.91	1635.09	0.04
3	27.66	38565.24	0.91	2455.69	0.04
4	41.03	75495.50	0.96	3315.77	0.04



5	54.41	124463.30	1.29	4478.34	0.05
6	67.78	185468.80	2.94	7127.58	0.08
7	81.16	258511.80	8.34	14632.15	0.16
8	94.50	343558.50	20.04	32671.33	0.26
9	105.91	438881.80	36.56	65572.97	0.38
10	98.37	527410.70	51.62	112030.30	0.46
11	90.82	609145.20	63.36	169050.60	0.52
12	83.27	684085.30	77.24	238562.50	0.59
13	75.72	752231.00	92.31	321643.70	0.66
14	68.17	813582.30	102.50	413897.50	0.70
15	60.62	868139.30	108.22	511291.30	0.72
16	53.07	915901.80	105.43	606178.30	0.71
17	45.70	957032.10	96.26	692812.70	0.67
18	49.65	1001718.00	93.89	777309.40	0.66
19	67.70	1062645.00	96.17	863863.60	0.67
20	100.95	1153496.00	98.57	952574.30	0.68
21	142.54	1281778.00	99.81	1042403.00	0.69
22	184.51	1447837.00	107.63	1139270.00	0.72
23	231.81	1656470.00	118.73	1246123.00	0.76
24	281.24	1909586.00	141.22	1373225.00	0.85
25	330.23	2206792.00	182.74	1537694.00	0.99
26	362.24	2532810.00	236.24	1750309.00	1.16
27	373.34	2868812.00	298.68	2019118.00	1.33
28	360.40	3193173.00	360.85	2343882.00	1.49
29	334.48	3494207.00	425.82	2727116.00	1.65
30	308.25	3771629.00	489.00	3167216.00	1.79
31	281.87	4025309.00	543.37	3656247.00	1.90
32	255.49	4255248.00	576.06	4174703.00	1.97
33	229.11	4461445.00	581.32	4697891.00	1.98
34	202.73	4643900.00	565.84	5207151.00	1.95
35	176.35	4802613.00	538.57	5691865.00	1.89
36	149.97	4937585.00	511.78	6152467.00	1.84
37	123.59	5048815.00	486.57	6590377.00	1.78
38	97.21	5136304.00	460.13	7004496.00	1.72
39	75.31	5204084.00	429.55	7391091.00	1.65
40	60.78	5258789.00	396.17	7747645.00	1.58
41	54.98	5308273.00	362.12	8073556.00	1.49
42	55.37	5358105.00	324.04	8365195.00	1.40
43	57.21	5409594.00	287.05	8623542.00	1.30
44	59.05	5462738.00	251.06	8849497.00	1.20
45	60.69	5517360.00	220.86	9048275.00	1.11
46	61.40	5572622.00	198.77	9227167.00	1.04
47	60.56	5627128.00	184.75	9393445.00	1.00
48	59.19	5680395.00	175.28	9551196.00	0.97
49	57.81	5732422.00	166.34	9700903.00	0.94
50	56.43	5783211.00	156.52	9841773.00	0.90
51	55.05	5832760.00	145.77	9972966.00	0.86
52	53.68	5881070.00	134.71	10094200.00	0.82
53	52.30	5928140.00	122.95	10204860.00	0.78
54	50.92	5973972.00	110.82	10304600.00	0.73
55	49.55	6018564.00	100.50	10395050.00	0.69
56	48.17	6061917.00	91.33	10477250.00	0.65



PROGRAMA HIDROLOGIA-V.1.0

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estac.LA HACHADURA.Ev:01-SET-2002/1:30AM

