

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**ANEXO VI
ANÁLISIS DE VULNERABILIDAD Y RIESGO**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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PROYECTO FOPAE 383/03

ID_LOTE	TIPOLOGÍA	ID ACTUAL	ZONA	AMENAZA	Pf	VULNERABILIDAD ACTUAL			
				FS		a	b	c	d
1-1	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-2	2	1	4	2,5	0,001	0	0	0,1	0,2
1-3	2	1	4	2,5	0,001	0	0	0,1	0,2
1-4	2	1	4	2,5	0,001	0	0	0,1	0,2
1-5	2	1	4	2,5	0,001	0	0	0,1	0,2
1-6	2	1	4	2,5	0,001	0	0	0,1	0,2
1-7	2	1	4	2,5	0,001	0	0	0,1	0,2
1-8	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-9	2	1	4	2,5	0,001	0	0	0,1	0,2
1-10	2	1	4	2,5	0,001	0	0	0,1	0,2
1-11	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-12	2	1	4	2,5	0,001	0	0	0,1	0,2
1-13	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-14	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-15	2	1	4	2,5	0,001	0	0	0,1	0,2
1-16	2	1	4	2,5	0,001	0	0	0,1	0,2
1-17	2	1	4	2,5	0,001	0	0	0,1	0,2
1-18	2	1	4	2,5	0,001	0	0	0,1	0,2
1-19	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-20	2	1	4	2,5	0,001	0	0	0,1	0,2
1-21	2	1	4	2,5	0,001	0	0	0,1	0,2
1-22	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-23	2	1	4	2,5	0,001	0	0	0,1	0,2
1-24	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-25	2	1	3	1,2	0,15	0	0	0,1	0,2
1-26	2	1	3	1,2	0,15	0	0	0,1	0,2
1-27	2	1	3	1,2	0,15	0	0	0,1	0,2
1-28	2	2	3	1,2	0,15	0,1	0,2	0,3	0,4
1-29	2	1	4	2,5	0,001	0	0	0,1	0,2
1-30	2	1	4	2,5	0,001	0	0	0,1	0,2
1-31	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-32	2	1	4	2,5	0,001	0	0	0,1	0,2
1-33	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-34	2	1	4	2,5	0,001	0	0	0,1	0,2
1-35	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-36	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
1-37	2	1	4	2,5	0,001	0	0	0,1	0,2
1-38	2	1	4	2,5	0,001	0	0	0,1	0,2
1-39	2	1	4	2,5	0,001	0	0	0,1	0,2
1-40	2	1	4	2,5	0,001	0	0	0,1	0,2
1-41	2	1	4	2,5	0,001	0	0	0,1	0,2
1-42	2	1	4	2,5	0,001	0	0	0,1	0,2
1-43	2	1	4	2,5	0,001	0	0	0,1	0,2

