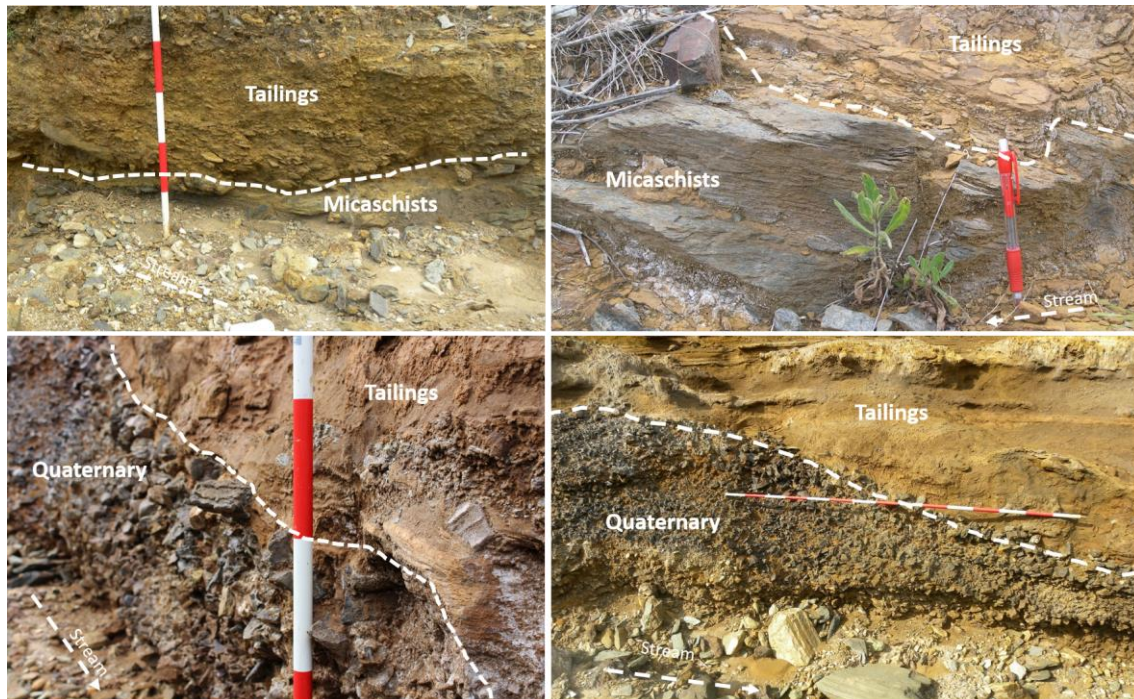**Figure S1.** The image shows the contact between the different geological materials and tailings. The discontinuous arrow indicates the direction of the runoff.

Figure S2. Factors of safety for the 13 boundary conditions analyzed, (a) in static conditions and (b) in pseudo-static conditions.