I	Q (I, IS) [M3/S]	VS (I) [M3]
1	15.82	14238.00
2	16.40	28998.00
3	16.40	43758.00
4	16.40	58518.00
5	16.98	73800.00
6	16.98	89082.00
7	16.98	104364.00
8	16.98	119646.00
9	16.98	134928.00
10	17.58	150750.00
11	18.19	167121.00
12	52.97	214794.00
13	81.02	287712.00
14	77.19	357183.00
15	72.23	422190.00
16	65.09	480771.00
17	61.66	536265.00
18	153.23	674172.00
19	209.20	862452.00
20	215.48	1056384.00
21	194.89	1231785.00
22	177.24	1391301.00
23	169.67	1544004.00
24	156.81	1685133.00
25	151.46	1821447.00
26	149.69	1956168.00
27	149.69	2090889.00
28	156.81	2232018.00
29	171.54	2386404.00
30	186.94	2554650.00
31	211.28	2744802.00
32	255.17	2974455.00
33	349.98	3289437.00
34	567.29	3799998.00
35	623.49	4361139.00
36	637.96	4935303.00
37	584.57	5461416.00
38	563.87	5968899.00
39	497.56	6416703.00
40	462.87	6833286.00
41	426.45	7217091.00
42	388.68	7566903.00
43	352.67	7884306.00



44	318.42	8170884.00
45	290.80	8432604.00
46	264.44	8670600.00
47	248.32	8894088.00
48	228.34	9099594.00
49	215.48	9293526.00
50	200.96	9474390.00
51	184.98	9640872.00
52	173.43	9796959.00
53	162.26	9942993.00
54	153.23	10080900.00
55	146.20	10212480.00
56	139.33	10337880.00
57	132.62	10457230.00
58	126.08	10570710.00
59	119.71	10678450.00
60	116.59	10783380.00
61	111.98	10884160.00
62	110.46	10983570.00
63	104.50	11077620.00
64	101.59	11169050.00
65	98.71	11257890.00
66	94.47	11342920.00
67	91.70	11425450.00
68	88.97	11505520.00
69	86.28	11583170.00
70	83.63	11658440.00
71	82.32	11732530.00
72	79.74	11804290.00
73	77.19	11873760.00
74	75.94	11942110.00



**SIMULACIÓN DE EVENTOS EN LA CUENCA
PROGRAMA HIDROLOGIA V.1.0**

EVENTO 2 (23-SET-2002)



PROGRAMA HIDROLOGIA-V.1.0
Desarrollado por el Prof. Juan Carlos BERTONI
Simula el comportamiento de Sistemas Hidrologicos
UNCordoba, ARGENTINA. Mail:jcbertoni@arnet.com.ar

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Transf.P-Q CUENCA ALTA (Estacion EL JOBO).Ev:02-23SET02/7:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 939.0000 [Km2]
Tiempo de Concentraci n de la Cuenca = 11.5895 [Hrs]
Intervalo de C lculo Seleccionado = 2.0000 [Hrs]
Condic n de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]
1	2.000	0.044	10	20.000	0.081	19	38.000	0.022
2	4.000	0.097	11	22.000	0.070	20	40.000	0.049
3	6.000	0.010	12	24.000	0.095	21	42.000	0.010
4	8.000	0.000	13	26.000	0.014	22	44.000	0.005
5	10.000	0.000	14	28.000	0.000	23	46.000	0.059
6	12.000	0.003	15	30.000	0.059	24	48.000	0.044
7	14.000	0.065	16	32.000	0.043	25	50.000	0.038
8	16.000	0.027	17	34.000	0.065			
9	18.000	0.087	18	36.000	0.013			

DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN									
		1	2	3	4	5	6	7	8
Area Parcial [%]	:	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN	:	79.00	82.00	0.00	0.00	0.00	0.00	0.00	0.00

HIETOGRAMAS TOTAL Y EFECTIVO (NETO)								
i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	2.112	0.000	10	3.888	0.678	19	1.056	0.541
2	4.656	0.000	11	3.360	0.870	20	2.352	1.249
3	0.480	0.000	12	4.560	1.535	21	0.480	0.262
4	0.000	0.000	13	0.672	0.257	22	0.240	0.132
5	0.000	0.000	14	0.000	0.000	23	2.832	1.600
6	0.144	0.000	15	2.832	1.160	24	2.112	1.242
7	3.120	0.000	16	2.064	0.919	25	1.824	1.103
8	1.296	0.000	17	3.120	1.496			
9	4.176	0.261	18	0.624	0.314			