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ID_LOTE	TIPOLOGÍA	ID ACTUAL	ZONA	AMENAZA	Pf	VULNERABILIDAD ACTUAL			
				FS		a	b	c	d
1-44	2	1	4	2,5	0,001	0	0	0,1	0,2
1-45	2	1	4	2,5	0,001	0	0	0,1	0,2
1-46	2	1	4	2,5	0,001	0	0	0,1	0,2
2-1	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-2	2	1	4	2,5	0,001	0	0	0,1	0,2
2-3	2	1	4	2,5	0,001	0	0	0,1	0,2
2-4	2	1	4	2,5	0,001	0	0	0,1	0,2
2-5	2	1	4	2,5	0,001	0	0	0,1	0,2
2-6	2	1	4	2,5	0,001	0	0	0,1	0,2
2-7	2	1	4	2,5	0,001	0	0	0,1	0,2
2-8	2	1	4	2,5	0,001	0	0	0,1	0,2
2-9	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-10	2	1	4	2,5	0,001	0	0	0,1	0,2
2-11	2	1	4	2,5	0,001	0	0	0,1	0,2
2-12	2	1	4	2,5	0,001	0	0	0,1	0,2
2-13	2	3	4	2,5	0,001	0,3	0,4	0,6	0,7
2-14	2	3	4	2,5	0,001	0,3	0,4	0,6	0,7
2-15	2	1	4	2,5	0,001	0	0	0,1	0,2
2-16	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-17	2	1	4	2,5	0,001	0	0	0,1	0,2
2-18	2	1	3	1,2	0,15	0	0	0,1	0,2
2-19	2	1	3	1,2	0,15	0	0	0,1	0,2
2-20	2	2	3	1,2	0,15	0,1	0,2	0,3	0,4
2-21	2	1	3	1,2	0,15	0	0	0,1	0,2
2-22	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-23	2	1	4	2,5	0,001	0	0	0,1	0,2
2-24	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-25	2	1	4	2,5	0,001	0	0	0,1	0,2
2-26	2	1	4	2,5	0,001	0	0	0,1	0,2
2-27	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-28	2	3	4	2,5	0,001	0,3	0,4	0,6	0,7
2-29	2	1	4	2,5	0,001	0	0	0,1	0,2
2-30	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-31	2	1	4	2,5	0,001	0	0	0,1	0,2
2-32	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-33	2	1	4	2,5	0,001	0	0	0,1	0,2
2-34	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-35	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-36	2	1	4	2,5	0,001	0	0	0,1	0,2
2-37	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-38	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-39	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
2-40	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4

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ID_LOTE	TIPOLOGÍA	ID ACTUAL	ZONA	AMENAZA	Pf	VULNERABILIDAD ACTUAL			
				FS		a	b	c	d
2-41	2	1	4	2,5	0,001	0	0	0,1	0,2
2-42	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-1	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-2	2	1	4	2,5	0,001	0	0	0,1	0,2
3-3	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-4	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-5	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-6	2	1	4	2,5	0,001	0	0	0,1	0,2
3-7	2	1	4	2,5	0,001	0	0	0,1	0,2
3-8	2	1	4	2,5	0,001	0	0	0,1	0,2
3-9	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-10	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-11	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-12	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-13	2	1	4	2,5	0,001	0	0	0,1	0,2
3-14	2	2	3	1,2	0,15	0,1	0,2	0,3	0,4
3-15	2	3	3	1,2	0,15	0,3	0,4	0,6	0,7
3-16	2	3	3	1,2	0,15	0,3	0,4	0,6	0,7
3-17	2	3	3	1,2	0,15	0,3	0,4	0,6	0,7
3-18	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-19	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-20	2	1	4	2,5	0,001	0	0	0,1	0,2
3-21	2	1	4	2,5	0,001	0	0	0,1	0,2
3-22	2	1	4	2,5	0,001	0	0	0,1	0,2
3-23	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-24	2	1	4	2,5	0,001	0	0	0,1	0,2
3-25	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-26	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-27	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-28	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-29	2	2	4	2,5	0,001	0,1	0,2	0,3	0,4
3-30	2	1	4	2,5	0,001	0	0	0,1	0,2
3-31	2	1	4	2,5	0,001	0	0	0,1	0,2
3-32	2	1	4	2,5	0,001	0	0	0,1	0,2
4-1	2	3	2	1,2	0,24	0,3	0,4	0,6	0,7
4-2	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
4-3	2	3	2	1,2	0,24	0,3	0,4	0,6	0,7
4-4	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
4-5	2	1	1	0,890408	0,76642	0	0	0,1	0,2
4-6	2	3	1	0,890408	0,76642	0,3	0,4	0,6	0,7
4-7	2	3	1	0,890408	0,76642	0,3	0,4	0,6	0,7
4-8	2	1	2	1,2	0,24	0	0	0,1	0,2
4-9	2	1	2	1,2	0,24	0	0	0,1	0,2

