ANEXOS

PLANOS

ANEXO A:

MODELAMIENTO HIDRÁULICO

Tr=100años ; Q=419m^3/s

Cuadro N°A.1 Resultados del modelamiento del Río Ica en la zona de estudio considerando una protección de altura preliminar en la margen izquierda (Tr=100 años).

Fuente, Elaboración propia

MODELAMIENTO HIDRÁULICO HEC-RAS														BORDE LIBRE				PROFUNDIDAD DE SOCAVACIÓN							
River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levedev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
3+180	419	389.8	395.0	393.4	395.5	0.001	1.8	2.8	149.4	42.2	0.5	48.0	5.3	0.8	395.8	6.1	3.5	0.98	1.00	2.0	0.387	1.23	9.9	4.6	385.2
3+160	419	390.3	394.9	-	395.5	0.002	2.0	3.2	131.6	40.0	0.6	67.6	4.6	0.8	395.7	5.4	3.3	0.98	1.00	2.0	0.387	1.47	9.5	4.9	385.4
3+120	419	390.4	394.9	-	395.4	0.002	1.6	2.7	153.0	47.8	0.5	50.3	4.5	0.8	395.7	5.3	3.2	0.98	1.00	2.0	0.387	1.29	8.4	3.9	386.5
3+100	419	390.5	394.9	-	395.3	0.002	1.9	2.6	158.9	56.0	0.5	47.8	4.4	0.8	395.7	5.2	2.8	0.98	1.00	2.0	0.387	1.34	8.4	4.0	386.5
3+080	419	390.5	394.7	-	395.3	0.002	2.0	2.9	144.3	58.4	0.6	54.4	4.2	0.8	395.5	5.0	2.5	0.98	1.00	2.0	0.387	1.62	9.1	4.9	385.6
3+040	419	390.3	394.7	-	395.1	0.001	1.8	2.4	175.8	65.4	0.5	37.5	4.5	0.8	395.5	5.3	2.7	0.98	1.00	2.0	0.387	1.26	8.2	3.7	386.5
3+020	419	390.3	394.7	-	395.1	0.002	1.7	2.4	172.2	66.6	0.5	37.5	4.4	0.8	395.5	5.2	2.6	0.98	1.00	2.0	0.387	1.32	8.4	3.9	386.3
3+000	419	390.2	394.7	-	395.1	0.001	1.8	2.4	178.5	65.7	0.5	36.9	4.5	0.8	395.5	5.3	2.7	0.98	1.00	2.0	0.387	1.23	8.2	3.7	386.5
2+980	419	390.0	394.6	-	395.0	0.002	2.0	2.4	171.8	63.4	0.5	42.7	4.6	0.8	395.4	5.4	2.7	0.98	1.00	2.0	0.387	1.28	8.6	4.0	386.0
2+960	419	390.0	394.5	-	395.0	0.002	2.1	2.6	161.3	59.5	0.6	47.0	4.5	0.8	395.3	5.3	2.7	0.98	1.00	2.0	0.387	1.36	8.8	4.3	385.7
2+940	419	390.3	394.4	-	394.9	0.002	2.3	2.8	148.6	58.9	0.6	59.7	4.2	0.8	395.2	5.0	2.5	0.98	1.00	2.0	0.387	1.55	8.9	4.7	385.6
2+920	419	390.1	394.5	-	394.9	0.001	1.6	2.4	174.0	61.9	0.5	36.9	4.4	0.8	395.3	5.2	2.8	0.98	1.00	2.0	0.387	1.23	7.9	3.5	386.6
2+900	419	390.1	394.5	-	394.8	0.001	1.5	2.1	201.5	64.2	0.4	26.9	4.5	0.8	395.3	5.3	3.1	0.98	1.00	2.0	0.387	0.99	6.9	2.4	387.6
2+880	419	390.1	394.5	-	394.8	0.001	1.4	2.1	199.4	64.6	0.4	26.5	4.4	0.8	395.3	5.2	3.1	0.98	1.00	2.0	0.387	1.01	6.8	2.5	387.7
2+840	419	389.7	394.4	-	394.7	0.001	1.3	2.4	177.9	58.9	0.4	33.8	4.6	0.8	395.2	5.4	3.0	0.98	1.00	2.0	0.387	1.15	8.0	3.4	386.3
2+820	419	389.5	394.4	-	394.7	0.001	1.3	2.2	189.3	60.3	0.4	30.2	4.9	0.8	395.2	5.7	3.1	0.98	1.00	2.0	0.387	1.05	8.0	3.1	386.4
2+800	419	389.5	394.4	-	394.7	0.001	1.5	2.0	207.7	61.5	0.4	27.0	4.9	0.8	395.2	5.7	3.4	0.98	1.00	2.0	0.387	0.91	7.3	2.4	387.1

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Leve diev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
2+780	419	389.3	394.4	-	394.6	0.001	1.2	1.8	239.9	64.0	0.3	19.9	5.2	0.8	395.2	6.0	3.7	0.98	1.00	2.0	0.387	0.74	6.6	1.5	387.8
2+760	419	389.5	394.4	-	394.6	0.000	1.0	1.6	271.1	92.6	0.3	13.6	5.0	0.8	395.2	5.8	2.9	0.98	1.00	2.0	0.387	0.77	6.5	1.6	387.9
2+740	419	389.3	394.4	-	394.6	0.000	0.9	1.5	275.6	93.1	0.3	13.3	5.1	0.8	395.2	5.9	3.0	0.98	1.00	2.0	0.387	0.75	6.6	1.5	387.8
2+720	419	389.1	394.3	-	394.6	0.001	1.3	1.8	228.2	83.9	0.4	19.8	5.3	0.8	395.1	6.1	2.7	0.98	1.00	2.0	0.387	0.96	8.3	3.0	386.1
2+700	419	389.0	394.3	-	394.6	0.001	1.6	1.9	216.0	81.1	0.4	23.9	5.3	0.8	395.1	6.1	2.7	0.98	1.00	2.0	0.387	1.03	8.6	3.4	385.6
2+680	419	389.0	394.3	-	394.5	0.001	1.5	1.8	229.0	81.0	0.4	21.0	5.3	0.8	395.1	6.1	2.8	0.98	1.00	2.0	0.387	0.93	8.1	2.8	386.2
2+640	419	389.3	394.1	-	394.5	0.001	1.6	2.2	194.4	80.3	0.4	25.4	4.9	0.8	394.9	5.7	2.4	0.98	1.00	2.0	0.387	1.22	8.9	4.0	385.2
2+620	419	389.2	394.1	-	394.5	0.001	1.6	2.2	188.4	79.1	0.4	25.0	4.9	0.8	394.9	5.7	2.4	0.98	1.00	2.0	0.387	1.27	9.2	4.3	384.9
2+600	419	389.0	394.0	-	394.4	0.001	1.6	2.4	177.3	76.0	0.4	26.2	5.0	0.8	394.8	5.8	2.3	0.98	1.00	2.0	0.387	1.37	10.0	5.0	384.0
2+580	419	389.1	394.0	-	394.4	0.001	1.4	2.4	172.1	65.6	0.5	32.0	4.9	0.8	394.8	5.7	2.6	0.98	1.00	2.0	0.387	1.31	9.4	4.5	384.6
2+560	419	388.8	393.9	-	394.4	0.001	1.2	2.5	167.6	57.9	0.5	35.3	5.2	0.8	394.7	6.0	2.9	0.98	1.00	2.0	0.387	1.26	9.7	4.6	384.2
2+540	419	388.6	393.9	-	394.3	0.001	1.6	2.3	181.2	56.8	0.5	34.8	5.3	0.8	394.7	6.1	3.2	0.98	1.00	2.0	0.387	1.09	9.1	3.8	384.9
2+520	419	389.0	393.9	-	394.3	0.001	1.4	2.4	176.2	54.7	0.4	35.6	4.9	0.8	394.7	5.7	3.2	0.98	1.00	2.0	0.387	1.11	8.4	3.5	385.5
2+500	419	388.9	393.9	-	394.3	0.001	1.2	2.3	185.5	51.8	0.4	32.0	5.0	0.8	394.7	5.8	3.6	0.98	1.00	2.0	0.387	0.99	7.9	2.9	386.0
2+480	419	388.7	393.8	-	394.2	0.001	1.6	2.5	166.6	44.5	0.5	42.4	5.1	0.8	394.6	5.9	3.7	0.98	1.00	2.0	0.387	1.06	8.5	3.4	385.3
2+460	419	388.7	393.7	-	394.2	0.002	2.0	2.9	147.1	41.9	0.5	54.7	4.9	0.8	394.5	5.7	3.5	0.98	1.00	2.0	0.387	1.26	9.2	4.3	384.4
2+420	419	388.5	393.5	-	394.1	0.002	1.9	3.0	139.8	37.5	0.5	57.9	5.0	0.8	394.3	5.8	3.7	0.98	1.00	2.0	0.387	1.27	9.5	4.5	384.0
2+400	419	388.5	393.6	-	394.1	0.001	1.7	2.8	150.7	40.8	0.5	48.4	5.1	0.8	394.4	5.9	3.7	0.98	1.00	2.0	0.387	1.19	9.2	4.1	384.4
2+380	419	388.4	393.6	-	394.0	0.001	1.7	2.6	161.5	42.2	0.5	43.7	5.1	0.8	394.4	5.9	3.8	0.98	1.00	2.0	0.387	1.08	8.7	3.5	384.9
2+360	419	388.3	393.5	391.7	394.0	0.001	1.8	2.7	158.1	42.2	0.5	46.1	5.3	0.8	394.3	6.1	3.7	0.98	1.00	2.0	0.387	1.12	9.2	3.9	384.3
2+340	419	388.3	393.2	392.0	393.9	0.002	2.3	3.3	125.3	34.4	0.6	73.7	5.0	0.8	394.0	5.8	3.6	0.98	1.00	2.0	0.387	1.44	10.2	5.3	383.0

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levediev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
2+320	419	388.3	392.8	392.1	393.8	0.004	3.1	4.1	102.9	30.6	0.8	121.5	4.5	0.8	393.6	5.3	3.4	0.98	1.00	2.0	0.387	1.85	10.9	6.4	381.8
2+300	419	388.4	392.5	392.1	393.7	0.004	2.8	4.4	95.5	29.2	0.8	129.4	4.1	0.8	393.3	4.9	3.3	0.98	1.00	2.0	0.387	2.03	10.5	6.3	382.1
2+280	419	388.3	392.5	391.9	393.6	0.004	2.4	4.1	101.2	31.7	0.8	107.2	4.3	0.8	393.3	5.1	3.2	0.98	1.00	2.0	0.387	1.95	10.7	6.4	381.9
2+260	419	388.3	391.9	391.9	393.5	0.006	2.8	5.0	83.5	28.5	1.0	165.1	3.6	0.8	392.7	4.4	2.9	0.98	1.00	2.0	0.387	2.50	10.5	6.8	381.5
2+240	419	388.3	392.2	391.6	393.2	0.004	2.0	4.1	102.5	30.6	0.8	107.3	4.0	0.8	393.0	4.8	3.3	0.98	1.00	2.0	0.387	1.86	9.4	5.4	382.8
2+220	419	388.2	392.3	391.4	393.1	0.003	2.1	3.6	116.5	34.0	0.7	84.8	4.1	0.8	393.1	4.9	3.4	0.98	1.00	2.0	0.387	1.62	8.7	4.7	383.6
2+200	419	388.2	392.3	391.3	393.0	0.003	2.1	3.5	121.4	36.1	0.6	78.3	4.1	0.8	393.1	4.9	3.4	0.98	1.00	2.0	0.387	1.57	8.5	4.5	383.8
2+180	419	388.2	392.4	391.1	392.9	0.002	2.0	3.1	135.8	39.4	0.6	62.8	4.1	0.8	393.2	4.9	3.4	0.98	1.00	2.0	0.387	1.38	7.9	3.8	384.4
2+160	419	388.2	392.3	391.0	392.9	0.002	1.8	3.1	135.8	38.7	0.6	61.2	4.1	0.8	393.1	4.9	3.5	0.98	1.00	2.0	0.387	1.36	7.8	3.7	384.5
2+140	419	388.2	392.3	391.0	392.8	0.002	1.7	3.0	140.6	40.3	0.5	56.0	4.1	0.8	393.1	4.9	3.5	0.98	1.00	2.0	0.387	1.32	7.6	3.5	384.7
2+120	419	388.2	392.1	391.0	392.8	0.002	1.9	3.3	125.5	36.8	0.6	70.5	3.9	0.8	392.9	4.7	3.4	0.98	1.00	2.0	0.387	1.50	7.9	4.0	384.2
2+100	419	388.2	391.8	391.2	392.7	0.004	2.4	3.9	106.7	35.5	0.8	107.2	3.6	0.8	392.6	4.4	3.0	0.98	1.00	2.0	0.387	1.92	8.5	4.9	383.3
2+080	419	388.0	391.9	391.0	392.6	0.003	2.0	3.4	123.1	38.9	0.6	77.9	3.8	0.8	392.7	4.6	3.2	0.98	1.00	2.0	0.387	1.61	8.2	4.3	383.7
2+060	419	388.0	391.9	390.8	392.5	0.002	1.9	3.1	136.0	42.4	0.6	63.1	3.9	0.8	392.7	4.7	3.2	0.98	1.00	2.0	0.387	1.45	7.7	3.8	384.2
2+040	419	388.0	391.9	390.7	392.4	0.002	1.7	2.9	144.9	44.5	0.5	55.1	3.9	0.8	392.7	4.7	3.3	0.98	1.00	2.0	0.387	1.34	7.4	3.4	384.5
2+020	419	388.0	391.9	390.6	392.4	0.002	1.7	2.8	148.7	45.4	0.5	52.1	3.9	0.8	392.7	4.7	3.3	0.98	1.00	2.0	0.387	1.30	7.2	3.3	384.7
2+000	419	388.0	391.9	390.4	392.3	0.001	1.6	2.5	165.4	47.1	0.5	42.2	4.0	0.8	392.7	4.8	3.5	0.98	1.00	2.0	0.387	1.12	6.6	2.6	385.4
1+980	419	387.9	391.9	390.3	392.3	0.001	1.4	2.5	170.3	49.1	0.4	38.9	4.0	0.8	392.7	4.8	3.5	0.98	1.00	2.0	0.387	1.10	6.5	2.5	385.5
1+960	419	387.8	391.9	390.2	392.2	0.001	1.3	2.3	184.4	52.1	0.4	33.0	4.2	0.8	392.7	5.0	3.5	0.98	1.00	2.0	0.387	1.00	6.4	2.2	385.5
1+940	419	387.8	391.9	390.1	392.2	0.001	1.3	2.2	192.9	55.1	0.4	31.4	4.2	0.8	392.7	5.0	3.5	0.98	1.00	2.0	0.387	0.96	6.2	2.0	385.7
1+920	419	387.8	391.9	390.0	392.2	0.001	1.2	2.0	205.6	57.0	0.4	27.8	4.2	0.8	392.7	5.0	3.6	0.98	1.00	2.0	0.387	0.88	5.9	1.7	386.1

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levediev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
1+900	419	387.8	391.9	390.0	392.2	0.001	1.1	2.1	203.1	55.7	0.4	28.0	4.2	0.8	392.7	5.0	3.6	0.98	1.00	2.0	0.387	0.89	5.9	1.7	386.1
1+880	419	387.8	391.9	390.0	392.1	0.001	1.2	2.1	200.0	54.2	0.4	30.3	4.1	0.8	392.7	4.9	3.7	0.98	1.00	2.0	0.387	0.90	5.8	1.7	386.0
1+860	419	387.8	391.8	390.0	392.1	0.001	1.3	2.2	192.1	53.3	0.4	33.4	4.1	0.8	392.6	4.9	3.6	0.98	1.00	2.0	0.387	0.95	6.0	1.9	385.8
1+840	419	387.8	391.8	390.0	392.1	0.001	1.3	2.2	189.6	52.3	0.4	33.0	4.1	0.8	392.6	4.9	3.6	0.98	1.00	2.0	0.387	0.96	6.0	1.9	385.8
1+820	419	387.8	391.8	390.0	392.1	0.001	1.3	2.2	189.0	53.3	0.4	31.8	4.1	0.8	392.6	4.9	3.5	0.98	1.00	2.0	0.387	0.97	6.0	2.0	385.8
1+800	419	387.8	391.7	390.1	392.1	0.001	1.1	2.4	171.5	51.4	0.4	38.7	4.0	0.8	392.5	4.8	3.3	0.98	1.00	2.0	0.387	1.12	6.5	2.5	385.2
1+780	419	387.5	391.4	390.3	392.0	0.002	1.3	3.2	133.1	42.4	0.6	63.3	3.9	0.8	392.2	4.7	3.1	0.98	1.00	2.0	0.387	1.50	7.8	4.0	383.6
1+760	419	387.5	390.9	390.6	391.9	0.005	2.2	4.0	104.0	39.1	0.8	117.3	3.4	0.8	391.7	4.2	2.7	0.98	1.00	2.0	0.387	2.14	8.7	5.3	382.2
1+740	419	387.5	390.7	390.3	391.8	0.006	2.4	4.1	101.7	40.4	0.9	132.3	3.2	0.8	391.5	4.0	2.5	0.98	1.00	2.0	0.387	2.27	8.5	5.3	382.2
1+720	419	387.5	390.9	390.1	391.6	0.003	1.8	3.3	128.5	46.2	0.7	84.0	3.4	0.8	391.7	4.2	2.8	0.98	1.00	2.0	0.387	1.68	7.4	3.9	383.6
1+700	419	387.5	390.9	390.1	391.5	0.003	1.8	3.2	130.7	47.9	0.7	77.8	3.4	0.8	391.7	4.2	2.7	0.98	1.00	2.0	0.387	1.68	7.2	3.8	383.6
1+680	419	387.5	390.5	390.3	391.4	0.005	2.2	3.9	107.5	46.0	0.8	111.6	3.0	0.8	391.3	3.8	2.3	0.98	1.00	2.0	0.387	2.26	7.7	4.7	382.7
1+660	419	387.5	390.5	390.1	391.3	0.004	2.2	3.5	120.7	51.0	0.8	91.1	3.0	0.8	391.3	3.8	2.4	0.98	1.00	2.0	0.387	1.99	7.2	4.1	383.3
1+640	419	387.3	390.6	389.9	391.1	0.003	1.8	3.2	132.8	51.6	0.7	73.2	3.3	0.8	391.4	4.1	2.6	0.98	1.00	2.0	0.387	1.72	7.1	3.8	383.4
1+620	419	387.3	390.4	389.9	391.1	0.004	2.0	3.4	125.0	50.5	0.7	83.7	3.2	0.8	391.2	4.0	2.5	0.98	1.00	2.0	0.387	1.87	7.2	4.0	383.2
1+600	419	387.3	390.4	389.9	391.0	0.003	1.9	3.2	130.2	57.3	0.7	75.6	3.1	0.8	391.2	3.9	2.3	0.98	1.00	2.0	0.387	1.90	7.1	4.0	383.2
1+580	419	387.2	390.4	389.8	390.9	0.003	1.9	2.9	142.8	63.3	0.7	65.8	3.1	0.8	391.2	3.9	2.3	0.98	1.00	2.0	0.387	1.74	6.7	3.6	383.6
1+560	419	387.1	390.4	389.6	390.8	0.002	1.6	2.7	156.5	65.0	0.6	54.4	3.3	0.8	391.2	4.1	2.4	0.98	1.00	2.0	0.387	1.52	6.4	3.2	383.9
1+540	419	386.9	390.3	389.6	390.8	0.002	1.7	2.7	155.7	66.7	0.6	54.1	3.4	0.8	391.1	4.2	2.3	0.98	1.00	2.0	0.387	1.56	6.9	3.5	383.5
1+520	419	387.0	390.4	389.3	390.7	0.002	1.4	2.2	189.9	73.5	0.5	39.6	3.4	0.8	391.2	4.2	2.6	0.98	1.00	2.0	0.387	1.20	5.7	2.3	384.7
1+500	419	387.0	390.4	389.2	390.6	0.001	1.3	2.2	192.9	71.5	0.5	35.6	3.4	0.8	391.2	4.2	2.7	0.98	1.00	2.0	0.387	1.14	5.5	2.1	384.9