Coeficiente CN Promedio en la Cuenca = 81.010 [adim]
Lluvia Total Sobre la Cuenca = 48.000 [mm]
L mina Efectiva (Neta) Total = 13.621 [mm]
Posición del Pico del hietograma = 0.000 [%]
Coeficiente de Escurrimiento Global = 0.284 [adim]
Volumen Escurrido Superficialmente = 12790020.000 [m3]

Parámetros del HU Triangular utilizado:

Tiempo al Pico = 7.95 [horas]
Caudal Pico = 245.56 [m3/s/mm]
Tiempo Base = 21.24 [horas]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Transf.P-Q CUENCA ALTA (Estacion EL JOBO).Ev:02-23SET02/7:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 680.0000 [Km2]
Tiempo de Concentración de la Cuenca = 3.1142 [Hrs]
Intervalo de C lculo Seleccionado = 2.0000 [Hrs]
Condición de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duración [horas]	L mina [%P]	i	Duración [horas]	L mina [%P]	i	Duración [horas]	L mina [%P]
1	2.000	0.322	10	20.000	0.150	19	38.000	0.000
2	4.000	0.075	11	22.000	0.014	20	40.000	0.000
3	6.000	0.066	12	24.000	0.055	21	42.000	0.000
4	8.000	0.000	13	26.000	0.000	22	44.000	0.015
5	10.000	0.000	14	28.000	0.000	23	46.000	0.015
6	12.000	0.100	15	30.000	0.000	24	48.000	0.033
7	14.000	0.000	16	32.000	0.000	25	50.000	0.025
8	16.000	0.051	17	34.000	0.000			
9	18.000	0.079	18	36.000	0.000			

DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN									
		1	2	3	4	5	6	7	8

Area Parcial [%]	:	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN	:	74.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00



HIETOGRAMAS TOTAL Y EFECTIVO (NETO)								
i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	24.794	0.610	10	11.550	6.311	19	0.000	0.000
2	5.775	1.178	11	1.078	0.635	20	0.000	0.000
3	5.082	1.456	12	4.235	2.560	21	0.000	0.000
4	0.000	0.000	13	0.000	0.000	22	1.155	0.716
5	0.000	0.000	14	0.000	0.000	23	1.155	0.723
6	7.700	2.832	15	0.000	0.000	24	2.541	1.615
7	0.000	0.000	16	0.000	0.000	25	1.925	1.245
8	3.927	1.693	17	0.000	0.000			
9	6.083	2.905	18	0.000	0.000			

Coeficiente CN Promedio en la Cuenca = 74.670 [adim]
 Lluvia Total Sobre la Cuenca = 77.000 [mm]
 L mina Efectiva (Neta) Total = 24.478 [mm]
 Coeficiente de Escurrimiento Global = 0.318 [adim]
 Volumen Escurrido Superficialmente = 16645230.000 [m3]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

Rio PAZ-Hidrograma estimado p/Estacion EL JOBO. (Sum:1+2).Ev:02-23SET02/7:30AM

HIDROGRAMA RESULTANTE:

I	Q(I,IS) [M3/S]	VS(I) [M3]
1	20.97	150993.90
2	63.45	607867.30
.....		
.....		
.....		
10	362.70	8118273.00
11	327.70	10477730.00
12	258.87	12341630.00
13	165.95	13536500.00
14	115.17	14365750.00
.....		
.....		
.....		
22	121.23	20153720.00
23	151.21	21242430.00
24	193.28	22634070.00
25	219.09	24211490.00
26	184.70	25541360.00
27	127.12	26456620.00
28	93.12	27127100.00
29	71.22	27639910.00
30	52.33	28016650.00



PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estacion EL JOBO.Ev:02-23SET02/7:30AM