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ID_LOTE	TIPOLOGÍA	ID ACTUAL	ZONA	AMENAZA	Pf	VULNERABILIDAD ACTUAL			
				FS		a	b	c	d
4-10	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
5-1	2	3	2	1,2	0,24	0,3	0,4	0,6	0,7
5-2	2	1	2	1,2	0,24	0	0	0,1	0,2
5-3	2	1	2	1,2	0,24	0	0	0,1	0,2
5-4	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
5-5	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
5-6	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
5-7	2	1	1	0,890408	0,76642	0	0	0,1	0,2
5-8	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
5-9	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
5-10	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
5-11	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
5-12	2	3	2	1,2	0,24	0,3	0,4	0,6	0,7
5-13	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
5-14	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-1	2	1	2	1,2	0,24	0	0	0,1	0,2
6-2	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-3	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-4	2	1	2	1,2	0,24	0	0	0,1	0,2
6-5	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
6-6	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
6-7	2	1	1	0,890408	0,76642	0	0	0,1	0,2
6-8	2	1	1	0,890408	0,76642	0	0	0,1	0,2
6-9	2	3	1	0,890408	0,76642	0,3	0,4	0,6	0,7
6-10	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
6-11	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
6-12	2	2	1	0,890408	0,76642	0,1	0,2	0,3	0,4
6-13	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-14	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-15	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-16	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-17	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4
6-18	2	2	2	1,2	0,24	0,1	0,2	0,3	0,4

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ID_LOTE	VULNERABILIDAD POTENCIAL									
	Solicitud	ID potencial	a	b	c	d	A1	A2	A3	A
1-1	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-2	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-3	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-4	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-5	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-6	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-7	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-8	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-9	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-10	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-11	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-12	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-13	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-14	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-15	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-16	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-17	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-18	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-19	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-20	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-21	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-22	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-23	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-24	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-25	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
1-26	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
1-27	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
1-28	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
1-29	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-30	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-31	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-32	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-33	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-34	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-35	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-36	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-37	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-38	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-39	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-40	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-41	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-42	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-43	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20

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ID_LOTE	VULNERABILIDAD POTENCIAL									
	Solicitud	ID potencial	a	b	c	d	A1	A2	A3	A
1-44	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-45	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
1-46	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-1	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-2	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-3	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-4	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-5	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-6	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-7	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-8	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-9	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-10	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-11	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-12	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-13	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-14	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-15	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-16	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-17	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-18	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
2-19	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
2-20	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
2-21	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
2-22	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-23	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-24	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-25	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-26	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-27	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-28	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-29	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-30	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-31	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-32	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-33	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-34	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-35	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-36	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-37	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-38	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-39	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-40	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20

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ID_LOTE	VULNERABILIDAD POTENCIAL									
	Solicitud	ID potencial	a	b	c	d	A1	A2	A3	A
2-41	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
2-42	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-1	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-2	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-3	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-4	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-5	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-6	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-7	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-8	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-9	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-10	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-11	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-12	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-13	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-14	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
3-15	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
3-16	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
3-17	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
3-18	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-19	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-20	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-21	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-22	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-23	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-24	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-25	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-26	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-27	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-28	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-29	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-30	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-31	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
3-32	VM5	2	0,1	0,2	0,3	0,4	0,05	0,10	0,05	0,20
4-1	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
4-2	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
4-3	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
4-4	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
4-5	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
4-6	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
4-7	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
4-8	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
4-9	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20

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ID_LOTE	VULNERABILIDAD POTENCIAL									
	Solicitud	ID potencial	a	b	c	d	A1	A2	A3	A
4-10	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-1	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-2	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-3	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-4	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-5	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-6	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-7	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-8	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-9	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-10	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
5-11	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-12	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-13	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
5-14	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-1	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-2	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-3	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-4	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-5	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-6	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-7	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-8	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-9	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-10	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-11	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-12	VM1	5	0,8	0,9	1	1	0,05	0,10	0,00	0,15
6-13	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-14	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-15	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-16	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-17	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20
6-18	VM2	4	0,6	0,7	0,8	0,9	0,05	0,10	0,05	0,20