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levedev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
1+480	419	387.0	390.3	389.3	390.6	0.002	1.4	2.4	178.3	75.5	0.5	37.3	3.3	0.8	391.1	4.1	2.4	0.98	1.00	2.0	0.387	1.35	6.0	2.7	384.3
1+460	419	387.0	390.3	389.0	390.6	0.001	1.2	2.1	201.8	76.9	0.4	32.1	3.3	0.8	391.1	4.1	2.6	0.98	1.00	2.0	0.387	1.11	5.3	1.9	385.0
1+440	419	386.8	390.3	388.9	390.5	0.001	1.2	2.0	214.1	76.8	0.4	28.1	3.6	0.8	391.1	4.4	2.8	0.98	1.00	2.0	0.387	1.01	5.3	1.7	385.0
1+420	419	386.8	390.3	388.8	390.5	0.001	1.1	1.8	228.6	79.7	0.4	24.3	3.6	0.8	391.1	4.4	2.9	0.98	1.00	2.0	0.387	0.93	5.0	1.4	385.3
1+400	419	386.8	390.3	388.7	390.5	0.001	1.2	1.8	227.8	76.8	0.4	24.5	3.5	0.8	391.1	4.3	3.0	0.98	1.00	2.0	0.387	0.91	4.9	1.4	385.4
1+380	419	386.7	390.3	388.7	390.5	0.001	1.3	1.9	221.1	73.9	0.4	26.4	3.5	0.8	391.1	4.3	3.0	0.98	1.00	2.0	0.387	0.93	5.0	1.4	385.3
1+360	419	386.7	390.2	388.7	390.4	0.001	1.3	2.0	213.8	73.4	0.4	27.5	3.5	0.8	391.0	4.3	2.9	0.98	1.00	2.0	0.387	0.98	5.2	1.6	385.1
1+340	419	386.5	390.1	388.7	390.4	0.001	1.5	2.2	195.0	69.1	0.4	32.1	3.6	0.8	390.9	4.4	2.8	0.98	1.00	2.0	0.387	1.10	5.8	2.2	384.3
1+320	419	386.5	390.1	388.7	390.4	0.001	1.6	2.2	194.9	68.7	0.4	32.6	3.6	0.8	390.9	4.4	2.8	0.98	1.00	2.0	0.387	1.09	5.8	2.1	384.4
1+300	419	386.5	390.1	388.5	390.4	0.001	1.5	2.0	206.4	69.7	0.4	30.0	3.6	0.8	390.9	4.4	3.0	0.98	1.00	2.0	0.387	1.00	5.4	1.8	384.7
1+280	419	386.5	390.1	388.5	390.3	0.001	1.3	2.0	208.4	69.1	0.4	27.7	3.6	0.8	390.9	4.4	3.0	0.98	1.00	2.0	0.387	0.98	5.3	1.7	384.8
1+260	419	386.5	390.1	388.4	390.3	0.001	1.3	1.9	220.1	72.7	0.4	25.2	3.6	0.8	390.9	4.4	3.0	0.98	1.00	2.0	0.387	0.93	5.1	1.5	385.0
1+240	419	386.4	390.1	388.4	390.3	0.001	1.2	1.9	220.0	72.9	0.4	25.5	3.7	0.8	390.9	4.5	3.0	0.98	1.00	2.0	0.387	0.93	5.2	1.5	384.9
1+220	419	386.3	390.0	388.5	390.3	0.001	1.2	2.0	204.9	69.5	0.4	28.8	3.8	0.8	390.8	4.6	2.9	0.98	1.00	2.0	0.387	1.01	5.7	1.9	384.3
1+200	419	386.3	389.9	388.5	390.2	0.001	1.5	2.3	185.1	62.9	0.4	34.5	3.7	0.8	390.7	4.5	2.9	0.98	1.00	2.0	0.387	1.13	6.0	2.3	383.9
1+180	419	386.3	389.8	388.7	390.2	0.002	1.5	2.6	159.2	57.6	0.5	47.6	3.6	0.8	390.6	4.4	2.8	0.98	1.00	2.0	0.387	1.36	6.6	3.0	383.2
1+160	419	386.2	389.5	388.8	390.1	0.003	1.6	3.3	129.1	51.6	0.7	72.9	3.3	0.8	390.3	4.1	2.5	0.98	1.00	2.0	0.387	1.80	7.3	4.0	382.2
1+140	419	386.0	389.5	388.5	390.1	0.002	1.4	2.9	144.8	51.8	0.6	54.3	3.5	0.8	390.3	4.3	2.8	0.98	1.00	2.0	0.387	1.49	7.0	3.4	382.6
1+120	419	386.0	389.5	388.4	390.0	0.002	1.9	2.9	143.2	48.8	0.6	57.6	3.5	0.8	390.3	4.3	2.9	0.98	1.00	2.0	0.387	1.46	6.8	3.3	382.7
1+100	419	386.0	389.4	388.5	390.0	0.002	2.0	3.0	141.1	50.8	0.6	60.6	3.4	0.8	390.2	4.2	2.8	0.98	1.00	2.0	0.387	1.53	6.9	3.4	382.6
1+080	419	385.9	389.5	388.4	389.9	0.002	1.9	2.7	157.8	55.9	0.5	50.1	3.6	0.8	390.3	4.4	2.8	0.98	1.00	2.0	0.387	1.36	6.6	3.0	382.9

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirant Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levediev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
1+060	419	385.8	389.5	388.3	389.8	0.002	1.7	2.4	173.4	63.4	0.5	43.9	3.7	0.8	390.3	4.5	2.7	0.98	1.00	2.0	0.387	1.26	6.6	2.8	382.9
1+040	419	385.7	389.4	388.3	389.8	0.002	1.6	2.4	178.3	65.8	0.5	43.8	3.7	0.8	390.2	4.5	2.7	0.98	1.00	2.0	0.387	1.23	6.4	2.7	383.0
1+020	419	385.7	389.3	388.4	389.7	0.002	1.8	2.8	151.6	58.5	0.6	59.5	3.5	0.8	390.1	4.3	2.6	0.98	1.00	2.0	0.387	1.50	7.0	3.5	382.3
1+000	419	385.7	389.4	388.1	389.6	0.001	1.4	2.2	188.5	66.3	0.5	36.1	3.6	0.8	390.2	4.4	2.8	0.98	1.00	2.0	0.387	1.13	5.9	2.3	383.5
0+980	419	385.7	389.3	388.1	389.6	0.002	1.5	2.4	173.4	62.5	0.5	43.5	3.6	0.8	390.1	4.4	2.8	0.98	1.00	2.0	0.387	1.25	6.2	2.6	383.1
0+960	419	385.7	389.2	388.1	389.6	0.002	1.5	2.6	163.6	60.5	0.5	48.6	3.5	0.8	390.0	4.3	2.7	0.98	1.00	2.0	0.387	1.35	6.4	2.9	382.8
0+940	419	385.6	389.2	388.1	389.5	0.002	1.4	2.5	169.2	62.0	0.5	44.0	3.6	0.8	390.0	4.4	2.7	0.98	1.00	2.0	0.387	1.29	6.4	2.8	382.7
0+920	419	385.5	389.2	388.0	389.5	0.002	1.2	2.5	171.0	62.6	0.5	42.1	3.7	0.8	390.0	4.5	2.7	0.98	1.00	2.0	0.387	1.28	6.5	2.8	382.7
0+900	419	385.5	389.1	387.9	389.5	0.001	1.3	2.4	178.0	62.4	0.5	40.3	3.7	0.8	389.9	4.5	2.9	0.98	1.00	2.0	0.387	1.19	6.2	2.5	383.0
0+880	419	385.5	389.1	387.9	389.4	0.002	1.3	2.5	167.1	59.1	0.5	43.9	3.6	0.8	389.9	4.4	2.8	0.98	1.00	2.0	0.387	1.28	6.4	2.8	382.7
0+860	419	385.3	389.0	387.8	389.4	0.002	1.2	2.6	163.9	59.0	0.5	43.4	3.7	0.8	389.8	4.5	2.8	0.98	1.00	2.0	0.387	1.32	6.8	3.1	382.2
0+840	419	385.3	388.9	387.7	389.3	0.002	1.5	2.6	160.9	56.0	0.5	45.1	3.7	0.8	389.7	4.5	2.9	0.98	1.00	2.0	0.387	1.32	6.7	3.0	382.2
0+820	419	385.2	388.8	387.7	389.3	0.002	1.7	2.8	147.5	54.3	0.6	53.9	3.6	0.8	389.6	4.4	2.7	0.98	1.00	2.0	0.387	1.49	7.0	3.5	381.8
0+800	419	385.2	388.8	387.6	389.2	0.002	1.6	2.8	149.9	56.3	0.5	47.5	3.5	0.8	389.6	4.3	2.7	0.98	1.00	2.0	0.387	1.48	7.0	3.4	381.8
0+780	419	385.2	388.8	387.6	389.2	0.002	1.5	2.7	153.7	65.1	0.5	42.0	3.5	0.8	389.6	4.3	2.4	0.98	1.00	2.0	0.387	1.57	7.2	3.7	381.5
0+760	419	385.0	388.7	387.7	389.2	0.002	1.6	2.9	146.6	59.9	0.6	50.5	3.6	0.8	389.5	4.4	2.4	0.98	1.00	2.0	0.387	1.61	7.6	4.0	381.0
0+740	419	385.0	388.7	387.5	389.1	0.002	1.8	2.6	161.0	61.8	0.5	44.8	3.7	0.8	389.5	4.5	2.6	0.98	1.00	2.0	0.387	1.40	7.0	3.3	381.7
0+720	419	385.0	388.7	387.3	389.0	0.001	1.6	2.4	174.5	66.5	0.5	35.9	3.7	0.8	389.5	4.5	2.6	0.98	1.00	2.0	0.387	1.29	6.6	2.9	382.1
0+700	419	385.0	388.6	387.4	389.0	0.002	1.7	2.6	160.7	62.8	0.5	40.4	3.6	0.8	389.4	4.4	2.6	0.98	1.00	2.0	0.387	1.42	6.9	3.3	381.7
0+680	419	384.9	388.5	387.4	389.0	0.002	1.7	2.9	144.0	55.5	0.6	50.7	3.6	0.8	389.3	4.4	2.6	0.98	1.00	2.0	0.387	1.57	7.4	3.8	381.1
0+660	419	384.8	388.4	387.5	388.9	0.002	1.8	3.0	141.7	58.2	0.6	51.4	3.6	0.8	389.2	4.4	2.4	0.98	1.00	2.0	0.387	1.67	7.8	4.2	380.6

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tirante Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levediev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
0+640	419	384.8	388.3	387.5	388.9	0.003	1.9	3.1	135.4	60.2	0.6	55.2	3.5	0.8	389.1	4.3	2.2	0.98	1.00	2.0	0.387	1.84	8.1	4.5	380.2
0+620	419	384.7	388.3	387.3	388.8	0.002	1.8	2.7	156.0	67.3	0.6	43.7	3.6	0.8	389.1	4.4	2.3	0.98	1.00	2.0	0.387	1.56	7.3	3.7	381.0
0+600	419	384.7	388.3	387.2	388.7	0.002	1.7	2.5	164.6	70.3	0.5	40.2	3.6	0.8	389.1	4.4	2.3	0.98	1.00	2.0	0.387	1.47	7.0	3.4	381.3
0+580	419	384.5	388.4	386.8	388.6	0.001	1.3	2.1	198.2	74.9	0.4	26.1	3.9	0.8	389.2	4.7	2.6	0.98	1.00	2.0	0.387	1.13	6.4	2.5	382.0
0+560	419	384.5	388.3	387.0	388.6	0.001	1.5	2.2	192.3	74.3	0.4	30.7	3.8	0.8	389.1	4.6	2.6	0.98	1.00	2.0	0.387	1.18	6.5	2.7	381.8
0+540	419	384.5	388.4	386.8	388.6	0.001	1.3	1.9	223.1	85.0	0.4	22.6	3.9	0.8	389.2	4.7	2.6	0.98	1.00	2.0	0.387	1.01	5.9	2.0	382.5
0+520	419	384.4	388.4	386.5	388.5	0.001	1.1	1.6	268.7	98.1	0.3	16.2	4.0	0.8	389.2	4.8	2.7	0.98	1.00	2.0	0.387	0.81	5.3	1.3	383.1
0+500	419	384.3	388.4	386.5	388.5	0.001	1.0	1.6	269.7	98.0	0.3	15.1	4.1	0.8	389.2	4.9	2.8	0.98	1.00	2.0	0.387	0.81	5.4	1.3	383.0
0+480	419	384.4	388.4	386.5	388.5	0.001	1.0	1.6	263.1	95.5	0.3	16.0	4.0	0.8	389.2	4.8	2.8	0.98	1.00	2.0	0.387	0.83	5.2	1.3	383.1
0+460	419	384.3	388.3	386.4	388.5	0.001	1.1	1.7	247.9	91.3	0.3	18.2	4.1	0.8	389.1	4.9	2.7	0.98	1.00	2.0	0.387	0.89	5.7	1.6	382.6
0+440	419	384.4	388.2	386.7	388.5	0.001	1.4	2.0	211.3	86.2	0.4	27.5	3.8	0.8	389.0	4.6	2.5	0.98	1.00	2.0	0.387	1.11	6.1	2.4	382.1
0+420	419	384.0	388.2	386.4	388.4	0.001	1.2	1.7	248.3	90.0	0.4	20.3	4.2	0.8	389.0	5.0	2.8	0.98	1.00	2.0	0.387	0.88	5.9	1.7	382.3
0+410	419	384.0	388.2	386.4	388.4	0.001	1.1	1.7	252.7	89.0	0.4	20.4	4.2	0.8	389.0	5.0	2.8	0.98	1.00	2.0	0.387	0.84	5.8	1.5	382.5
0+400	419	384.0	388.2	386.5	388.4	0.001	1.3	1.7	249.0	84.7	0.4	21.7	4.2	0.8	389.0	5.0	2.9	0.98	1.00	2.0	0.387	0.84	5.7	1.5	382.5
0+380	419	384.0	388.2	386.6	388.4	0.001	1.3	1.8	231.1	73.4	0.4	27.6	4.2	0.8	389.0	5.0	3.1	0.98	1.00	2.0	0.387	0.86	5.8	1.6	382.4
0+360	419	384.0	388.2	386.6	388.4	0.001	0.9	1.8	232.6	77.7	0.4	26.5	4.2	0.8	389.0	5.0	3.0	0.98	1.00	2.0	0.387	0.88	5.9	1.7	382.3
0+340	419	384.0	388.2	386.5	388.4	0.001	1.1	1.7	241.1	83.5	0.4	24.8	4.2	0.8	389.0	5.0	2.9	0.98	1.00	2.0	0.387	0.87	5.8	1.6	382.3
0+320	419	384.0	388.1	386.5	388.3	0.001	1.2	1.8	235.0	84.0	0.4	26.0	4.2	0.8	388.9	5.0	2.8	0.98	1.00	2.0	0.387	0.92	6.0	1.8	382.2
0+300	419	383.8	388.0	386.6	388.3	0.001	1.4	2.0	205.6	79.6	0.5	32.5	4.3	0.8	388.8	5.1	2.6	0.98	1.00	2.0	0.387	1.11	7.0	2.8	381.0
0+280	419	383.8	387.8	386.8	388.3	0.002	1.9	2.5	170.8	77.0	0.6	44.7	4.0	0.8	388.6	4.8	2.2	0.98	1.00	2.0	0.387	1.47	8.1	4.1	379.7
0+260	419	383.8	386.7	386.5	388.1	0.007	2.3	4.5	93.3	50.6	1.0	129.2	3.0	0.8	387.5	3.8	1.8	0.98	1.00	2.0	0.387	3.05	9.5	6.5	377.2

River Sta	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	B.L (m)	Protec. Elev (m)	Altura máx. (m)	Tiran Hidráulico (m)	Coef. Contracc. μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	(Levediev) (ts) (m)	Prof. Socavación ts-y	Socav. Elev
0+240	419	383.8	387.1	386.4	387.8	0.003	2.0	3.1	137.4	82.7	0.7	53.7	3.4	0.8	387.9	4.2	1.7	0.98	1.00	2.0	0.387	2.22	8.7	5.4	378.4
0+220	419	383.8	386.9	386.3	387.7	0.004	2.0	3.4	125.1	82.0	0.8	60.4	3.1	0.8	387.7	3.9	1.5	0.98	1.00	2.0	0.387	2.58	9.0	5.9	377.9
0+200	419	383.8	386.9	386.3	387.6	0.004	1.9	3.2	130.4	81.7	0.7	56.9	3.1	0.8	387.7	3.9	1.6	0.98	1.00	2.0	0.387	2.40	8.5	5.4	378.4
0+180	419	383.5	386.9	386.1	387.5	0.003	1.5	2.8	148.2	82.3	0.6	46.2	3.4	0.8	387.7	4.2	1.8	0.98	1.00	2.0	0.387	1.95	8.2	4.8	378.7
0+160	419	383.5	386.6	386.1	387.4	0.005	1.3	3.5	119.7	87.3	0.8	62.9	3.1	0.8	387.4	3.9	1.4	0.98	1.00	2.0	0.387	2.89	9.4	6.4	377.1
0+140	419	383.5	386.5	386.1	387.3	0.005	0.9	3.4	123.1	97.1	0.8	58.7	3.0	0.8	387.3	3.8	1.3	0.98	1.00	2.0	0.387	2.97	9.3	6.4	377.1
0+120	419	383.5	386.6	385.9	387.1	0.003	0.8	2.6	161.3	120.0	0.6	35.9	3.1	0.8	387.4	3.9	1.3	0.98	1.00	2.0	0.387	2.18	7.9	4.8	378.7
0+100	419	383.5	386.6	-	387.1	0.002	0.8	2.5	169.1	120.0	0.6	33.3	3.1	0.8	387.4	3.9	1.4	0.98	1.00	2.0	0.387	2.01	7.5	4.3	379.1
0+080	419	383.5	386.6	-	387.0	0.002	1.1	2.4	177.0	120.0	0.6	33.7	3.1	0.8	387.4	3.9	1.5	0.98	1.00	2.0	0.387	1.86	7.1	3.9	379.5
0+060	419	383.5	386.5	-	386.9	0.003	0.8	2.5	166.3	120.0	0.6	34.2	3.0	0.8	387.3	3.8	1.4	0.98	1.00	2.0	0.387	2.07	7.4	4.3	379.1
0+040	419	383.4	386.5	-	386.9	0.002	0.9	2.3	179.9	120.0	0.6	32.4	3.1	0.8	387.3	3.9	1.5	0.98	1.00	2.0	0.387	1.81	6.7	3.7	379.7
0+020	419	383.3	386.5	385.6	386.8	0.002	1.1	2.2	192.9	120.0	0.5	30.8	3.2	0.8	387.3	4.0	1.6	0.98	1.00	2.0	0.387	1.62	6.6	3.4	379.9

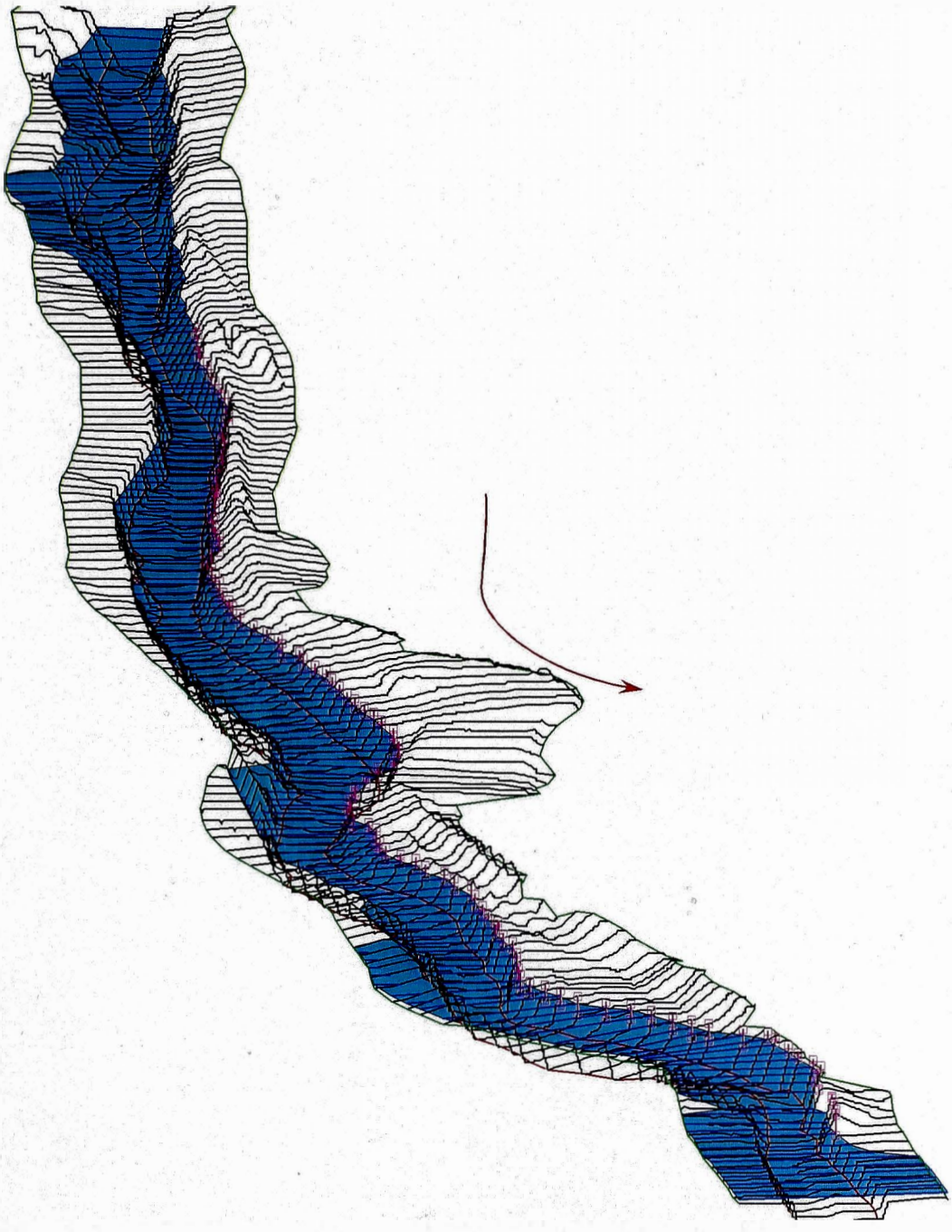


Figura N°A.1 Zona de inundación considerando una protección de altura preliminar en la margen izquierda del área en estudio (Tr=100 años). Fuente, Elaboración propia.