I	Q (I, IS) [M3/S]	VS (I) [M3]
1	13.72	98784.00
2	13.72	197568.00
3	27.29	394056.00
4	25.26	575928.00
5	20.82	725832.00
6	18.48	858888.00
7	28.70	1065528.00
8	74.12	1599192.00
9	145.75	2648592.00
10	235.46	4343904.00
11	349.31	6858936.00
12	265.06	8767368.00
13	158.92	9911592.00
14	118.22	10762780.00
15	116.77	11603520.00
16	106.91	12373270.00
17	109.68	13162970.00
18	108.29	13942660.00
19	100.13	14663590.00
20	92.30	15328150.00
21	78.77	15895300.00
22	78.77	16462440.00
23	83.56	17064070.00
24	106.91	17833820.00
25	118.22	18685010.00
26	97.49	19386940.00
27	78.77	19954080.00
28	67.41	20439430.00
29	59.99	20871360.00
30	53.00	21252960.00
31	49.20	21607200.00
32	45.55	21935160.00
33	42.90	22244040.00
34	41.18	22540540.00
35	39.50	22824940.00
36	37.04	23091620.00
37	35.44	23346790.00
38	33.88	23590730.00
39	33.11	23829120.00
40	31.61	24056710.00
41	30.13	24273650.00
42	28.70	24480290.00
43	27.99	24681820.00
44	27.29	24878300.00
45	26.61	25069900.00



PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ-Transf.P-Q CUENCA MEDIA (Estac.JOBO a HACHADURA).Ev:02-23SET02/7:30AM

HIDROGRAMA DE PROYECTO - METODO INTEGRAL DEL SCS-CN

Area de la Cuenca = 421.0000 [Km2]
Tiempo de Concentraci n de la Cuenca = 5.6303 [Hrs]
Intervalo de C lculo Seleccionado = 2.0000 [Hrs]
Condici n de Humedad Antecedente = 1.0000

DATOS DE PRECIPITACION								
i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]	i	Duraci�n [horas]	L mina [%P]
1	2.000	0.044	10	20.000	0.081	19	38.000	0.022
2	4.000	0.097	11	22.000	0.070	20	40.000	0.049
3	6.000	0.010	12	24.000	0.095	21	42.000	0.010
4	8.000	0.000	13	26.000	0.014	22	44.000	0.005
5	10.000	0.000	14	28.000	0.000	23	46.000	0.059
6	12.000	0.003	15	30.000	0.059	24	48.000	0.044
7	14.000	0.065	16	32.000	0.043	25	50.000	0.038
8	16.000	0.027	17	34.000	0.065			
9	18.000	0.087	18	36.000	0.013			

DISTRIBUCION DE LAS AREAS Y COEFICIENTES CN								
	1	2	3	4	5	6	7	8
Area Parcial [%] :	33.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeficiente CN :	72.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00

HIETOGRAMAS TOTAL Y EFECTIVO (NETO)								
i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]	i	P.Total [mm]	P.Neta [mm]
1	6.600	0.000	10	12.150	7.103	19	3.300	2.718
2	14.550	0.490	11	10.500	6.886	20	7.350	6.129
3	1.500	0.248	12	14.250	10.175	21	1.500	1.263
4	0.000	0.000	13	2.100	1.566	22	0.750	0.633
5	0.000	0.000	14	0.000	0.000	23	8.850	7.533
6	0.450	0.083	15	8.850	6.755	24	6.600	5.692
7	9.750	2.682	16	6.450	5.066	25	5.700	4.962
8	4.050	1.535	17	9.750	7.853			
9	13.050	6.211	18	1.950	1.596			

Coeficiente CN Promedio en la Cuenca = 77.360 [adim]
Lluvia Total Sobre la Cuenca = 150.000 [mm]
L mina Efectiva (Neta) Total = 87.178 [mm]
Coeficiente de Escurrimiento Global = 0.581 [adim]
Volumen Escurrido Superficialmente = 36701780.000 [m3]



Parámetros del HU Triangular utilizado:

Tiempo al Pico	=	4.38 [horas]
Caudal Pico	=	200.01 [m3/s/mm]
Tiempo Base	=	11.69 [horas]

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ-Transito de crecidas. De Estac. JOBO a HACHADURA.Ev:02-23SET02/7:30AM