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ID_LOTE	VULNERABILIDAD POTENCIAL						VULNERABILIDAD FISICA			
	Centroide	Prom máx.	Alto	Medio	Bajo	Categoría	a	b	c	d
1-1	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-2	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-3	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-4	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-5	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-6	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-7	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-8	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-9	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-10	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-11	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-12	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-13	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-14	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-15	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-16	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-17	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-18	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-19	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-20	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-21	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-22	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-23	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-24	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-25	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
1-26	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
1-27	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
1-28	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
1-29	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-30	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-31	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-32	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-33	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-34	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-35	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-36	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
1-37	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-38	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-39	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-40	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-41	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-42	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-43	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52

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ID_LOTE	VULNERABILIDAD POTENCIAL						VULNERABILIDAD FISICA			
	Centroide	Prom máx.	Alto	Medio	Bajo	Categoría	a	b	c	d
1-44	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-45	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
1-46	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-1	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-2	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-3	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-4	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-5	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-6	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-7	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-8	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-9	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-10	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-11	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-12	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-13	0,25	0,25	0,00	0,06	0,94	B	0,37	0,52	0,72	0,82
2-14	0,25	0,25	0,00	0,06	0,94	B	0,37	0,52	0,72	0,82
2-15	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-16	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-17	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-18	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
2-19	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
2-20	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
2-21	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
2-22	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-23	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-24	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-25	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-26	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-27	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-28	0,25	0,25	0,00	0,06	0,94	B	0,37	0,52	0,72	0,82
2-29	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-30	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-31	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-32	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-33	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-34	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-35	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-36	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-37	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-38	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-39	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
2-40	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64

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ID_LOTE	VULNERABILIDAD POTENCIAL						VULNERABILIDAD FISICA			
	Centroide	Prom máx.	Alto	Medio	Bajo	Categoría	a	b	c	d
2-41	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
2-42	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-1	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-2	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-3	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-4	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-5	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-6	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-7	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-8	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-9	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-10	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-11	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-12	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-13	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-14	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
3-15	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
3-16	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
3-17	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
3-18	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-19	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-20	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-21	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-22	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-23	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-24	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-25	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-26	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-27	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-28	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-29	0,25	0,25	0,00	0,06	0,94	B	0,19	0,36	0,51	0,64
3-30	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-31	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
3-32	0,25	0,25	0,00	0,06	0,94	B	0,1	0,2	0,37	0,52
4-1	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
4-2	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
4-3	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
4-4	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
4-5	0,92	0,95	1,00	0,00	0,00	A	0,8	0,9	1	1
4-6	0,92	0,95	1,00	0,00	0,00	A	0,86	0,94	1	1
4-7	0,92	0,95	1,00	0,00	0,00	A	0,86	0,94	1	1
4-8	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
4-9	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92

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ID_LOTE	VULNERABILIDAD POTENCIAL						VULNERABILIDAD FISICA			
	Centroide	Prom máx.	Alto	Medio	Bajo	Categoría	a	b	c	d
4-10	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
5-1	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
5-2	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
5-3	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
5-4	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
5-5	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
5-6	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
5-7	0,92	0,95	1,00	0,00	0,00	A	0,8	0,9	1	1
5-8	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
5-9	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
5-10	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
5-11	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
5-12	0,75	0,75	0,94	0,06	0,00	A	0,72	0,82	0,92	0,97
5-13	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
5-14	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-1	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
6-2	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-3	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-4	0,75	0,75	0,94	0,06	0,00	A	0,6	0,7	0,82	0,92
6-5	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
6-6	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
6-7	0,92	0,95	1,00	0,00	0,00	A	0,8	0,9	1	1
6-8	0,92	0,95	1,00	0,00	0,00	A	0,8	0,9	1	1
6-9	0,92	0,95	1,00	0,00	0,00	A	0,86	0,94	1	1
6-10	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
6-11	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
6-12	0,92	0,95	1,00	0,00	0,00	A	0,82	0,92	1	1
6-13	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-14	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-15	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-16	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-17	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94
6-18	0,75	0,75	0,94	0,06	0,00	A	0,64	0,76	0,86	0,94