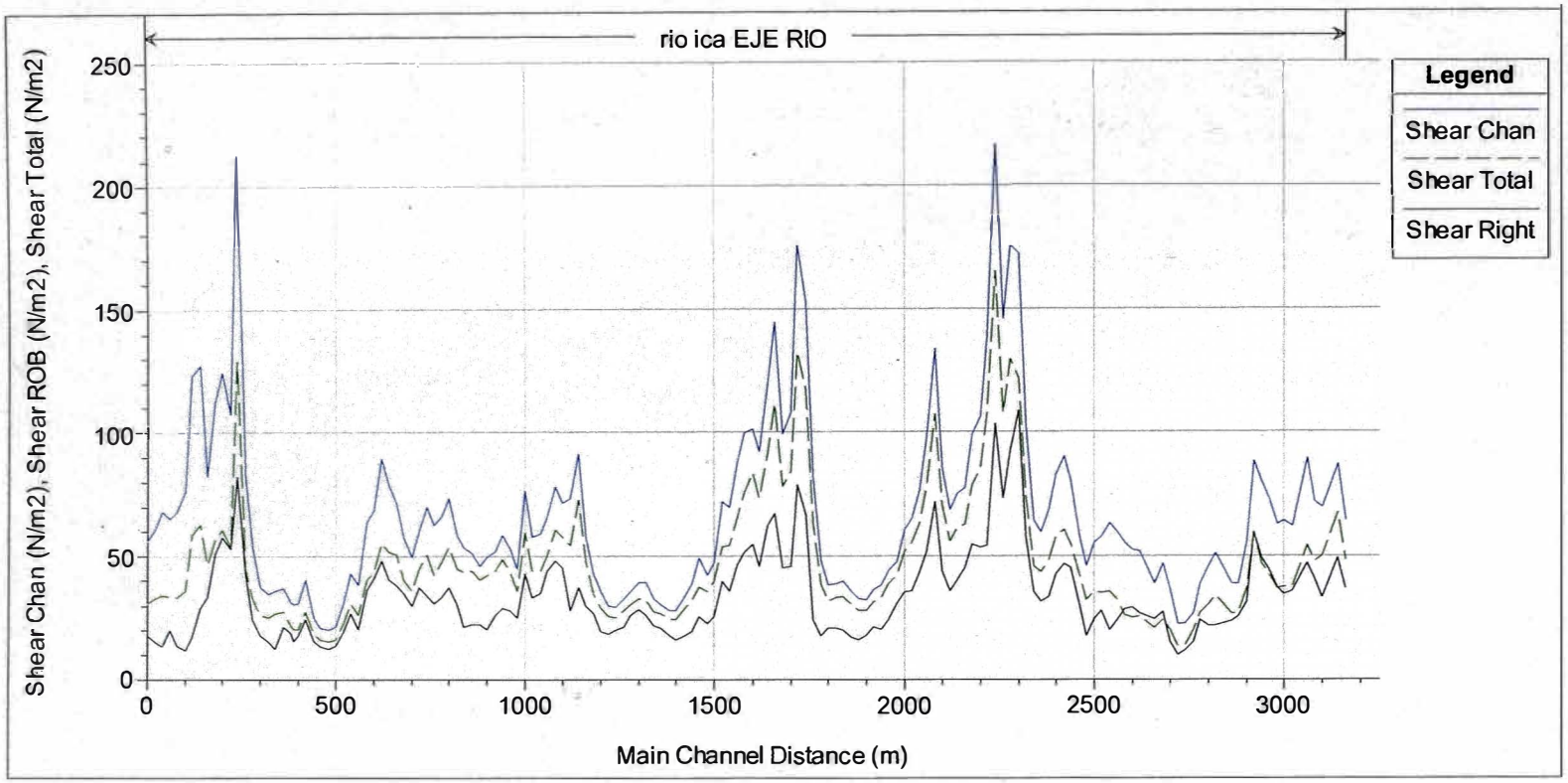


Figura N°A.2 Esfuerzos cortantes considerando una protección de altura preliminar en la margen izquierda del Río Ica (Tr=100 años). Fuente, Elaboración propia

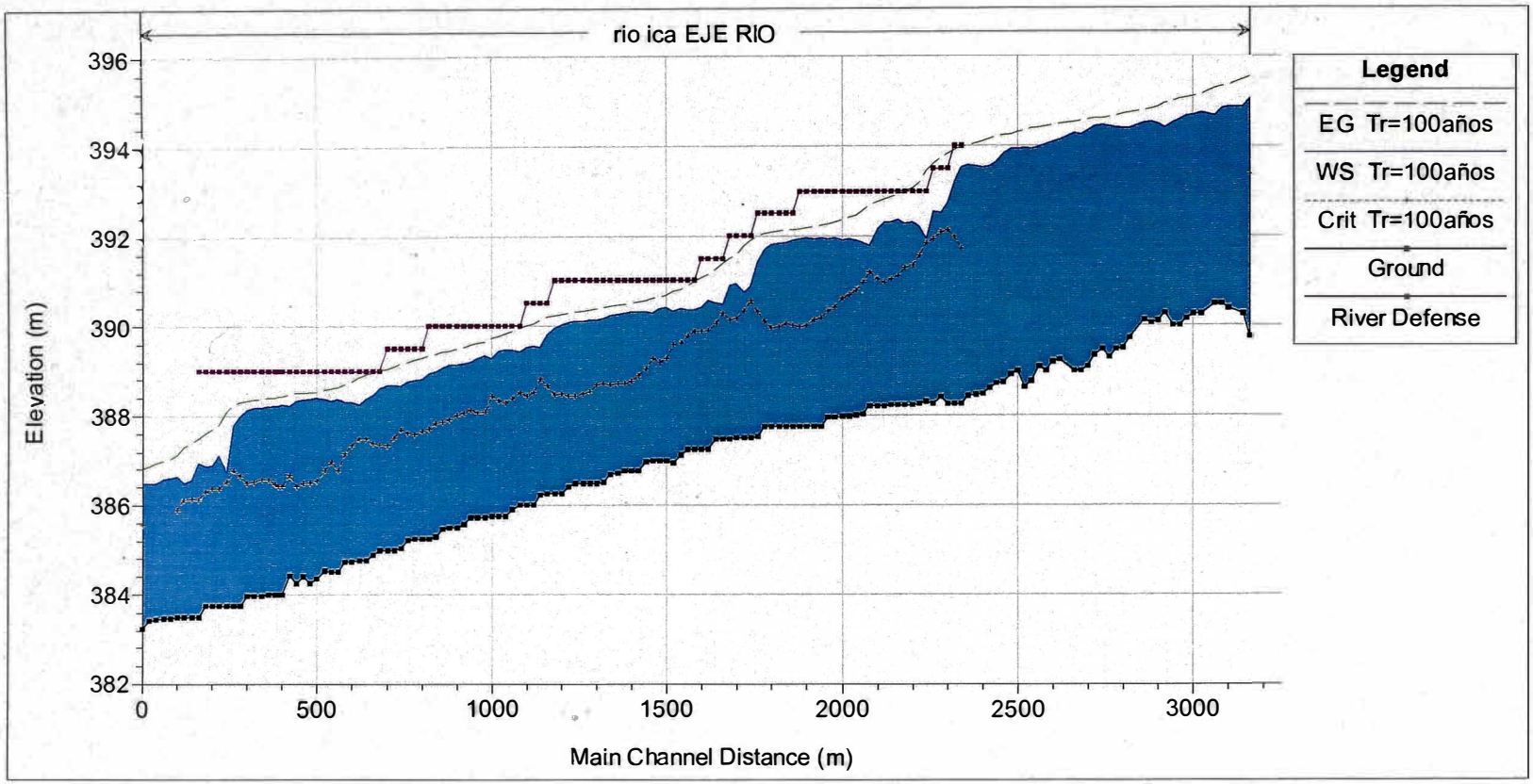


Figura N°A.3 Elevación del nivel de agua considerando una protección de altura preliminar en la margen izquierda de la zona en estudio (Tr=100 años). Fuente, Elaboración propia.

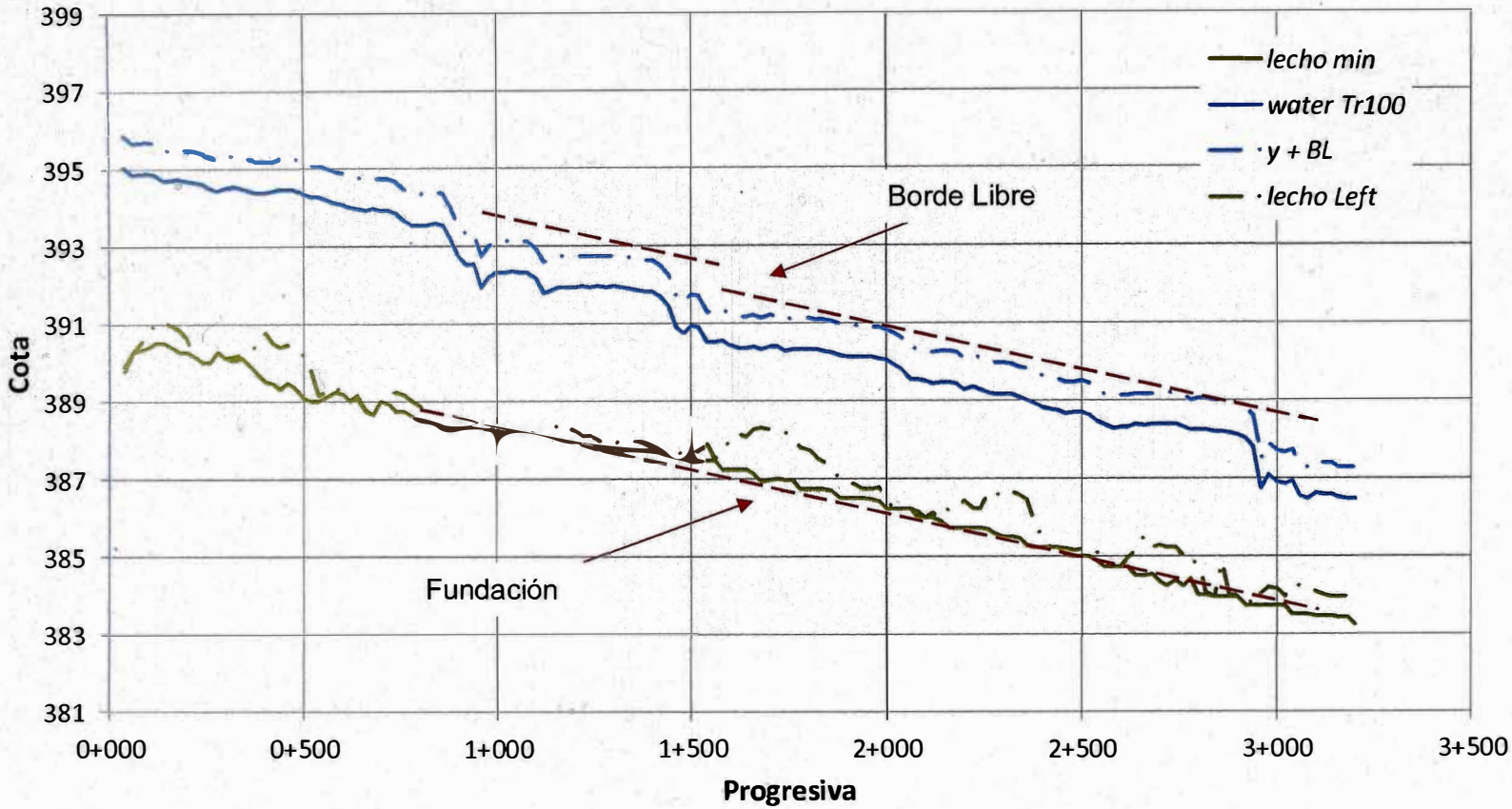


Figura N°A.4 Elevación del borde libre y cimentación de la protección ribereña. Fuente, Elaboración propia

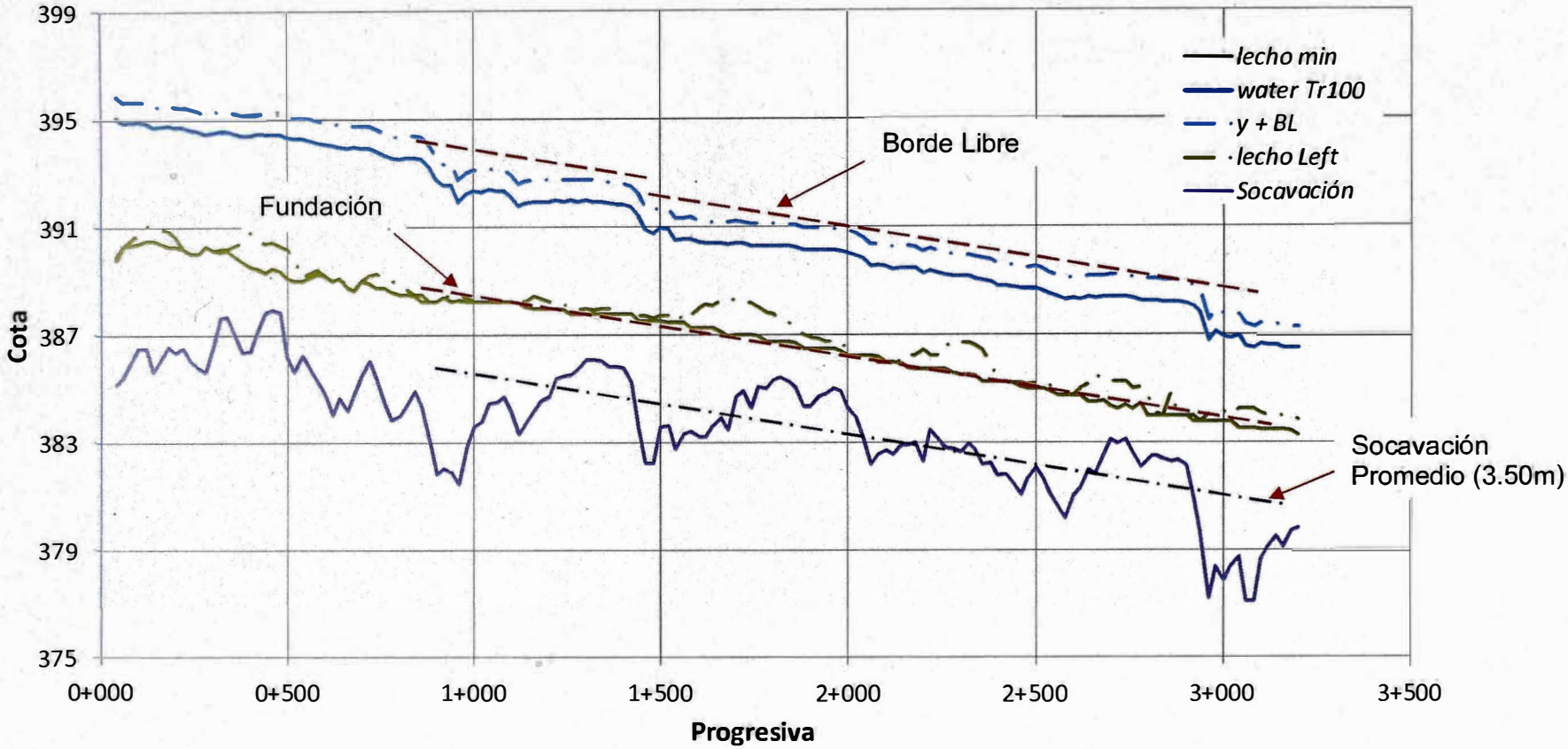


Figura N°A.5 Nivel de Socavación para la defensa ribereña. Fuente, Elaboración propia

ANEXO B:

ANÁLISIS DE ESTABILIDAD EXTERNA DE GEOCONTENDORES

B.1 ANÁLISIS ESTÁTICO

Gabion analysis

Input data

Project

Task : REVESTIMIENTO RIO ICA
Date : 14/11/2013

Material of blocks - filling

No.	Name	γ [kN/m³]	ϕ [°]	c [kPa]
1	GEOCONTENEDOR	19.00	15.00	2.00

Material of blocks - mesh

No.	Name	Strength overh. R_t [kN/m]	Spacing of vert. meshes b [m]	Bear.cap. of front joint R_s [kN/m]
1	GEOCONTENEDOR	52.81	5.00	52.81

Geometry of structure

No.	Width b [m]	Height h [m]	Offset a [m]	Material
5	2.50	1.00	0.50	GEOCONTENEDOR
4	2.50	1.00	0.50	GEOCONTENEDOR
3	2.50	1.00	0.50	GEOCONTENEDOR
2	2.50	1.00	0.50	GEOCONTENEDOR
1	2.50	1.00	-	GEOCONTENEDOR

Gabion slope = 0.00 °
Overall height = 5.00 m
Overall wall volume = 12.50 m³/m

Soil parameters

TALUD

Unit weight :	γ = 19.00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 30.00 °
Cohesion of soil :	c_{ef} = 10.00 kPa
Angle of friction struc.-soil :	δ = 15.00 °
Soil :	cohesive
Poisson's ratio :	ν = 0.35
Saturated unit weight :	γ_{sat} = 20.00 kN/m³

FUNDACION

Unit weight :	γ = 18.00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 35.00 °
Cohesion of soil :	c_{ef} = 5.00 kPa
Angle of friction struc.-soil :	δ = 15.00 °
Soil :	cohesionless

Saturated unit weight : γ_{sat} = 20.00 kN/m3

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	5.00	TALUD	
2	3.00	FUNDACION	
3	-	FUNDACION	

Terrain profile
Terrain behind the structure is flat.

Water influence
GWT behind the structure lies at a depth of 2.00 m
GWT in front of the structure lies at a depth of 4.70 m
Subgrade at the heel is permeable.
Hydraulic gradient = 1.35

Resistance on front face of the structure
Resistance on front face of the structure: at rest
Soil on front face of the structure - FUNDACION
Soil thickness in front of structure h = 0.30 m
Terrain in front of structure is flat.