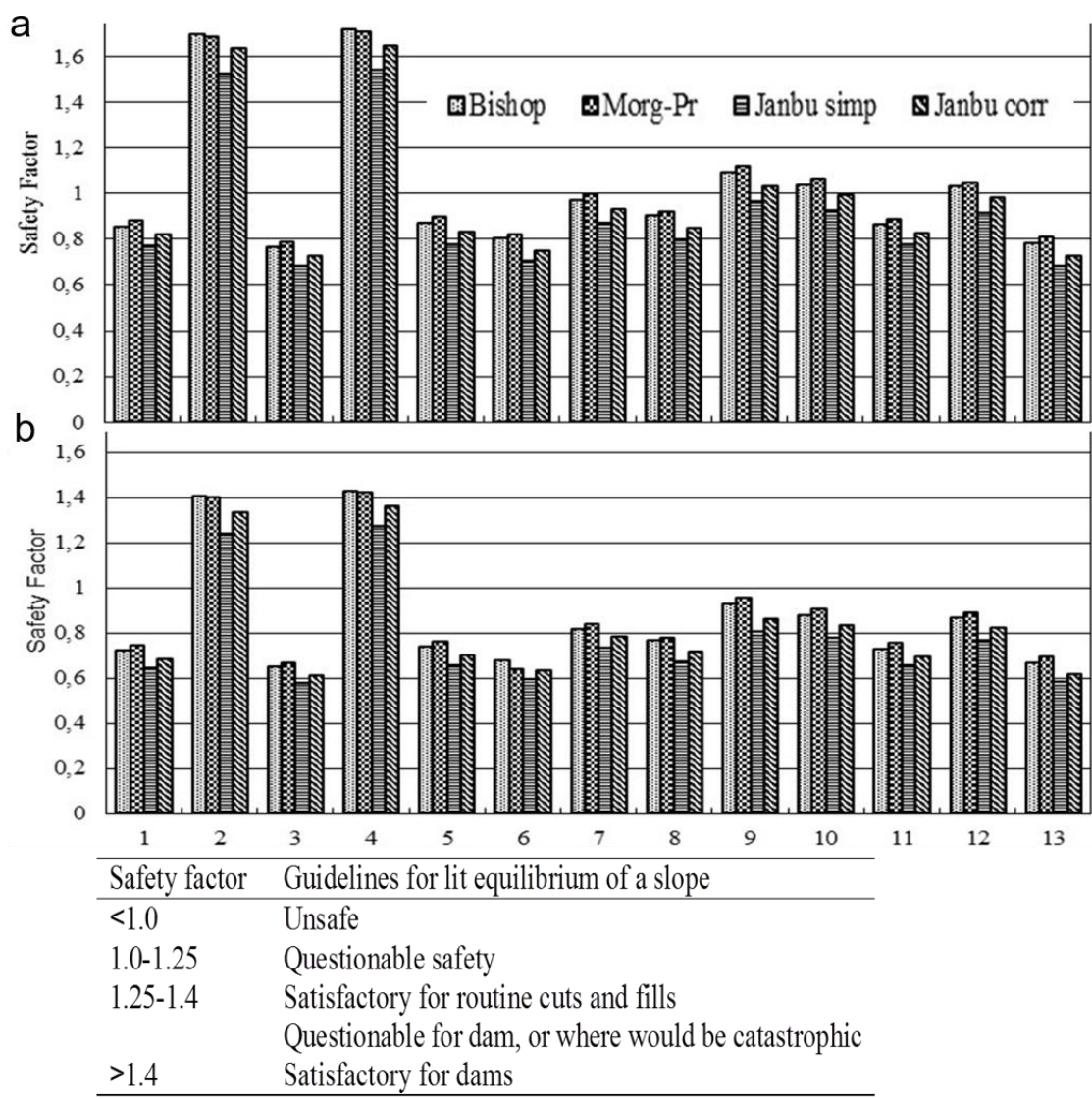| Safety factor	Guidelines for lit equilibrium of a slope
<1.0	Unsafe
1.0-1.25	Questionable safety
1.25-1.4	Satisfactory for routine cuts and fills
	Questionable for dam, or where would be catastrophic
>1.4	Satisfactory for dams

Table S1. Local magnitude (Richter scale) of the seismic events during 1967 over 500 km ratio from El Descargador tailings dam, source Spanish National Geographic Institute (IGN).

Event	Date	Depth Km	Magnitude	Latitude	Longitude	D_0 Km
1	25/01/67	5	3.2	38.0983	-1.1167	58
2	25/01/67	5	3.2	38.3567	-1.0617	84
3	30/01/67	5	2.9	35.2883	-3.5250	352
4	07/02/67	20	-	36.2450	-0.2783	161
5	04/03/67	-	2.8	41.9000	2.8400	572
6	05/03/67	-	3.2	37.7500	-1.0000	19
7	09/03/67	-	-	41.9500	2.6333	567
8	17/03/67	5	4.1	34.9367	-5.4317	507
9	27/03/67	-	-	38.3500	-0.5000	87
10	07/04/67	-	2.9	38.3667	-0.8000	83
11	10/04/67	-	3.0	37.0500	-1.5000	85
12	23/04/67	5	4.8	36.2567	2.3983	327
13	27/04/67	-	4.7	35.7000	-0.2000	221
14	27/04/67	-	-	34.5000	-6.0000	578
15	05/05/67	-	-	40.8167	0.5167	375
16	12/05/67	5	2.6	39.9700	-3.9183	280
17	14/05/67	5	3.0	36.8533	-1.7633	117
18	17/05/67	5	2.9	36.3033	-3.1367	250
19	17/05/67	19	4.1	37.7933	-4.3100	305
20	27/05/67	5	4.7	35.8583	-0.1933	204
21	27/05/67	-	3.1	37.5500	-4.0000	277
22	30/05/67	-	2.7	36.2500	-4.2000	334
23	06/06/67	-	3.5	40.4000	4.1800	535
24	18/06/67	-	3.1	36.8250	-3.5533	254
25	01/07/67	5	3.2	36.3817	-3.4883	271
26	02/07/67	5	3.4	36.7283	-3.6556	267
27	11/07/67	-	3.1	38.2000	-0.6000	69
28	13/07/67	5	5.0	35.5300	-0.1267	241
29	21/07/67	5	3.6	36.7283	-3.4450	250
30	23/07/67	-	3.0	36.0000	-3.6500	272
31	24/07/67	5	3.2	35.6350	-0.2883	226
32	25/07/67	5	4.5	37.4583	-3.5583	239
33	26/07/67	5	2.5	37.1917	-3.3717	226
34	27/07/67	5	3.3	36.6333	-5.4967	426
35	29/07/67	5	4.2	38.3567	-1.3833	94
36	30/07/67	5	2.4	10.8217	-1.2350	357
37	01/08/67	-	2.9	38.3000	-1.3500	87
38	03/08/67	5	3.9	38.3567	-1.2883	90
39	03/08/67	5	3.5	38.3567	-1.2833	90
40	03/08/67	-	-	38.3567	-1.2833	90
41	15/08/67	5	2.8	37.3917	-2.4483	143