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ID_LOTE	VULNERABILIDAD FISICA									
	A1	A2	A3	A	Centroide	Prom max	Alto	Medio	Bajo	Categoría
1-1	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-2	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-3	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-4	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-5	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-6	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-7	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-8	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-9	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-10	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-11	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-12	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-13	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-14	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-15	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-16	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-17	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-18	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-19	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-20	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-21	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-22	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-23	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-24	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-25	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
1-26	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
1-27	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
1-28	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
1-29	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-30	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-31	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-32	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-33	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-34	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-35	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-36	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
1-37	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-38	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-39	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-40	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-41	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-42	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-43	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B

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ID_LOTE	VULNERABILIDAD FISICA									
	A1	A2	A3	A	Centroide	Prom max	Alto	Medio	Bajo	Categoría
1-44	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-45	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
1-46	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-1	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-2	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-3	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-4	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-5	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-6	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-7	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-8	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-9	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-10	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-11	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-12	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-13	0,08	0,20	0,05	0,33	0,61	0,62	0,37	0,63	0,00	M
2-14	0,08	0,20	0,05	0,33	0,61	0,62	0,37	0,63	0,00	M
2-15	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-16	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-17	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-18	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
2-19	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
2-20	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
2-21	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
2-22	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-23	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-24	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-25	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-26	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-27	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-28	0,08	0,20	0,05	0,33	0,61	0,62	0,37	0,63	0,00	M
2-29	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-30	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-31	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-32	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-33	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-34	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-35	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-36	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-37	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-38	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-39	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
2-40	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M

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ID_LOTE	VULNERABILIDAD FISICA									
	A1	A2	A3	A	Centroide	Prom max	Alto	Medio	Bajo	Categoría
2-41	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
2-42	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-1	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-2	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-3	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-4	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-5	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-6	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-7	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-8	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-9	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-10	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-11	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-12	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-13	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-14	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
3-15	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
3-16	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
3-17	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
3-18	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-19	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-20	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-21	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-22	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-23	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-24	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-25	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-26	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-27	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-28	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-29	0,09	0,15	0,07	0,30	0,42	0,44	0,00	0,75	0,25	M
3-30	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-31	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
3-32	0,05	0,17	0,08	0,30	0,30	0,29	0,00	0,32	0,68	B
4-1	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
4-2	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
4-3	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
4-4	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
4-5	0,05	0,10	0,00	0,15	0,92	0,95	1,00	0,00	0,00	A
4-6	0,04	0,06	0,00	0,10	0,95	0,97	1,00	0,00	0,00	A
4-7	0,04	0,06	0,00	0,10	0,95	0,97	1,00	0,00	0,00	A
4-8	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
4-9	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A

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ID_LOTE	VULNERABILIDAD FISICA									
	A1	A2	A3	A	Centroide	Prom max	Alto	Medio	Bajo	Categoría
4-10	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
5-1	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
5-2	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
5-3	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
5-4	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
5-5	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
5-6	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
5-7	0,05	0,10	0,00	0,15	0,92	0,95	1,00	0,00	0,00	A
5-8	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
5-9	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
5-10	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
5-11	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
5-12	0,05	0,10	0,03	0,18	0,86	0,87	1,00	0,00	0,00	A
5-13	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
5-14	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-1	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
6-2	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-3	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-4	0,05	0,12	0,05	0,22	0,76	0,76	0,94	0,06	0,00	A
6-5	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
6-6	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
6-7	0,05	0,10	0,00	0,15	0,92	0,95	1,00	0,00	0,00	A
6-8	0,05	0,10	0,00	0,15	0,92	0,95	1,00	0,00	0,00	A
6-9	0,04	0,06	0,00	0,10	0,95	0,97	1,00	0,00	0,00	A
6-10	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
6-11	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
6-12	0,05	0,08	0,00	0,13	0,93	0,96	1,00	0,00	0,00	A
6-13	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-14	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-15	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-16	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-17	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A
6-18	0,06	0,10	0,04	0,20	0,80	0,81	1,00	0,00	0,00	A