Analysis settings
Active earth pressure calculation - Coulomb (CSN 730037)
Passive earth pressure calculation - Caqout-Kerisel (CSN 730037)
Analysis carried out according to classical theory (safety factor)

Safety factor for slip = 1.50
Safety factor for overturning = 1.50
Factor of safety for bearing capacity = 2.00
Safety factor for net stress = 1.50
Coeff. of reduction of friction between blocks k_t = 0.80

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Weight - wall	0.00	-2.58	230.00	2.28	1.000
FF resistance	-0.03	-0.10	0.00	0.00	1.000
Active pressure	27.75	-1.08	7.44	2.81	1.000
Water pressure	40.50	-1.10	0.00	4.50	1.000

Verification of complete wall

Check for overturning stability

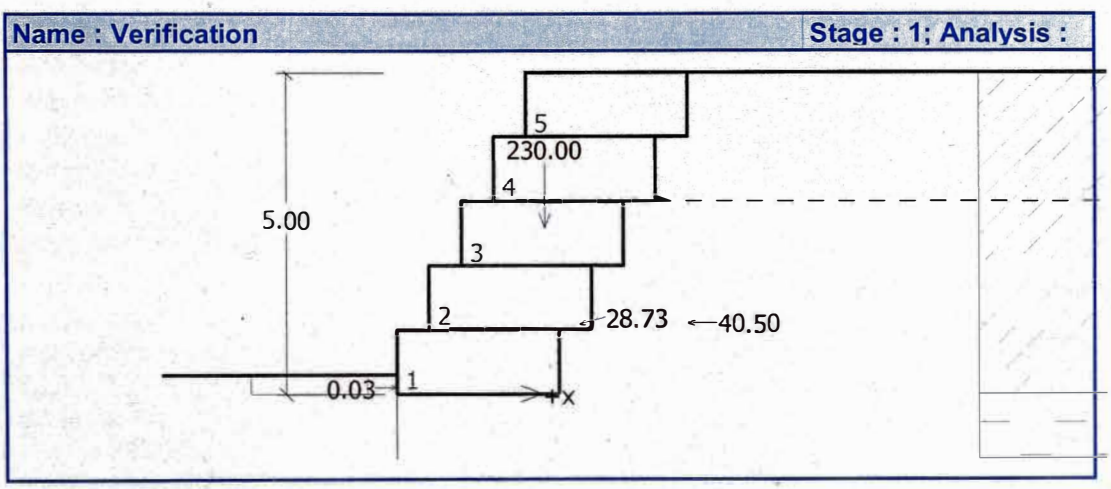
Resisting moment M_{res} = 545.93 kNm/m
Overturning moment M_{ovr} = 74.50 kNm/m

Safety factor = 7.33 > 1.50
Wall for overturning is SATISFACTORY

Check for slip
Resisting horizontal force H_{res} = 162.08 kN/m
Active horizontal force H_{act} = 68.22 kN/m

Safety factor = 2.38 > 1.50
Wall for slip is SATISFACTORY

Forces acting at the centre of footing bottom
Overall moment M = -174.64 kNm/m
Normal force N = 237.44 kN/m
Shear force Q = 68.22 kN/m
Overall check - WALL is SATISFACTORY



Bearing capacity of foundation soil

Forces acting at the centre of the footing bottom

Number	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [m]	Stress [kPa]
1	-174.64	237.44	68.22	0.00	94.97

Spread footing verification

Input data

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	TALUD		30.00	10.00	19.00	10.00	15.00
2	FUNDACION		35.00	5.00	18.00	10.00	15.00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ [°]	ν [-]	OCR [-]	K_r [-]
1	TALUD		cohesive	-	0.35	-	-
2	FUNDACION		cohesionless	35.00	-	-	-

Soil parameters

TALUD

Unit weight :	γ	=	19.00 kN/m³
Angle of internal friction :	φ_{ef}	=	30.00 °
Cohesion of soil :	c_{ef}	=	10.00 kPa
Deformation modulus :	E_{def}	=	30.00 MPa
Poisson's ratio :	ν	=	0.35
Saturated unit weight :	γ_{sat}	=	20.00 kN/m³

FUNDACION

Unit weight :	γ	=	18.00 kN/m³
Angle of internal friction :	φ_{ef}	=	35.00 °
Cohesion of soil :	c_{ef}	=	5.00 kPa
Deformation modulus :	E_{def}	=	20.00 MPa
Poisson's ratio :	ν	=	0.35
Saturated unit weight :	γ_{sat}	=	20.00 kN/m³

Foundation

Foundation type: strip footing

Depth from ground surface	h_z	=	5.00 m
Depth of footing bottom	d	=	0.30 m
Foundation thickness	t	=	1.00 m
Incl. of finished grade	s_1	=	0.00 °
Incl. of footing bottom	s_2	=	0.00 °

Unit weight of soil above foundation = 19.00 kN/m³

Geometry of structure

Foundation type: strip footing

Overall strip footing length	=	100.00 m
Strip footing width (x)	=	2.50 m
Column width in the direction of x	=	0.10 m
Volume of strip footing	=	2.50 m³/m

Inserted loading is considered per unit length of continuous footing span.

Material of structure

Unit weight γ = 23.00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992 1-1 (EC2).

Concrete : C 20/25
Longitudinal steel : B500
Transverse steel: B500

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	5.00	TALUD	
2	3.00	FUNDACION	
3	-	FUNDACION	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	YES		LC 1	Service	179.94	-68.22	-68.22
2	YES		LC 2	Design	179.94	-68.22	-68.22

Ground water table

The ground water table is at a depth of 4.70 m from the original terrain.

Analysis settings

Type of analysis - Analysis for drained conditions
Analysis of vertical bearing capacity - Standard approach
Analysis of settlement - Analysis using oedometric modulus (CSN 73 1001)
Bounding of influence zone - by percentage of Sigma,Or
Coeff. of bounding of influence zone = 10.00 %
Analysis carried out according to classical theory (safety factor)

Factor of safety - vertical bearing capacity = 2.50
Factor of safety - horizontal bearing capacity = 1.50

Verification No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.
Computed self weight of strip foundation G = 57.50 kN/m
Computed weight of overburden Z = 0.00 kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Parameters of slip surface below foundation:
Depth of slip surface z_{sp} = 4.76 m
Length of slip surface l_{sp} = 15.70 m
Design bearing capacity of found.soil R_d = 388.74 kPa
Extreme contact pressure σ = 94.97 kPa

Factor of safety = 4.09 > 2.50
Bearing capacity in the vertical direction is SATISFACTORY

Horizontal bearing capacity check

Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 0.23 kN
Friction angle foundation-footing bottom ψ = 35.00 °
Cohesion foundation-footing bottom a = 5.00 kPa
Horizontal bearing capacity R_{dh} = 178.98 kN
Extreme horizontal force H = 68.22 kN

Factor of safety = 2.62 > 1.50
Bearing capacity in the horizontal direction is SATISFACTORY

Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 57.50 kN/m
Computed weight of overburden Z = 0.00 kN/m
Settlement of mid point of longitudinal edge = 4.0 mm
Settlement of mid point of transverse edge 1 = 7.3 mm
Settlement of mid point of transverse edge 2 = 7.3 mm
(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 20.00 MPa
Foundation in the longitudinal direction is rigid (k=92.80)
Foundation in the direction of width is rigid (k=1450.00)

Overall settlement and rotation of foundation:
Foundation settlement = 8.7 mm
Depth of influence zone = 7.80 m
Rotation in direction of width = 0.000 (tan*1000)

Dimensioning No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Weight - wall	0.00	-2.00	190.00	2.00	1.000
Active pressure	16.35	-0.73	4.38	2.65	1.000
Water pressure	20.00	-0.67	0.00	4.00	0.750

Verification of construction joint above the block No.: 1

Check for overturning stability:
Resisting moment M_{res} = 391.62 kNm/m
Overturning moment M_{ovr} = 21.95 kNm/m

Safety factor = 17.84 > 1.50
Joint for overturning stability is SATISFACTORY

Check for slip:
Resisting horizontal force H_{res} = 57.08 kN/m
Active horizontal force H_{act} = 31.35 kN/m

Safety factor = 1.82 > 1.50
Joint for slip is SATISFACTORY

Forces acting on the bottom block:

Moment	M =	-126.70	kNm/m
Normal force	N =	194.38	kN/m
Shear force	Q =	31.35	kN/m
Maximum pressure on the bottom block	=	77.75	kPa
Red.Coeff. by offset of top block	=	0.00	
Average value of pressure on face	=	5.55	kPa
Shear force trasmitted by friction	=	46.67	kN/m

Bearing capacity against transverse pressure:

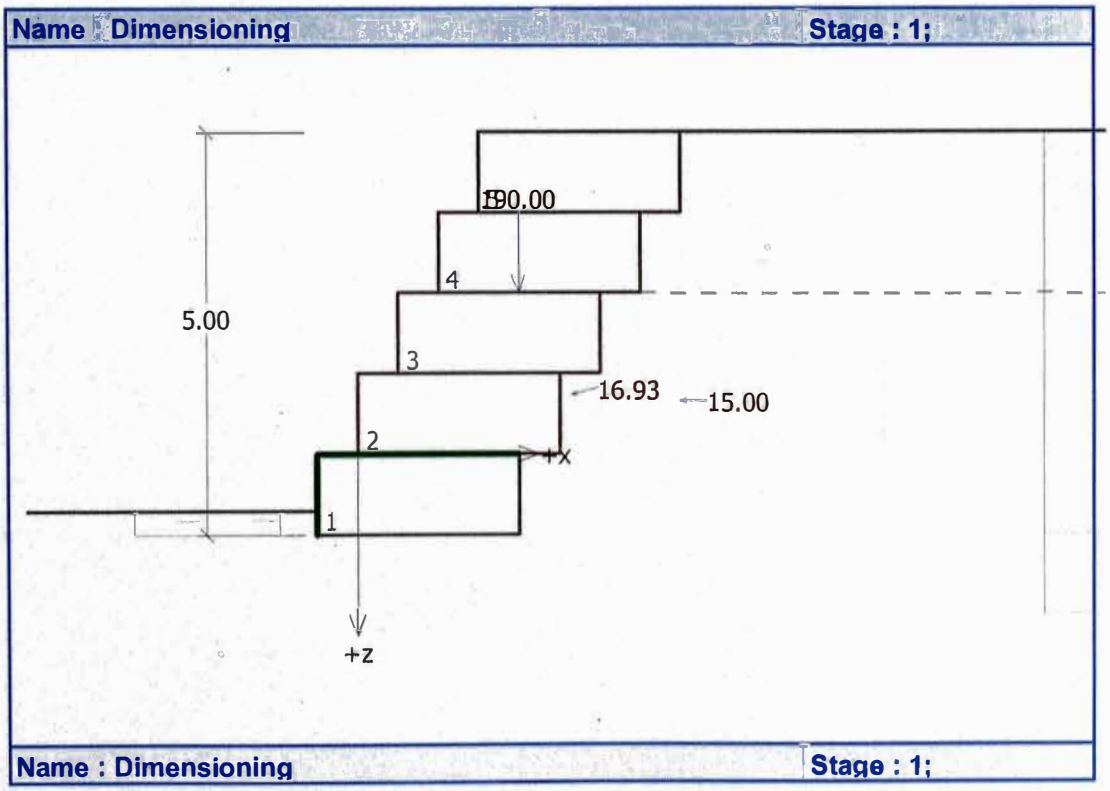
Joint bear.capacity	=	52.81	kN/m
Computed stress-state	=	4.63	kN/m

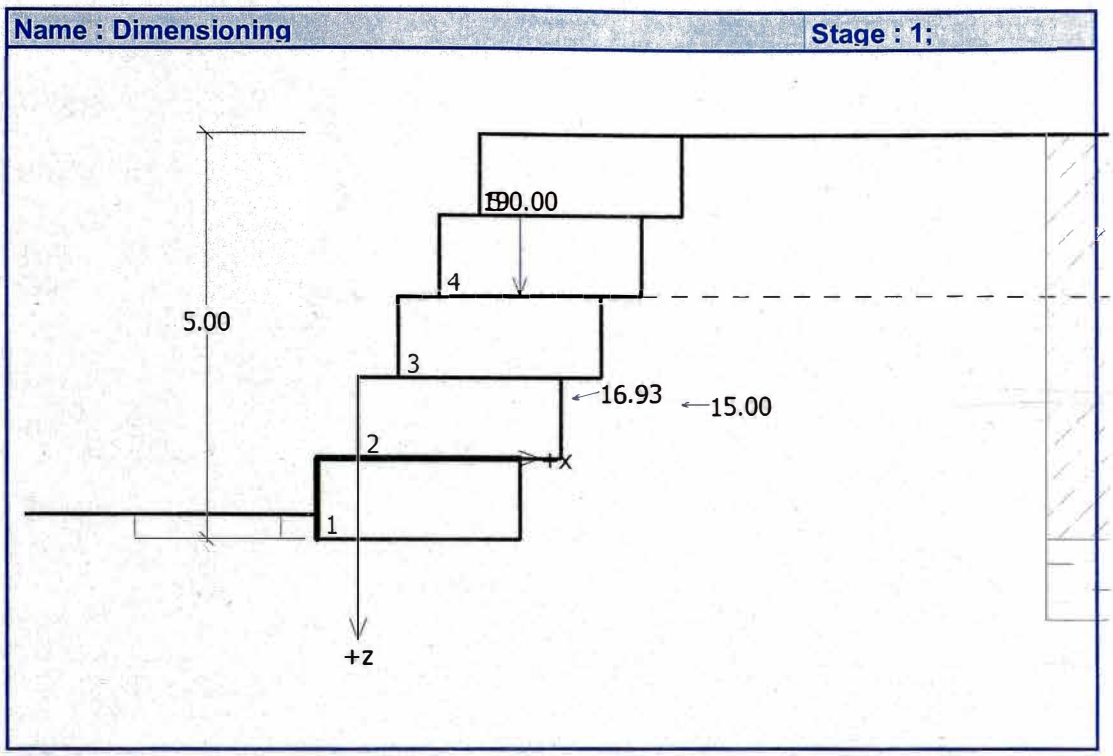
Safety factor = 11.42 > 1.50
Transverse pressure check is SATISFACTORY

Joint btw. blocks check:

Mesh material bear.capacity	=	52.81	kN/m
Computed stress-state	=	4.63	kN/m

Safety factor = 11.42 > 1.50
Joint between blocks is SATISFACTORY




Name : Dimensioning
Stage : 1;
5.00
4
3
2
1
16.93
15.00
+x
+z

B.2 ANÁLISIS SÍSMICO

Gabion analysis

Input data

Project

Task : REVESTIMIENTO RIO ICA
Date : 14/11/2013

Material of blocks - filling

No.	Name	γ [kN/m³]	ϕ [°]	c [kPa]
1	GEOCONTENEDOR	19.00	15.00	2.00

Material of blocks - mesh

No.	Name	Strength overh. R_t [kN/m]	Spacing of vert. meshes b [m]	Bear.cap. of front joint R_s [kN/m]
1	GEOCONTENEDOR	52.81	5.00	52.81

Geometry of structure

No.	Width b [m]	Height h [m]	Offset a [m]	Material
5	2.50	1.00	0.50	GEOCONTENEDOR
4	2.50	1.00	0.50	GEOCONTENEDOR
3	2.50	1.00	0.50	GEOCONTENEDOR
2	2.50	1.00	0.50	GEOCONTENEDOR
1	2.50	1.00	-	GEOCONTENEDOR

Gabion slope = 0.00 °
Overall height = 5.00 m
Overall wall volume = 12.50 m³/m

Soil parameters

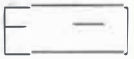
TALUD

Unit weight :	γ = 19.00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 30.00 °
Cohesion of soil :	c_{ef} = 10.00 kPa
Angle of friction struc.-soil :	δ = 15.00 °
Soil :	cohesive
Poisson's ratio :	ν = 0.35
Saturated unit weight :	γ_{sat} = 20.00 kN/m³

FUNDACION

Unit weight :	γ = 18.00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 35.00 °
Cohesion of soil :	c_{ef} = 5.00 kPa
Angle of friction struc.-soil :	δ = 15.00 °
Soil :	cohesionless
Saturated unit weight :	γ_{sat} = 20.00 kN/m³

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	5.00	TALUD	
2	3.00	FUNDACION	
3	-	FUNDACION	

Terrain profile
Terrain behind the structure is flat.

Water influence
Ground water table is located below the structure.

Resistance on front face of the structure
Resistance on front face of the structure: at rest
Soil on front face of the structure - FUNDACION
Soil thickness in front of structure h = 0.30 m
Terrain in front of structure is flat.

Earthquake
Horizontal seismic coefficient K_h = 0.2000
Vertical seismic coefficient K_v = 0.0000
Water below the GWT is restricted.

Analysis settings
Active earth pressure calculation - Coulomb (CSN 730037)
Passive earth pressure calculation - Caqout-Kerisel (CSN 730037)
Earthquake analysis theory - Mononobe-Okabe
Analysis carried out according to classical theory (safety factor)

Safety factor for slip = 1.13
Safety factor for overturning = 1.13
Factor of safety for bearing capacity = 1.88
Safety factor for net stress = 1.13
Coeff. of reduction of friction between blocks k_t = 0.80

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Weight - wall	0.00	-2.50	237.50	2.25	1.000
Earthq.- constr.	57.50	-2.50	0.00	2.25	1.000
FF resistance	-0.35	-0.10	0.00	0.00	1.000
Active pressure	28.83	-1.08	7.72	2.81	1.000
Earthq.- act.pressure	34.55	-3.33	9.26	3.90	1.000

Verification of complete wall

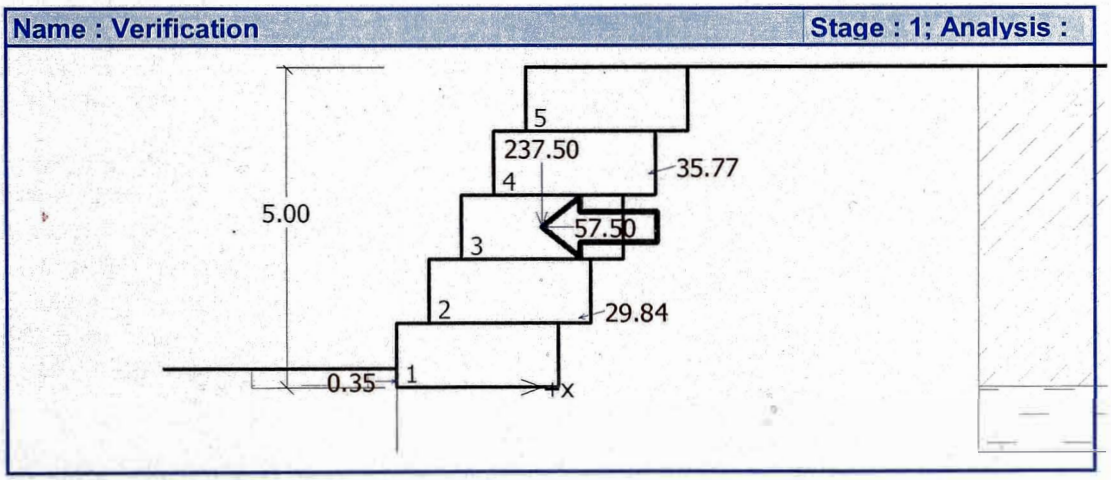
Check for overturning stability
Resisting moment M_{res} = 592.21 kNm/m
Overturning moment M_{ovr} = 289.90 kNm/m

Safety factor = 2.04 > 1.13
Wall for overturning is SATISFACTORY

Check for slip
Resisting horizontal force H_{res} = 170.68 kN/m
Active horizontal force H_{act} = 120.53 kN/m

Safety factor = 1.42 > 1.13
Wall for slip is SATISFACTORY

Forces acting at the centre of footing bottom
Overall moment M = 15.79 kNm/m
Normal force N = 254.48 kN/m
Shear force Q = 120.53 kN/m
Overall check - WALL is SATISFACTORY



Bearing capacity of foundation soil

Forces acting at the centre of the footing bottom

Number	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [m]	Stress [kPa]
1	15.79	254.48	120.53	0.06	107.11

Spread footing verification

Input data

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	TALUD		30.00	10.00	19.00	10.00	15.00

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
2	FUNDACION		35.00	5.00	18.00	10.00	15.00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ [°]	ν [-]	OCR [-]	K_r [-]
1	TALUD		cohesive	-	0.35	-	-
2	FUNDACION		cohesionless	35.00	-	-	-

Soil parameters

TALUD

Unit weight : γ = 19.00 kN/m³
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 10.00 kPa
Deformation modulus : E_{def} = 30.00 MPa
Poisson's ratio : ν = 0.35
Saturated unit weight : γ_{sat} = 20.00 kN/m³

FUNDACION

Unit weight : γ = 18.00 kN/m³
Angle of internal friction : φ_{ef} = 35.00 °
Cohesion of soil : c_{ef} = 5.00 kPa
Deformation modulus : E_{def} = 20.00 MPa
Poisson's ratio : ν = 0.35
Saturated unit weight : γ_{sat} = 20.00 kN/m³

Foundation

Foundation type: strip footing

Depth from ground surface h_z = 5.00 m
Depth of footing bottom d = 0.30 m
Foundation thickness t = 1.00 m
Incl. of finished grade s_1 = 0.00 °
Incl. of footing bottom s_2 = 0.00 °
Unit weight of soil above foundation = 19.00 kN/m³

Geometry of structure

Foundation type: strip footing

Overall strip footing length = 100.00 m
Strip footing width (x) = 2.50 m
Column width in the direction of x = 0.10 m
Volume of strip footing = 2.50 m³/m
Inserted loading is considered per unit length of continuous footing span.

Material of structure

Unit weight γ = 23.00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992 1-1 (EC2).