PROPAGACIÓN CAUDAL-CAUDAL MUSKINGUM-CUNGE

PARAMETROS ADOPTADOS:

DX =	3411.60	RUG =	0.04	B =	65.00
S0 =	0.0100	DTCAL =	1800.00	NTRECH =	10

NRO. DE LOS HIDROGRAMAS DE MONTANTE Y JUSANTE: 3 6

HIDROGRAMA DE APOORTE DISTRIBUIDO: 5

HIDROGRAMAS RESULTANTES:

I	MONTANTE		JUSANTE		
	Q	VOL	Q	VOL	H
	[M3/S]	[M3]	[M3/S]	[M3]	[M]
1	20.97	150993.90	20.97	150993.90	0.27
2	63.45	607867.30	41.19	447558.20	0.41
3	104.82	1362606.00	90.90	1102022.00	0.65
8	106.54	4317182.00	155.73	4751306.00	0.90
9	165.23	5506868.00	233.39	6431737.00	1.15
10	362.70	8118273.00	436.42	9573983.00	1.67
11	327.70	10477730.00	638.39	14170370.00	2.10
12	258.87	12341630.00	662.16	18937950.00	2.14
13	165.95	13536500.00	623.61	23427950.00	2.07
14	115.17	14365750.00	477.07	26862840.00	1.76
15	82.65	14960810.00	349.78	29381230.00	1.46
16	84.65	15570290.00	310.47	31616630.00	1.36
17	93.41	16242870.00	346.76	34113320.00	1.45
18	103.85	16990590.00	391.05	36928880.00	1.56
24	193.28	22634070.00	383.43	51651130.00	1.54
25	219.09	24211490.00	468.83	55026690.00	1.74
26	184.70	25541360.00	472.03	58425300.00	1.75
27	127.12	26456620.00	364.55	61050050.00	1.50
28	93.12	27127100.00	224.74	62668140.00	1.12
29	71.22	27639910.00	127.58	63586700.00	0.80
30	52.33	28016650.00	72.28	64107120.00	0.57



PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estac.LA HACHADURA.Ev:02-23SET02/7:30AM

I	Q (I, IS) [M3/S]	VS (I) [M3]
1	20.06	144432.00
2	22.72	308016.00
3	23.40	476496.00
4	38.46	753408.00
5	37.57	1023912.00
6	44.94	1347480.00
7	41.17	1643904.00
8	56.14	2048112.00
9	73.45	2576952.00
10	97.29	3277440.00
11	246.05	5049000.00
12	400.12	7929864.00
13	739.96	13257580.00
14	648.92	17929800.00
15	605.64	22290410.00
16	450.56	25534440.00
17	358.10	28112760.00
18	288.35	30188880.00
19	271.50	32143680.00
20	243.81	33899110.00
21	234.90	35590390.00
22	239.33	37313570.00
23	213.38	38849900.00
24	190.89	40224310.00
25	194.89	41627520.00
26	213.38	43163860.00
27	211.28	44685070.00
28	211.28	46206290.00
29	219.73	47788340.00
30	190.89	49162750.00
31	153.23	50266010.00
32	132.62	51220870.00
33	113.50	52038070.00
34	101.58	52769450.00
35	91.70	53429690.00
36	84.95	54041330.00
37	78.46	54606240.00
38	72.22	55126220.00
39	69.80	55628780.00
40	65.08	56097360.00
41	61.65	56541240.00
42	58.32	56961140.00
43	56.14	57365350.00
44	52.96	57746660.00



**SIMULACIÓN DE EVENTOS EN LA CUENCA
PROGRAMA HIDROLOGIA V.1.0**

EVENTO 3 (15-OCT-2002)



PROGRAMA HIDROLOGIA-V.1.0

Desarrollado por el Prof. Juan Carlos BERTONI

Simula el comportamiento de Sistemas Hidrologicos

UNCordoba, ARGENTINA. Mail:jcbertoni@arnet.com.ar

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estacion EL JOBO.Evento:15-OCT-2002/5:00AM