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ID_LOTE	RIESGO FISICO											
	a	b	c	d	A1	A2	A3	A	Centroide	Prom max	Categoría	
1-1	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-2	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-3	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-4	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-5	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-6	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-7	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-8	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-9	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-10	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-11	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-12	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-13	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-14	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-15	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-16	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-17	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-18	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-19	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-20	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-21	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-22	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-23	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-24	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-25	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
1-26	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
1-27	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
1-28	0,096	0,114	0,129	0,141	0,01	0,02	0,01	0,03	0,12	0,12	0,12	M
1-29	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-30	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-31	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-32	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-33	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-34	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-35	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-36	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-37	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-38	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-39	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-40	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-41	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-42	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-43	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B

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ID_LOTE	RIESGO FISICO											
	a	b	c	d	A1	A2	A3	A	Centroide	Prom max	Categoría	
1-44	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-45	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
1-46	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-1	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-2	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-3	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-4	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-5	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-6	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-7	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-8	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-9	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-10	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-11	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-12	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-13	0,00037	0,00052	0,00072	0,00082	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-14	0,00037	0,00052	0,00072	0,00082	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-15	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-16	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-17	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-18	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
2-19	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
2-20	0,096	0,114	0,129	0,141	0,01	0,02	0,01	0,03	0,12	0,12	0,12	M
2-21	0,09	0,105	0,123	0,138	0,01	0,02	0,01	0,03	0,11	0,11	0,11	M
2-22	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-23	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-24	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-25	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-26	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-27	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-28	0,00037	0,00052	0,00072	0,00082	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-29	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-30	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-31	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-32	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-33	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-34	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-35	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-36	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-37	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-38	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-39	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-40	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B

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ID_LOTE	RIESGO FISICO											
	a	b	c	d	A1	A2	A3	A	Centroide	Prom max	Categoría	
2-41	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
2-42	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-1	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-2	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-3	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-4	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-5	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-6	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-7	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-8	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-9	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-10	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-11	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-12	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-13	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-14	0,096	0,114	0,129	0,141	0,01	0,02	0,01	0,03	0,12	0,12	0,12	M
3-15	0,108	0,123	0,138	0,1455	0,01	0,02	0,00	0,03	0,13	0,13	0,13	M
3-16	0,108	0,123	0,138	0,1455	0,01	0,02	0,00	0,03	0,13	0,13	0,13	M
3-17	0,108	0,123	0,138	0,1455	0,01	0,02	0,00	0,03	0,13	0,13	0,13	M
3-18	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-19	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-20	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-21	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-22	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-23	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-24	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-25	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-26	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-27	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-28	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-29	0,00019	0,00036	0,00051	0,00064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-30	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-31	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
3-32	0,0001	0,0002	0,00037	0,00052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	B
4-1	0,1728	0,1968	0,2208	0,2328	0,01	0,02	0,01	0,04	0,21	0,21	0,21	A
4-2	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	0,19	A
4-3	0,1728	0,1968	0,2208	0,2328	0,01	0,02	0,01	0,04	0,21	0,21	0,21	A
4-4	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	0,74	A
4-5	0,613136	0,689778	0,76642	0,76642	0,04	0,08	0,00	0,11	0,71	0,73	0,73	A
4-6	0,6591212	0,7204348	0,76642	0,76642	0,03	0,05	0,00	0,08	0,73	0,74	0,74	A
4-7	0,6591212	0,7204348	0,76642	0,76642	0,03	0,05	0,00	0,08	0,73	0,74	0,74	A
4-8	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	0,18	A
4-9	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	0,18	A