Concrete : C 20/25
Longitudinal steel : B500
Transverse steel: B500

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	5.00	TALUD	
2	3.00	FUNDACION	
3	-	FUNDACION	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	YES		LC 1	Service	196.98	-104.74	-120.53
2	YES		LC 2	Design	196.98	-104.74	-120.53

Analysis settings

Type of analysis - Analysis for drained conditions
Analysis of vertical bearing capacity - Standard approach
Analysis of settlement - Analysis using oedometric modulus (CSN 73 1001)
Bounding of influence zone - by percentage of Sigma,Or
Coeff. of bounding of influence zone = 10.00 %
Analysis carried out according to classical theory (safety factor)

Factor of safety - vertical bearing capacity = 1.88
Factor of safety - horizontal bearing capacity = 1.13

Verification No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.
Computed self weight of strip foundation G = 57.50 kN/m
Computed weight of overburden Z = 0.00 kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Parameters of slip surface below foundation:
Depth of slip surface z_{sp} = 4.76 m
Length of slip surface l_{sp} = 15.70 m
Design bearing capacity of found.soil R_d = 321.15 kPa
Extreme contact pressure σ = 107.11 kPa

Factor of safety = 3.00 > 1.88
Bearing capacity in the vertical direction is SATISFACTORY

Horizontal bearing capacity check

Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 0.43 kN
Friction angle foundation-footing bottom ψ = 35.00 °
Cohesion foundation-footing bottom a = 5.00 kPa

Horizontal bearing capacity R_{dh} = 190.50 kN
Extreme horizontal force H = 120.53 kN

Factor of safety = 1.58 > 1.13
Bearing capacity in the horizontal direction is SATISFACTORY

Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 57.50 kN/m
Computed weight of overburden Z = 0.00 kN/m
Settlement of mid point of longitudinal edge = 3.8 mm
Settlement of mid point of transverse edge 1 = 7.2 mm
Settlement of mid point of transverse edge 2 = 6.5 mm
(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 20.00 MPa
Foundation in the longitudinal direction is rigid (k=92.80)
Foundation in the direction of width is rigid (k=1450.00)

Overall settlement and rotation of foundation:
Foundation settlement = 8.4 mm
Depth of influence zone = 6.43 m
Rotation in direction of width = 0.281 (tan*1000)

Dimensioning No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Weight - wall	0.00	-2.00	190.00	2.00	1.000
Earthq.- constr.	46.00	-2.00	0.00	2.00	1.000
Active pressure	13.73	-0.74	3.68	2.66	1.000
Earthq.- act.pressure	22.11	-2.67	5.92	3.56	1.000

Verification of construction joint above the block No.: 1

Check for overturning stability:
Resisting moment M_{res} = 410.89 kNm/m
Overturning moment M_{ovr} = 161.17 kNm/m

Safety factor = 2.55 > 1.13
Joint for overturning stability is SATISFACTORY

Check for slip:
Resisting horizontal force H_{res} = 58.48 kN/m
Active horizontal force H_{act} = 81.85 kN/m

Safety factor = 0.71 < 1.13
Joint for slip is NOT SATISFACTORY (INCORPORAR GEOTEXTIL EN INTERFAZ)

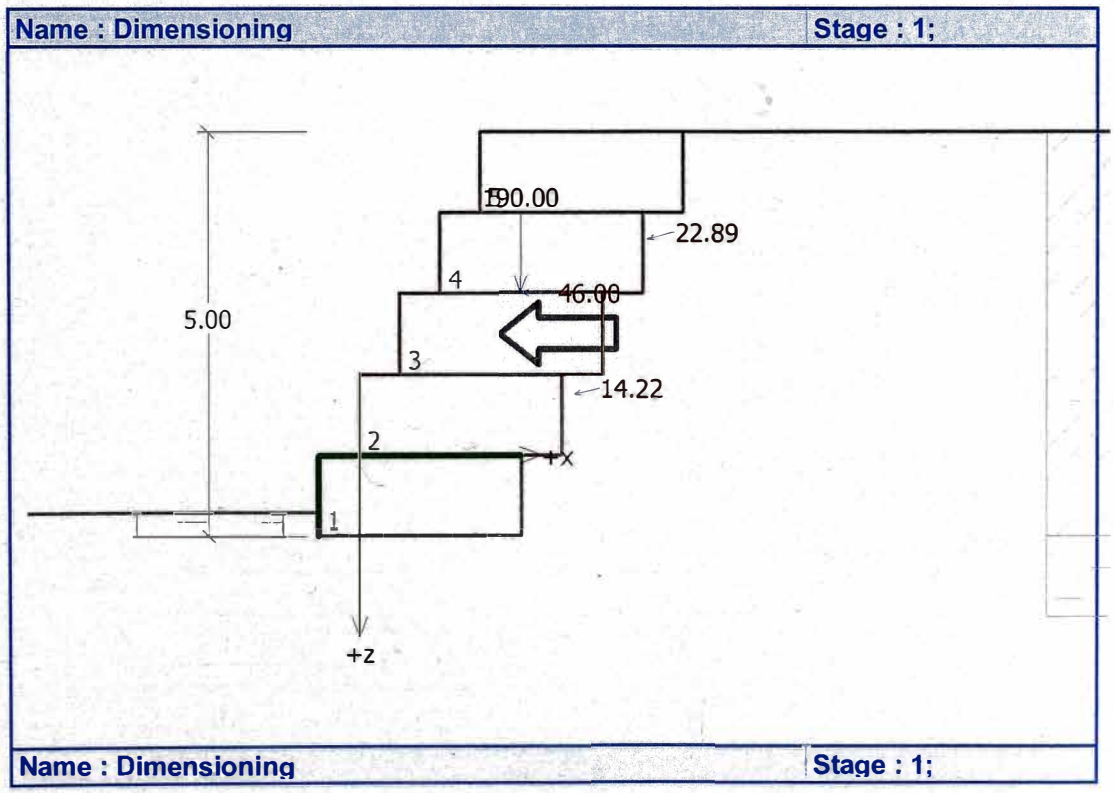
Forces acting on the bottom block:
Moment M = -0.21 kNm/m
Normal force N = 199.60 kN/m
Shear force Q = 81.85 kN/m
Maximum pressure on the bottom block = 79.84 kPa
Red.Coeff. by offset of top block = 0.00
Average value of pressure on face = 5.55 kPa
Shear force trasmitted by friction = 47.79 kN/m

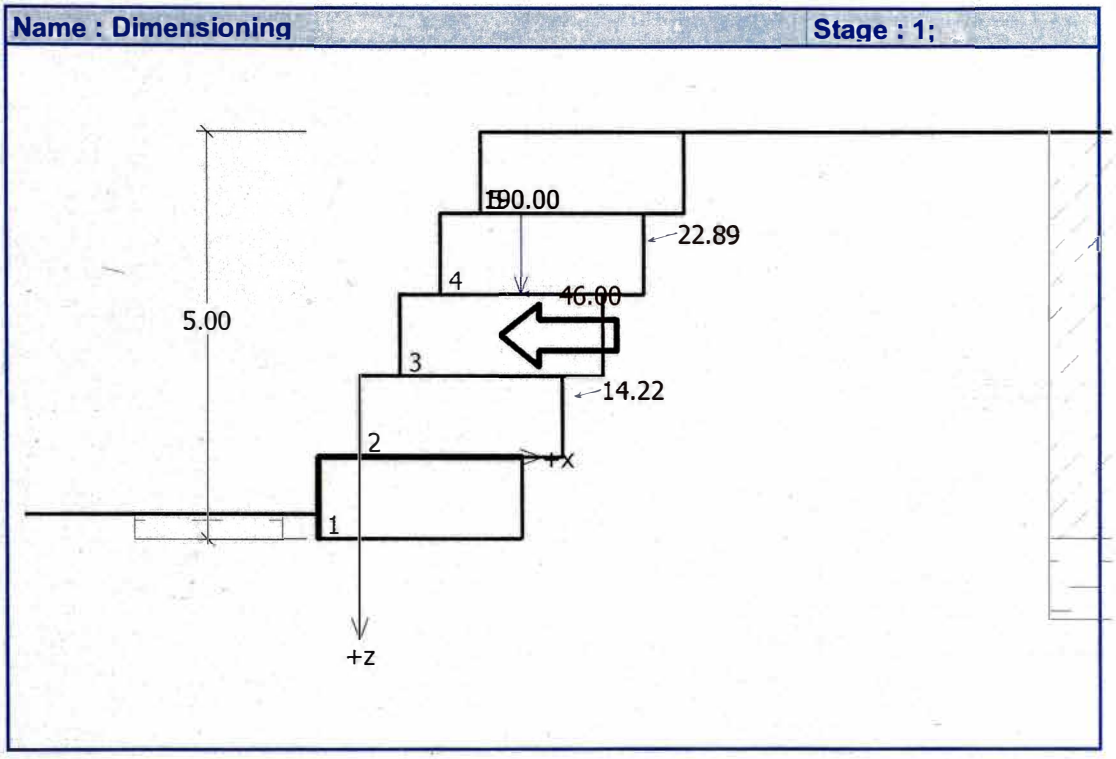
Bearing capacity against transverse pressure:
Joint bear.capacity = 52.81 kN/m
Computed stress-state = 4.63 kN/m

Safety factor = 11.42 > 1.13
Transverse pressure check is SATISFACTORY

Joint btw. blocks check:
Mesh material bear.capacity = 52.81 kN/m
Computed stress-state = 38.68 kN/m

Safety factor = 1.37 > 1.13
Joint between blocks is SATISFACTORY




Name : Dimensioning
Stage : 1;
5.00
22.89
46.00
14.22
1
2
3
4
+x
+z

ANEXO C:

ANÁLISIS DE ESTABILIDAD INTERNA DE GEOCONTENDORES

MÉTODO DE LESHCHINSKY

C.1 ANÁLISIS SIN CONSIDERAR DEFORMACIÓN DE MATERIAL

Geosynthetic Confined Pressurized Slurry

Resistencia Geotextil

PROJECT IDENTIFICATION

Title: Resistencia Geotextil
Project Number: Private
Designer: Private

Description:

File path and name: C:\Documents and Settings\Administrador\Escritorio\geoc.....
Date and time of creating the input data: Mon Nov 18 18:14:55 2013

Design Philosophy and Program Developed by:

Ora Leshchinsky, P.E.
Dov Leshchinsky, Ph.D.
33 The Horseshoe
Newark, Delaware 19711, USA

INPUT DATA

Circumference of tube, [m]	6.0
Unit weight of lower layer of slurry, [kN/m ^{3}]	18.00
Unit weight of upper layer of slurry, [kN/m ^{3}]	18.00
Unit weight of fluid outside tube, lower layer, [kN/m ^{3}]	10.00
Unit weight of fluid outside tube, upper layer, [kN/m ^{3}]	0.00
Specified height of lower layer of slurry, Hin-L, [m]	1.0
Specified height of outside lower layer of fluid, Hout-L, [m]	0.0

GEOSYNTHETIC DESIGN PARAMETERS:

1. Reduction factor for installation damage, RFid	1.17
2. Reduction factor for durability, RFd	1.15
3. Reduction factor for creep, RFc	1.52
4. Reduction factor for seam strength, RFss, in tube's:	
axial (longitudial) direction	2.00
circumferential direction	2.00

Maximum height of 1.00 [m] was specified.

RESULTS

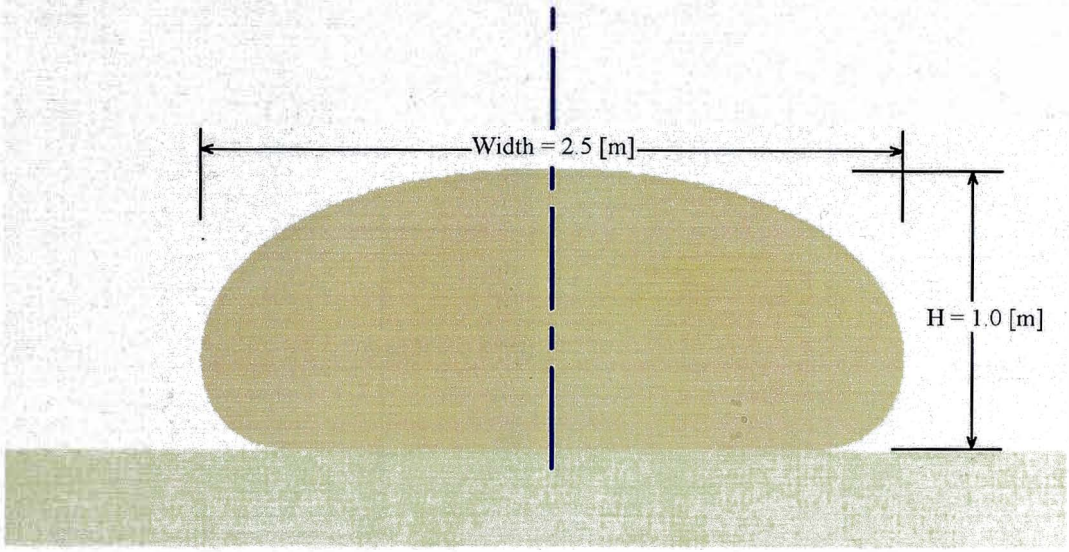
Results correspond to a circumference of tube of 6.0 [m] and maximum tube height of 1.0 [m].

Geosynthetic in CIRCUMFERENTIAL direction:	
Tensial force at WORKING conditions, [kN/m]	6
Required ULTIMATE strength, [kN/m]	23
Geosynthetic in AXIAL direction:	
Tensial force at WORKING conditions, [kN/m]	4
Required ULTIMATE strength, [kN/m]	17
Maximum height of tube, H [m]	1.0
Maximum width of tube, W [m]	2.5
(max. width is at height 0.3 [m] from base)	
Ratio H / W	0.397
Width of base of tube resting on foundation soil, [m]	1.9
Cross-sectional area of lower layer of slurry, [m ^{2}]	2.1
Cross-sectional area of upper layer of slurry, [m ^{2}]	0.0
Total storage capacity of tube per unit length, [m ^{3}/m]	2.1
Net pumping pressure within tube at inlet, [kPa]	1.9

CONSOLIDATED TUBE:

Unit weight of consolidated (saturated) fill, [kN/m ^{3}]	20.0
Consolidated cross-section area, [m ^{2}]	1.7
Final height, H [m]	0.8

CROSS-SECTION:



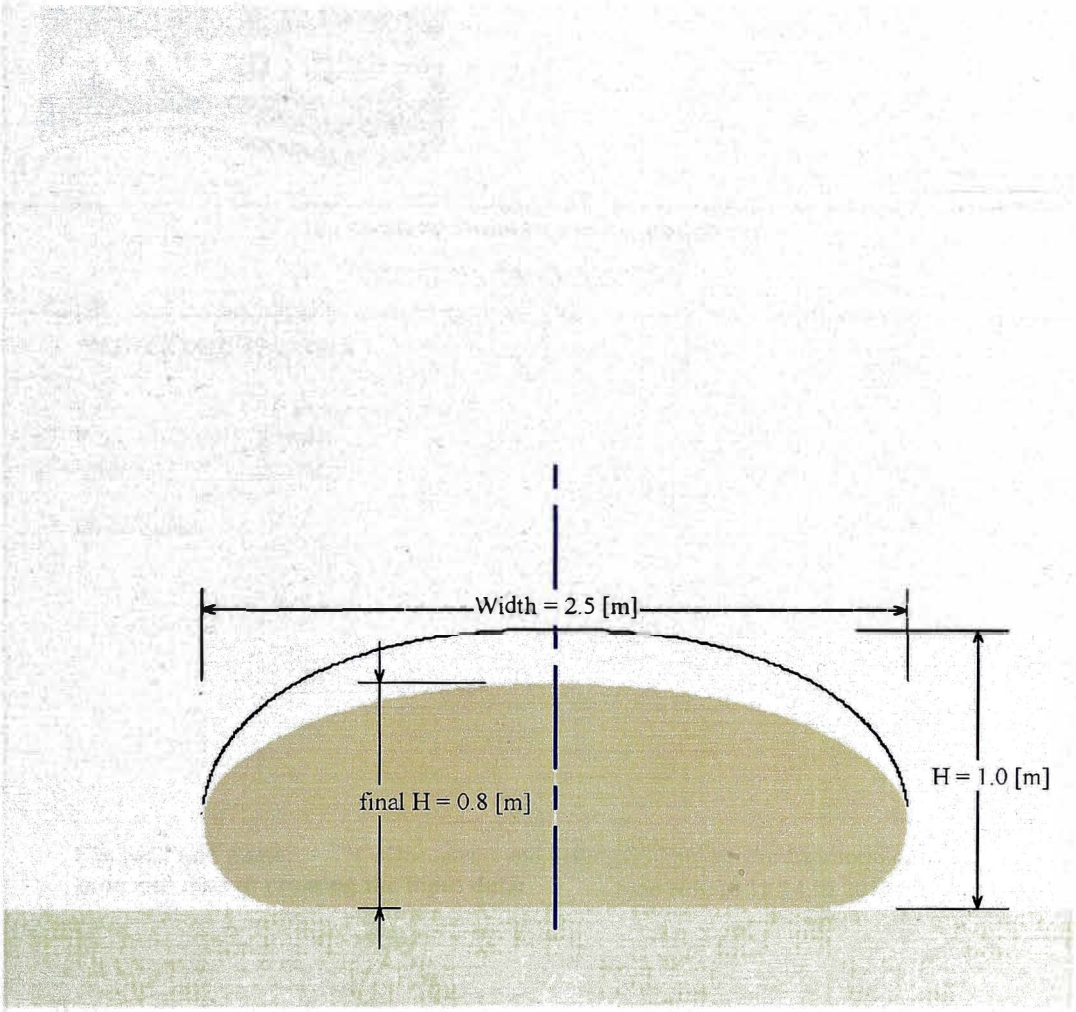
SCALE:

0 1.0 2.0 [m]

Circumference = 6.0 [m]
Pumping pressure = 1.9 [kPa]
Cross-sectional area of tube = 2.1 [m ²]

T-ult (circumferential) = 23 [kN/m]
T-ult (axial) = 17 [kN/m]

CROSS-SECTION AFTER CONSOLIDATION: OPTION #1



SCALE:

0 1.0 2.0 [m]

Unit weight of slurry = 18.0 [kN/m ³]
Unit weight of consolidated (saturated) fill = 20.0 [kN/m ³]
Initial cross-sectional area of tube = 2.1 [m ²]
Consolidated cross-sectional area of tube = 1.7 [m ²]

C.2 ANÁLISIS CONSIDERANDO DEFORMACIÓN DE MATERIAL

ANDEX

Geosynthetic Confined Pressurized Slurry

Resistencia Geotextil

PROJECT IDENTIFICATION

Title: Resistencia Geotextil
Project Number: Private
Designer: Private

Description:

File path and name: C:\Documents and Settings\Administrador\Escritorio\geoc.....
Date and time of creating the input data: Mon Nov 18 18:14:55 2013

Design Philosophy and Program Developed by:

Ora Leshchinsky, P.E.
Dov Leshchinsky, Ph.D.
33 The Horseshoe
Newark, Delaware 19711, USA

INPUT DATA

Circumference of tube, [m]	6.0
Unit weight of lower layer of slurry, [kN/m ^{3}]	18.00
Unit weight of upper layer of slurry, [kN/m ^{3}]	18.00
Unit weight of fluid outside tube, lower layer, [kN/m ^{3}]	10.00
Unit weight of fluid outside tube, upper layer, [kN/m ^{3}]	0.00
Specified height of lower layer of slurry, Hin-L, [m]	1.2
Specified height of outside lower layer of fluid, Hout-L, [m]	0.0

GEOSYNTHETIC DESIGN PARAMETERS:

1. Reduction factor for installation damage, RFid	1.17
2. Reduction factor for durability, RFd	1.15
3. Reduction factor for creep, RFc	1.52
4. Reduction factor for seam strength, RFss, in tube's:	
axial (longitudial) direction	2.00
circumferential direction	2.00

Maximum height of 1.20 [m] was specified.

RESULTS

Results correspond to a circumference of tube of 6.2 [m] and maximum tube height of 1.2 [m].