I	Q(I,IS) [M3/S]	VS(I) [M3]
1	10.50	9450.00
2	10.40	18810.00
3	10.30	28080.00
4	10.20	37260.00
5	10.18	46422.00
6	10.15	55557.00
7	10.09	64638.00
8	11.38	74880.00
9	18.48	91512.00
10	20.82	110250.00
11	20.82	128988.00
12	20.82	147726.00
13	20.22	165924.00
14	20.22	184122.00
15	19.63	201789.00
16	19.05	218934.00
17	19.05	236079.00
18	18.48	252711.00
19	18.48	269343.00
20	17.91	285462.00
21	17.91	301581.00
22	17.36	317205.00
23	16.81	332334.00
24	16.81	347463.00
25	16.81	362592.00
26	16.27	377235.00
27	16.27	391878.00
28	15.74	406044.00
29	15.74	420210.00
30	15.74	434376.00
31	15.22	448074.00
32	15.22	461772.00
33	15.22	475470.00
34	15.22	489168.00
35	14.71	502407.00
36	14.71	515646.00
37	14.21	528435.00
38	14.21	541224.00
39	14.21	554013.00
40	14.21	566802.00



PROGRAMA HIDROLOGIA-V.1.0

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estac.LA HACHADURA.Evento:15-OCT-2002/5:00AM

I	Q (I, IS) [M3/S]	VS (I) [M3]
1	14.16	12744.00
2	14.16	25488.00
3	14.16	38232.00
4	14.16	50976.00
5	14.16	63720.00
6	14.16	76464.00
7	14.16	89208.00
8	14.16	101952.00
9	14.16	114696.00
10	14.16	127440.00
11	14.16	140184.00
12	14.16	152928.00
13	14.16	165672.00
14	14.16	178416.00
15	14.16	191160.00
16	14.16	203904.00
17	14.16	216648.00
18	14.16	229392.00
19	14.16	242136.00
20	14.16	254880.00
21	14.16	267624.00
22	14.16	280368.00
23	14.16	293112.00
24	14.16	305856.00
25	13.62	318114.00
26	13.62	330372.00
27	14.16	343116.00
28	14.16	355860.00
29	14.16	368604.00
30	14.16	381348.00
31	14.16	394092.00
32	14.16	406836.00
33	14.16	419580.00
34	15.82	433818.00
35	20.71	452457.00
36	22.72	472905.00
37	23.41	493974.00
38	24.11	515673.00
39	22.72	536121.00
40	22.72	556569.00
41	22.72	577017.00
42	22.04	596853.00
43	22.04	616689.00



44	21.37	635922.00
45	21.37	655155.00
46	21.37	674388.00
47	20.71	693027.00
48	20.71	711666.00
49	20.07	729729.00
50	20.07	747792.00
51	20.07	765855.00
52	20.07	783918.00
53	19.43	801405.00
54	19.43	818892.00
55	19.43	836379.00
56	19.43	853866.00
57	18.80	870786.00
58	18.80	887706.00
59	18.80	904626.00
60	18.80	921546.00
61	18.19	937917.00
62	18.19	954288.00
63	18.19	970659.00
64	18.19	987030.00
65	18.19	1003401.00
66	17.58	1019223.00
67	17.58	1035045.00
68	17.58	1050867.00
69	17.58	1066689.00
70	17.58	1082511.00
71	17.58	1098333.00
72	16.98	1113615.00
73	16.98	1128897.00
74	16.98	1144179.00



**SIMULACIÓN DE EVENTOS EN LA CUENCA
PROGRAMA HIDROLOGIA V.1.0**

EVENTO 4 (31-MAY-2003)



PROGRAMA HIDROLOGIA-V.1.0

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estacion EL JOBO.Ev:04-31MAY03/15:45AM