42	16/08/67	-	-	35.5000	-1.3000	239
43	08/09/67	-	3.7	40.9700	-2.0200	384
44	11/09/67	5	4.6	36.2500	2.8683	365
45	21/09/67	5	-	34.9383	-4.2567	427
46	21/09/67	-	3.1	36.8500	-4.2500	312
47	22/09/67	5	3.6	36.8667	-3.1317	218
48	27/09/67	-	-	33.5000	2.0000	526
49	01/10/67	-	2.9	36.7000	-4.7000	356
50	02/10/67	-	-	38.5667	-0.5500	107
51	02/10/67	-	-	38.5667	-0.5500	107
52	02/10/67	5	3.7	38.5750	-0.5450	110
53	06/10/67	5	3.6	35.1350	-4.1133	401
54	28/10/67	9	-	36.8067	-5.1383	390
55	01/11/67	12	3.3	35.6933	-3.7300	334
56	07/11/67	23	3.0	34.7133	-3.0983	381
57	08/11/67	-	2.6	37.1000	-4.0500	288
58	14/11/67	5	3.1	35.4117	-3.5600	344
59	14/11/67	20	4.0	35.4250	-3.8017	358
60	16/11/67	13	3.8	35.3500	-3.5017	346
61	17/11/67	-	3.1	36.8000	-5.4500	417
62	17/11/67	18	3.2	36.7283	-4.4100	330
63	26/11/67	-	-	35.5000	-0.5000	237
64	26/11/67	5	3.8	39.0733	-3.4667	279
65	29/12/67	5	2.9	36.5350	-2.4267	184

Table S2. Particle size distribution (PSD) of the tailings samples collected in the trial pit (P1–P9) and the sand dykes (W1–W13). D10, D30, D50, D60, D90 are the particle size at the 10, 30, 50, 60, 90 % point of the cumulative undersize PSD in microns, Cu is the coefficient of uniformity, Ccis the coefficient of curvature, Sr is degree of saturation, e is void ratio, w is gravimetric water content, n is porosity, C is cohesion and φ is friction angle .