Geosynthetic in CIRCUMFERENTIAL direction:	
Tensial force at WORKING conditions, [kN/m]	10
Required ULTIMATE strength, [kN/m]	39
Geosynthetic in AXIAL direction:	
Tensial force at WORKING conditions, [kN/m]	7
Required ULTIMATE strength, [kN/m]	27
Maximum height of tube, H [m]	1.2
Maximum width of tube, W [m]	2.5
(max. width is at height 0.4 [m] from base)	
Ratio H / W	0.483
Width of base of tube resting on foundation soil, [m]	1.7
Cross-sectional area of lower layer of slurry, [m ^{2}]	2.5
Cross-sectional area of upper layer of slurry, [m ^{2}]	0.0
Total storage capacity of tube per unit length, [m ^{3}/m]	2.5
Net pumping pressure within tube at inlet, [kPa]	4.4

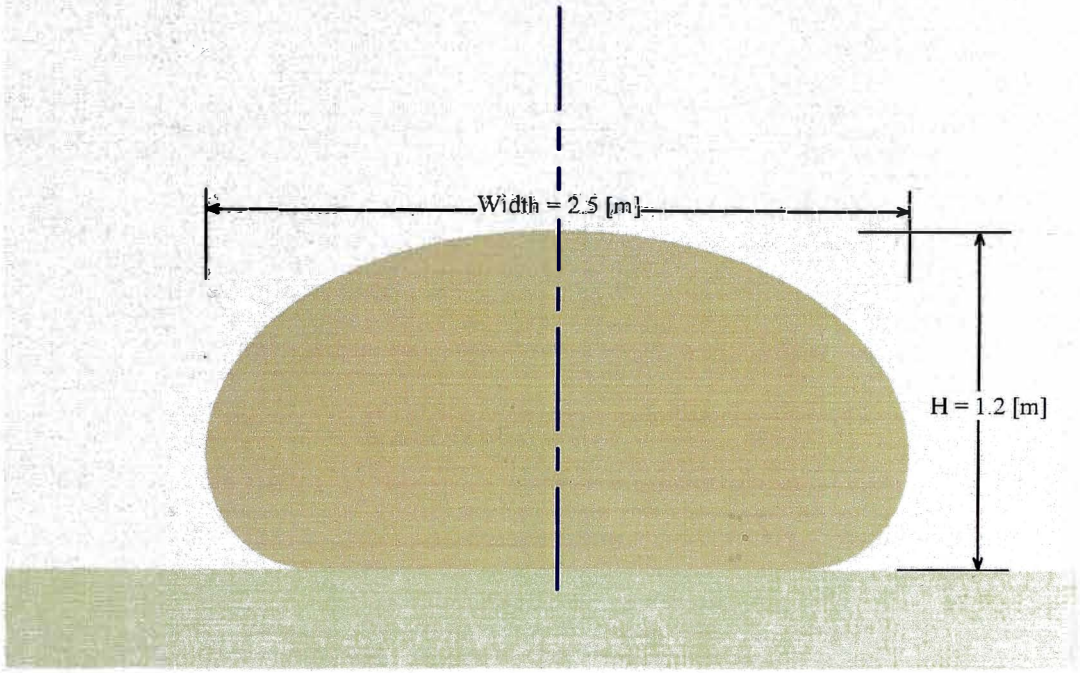
CONSOLIDATED TUBE:

Unit weight of consolidated (saturated) fill, [kN/m ^{3}]	20.0
Consolidated cross-section area, [m ^{2}]	2.0
Final height, H [m]	1.0

GeoCoPS Version 2.0
Printed on: Mon Nov 18 21:02:00 2013

Resistencia Geotextil
C:\Documents and Settings\Administrador\Escritorio\geocops test\seccion 1.0x2.5x5.0_consolid.Geo

CROSS-SECTION:



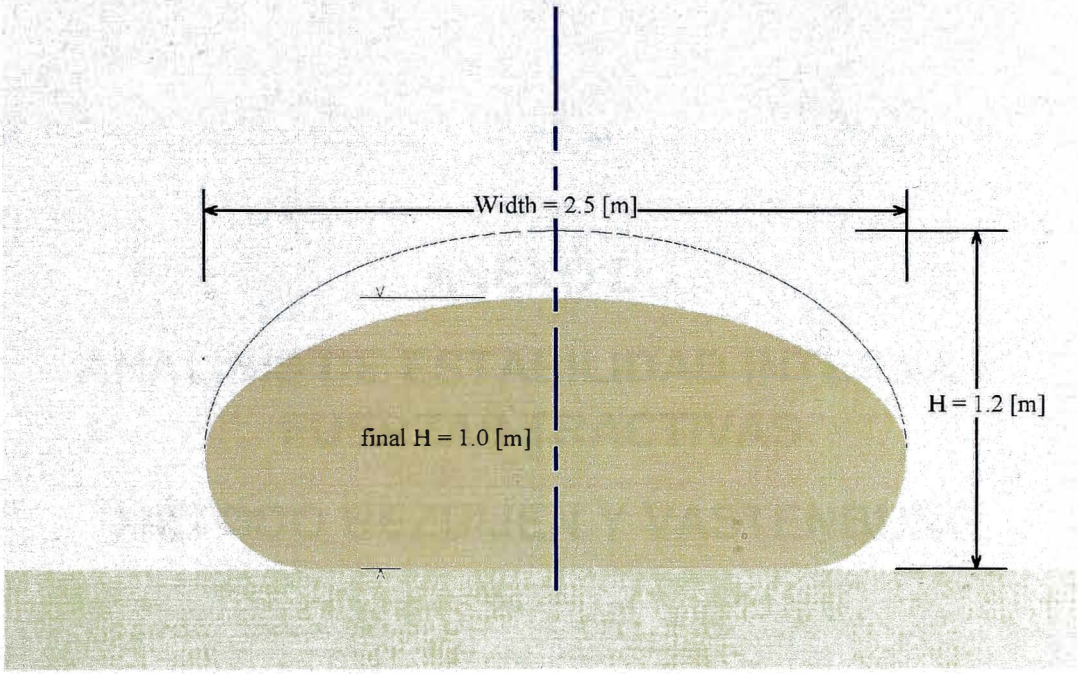
SCALE:

0 1.0 2.0 [m]

Circumference = 6.2 [m]
Pumping pressure = 4.4 [kPa]
Cross-sectional area of tube = 2.5 [m ²]

T-ult (circumferential) = 39 [kN/m]
T-ult (axial) = 27 [kN/m]

CROSS-SECTION AFTER CONSOLIDATION: OPTION #1



SCALE:

0 1.0 2.0 [m]

Unit weight of slurry = 18.0 [kN/m ³]
Unit weight of consolidated (saturated) fill = 20.0 [kN/m ³]
Initial cross-sectional area of tube = 2.5 [m ²]
Consolidated cross-sectional area of tube = 2.0 [m ²]

ANEXO D:

ANALISIS DE ESTABILIDAD INTERNA Y FUERZAS TRACTIVAS

MÉTODO BEZUIJEN Y VASTENBURG

ANALISIS DE GEOCONTENEDORES SEGÚN BEZUIJEN Y VASTENBURG GEOSYSTEMS. DESIGN RULES AND APPLICATIONS (2013)

Datos

Oleaje

Altura de ola (Hs)	0.20 m
Periodo Pico (Tp)	5.00 s

Material

Porosidad de material (n)	0.40		
Peso Especifico de suelo (Gs)	26.50 kN/m3	densidad de suelo humedo	19.80 kN/m3
Peso Especifico de Agua (Gw)	10.00 kN/m3		ok
Estimación de Consolidación			
Densidad de suelo húmedo (en trabajo)	20.00 kN/m3	humedad final	0.25
Densidad de suelo suelto (llenado de bag/slurry)	18.00 kN/m3	humedad inicial	0.40

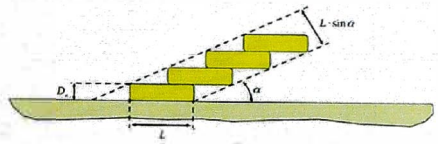
Geometría

Angulo de talud (2V:1H)	63.4 °	Relacion de asentamiento	0.20
Gravedad	9.81 m/s2	asentamiento de material	0.20 m
Borde Libre (Rc)	1.00 m		0.20 m
Velocidad máx. a lo largo del talud	4.00 m/s2	Alto de Geobag + asent.	1.20 m
Tirante de agua	4.00 m		

Geobag

Ancho (b,L)	2.50 m
Alto (Dn)	1.00 m
longitud	5.00 m
Volumen	12.50 m3

Installation geometry I



$D_k = L \cdot \sin\alpha$

Solución

1. Calculos Iniciales

Relación de Densidades	$\Delta_r = (1-n)\cdot\frac{\rho_s-\rho_w}{\rho_w}$	0.99
Longitud de ola en aguas profundas	$L_0 = \frac{gT_p^2}{2\pi}$	39.03
Breaker Parameter	$\xi = \frac{\tan\alpha}{\sqrt{H_s/L_0}}$	27.90
Espesor efectivo	$D_k = L\cdot\sin\alpha$	2.24 m

2. Estabilidad contra olas

Parametro de estabilidad

$\frac{H_s}{\Delta_r D_k} \le 1.4$ Para olas irregulares, talud 1:3 o menos

$\frac{H_s}{\Delta_r D_k} \le \frac{2.75}{\sqrt{\xi}}$ Para taludes 1:3 o mayores

0.09 ≤ 0.52 cumple

Para elementos en el borde Libre

$\frac{H_s}{\Delta_r D_k} \le 0.79 + 0.09\frac{R_c}{H_s}$

0.09 ≤ 1.24 cumple

no corregir			
Espesor efectivo min.	1.50 m		
Nuevo ancho geobag	1.68 m		
0.13	≤	1.24	cumple

3. Estabilidad contra corrientes longitudinales

Relacion de Pilarczyk para Revestimientos

$$\Delta_i D_k \geq 0.035 \cdot \frac{\Phi K_T K_h u_a^2}{\Psi K_s 2g}$$

Dk (espesor)		1.73 m	cumple
Parametro de Estabilidad (Φ)		1.50	
Parametro de Shields (ψ)		0.05	
Factor de turbulencia (Kt)		2.00	
Rugosidad Equivalente según Nikuradse (Kr)		2.30 m	
Angulo de interface entre geobag y terreno		40 °	
Factor de Inclinación (Ks)		1.00	
Factor de profundidad (Kh)		1.00	
.-Perfil long. desarrollado		1.15	
.-Perfil no desarrollado		0.90	
-Flujo muy rugoso (h/Kr<5)		1.00	
	1.74		

Table 3.1 Turbulence factor K_t for various hydraulic conditions [22].

Condition	K_t [–]
Normal turbulence in rivers	1.0
Higher turbulence: river bends	1.5
Turbulence at groynes	2.0
Strong turbulence: hydraulic jumps, sharp bends, local disruptions	2.0
Turbulence as the result of propeller jets and other water jets	3.0–4.0

4. Estabilidad cuando se esta sujeto a flujo por encima de la estructura

Condición:

$$\frac{u_a}{\sqrt{g\Delta_i D_k}} \leq F$$

$F = 1.2$ [22];
$F = 0.5 - 1.0$ [9, in Dutch];
$F = 0.9 - 1.8$ [19].

0.86	≤	1.2	cumple

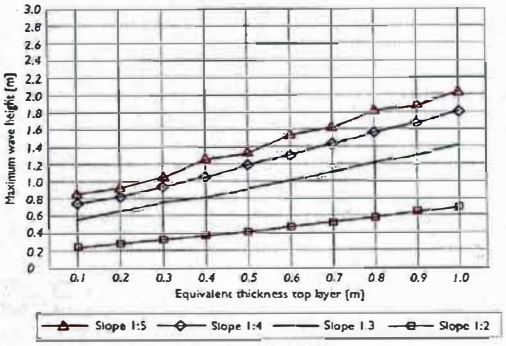


Figure C.1 Design chart for shearing of subsoil for $S_{op} = 0.03$.

5. Estabilidad por falla del terreno (por oleaje)

Condición:

$$s_{op} = \frac{H_s}{L_0} = \frac{2\pi H_s}{g T_p^2}$$

Sop = 0.005

$$\Delta\Phi_{max} \leq (\Delta_i D_k + \Delta_i z) \cdot \left(\cos\alpha - \frac{\sin\alpha}{\tan\delta}\right)$$

De la Tabla C.1 *(aprox.)*

Máx. diferencia para la altura de	ΔΦ <	0.40 m	
Ola	Hs < ΔΦ	cumple	

5. Tensión requerida para el Geosintético

Tipo de Geosintético	Geotextil tejido bidireccional ANDEX-108T	
Material	Poliester	
Tensión máxima	108 kN/m	
Deformación máxima	11.5 %	
Modulo de rigidez (J)	939.13 kN/m	

$$T = \sqrt{2 \cdot \frac{D_g}{b} \cdot \frac{V}{S} \cdot \frac{J}{C_d} \cdot \left(\frac{\rho - \rho_w}{\rho_w}\right) \cdot \rho \cdot g}$$

72.56 kN/m — se corrigio longitud x metro lineal

Reducción por uniones o costura 70 %

Tension en Geosintético 103.65 kN/m

Factor seguridad $\frac{T_m}{T_{geotextile}}$ 1.04 > 1.0 cumple

ANEXO E:

ANALISIS DE FUERZAS TRACTIVAS

MÉTODO DE SHIELDS

ANÁLISIS DE FUERZA TRÁCTICA EN GEOCONTENEDORES
METODO DE SHIELDS

Datos

Shields

Parametro de Shields (ψ)		0.05	*recomendado por Geosystems Design rules and applications*

Material

Peso Especifico de suelo (Gs, ys)	gravedad es	26.50	kN/m3
Peso Especifico de Agua (Gw)		10.00	kN/m3

Geometria

Angulo de talud (2V:1H)	63.4	°
Gravedad	9.81	m/s2

Geocontenedor (Geobag)

Ancho (b,L)	2.50	m
Alto (Dn)	1.00	m
longitud	5.00	m
Volumen	12.50	m3

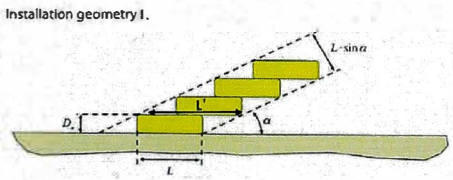
Solución

$$\tau_{cr} = \varphi(\gamma_s - \gamma_w)D$$

Ecuacion de Shields para iniciación de movimiento en particulas de diametro D

1. Calculos Iniciales

Espesor efectivo $D_k = L \cdot \sin\alpha$ 2.24 m *sugerido*



$D_k = L \cdot \sin\alpha$

Correción por Inclinación $K = \frac{\tau_{cr}}{\tau_{co}} = 1 - \frac{sen^2\alpha}{sen^2\phi}$ *Relación entre enfuerzo cortante crítico del talud con respecto al fondo*

Angulo de interface entre geocontenedor y terreno (reposo) 40 °

Factor de Inclinación (Ks) #¡NUM! *de formula*
1.00 *sugerido*

Para la situacion escalonada no se generan fuerzas en la direccion de talud solo actua la fuerz tractiva del agua (podemos considerar la pendiente de cauce pero es despreciable 2%)

2. Resultado

$$\tau_{cr} = K\varphi(\gamma_s - \gamma_w)D_k$$

Ecuacion de Shields corregida

$\tau_{cr} =$ 1848 N/m2

Zonas en Curva

Correción por turbulencia

Tipo de turbulencia	Sitio	Parámetro de turbulencia K_T
Normal	Muros laterales	1.0
Mediana	Curvas suaves	1.5
Fuerte	Resaltos hidráulicos y curvas fuertes	2.0
	Sitios de alta turbulencia	2.0 a 2.5
Carga directa del agua sobre revestimiento	Jets espirales	3.0 a 4.0

K_T = 2.00
curvo fuerte

$$K_T \tau_{cr} = K\varphi(\gamma_s - \gamma_w) D_k$$ Ecuacion de Shields corregida por turbulencia

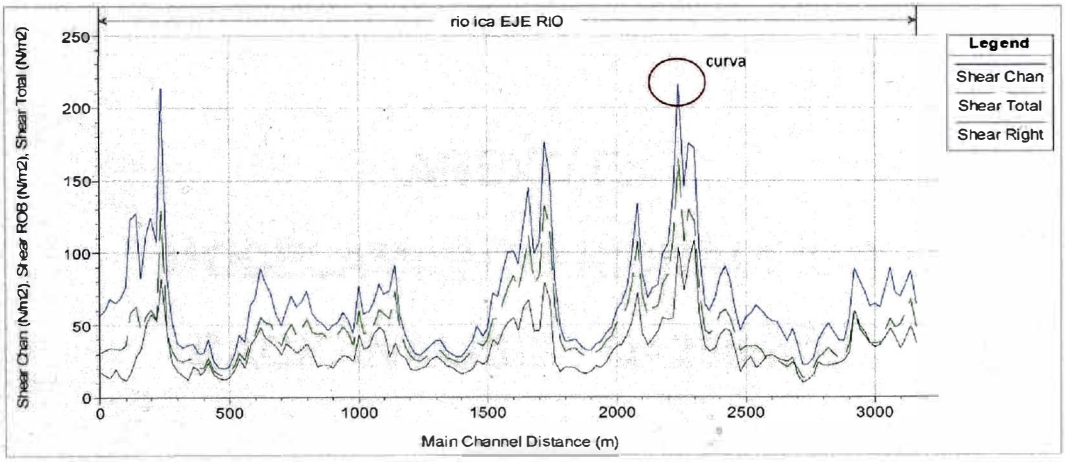
Afecta directamente a la velocidad incrementando el esfuerzo cortante (direct. Propor. A Tcr)

τ_{cr} = 924.0 N/m2

Comparativo (*Caso de estudio*)

$\tau_{máx.}$ = 216.4 N/m2

$\tau_{cr} \geq \tau_{máx}$
ok



ANEXO F:

MODELAMIENTO HIDRÁULICO

BACKANALISIS ; Q=250m^3/s

Cuadro N°F.1 Resultados del modelamiento del Río Ica en la zona de estudio considerando un caudal igual a 250 m^3/s. Fuente, Elaboración propia.

MODELAMIENTO HIDRÁULICO HEC-RAS														PROFUNDIDAD DE SOCAVACIÓN							
River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
3+180	250	389.75	394.0	392.5	394.3	0.001	1.5	2.3	108.7	37.3	0.4	35.0	4.3	2.9	0.98	1.00	2.0	0.387	1.15	7.3	3.0	386.8
3+160	250	390.26	393.9		394.3	0.002	1.7	2.7	93.8	36.3	0.6	51.7	3.6	2.6	0.98	1.00	2.0	0.387	1.45	7.0	3.4	386.9
3+120	250	390.37	393.8		394.2	0.002	1.4	2.4	106.1	42.5	0.5	39.6	3.5	2.5	0.98	1.00	2.0	0.387	1.31	6.2	2.7	387.6
3+100	250	390.48	393.8		394.1	0.002	1.6	2.4	106.6	42.8	0.5	42.3	3.3	2.5	0.98	1.00	2.0	0.387	1.30	5.9	2.6	387.9
3+080	250	390.49	393.6		394.1	0.003	1.7	2.8	90.0	39.7	0.6	57.0	3.1	2.3	0.98	1.00	2.0	0.387	1.64	6.4	3.3	387.2
3+040	250	390.25	393.6		394.0	0.002	1.5	2.3	110.5	43.4	0.5	38.1	3.4	2.5	0.98	1.00	2.0	0.387	1.24	5.8	2.4	387.8
3+020	250	390.25	393.6		393.9	0.002	1.6	2.4	104.2	43.7	0.5	40.0	3.3	2.4	0.98	1.00	2.0	0.387	1.37	6.1	2.8	387.5
3+000	250	390.15	393.5		393.9	0.002	1.7	2.4	105.2	54.8	0.5	33.5	3.4	1.9	0.98	1.00	2.0	0.387	1.57	6.8	3.5	386.7
2+980	250	390	393.4		393.8	0.002	2.0	2.5	99.9	49.8	0.6	43.1	3.4	2.0	0.98	1.00	2.0	0.387	1.61	7.0	3.6	386.4
2+960	250	390	393.3		393.8	0.002	2.0	2.6	95.9	45.3	0.6	46.9	3.3	2.1	0.98	1.00	2.0	0.387	1.61	6.9	3.5	386.5
2+940	250	390.27	393.0	392.8	393.7	0.006	2.8	3.3	74.9	44.2	0.9	91.2	2.8	1.7	0.98	1.00	2.0	0.387	2.40	7.5	4.7	385.6
2+920	250	390.1	393.2		393.5	0.002	1.6	2.5	100.1	44.7	0.5	44.2	3.1	2.2	0.98	1.00	2.0	0.387	1.49	5.9	2.8	387.3
2+900	250	390.05	393.2		393.5	0.001	1.4	2.0	125.8	50.0	0.4	27.8	3.2	2.5	0.98	1.00	2.0	0.387	1.10	4.9	1.7	388.3
2+880	250	390.12	393.2		393.4	0.001	1.3	2.0	127.4	47.8	0.4	27.9	3.1	2.7	0.98	1.00	2.0	0.387	1.04	4.6	1.5	388.6
2+840	250	389.73	393.1		393.4	0.001	1.2	2.2	114.2	44.4	0.5	34.0	3.4	2.6	0.98	1.00	2.0	0.387	1.19	5.6	2.2	387.5
2+820	250	389.5	393.1		393.4	0.001	1.2	2.0	122.9	47.2	0.4	29.6	3.6	2.6	0.98	1.00	2.0	0.387	1.10	5.7	2.1	387.4
2+800	250	389.48	393.1		393.3	0.001	1.3	1.8	137.5	50.1	0.4	25.7	3.6	2.7	0.98	1.00	2.0	0.387	0.95	5.2	1.6	387.9