I	Q(I, IS) [M3/S]	VS(I) [M3]
1	14.71	13239.00
2	14.70	26469.00
3	14.69	39690.00
4	14.68	52902.00
5	14.67	66105.00
6	14.66	79299.00
7	14.65	92484.00
8	14.64	105660.00
9	14.63	118827.00
10	14.62	131985.00
11	14.61	145134.00
12	14.60	158274.00
13	14.60	171414.00
14	14.61	184563.00
15	14.61	197712.00
16	14.62	210870.00
17	14.66	224064.00
18	14.65	237249.00
19	14.64	250425.00
20	14.66	263619.00
21	14.66	276813.00
22	14.65	289998.00
23	14.65	303183.00
24	14.64	316359.00
25	14.71	329598.00
26	15.22	343296.00
27	15.22	356994.00
28	15.22	370692.00
29	16.81	385821.00
30	21.43	405108.00
31	22.67	425511.00
32	22.04	445347.00
33	21.43	464634.00
34	20.82	483372.00
35	20.22	501570.00
36	19.63	519237.00
37	19.05	536382.00
38	18.48	553014.00
39	17.91	569133.00
40	17.36	584757.00
41	16.81	599886.00
42	16.27	614529.00
43	15.74	628695.00



PROGRAMA HIDROLOGIA-V.1.0

PROYECTO OEA/BID/C.BLANCOS-CUENCA RIO PAZ-SISTEMA DE PRONOSTICO HIDROLOGICO

RIO PAZ- Hidrograma registrado en Estac.LA HACHADURA.Ev:04-31MAY03/15:45AM

I	Q(I,IS) [M3/S]	VS(I) [M3]
1	22.65	20385.00
2	22.64	40761.00
3	22.63	61128.00
4	22.62	81486.00
5	22.62	101844.00
6	22.61	122193.00
7	22.61	142542.00
8	21.60	161982.00
9	22.60	182322.00
10	22.59	202653.00
11	22.58	222975.00
12	22.58	243297.00
13	22.57	263610.00
14	22.57	283923.00
15	22.58	304245.00
16	21.59	323676.00
17	22.60	344016.00
18	22.59	364347.00
19	22.57	384660.00
20	22.55	404955.00
21	22.57	425268.00
22	22.59	445599.00
23	22.60	465939.00
24	21.63	485406.00
25	22.65	505791.00
26	22.60	526131.00
27	22.55	546426.00
28	22.45	566631.00
29	22.40	586791.00
30	22.36	606915.00
31	22.34	627021.00
32	21.33	646218.00
33	22.31	666297.00
34	22.28	686349.00
35	22.26	706383.00
36	22.25	726408.00
37	22.24	746424.00
38	22.23	766431.00
39	22.22	786429.00
40	22.20	806409.00
41	22.18	826371.00
42	22.15	846306.00
43	22.12	866214.00



44	22.10	886104.00
45	22.06	905958.00
46	22.04	925794.00
47	22.04	945630.00
48	21.37	964863.00
49	21.37	984096.00
50	21.37	1003329.00
51	21.37	1022562.00
52	21.37	1041795.00
53	20.71	1060434.00
54	20.71	1079073.00
55	21.37	1098306.00
56	21.37	1117539.00
57	22.04	1137375.00
58	24.11	1159074.00
59	25.54	1182060.00
60	26.27	1205703.00
61	27.01	1230012.00
62	26.27	1253655.00
63	26.27	1277298.00
64	25.54	1300284.00
65	24.82	1322622.00
66	24.82	1344960.00
67	24.11	1366659.00
68	24.11	1388358.00
69	23.41	1409427.00
70	23.41	1430496.00
71	22.72	1450944.00
72	22.72	1471392.00
73	22.04	1491228.00
74	22.04	1511064.00
75	21.37	1530297.00
76	21.37	1549530.00
77	20.71	1568169.00
78	20.71	1586808.00
79	20.71	1605447.00
80	20.07	1623510.00
81	20.07	1641573.00
82	20.07	1659636.00
83	19.43	1677123.00
84	19.43	1694610.00
85	19.43	1712097.00
86	19.43	1729584.00
87	18.80	1746504.00
88	18.80	1763424.00
89	18.80	1780344.00
90	18.80	1797264.00
91	18.80	1814184.00
92	18.19	1830555.00
93	18.19	1846926.00
94	18.19	1863297.00
95	0.00	1863297.00