No.	D_{10}	D_{30}	D_{50}	D_{60}	D_{90}	C_u	C_c	Gs	Sr	e	w	n	C (MPa)	Φ (°C)	Dry density (g/cm³)	Gradation
P1	11.30	117.01	211.51	264.38	547.29	23.40	4.58	3.01	1.00	0.90	0.30	0.47	0	27	17.6	SM
P2	1.17	3.72	9.74	16.06	77.68	13.73	0.74	2.91	1.00	1.02	0.35	0.50	0	28	14.23	n.a.
P3	7.04	68.04	114.87	138.90	257.53	19.73	4.73	2.93	1.00	0.98	0.33	0.49	0	29	15.9	SM
P4	3.17	28.86	79.48	107.72	262.74	33.98	2.44	2.94	1.00	0.96	0.33	0.49	0	28	18.1	SM
P5	15.15	137.56	216.32	258.43	469.19	17.06	4.83	2.96	1.00	0.88	0.30	0.47	0	27	14.23	SM
P6	2.32	15.70	66.31	104.45	372.60	45.02	1.02	2.92	1.00	1.05	0.36	0.51	0	28	15.9	SM
P7	12.81	142.44	252.19	312.39	641.69	24.39	5.07	2.96	1.00	0.97	0.33	0.49	0	26	18.9	SM
P8	1.56	5.26	16.05	28.51	147.01	18.28	0.62	2.86	1.00	1.20	0.42	0.55	0	27	17.69	n.a.
P9	0.91	2.43	4.63	6.36	20.34	6.99	1.02	2.85	1.00	1.16	0.41	0.54	0	28	15.26	n.a.
W1	45.64	167.67	273.37	336.02	688.91	7.36	1.83	3.06	0.32	0.96	0.10	0.49	0	29	18.3	SW-SM
W2	27.47	155.39	245.86	292.37	514.53	10.64	3.01	3.04	0.30	1.02	0.10	0.50	0	30	18.2	SM
W3	27.10	179.24	310.12	381.96	746.85	14.09	3.10	2.97	0.40	1.05	0.14	0.51	0	31	19.7	SM
W4	29.12	190.90	324.02	396.82	756.39	13.63	3.15	3.09	0.50	1.08	0.17	0.52	0	37	19.1	SM
W5	17.79	154.99	305.17	378.53	737.95	21.28	3.57	3.14	0.20	1.09	0.07	0.52	0	26	18.4	SM
W6	53.61	339.33	568.55	689.89	1257.98	12.87	3.11	2.91	0.39	0.95	0.13	0.49	0	27	16.5	n.a.
W7	167.22	291.50	395.25	454.45	755.50	2.72	1.12	3.01	0.10	0.94	0.03	0.48	0	29	19.4	n.a.
W8	18.52	130.25	257.96	327.72	673.80	17.70	2.80	3.12	0.11	1.06	0.04	0.51	0	30	18.6	SM
W9	24.98	164.08	284.20	354.99	795.84	14.21	3.04	3.14	0.08	1.07	0.03	0.52	0	29	19.3	SM
W10	116.46	271.76	370.07	423.39	676.33	3.64	1.50	3.01	0.18	0.94	0.06	0.48	0	30	16.8	n.a.
W11	4.08	25.03	75.06	131.61	620.84	32.26	1.17	3.03	0.29	1.01	0.10	0.50	0	29	18.7	SM
W12	4.39	30.81	111.74	190.02	604.93	43.28	1.14	3.03	0.12	1.02	0.04	0.50	0	29	19.4	SM

Table S3. Safety factors for different calculation hypotheses. Fs is phreatic surface, BS is Bishop simplify Method, MP is Morgenstem-Price Methods, JS is Janbú simplify Method, JC is Janbú simplify Method. Sp is that the height of the water table is at the surface of the dam and Md is at the middle and D means that the dam of tailings dam is dry. *In scenario 13, the lagoons are considered full of water.

Hypothesis	Sandy (m)	Silty (m)	Dam (m)	FS	BS	MP	JS	JC	BS	MP	JS	JC
					Static				Pseudo-static (PGA=0.18)			
1	2	1	1	Sp	0.85	0.88	0.77	0.82	0.77	0.75	0.65	0.69
2	2	1	1	Md	1.69	1.69	1.52	1.63	1.40	1.4	1.24	1.33
3	1	2	1	Sp	0.76	0.86	0.68	0.72	0.65	0.67	0.58	0.61
4	1	2	1	Md	1.71	1.70	1.53	1.65	1.42	1.43	1.27	1.36
5	2	1	2	Sp	0.87	0.90	0.77	0.83	0.74	0.76	0.66	0.70
6	1	2	2	D	0.80	0.82	0.70	0.75	0.68	0.64	0.60	0.63
7	2	1	1	D	0.96	0.99	0.87	0.93	0.82	0.84	0.73	0.78
8	1	2	1	D	0.90	0.92	0.79	0.84	0.77	0.78	0.67	0.71
9	2	1	2	D	1.09	1.12	0.96	1.03	0.93	0.96	0.81	0.86
10	1	2	2	D	1.03	1.03	0.92	0.99	0.88	0.91	0.78	0.83
11	0.5	2	1	D	0.86	0.89	0.77	0.82	0.73	0.76	0.66	0.69
12	0.5	2	2	D	1.03	1.05	0.91	0.98	0.87	0.89	0.77	0.82
13*	1	2	1	D	0.71	0.81	0.68	0.73	0.67	0.70	0.58	0.62