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
2+780	250	389.29	393.1		393.3	0.001	1.0	1.5	163.8	55.6	0.3	16.9	3.9	2.9	0.98	1.00	2.0	0.387	0.76	4.8	0.9	388.4
2+760	250	389.47	393.1		393.3	0.001	1.0	1.5	164.7	57.6	0.3	15.9	3.7	2.9	0.98	1.00	2.0	0.387	0.77	4.5	0.9	388.6
2+740	250	389.34	393.1		393.3	0.001	0.9	1.5	166.3	57.1	0.3	15.4	3.8	2.9	0.98	1.00	2.0	0.387	0.75	4.6	0.8	388.5
2+720	250	389.09	393.0		393.2	0.001	1.2	1.9	131.7	50.2	0.4	24.8	4.0	2.6	0.98	1.00	2.0	0.387	1.02	6.1	2.1	387.0
2+700	250	389	392.9		393.2	0.001	1.5	2.1	119.5	51.8	0.5	28.5	3.9	2.3	0.98	1.00	2.0	0.387	1.22	6.8	2.9	386.1
2+680	250	389	392.9		393.2	0.001	1.4	1.9	134.7	52.5	0.4	23.4	3.9	2.6	0.98	1.00	2.0	0.387	1.01	6.0	2.1	386.9
2+640	250	389.25	392.8		393.1	0.001	1.6	2.3	110.2	47.0	0.5	31.7	3.5	2.3	0.98	1.00	2.0	0.387	1.31	6.3	2.8	386.4
2+620	250	389.18	392.8		393.1	0.001	1.5	2.2	111.4	44.0	0.5	31.2	3.6	2.5	0.98	1.00	2.0	0.387	1.23	6.2	2.6	386.6
2+600	250	389	392.7		393.0	0.001	1.4	2.3	109.4	41.3	0.5	32.7	3.7	2.6	0.98	1.00	2.0	0.387	1.22	6.4	2.7	386.3
2+580	250	389.09	392.7		393.0	0.001	1.5	2.3	108.4	42.2	0.5	34.5	3.6	2.6	0.98	1.00	2.0	0.387	1.25	6.3	2.7	386.4
2+560	250	388.75	392.6		393.0	0.002	1.4	2.4	104.6	40.9	0.5	35.2	3.9	2.6	0.98	1.00	2.0	0.387	1.31	7.0	3.2	385.6
2+540	250	388.64	392.6		392.9	0.001	1.5	2.2	114.1	44.3	0.5	32.7	4.0	2.6	0.98	1.00	2.0	0.387	1.19	6.8	2.9	385.8
2+520	250	388.99	392.6		392.9	0.001	1.5	2.2	112.0	42.0	0.5	34.3	3.6	2.7	0.98	1.00	2.0	0.387	1.18	6.0	2.4	386.5
2+500	250	388.91	392.6		392.9	0.001	1.3	2.0	123.1	42.6	0.4	28.8	3.7	2.9	0.98	1.00	2.0	0.387	1.02	5.6	1.9	387.0
2+480	250	388.74	392.5		392.8	0.001	1.5	2.2	112.9	38.6	0.5	36.1	3.8	2.9	0.98	1.00	2.0	0.387	1.10	6.1	2.3	386.4
2+460	250	388.72	392.4		392.8	0.002	1.8	2.6	96.7	35.3	0.5	49.2	3.6	2.7	0.98	1.00	2.0	0.387	1.35	6.7	3.1	385.6
2+440	250	388.6	392.3		392.7	0.002	1.7	2.8	90.8	33.8	0.6	54.6	3.7	2.7	0.98	1.00	2.0	0.387	1.46	7.1	3.5	385.1
2+420	250	388.48	392.2		392.7	0.002	1.7	2.6	94.7	33.1	0.5	49.1	3.8	2.9	0.98	1.00	2.0	0.387	1.34	6.9	3.2	385.3
2+400	250	388.46	392.3		392.6	0.002	1.5	2.5	101.1	35.5	0.5	41.5	3.8	2.8	0.98	1.00	2.0	0.387	1.26	6.7	2.9	385.5
2+380	250	388.44	392.3		392.6	0.001	1.4	2.3	109.3	37.4	0.5	37.1	3.8	2.9	0.98	1.00	2.0	0.387	1.14	6.3	2.5	385.9
2+360	250	388.25	392.2	390.9	392.6	0.001	1.5	2.4	106.1	36.8	0.5	39.6	4.0	2.9	0.98	1.00	2.0	0.387	1.19	6.8	2.8	385.4

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
2+340	250	388.25	392.0	391.0	392.5	0.002	1.9	2.9	86.1	30.5	0.6	61.5	3.7	2.8	0.98	1.00	2.0	0.387	1.48	7.4	3.7	384.6
2+320	250	388.25	391.6	391.1	392.4	0.004	2.7	3.5	71.4	27.1	0.8	98.1	3.4	2.6	0.98	1.00	2.0	0.387	1.87	7.8	4.4	383.8
2+300	250	388.4	391.5	391.1	392.3	0.005	2.4	3.8	66.2	26.3	0.8	105.3	3.1	2.5	0.98	1.00	2.0	0.387	2.09	7.4	4.4	384.0
2+280	250	388.25	391.4	391.0	392.2	0.004	2.1	3.6	68.9	27.4	0.7	91.9	3.2	2.5	0.98	1.00	2.0	0.387	2.01	7.6	4.4	383.8
2+260	250	388.3	391.2	390.9	392.1	0.005	2.2	4.0	62.8	26.1	0.9	113.3	2.9	2.4	0.98	1.00	2.0	0.387	2.26	7.3	4.5	383.8
2+240	250	388.25	391.3	390.7	391.9	0.003	1.6	3.3	75.4	28.7	0.7	77.3	3.0	2.6	0.98	1.00	2.0	0.387	1.78	6.6	3.6	384.7
2+220	250	388.24	391.3	390.5	391.8	0.003	1.7	3.0	84.2	31.9	0.6	63.7	3.1	2.6	0.98	1.00	2.0	0.387	1.59	6.2	3.1	385.1
2+200	250	388.24	391.3	390.5	391.8	0.003	1.8	2.9	86.6	33.5	0.6	60.1	3.1	2.6	0.98	1.00	2.0	0.387	1.56	6.0	3.0	385.2
2+180	250	388.23	391.3	390.3	391.7	0.002	1.7	2.6	95.9	37.1	0.5	49.0	3.1	2.6	0.98	1.00	2.0	0.387	1.41	5.7	2.6	385.6
2+160	250	388.22	391.3	390.2	391.7	0.002	1.5	2.6	97.0	36.2	0.5	47.2	3.1	2.7	0.98	1.00	2.0	0.387	1.36	5.5	2.4	385.8
2+140	250	388.21	391.3	390.2	391.6	0.002	1.4	2.5	99.8	37.7	0.5	43.6	3.1	2.7	0.98	1.00	2.0	0.387	1.33	5.4	2.3	385.9
2+120	250	388.21	391.1	390.2	391.6	0.002	1.6	2.8	90.1	34.5	0.6	53.9	2.9	2.6	0.98	1.00	2.0	0.387	1.49	5.6	2.6	385.6
2+100	250	388.2	390.9	390.4	391.5	0.004	2.0	3.3	76.0	32.7	0.7	82.8	2.7	2.3	0.98	1.00	2.0	0.387	1.91	5.9	3.3	384.9
2+080	250	388.02	390.9	390.2	391.4	0.003	1.7	2.9	87.4	36.0	0.6	60.3	2.9	2.4	0.98	1.00	2.0	0.387	1.62	5.8	2.9	385.1
2+060	250	387.99	390.9	390.1	391.3	0.002	1.6	2.6	95.4	39.4	0.6	50.6	2.9	2.4	0.98	1.00	2.0	0.387	1.48	5.5	2.6	385.4
2+040	250	387.98	390.9	390.0	391.3	0.002	1.5	2.5	101.2	41.9	0.5	44.8	2.9	2.4	0.98	1.00	2.0	0.387	1.40	5.3	2.4	385.6
2+020	250	387.97	390.9	389.9	391.2	0.002	1.5	2.4	103.8	42.4	0.5	42.7	2.9	2.4	0.98	1.00	2.0	0.387	1.35	5.2	2.3	385.7
2+000	250	387.95	390.9	389.8	391.2	0.001	1.4	2.1	117.1	45.8	0.4	33.5	3.0	2.6	0.98	1.00	2.0	0.387	1.16	4.7	1.8	386.2
1+980	250	387.94	390.9	389.7	391.1	0.001	1.2	2.1	120.0	47.1	0.4	31.4	2.9	2.5	0.98	1.00	2.0	0.387	1.14	4.6	1.7	386.3
1+960	250	387.75	390.9	389.6	391.1	0.001	1.1	1.9	131.0	49.6	0.4	26.0	3.1	2.6	0.98	1.00	2.0	0.387	1.02	4.6	1.5	386.3
1+940	250	387.75	390.9	389.5	391.1	0.001	1.2	1.8	136.1	52.3	0.4	25.1	3.1	2.6	0.98	1.00	2.0	0.387	0.99	4.5	1.4	386.4

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
1+920	250	387.75	390.9	389.4	391.0	0.001	1.1	1.7	146.0	54.3	0.4	21.9	3.1	2.7	0.98	1.00	2.0	0.387	0.90	4.2	1.1	386.7
1+900	250	387.75	390.9	389.4	391.0	0.001	1.0	1.7	145.0	53.1	0.4	21.8	3.1	2.7	0.98	1.00	2.0	0.387	0.90	4.1	1.0	386.7
1+880	250	387.75	390.8	389.4	391.0	0.001	1.0	1.8	143.2	52.6	0.4	23.3	3.1	2.7	0.98	1.00	2.0	0.387	0.91	4.1	1.1	386.7
1+860	250	387.75	390.8	389.4	391.0	0.001	1.1	1.8	136.9	50.8	0.4	25.8	3.0	2.7	0.98	1.00	2.0	0.387	0.96	4.2	1.2	386.5
1+840	250	387.75	390.8	389.4	391.0	0.001	1.2	1.8	136.1	49.7	0.4	25.4	3.0	2.7	0.98	1.00	2.0	0.387	0.96	4.2	1.2	386.6
1+820	250	387.75	390.8	389.3	390.9	0.001	1.2	1.9	134.9	49.1	0.4	24.9	3.0	2.7	0.98	1.00	2.0	0.387	0.96	4.2	1.2	386.6
1+800	250	387.75	390.7	389.4	390.9	0.001	1.1	2.1	120.4	45.5	0.4	31.8	2.9	2.6	0.98	1.00	2.0	0.387	1.11	4.5	1.6	386.2
1+780	250	387.53	390.5	389.5	390.9	0.002	1.1	2.6	95.2	37.7	0.5	49.4	2.9	2.5	0.98	1.00	2.0	0.387	1.44	5.5	2.5	385.0
1+760	250	387.5	390.1	389.7	390.8	0.004	1.8	3.3	75.5	35.3	0.8	85.9	2.6	2.1	0.98	1.00	2.0	0.387	2.03	6.1	3.5	384.0
1+740	250	387.5	390.1	389.6	390.7	0.004	2.2	3.2	77.6	34.8	0.8	89.2	2.6	2.2	0.98	1.00	2.0	0.387	1.93	5.8	3.2	384.3
1+720	250	387.49	390.1	389.5	390.6	0.003	1.7	2.7	93.8	41.6	0.6	62.4	2.7	2.3	0.98	1.00	2.0	0.387	1.58	5.2	2.5	385.0
1+700	250	387.48	390.1	389.4	390.5	0.003	1.7	2.7	93.3	43.1	0.6	59.6	2.6	2.2	0.98	1.00	2.0	0.387	1.63	5.1	2.5	384.9
1+680	250	387.48	389.8	389.5	390.4	0.004	1.8	3.2	78.4	40.8	0.8	81.3	2.3	1.9	0.98	1.00	2.0	0.387	2.10	5.4	3.1	384.4
1+660	250	387.47	389.8	389.3	390.3	0.004	1.7	2.9	86.1	45.3	0.7	69.0	2.3	1.9	0.98	1.00	2.0	0.387	1.93	5.1	2.8	384.7
1+640	250	387.25	389.8	389.2	390.2	0.003	1.6	2.6	95.2	48.9	0.6	52.2	2.6	1.9	0.98	1.00	2.0	0.387	1.72	5.3	2.7	384.6
1+620	250	387.25	389.7	389.2	390.1	0.004	1.6	2.8	88.0	47.5	0.7	65.3	2.4	1.9	0.98	1.00	2.0	0.387	1.92	5.3	2.9	384.3
1+600	250	387.25	389.6	389.2	390.1	0.004	1.5	2.9	86.7	51.4	0.7	65.1	2.3	1.7	0.98	1.00	2.0	0.387	2.08	5.3	3.0	384.3
1+580	250	387.24	389.5	389.2	390.0	0.004	1.5	2.7	92.4	56.1	0.7	60.0	2.3	1.6	0.98	1.00	2.0	0.387	1.98	5.0	2.8	384.5
1+560	250	387.11	389.5	389.0	389.9	0.003	1.2	2.5	100.6	60.4	0.6	49.1	2.4	1.7	0.98	1.00	2.0	0.387	1.81	5.0	2.6	384.5
1+540	250	386.93	389.4	389.0	389.8	0.003	1.3	2.6	97.7	56.8	0.6	52.9	2.5	1.7	0.98	1.00	2.0	0.387	1.82	5.3	2.8	384.1
1+520	250	386.98	389.5	388.8	389.7	0.002	1.1	2.0	123.4	69.2	0.5	35.9	2.5	1.8	0.98	1.00	2.0	0.387	1.41	4.4	1.9	385.1

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
1+500	250	386.99	389.4	388.7	389.7	0.002	1.0	2.0	127.5	68.7	0.5	31.1	2.5	1.9	0.98	1.00	2.0	0.387	1.33	4.1	1.7	385.3
1+480	250	386.98	389.3	388.7	389.6	0.002	1.1	2.3	110.7	63.2	0.5	38.8	2.4	1.8	0.98	1.00	2.0	0.387	1.59	4.5	2.1	384.9
1+460	250	386.97	389.4	388.5	389.6	0.002	1.1	1.9	131.4	70.1	0.5	30.1	2.4	1.9	0.98	1.00	2.0	0.387	1.28	3.9	1.5	385.5
1+440	250	386.75	389.3	388.4	389.5	0.001	1.0	1.8	142.9	70.9	0.4	25.1	2.6	2.0	0.98	1.00	2.0	0.387	1.12	3.9	1.3	385.4
1+420	250	386.75	389.3	388.3	389.5	0.001	1.0	1.6	153.7	74.7	0.4	21.3	2.6	2.1	0.98	1.00	2.0	0.387	1.03	3.7	1.1	385.7
1+400	250	386.75	389.3	388.2	389.5	0.001	1.0	1.6	154.7	73.4	0.4	21.1	2.6	2.1	0.98	1.00	2.0	0.387	1.00	3.6	1.0	385.7
1+380	250	386.72	389.3	388.2	389.4	0.001	1.1	1.7	150.7	70.9	0.4	22.4	2.6	2.1	0.98	1.00	2.0	0.387	1.02	3.6	1.1	385.7
1+360	250	386.69	389.3	388.2	389.4	0.001	1.2	1.7	144.6	68.5	0.4	23.5	2.6	2.1	0.98	1.00	2.0	0.387	1.07	3.7	1.2	385.5
1+340	250	386.5	389.2	388.2	389.4	0.001	1.2	1.9	133.7	62.8	0.4	27.9	2.7	2.1	0.98	1.00	2.0	0.387	1.15	4.2	1.5	385.0
1+320	250	386.49	389.2	388.2	389.4	0.001	1.3	1.9	133.3	62.0	0.4	28.5	2.7	2.2	0.98	1.00	2.0	0.387	1.15	4.1	1.5	385.0
1+300	250	386.49	389.2	388.0	389.3	0.001	1.2	1.8	143.0	63.3	0.4	25.2	2.7	2.3	0.98	1.00	2.0	0.387	1.04	3.8	1.2	385.3
1+280	250	386.49	389.1	388.0	389.3	0.001	1.1	1.7	145.1	62.8	0.4	23.0	2.7	2.3	0.98	1.00	2.0	0.387	1.01	3.7	1.1	385.4
1+260	250	386.48	389.1	387.9	389.3	0.001	1.1	1.6	152.7	66.8	0.4	21.1	2.7	2.3	0.98	1.00	2.0	0.387	0.96	3.6	1.0	385.5
1+240	250	386.41	389.1	387.9	389.3	0.001	1.1	1.7	151.6	68.1	0.4	21.3	2.7	2.2	0.98	1.00	2.0	0.387	0.99	3.8	1.1	385.4
1+220	250	386.25	389.1	387.9	389.2	0.001	1.1	1.8	140.2	63.9	0.4	23.8	2.8	2.2	0.98	1.00	2.0	0.387	1.08	4.2	1.4	384.9
1+200	250	386.25	389.0	387.9	389.2	0.001	1.3	1.9	129.3	56.5	0.4	28.4	2.8	2.3	0.98	1.00	2.0	0.387	1.14	4.2	1.5	384.8
1+180	250	386.25	388.9	388.0	389.2	0.002	1.4	2.3	110.4	51.0	0.5	41.3	2.6	2.2	0.98	1.00	2.0	0.387	1.38	4.7	2.0	384.2
1+160	250	386.23	388.7	388.2	389.1	0.004	1.7	2.8	88.2	45.1	0.7	65.9	2.4	2.0	0.98	1.00	2.0	0.387	1.85	5.2	2.7	383.5
1+140	250	386	388.7	387.9	389.0	0.002	1.2	2.4	102.8	45.6	0.6	44.4	2.7	2.3	0.98	1.00	2.0	0.387	1.44	4.9	2.2	383.8
1+120	250	386	388.6	387.8	389.0	0.002	1.7	2.4	103.2	43.8	0.5	45.7	2.6	2.4	0.98	1.00	2.0	0.387	1.40	4.7	2.1	383.9
1+100	250	386	388.5	387.8	388.9	0.002	1.6	2.5	98.7	45.6	0.6	50.3	2.5	2.2	0.98	1.00	2.0	0.387	1.55	4.8	2.3	383.7

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
1+080	250	385.9	388.5	387.7	388.9	0.002	1.5	2.3	109.7	50.1	0.5	42.4	2.6	2.2	0.98	1.00	2.0	0.387	1.38	4.7	2.0	383.9
1+060	250	385.75	388.5	387.6	388.8	0.002	1.3	2.2	116.1	56.8	0.5	37.7	2.8	2.0	0.98	1.00	2.0	0.387	1.36	4.9	2.1	383.6
1+040	250	385.74	388.5	387.7	388.8	0.002	1.3	2.1	116.9	61.3	0.5	38.6	2.7	1.9	0.98	1.00	2.0	0.387	1.42	5.0	2.2	383.5
1+020	250	385.74	388.3	387.8	388.7	0.003	1.5	2.6	96.8	53.1	0.6	56.1	2.6	1.8	0.98	1.00	2.0	0.387	1.77	5.4	2.8	382.9
1+000	250	385.73	388.4	387.5	388.6	0.002	1.1	2.0	124.5	62.5	0.5	31.8	2.6	2.0	0.98	1.00	2.0	0.387	1.29	4.4	1.8	383.9
0+980	250	385.72	388.3	387.5	388.6	0.002	1.4	2.2	115.0	55.5	0.5	39.4	2.6	2.1	0.98	1.00	2.0	0.387	1.36	4.5	1.9	383.8
0+960	250	385.71	388.2	387.6	388.5	0.002	1.3	2.3	107.4	55.3	0.6	45.1	2.5	1.9	0.98	1.00	2.0	0.387	1.52	4.7	2.2	383.5
0+940	250	385.58	388.2	387.5	388.5	0.002	1.4	2.3	110.8	56.9	0.5	41.8	2.6	1.9	0.98	1.00	2.0	0.387	1.48	4.8	2.2	383.4
0+920	250	385.5	388.1	387.4	388.4	0.002	1.1	2.3	110.9	57.2	0.5	40.8	2.6	1.9	0.98	1.00	2.0	0.387	1.48	4.9	2.2	383.3
0+900	250	385.49	388.1	387.3	388.4	0.002	1.0	2.2	115.8	59.4	0.5	38.2	2.6	1.9	0.98	1.00	2.0	0.387	1.41	4.7	2.1	383.4
0+880	250	385.48	388.1	387.3	388.3	0.002	1.2	2.3	110.5	54.2	0.5	41.2	2.6	2.0	0.98	1.00	2.0	0.387	1.44	4.6	2.1	383.4
0+860	250	385.28	388.0	387.2	388.3	0.002	1.1	2.3	107.8	51.7	0.5	40.8	2.7	2.1	0.98	1.00	2.0	0.387	1.45	5.0	2.3	383.0
0+840	250	385.25	388.0	387.1	388.2	0.002	1.3	2.3	110.6	48.8	0.5	39.0	2.7	2.3	0.98	1.00	2.0	0.387	1.34	4.7	2.0	383.3
0+820	250	385.24	387.9	387.0	388.2	0.002	1.6	2.4	104.1	44.1	0.5	45.8	2.6	2.4	0.98	1.00	2.0	0.387	1.38	4.6	2.0	383.2
0+800	250	385.24	387.9	386.9	388.2	0.002	1.6	2.3	107.0	44.3	0.5	42.5	2.6	2.4	0.98	1.00	2.0	0.387	1.32	4.5	1.8	383.4
0+780	250	385.22	387.8	387.0	388.1	0.002	1.5	2.4	105.2	46.3	0.5	43.3	2.6	2.3	0.98	1.00	2.0	0.387	1.40	4.6	2.0	383.2
0+760	250	385.03	387.7	387.0	388.1	0.003	1.6	2.6	96.0	45.4	0.6	52.7	2.7	2.1	0.98	1.00	2.0	0.387	1.61	5.2	2.6	382.4
0+740	250	385	387.7	386.9	388.0	0.002	1.7	2.4	106.0	48.7	0.5	44.4	2.7	2.2	0.98	1.00	2.0	0.387	1.43	4.9	2.2	382.8
0+720	250	385	387.7	386.7	387.9	0.002	1.5	2.1	117.7	51.0	0.5	35.8	2.7	2.3	0.98	1.00	2.0	0.387	1.24	4.4	1.7	383.3
0+700	250	385	387.6	386.7	387.9	0.002	1.6	2.3	108.9	47.4	0.5	41.8	2.6	2.3	0.98	1.00	2.0	0.387	1.34	4.5	1.9	383.1
0+680	250	384.88	387.5	386.7	387.9	0.002	1.6	2.5	98.6	43.3	0.6	50.2	2.6	2.3	0.98	1.00	2.0	0.387	1.49	4.9	2.2	382.6