PROYECTO FOPAE 383/03

ID_LOTE	RIESGO FISICO										
	a	b	c	d	A1	A2	A3	A	Centroide	Prom max	Categoría
4-10	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
5-1	0,1728	0,1968	0,2208	0,2328	0,01	0,02	0,01	0,04	0,21	0,21	A
5-2	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	A
5-3	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	A
5-4	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
5-5	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
5-6	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
5-7	0,613136	0,689778	0,76642	0,76642	0,04	0,08	0,00	0,11	0,71	0,73	A
5-8	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
5-9	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
5-10	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
5-11	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
5-12	0,1728	0,1968	0,2208	0,2328	0,01	0,02	0,01	0,04	0,21	0,21	A
5-13	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
5-14	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-1	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	A
6-2	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-3	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-4	0,144	0,168	0,1968	0,2208	0,01	0,03	0,01	0,05	0,18	0,18	A
6-5	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
6-6	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
6-7	0,613136	0,689778	0,76642	0,76642	0,04	0,08	0,00	0,11	0,71	0,73	A
6-8	0,613136	0,689778	0,76642	0,76642	0,04	0,08	0,00	0,11	0,71	0,73	A
6-9	0,6591212	0,7204348	0,76642	0,76642	0,03	0,05	0,00	0,08	0,73	0,74	A
6-10	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
6-11	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
6-12	0,6284644	0,7051064	0,76642	0,76642	0,04	0,06	0,00	0,10	0,71	0,74	A
6-13	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-14	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-15	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-16	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-17	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A
6-18	0,1536	0,1824	0,2064	0,2256	0,01	0,02	0,01	0,05	0,19	0,19	A

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**ANEXO VII
PRESUPUESTO DE ALTERNATIVAS**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

PRESUPUESTO DE OBRA

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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PROYECTO FOPAE 383/03
GEOCING LTDA.
PRESUPUESTO DE OBRA - PARTE BAJA - ALTERNATIVA 1 - MURO EN TIERRA ARMADA

ÍTEM	GRUPO DE OBRA	DESCRIPCIÓN	UN	CANTIDAD	VALOR UNITARIO	VALOR TOTAL
1	PRELIMINARES					
1,1		LOCALIZACION Y REPLANTEO	GL	1,00	1.000.000,00	1.000.000,00
1,2		DEMOLICIÓN GAVIÓN EXISTENTE	M3	460,00	2.080,00	956.800,00
					<i>TOTAL</i>	<i>\$ 1.956.800,00</i>
2	EXCAVACIÓN					
2,1		EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD	M3	8.750,00	7.746,67	67.783.333,33
2,2		EXCAVACIÓN MANUAL	M3	310,00	7.300,00	2.263.000,00
					<i>TOTAL</i>	<i>\$ 70.046.333,33</i>
3	CANALIZACIÓN					
3,1		REVESTIMIENTO DE CANAL EN COLCHACRETO	M2	4.811,40	176.208,62	847.810.154,27
3,2		RELLENO EN ROCA	M3	605,00	40.450,00	24.472.250,00
					<i>TOTAL</i>	<i>\$ 872.282.404,27</i>
4	ESTRUCTURAS DE CONTENCIÓN					
4,1		MURO EN TIERRA ARMADA	M3	6.613,75	58.882,42	389.433.625,65
					<i>TOTAL</i>	<i>\$ 389.433.625,65</i>
5	OBRAS DE DRENAJE					
5,1		PANTALLA DRENANTE	ML	105,00	270.975,90	28.452.469,50
5,2		TRINCHERA DRENANTE	ML	200,00	105.832,28	21.166.455,80
5,3		SUBDRENES HORIZONTALES	ML	1.350,00	167.517,20	226.148.220,00
5,4		POZOS DE INSPECCIÓN	UN	4,00	3.500.000,00	14.000.000,00
5,5		TUBERÍA PVC GERFORD	ML	200,00	45.000,00	9.000.000,00
					<i>TOTAL</i>	<i>\$ 298.767.145,30</i>