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav.
0+660	250	384.75	387.4	386.7	387.8	0.003	1.4	2.7	93.7	45.2	0.6	53.2	2.6	2.1	0.98	1.00	2.0	0.387	1.67	5.3	2.7	382.1
0+640	250	384.75	387.2	386.6	387.7	0.004	1.5	2.9	86.0	43.8	0.7	64.7	2.5	2.0	0.98	1.00	2.0	0.387	1.89	5.4	2.9	381.8
0+620	250	384.74	387.2	386.6	387.6	0.003	1.5	2.6	96.5	48.4	0.6	53.5	2.5	2.0	0.98	1.00	2.0	0.387	1.67	5.0	2.5	382.3
0+600	250	384.73	387.2	386.5	387.6	0.002	1.6	2.5	101.6	48.6	0.6	49.1	2.5	2.1	0.98	1.00	2.0	0.387	1.53	4.7	2.2	382.6
0+580	250	384.5	387.3	386.2	387.5	0.001	1.2	1.9	128.7	54.4	0.4	29.1	2.8	2.4	0.98	1.00	2.0	0.387	1.12	4.2	1.5	383.0
0+560	250	384.5	387.2	386.4	387.5	0.002	1.3	2.1	120.1	59.2	0.5	35.7	2.7	2.0	0.98	1.00	2.0	0.387	1.33	4.6	1.9	382.6
0+540	250	384.53	387.2	386.2	387.4	0.001	1.0	1.8	140.6	69.6	0.4	26.0	2.7	2.0	0.98	1.00	2.0	0.387	1.14	4.2	1.5	383.1
0+520	250	384.36	387.2	386.0	387.4	0.001	0.9	1.5	171.3	81.0	0.3	17.2	2.9	2.1	0.98	1.00	2.0	0.387	0.90	3.8	0.9	383.4
0+500	250	384.25	387.2	386.0	387.3	0.001	0.8	1.5	171.6	79.7	0.3	16.6	3.0	2.2	0.98	1.00	2.0	0.387	0.89	3.9	0.9	383.3
0+480	250	384.4	387.2	386.0	387.3	0.001	0.9	1.5	166.5	77.8	0.3	17.7	2.8	2.1	0.98	1.00	2.0	0.387	0.92	3.7	0.9	383.5
0+460	250	384.25	387.2	385.9	387.3	0.001	1.0	1.6	159.0	68.5	0.4	19.8	2.9	2.3	0.98	1.00	2.0	0.387	0.92	3.9	1.0	383.3
0+440	250	384.43	387.1	386.1	387.3	0.002	1.2	2.0	127.7	59.8	0.5	32.6	2.6	2.1	0.98	1.00	2.0	0.387	1.20	4.2	1.6	382.9
0+420	250	384	387.1	385.8	387.2	0.001	1.0	1.7	151.5	65.2	0.4	21.9	3.1	2.3	0.98	1.00	2.0	0.387	0.96	4.3	1.2	382.8
0+410	250	384	387.1	385.8	387.2	0.001	1.1	1.6	155.8	70.3	0.4	20.7	3.1	2.2	0.98	1.00	2.0	0.387	0.96	4.3	1.2	382.8
0+400	250	384	387.1	385.9	387.2	0.001	1.2	1.6	153.4	69.6	0.4	21.9	3.1	2.2	0.98	1.00	2.0	0.387	0.98	4.3	1.3	382.7
0+380	250	383.99	387.0	386.1	387.2	0.001	1.3	1.7	145.3	67.2	0.4	27.2	3.0	2.2	0.98	1.00	2.0	0.387	1.05	4.5	1.5	382.5
0+360	250	383.98	387.0	386.1	387.2	0.001	0.8	1.8	141.8	65.4	0.4	27.9	3.0	2.2	0.98	1.00	2.0	0.387	1.07	4.5	1.5	382.5
0+340	250	383.98	387.0	386.0	387.1	0.001	1.0	1.8	142.4	66.2	0.4	27.8	3.0	2.2	0.98	1.00	2.0	0.387	1.08	4.5	1.5	382.5
0+320	250	383.97	386.9	385.9	387.1	0.002	1.2	1.9	134.4	65.6	0.5	30.9	2.9	2.0	0.98	1.00	2.0	0.387	1.18	4.7	1.8	382.2
0+300	250	383.75	386.7	386.0	387.1	0.002	1.4	2.3	110.7	51.8	0.5	42.9	3.0	2.1	0.98	1.00	2.0	0.387	1.39	5.4	2.4	381.3
0+280	250	383.75	386.3	386.0	387.0	0.005	2.2	3.2	78.5	40.1	0.8	85.2	2.6	2.0	0.98	1.00	2.0	0.387	2.08	6.1	3.5	380.3

River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel left (m/s)	Vel Total (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Shear Total (N/m2)	y (m)	Tirante Hidráulico (m)	Coef. Contracción μ	Coef. Periodo β	Dm m	Exponente x	Coef. α	Socavación (Levediev) (ts) (m)	Prof. Socavación ts-y	Nivel de Socav
0+260	250	383.75	386.2	385.9	386.9	0.005	1.6	3.4	73.9	35.1	0.8	90.8	2.5	2.1	0.98	1.00	2.0	0.387	2.10	5.8	3.3	380.4
0+240	250	383.75	386.3	385.7	386.7	0.003	1.6	2.9	87.7	40.2	0.7	65.5	2.5	2.2	0.98	1.00	2.0	0.387	1.73	5.2	2.7	381.1
0+220	250	383.75	386.2	385.6	386.7	0.003	1.5	2.9	87.6	40.7	0.7	65.0	2.5	2.2	0.98	1.00	2.0	0.387	1.75	5.1	2.6	381.1
0+200	250	383.75	386.2	385.6	386.6	0.003	1.5	2.9	87.5	40.9	0.7	64.6	2.4	2.1	0.98	1.00	2.0	0.387	1.76	4.9	2.5	381.2
0+180	250	383.5	386.2	385.4	386.5	0.003	1.2	2.6	95.9	44.3	0.6	52.9	2.7	2.2	0.98	1.00	2.0	0.387	1.59	5.2	2.5	381.0
0+160	250	383.5	386.1		386.5	0.003	1.3	2.7	91.8	45.0	0.6	59.0	2.6	2.0	0.98	1.00	2.0	0.387	1.73	5.3	2.7	380.8
0+140	250	383.5	386.0		386.4	0.003	1.4	2.7	94.1	48.4	0.6	56.9	2.5	1.9	0.98	1.00	2.0	0.387	1.74	5.2	2.7	380.8
0+120	250	383.49	386.0		386.3	0.002	1.2	2.4	106.5	51.8	0.5	44.1	2.5	2.1	0.98	1.00	2.0	0.387	1.48	4.6	2.1	381.4
0+100	250	383.48	386.0		386.3	0.002	1.3	2.3	110.5	53.3	0.5	40.5	2.5	2.1	0.98	1.00	2.0	0.387	1.42	4.5	2.0	381.5
0+080	250	383.46	385.9		386.2	0.002	1.4	2.3	108.1	77.8	0.5	30.4	2.5	1.4	0.98	1.00	2.0	0.387	1.89	5.4	2.9	380.5
0+060	250	383.45	385.9		386.2	0.002	1.2	2.3	108.0	53.8	0.5	42.5	2.5	2.0	0.98	1.00	2.0	0.387	1.48	4.5	2.0	381.4
0+040	250	383.43	385.9		386.1	0.002	1.3	2.2	113.3	56.7	0.5	39.0	2.4	2.0	0.98	1.00	2.0	0.387	1.42	4.3	1.9	381.6
0+020	250	383.25	385.8	385.0	386.1	0.002	0.6	2.1	118.2	83.5	0.5	27.2	2.6	1.4	0.98	1.00	2.0	0.387	1.71	5.3	2.7	380.6

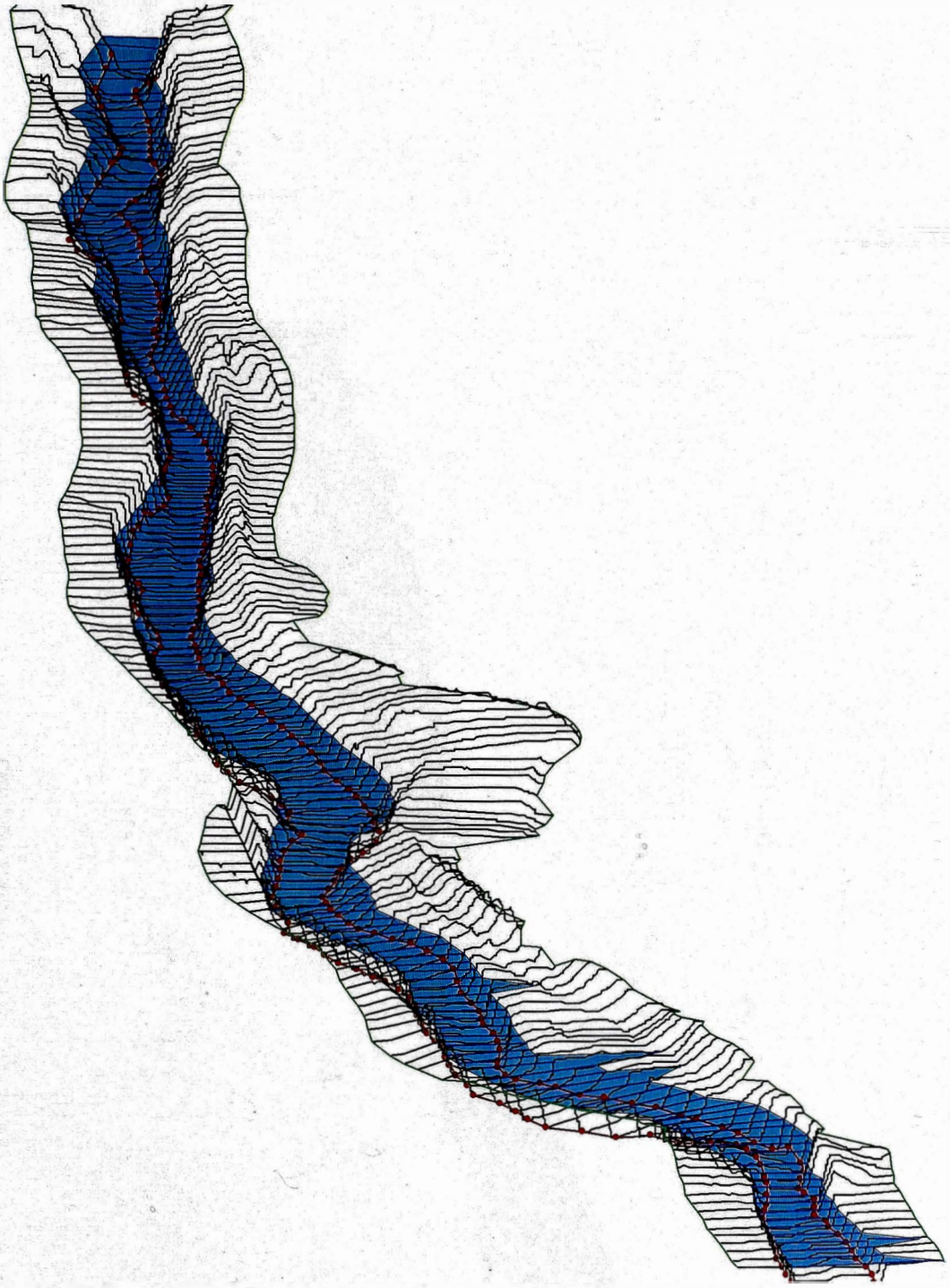


Figura N°F.1 Zona de inundación considerando un caudal igual a 250 m^3/s en el área de estudio.
Fuente, Elaboración propia.

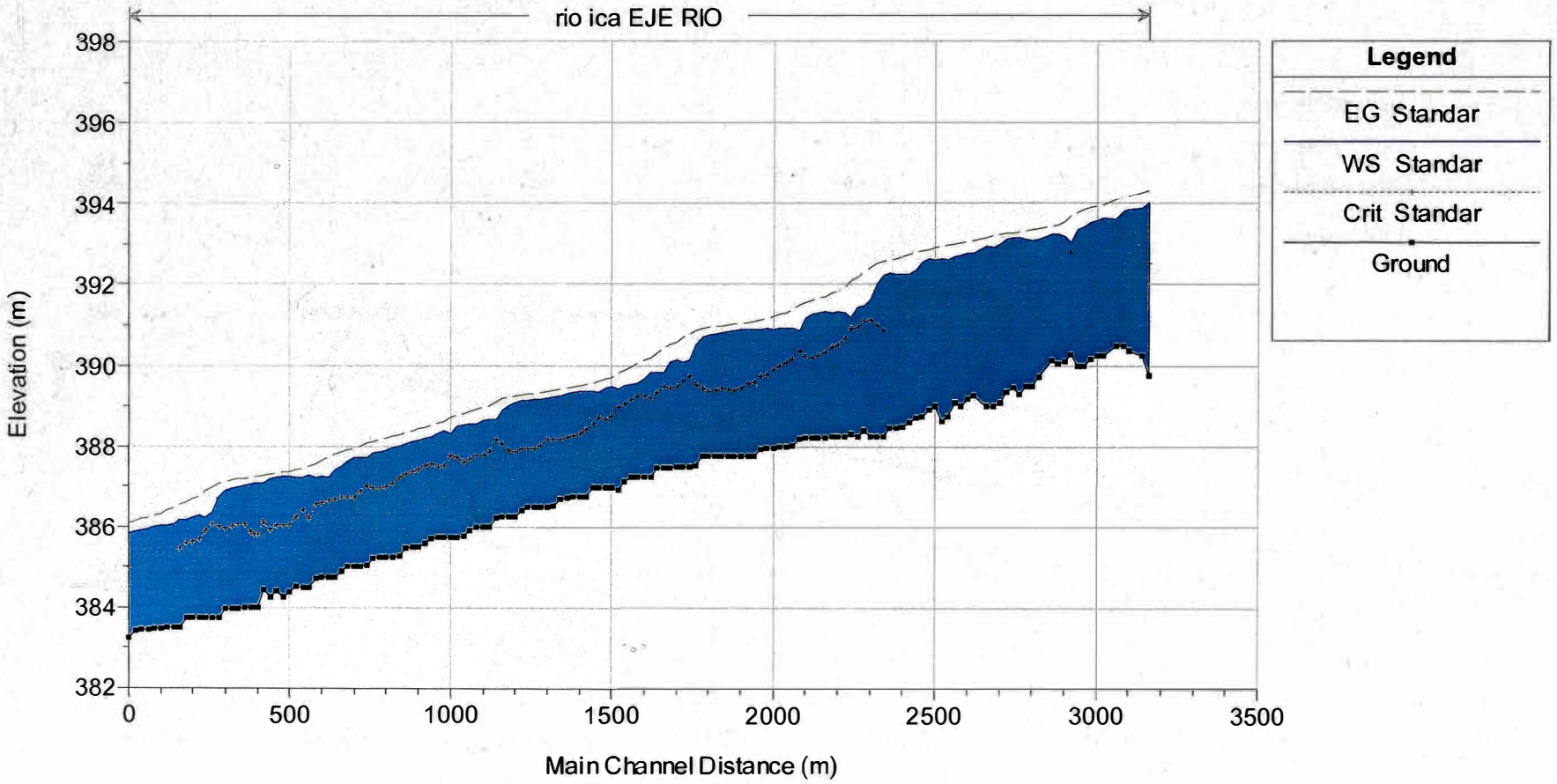


Figura N°F.2 Elevación del nivel de agua considerando un caudal igual a 250 m^3/s en el área de estudio. Fuente, Elaboración propia.

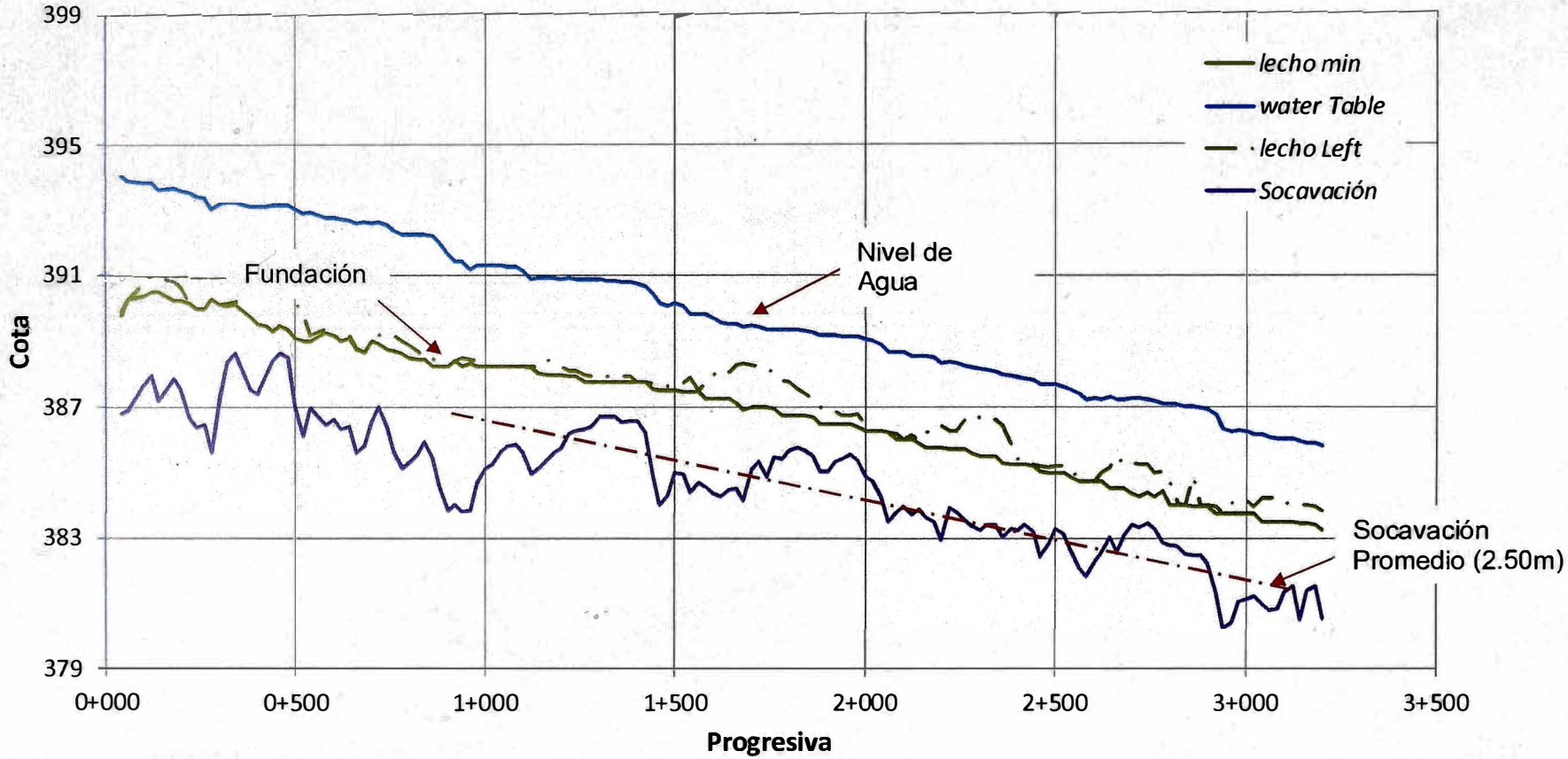


Figura N°F.3 Nivel de Socavación para la defensa ribereña. Fuente, Elaboración propia