GRAN TOTAL \$ 1.632.486.308,55

PROYECTO FOPAE 383/03
GEOCING LTDA.
PRESUPUESTO DE OBRA - PARTE BAJA - ALTERNATIVA 2 - MURO DE CONTENCIÓN

ÍTEM	GRUPO DE OBRA	DESCRIPCIÓN	UN	CANTIDAD	VALOR UNITARIO	VALOR TOTAL
1	PRELIMINARES					
1,1		LOCALIZACION Y REPLANTEO	GL	1,00	1.000.000,00	1.000.000,00
1,2		DEMOLICIÓN GAVIÓN EXISTENTE	M3	460,00	2.080,00	956.800,00
					<i>TOTAL</i>	<i>\$ 1.956.800,00</i>
2	EXCAVACIÓN					
2,1		EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD	M3	9.200,00	7.746,67	71.269.333,33
2,2		EXCAVACIÓN MANUAL	M3	310,00	7.300,00	2.263.000,00
					<i>TOTAL</i>	<i>\$ 73.532.333,33</i>
3	RELLENOS GRANULARES					
3,1		RELLENO EN MATERIAL SELECCIONADO	M3	4.600,00	19.151,90	88.098.740,00
					<i>TOTAL</i>	<i>88.098.740,00</i>
4	CANALIZACIÓN					
4,1		RELLENO EN ROCA	M3	1.010,00	40.450,00	40.854.500,00
4,2		REVESTIMIENTO DE CANAL EN COLCHACRETO	M2	4.811,40	176.208,62	847.810.154,27
					<i>TOTAL</i>	<i>\$ 888.664.654,27</i>
5	ESTRUCTURAS DE CONTENCIÓN					
5,1		MURO DE CONTENCIÓN EN CONCRETO REFORZADO	M3	655,00	815.000,00	533.825.000,00
					<i>TOTAL</i>	<i>\$ 533.825.000,00</i>
6	OBRAS DE DRENAJE					
6,1		PANTALLA DRENANTE	ML	105,00	270.975,90	28.452.469,50
6,2		TRINCHERA DRENANTE	ML	200,00	105.832,28	21.166.455,80
6,3		SUBDRENES HORIZONTALES	ML	1.350,00	167.517,20	226.148.220,00
6,4		POZOS DE INSPECCIÓN	UN	4,00	3.500.000,00	14.000.000,00
6,5		TUBERÍA PVC	ML	200,00	45.000,00	9.000.000,00
					<i>TOTAL</i>	<i>\$ 298.767.145,30</i>

GRAN TOTAL \$ 1.884.844.672,90

PROYECTO FOPAE 383/03
GEOCING LTDA.
PRESUPUESTO DE OBRA - PARTE BAJA - ALTERNATIVA 3 - BOX CULVERT

ÍTEM	GRUPO DE OBRA	DESCRIPCIÓN	UN	CANTIDAD	VALOR UNITARIO	VALOR TOTAL
1	PRELIMINARES					
1,1		LOCALIZACION Y REPLANTEO	GL	1,00	1.000.000,00	1.000.000,00
1,2		DEMOLICIÓN GAVIÓN EXISTENTE	M3	460,00	2.080,00	956.800,00
					<i>TOTAL</i>	<i>\$ 1.956.800,00</i>
2	EXCAVACIÓN					
2,1		EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD	M3	8.750,00	7.746,67	67.783.333,33
2,2		EXCAVACIÓN MANUAL	M3	310,00	7.300,00	2.263.000,00
					<i>TOTAL</i>	<i>\$ 70.046.333,33</i>
3	CANALIZACIÓN					
3,1		CANALIZACIÓN EN BOX CULVERT	GL	1,00	1.200.000.000,00	1.200.000.000,00
					<i>TOTAL</i>	<i>\$ 1.200.000.000,00</i>
4	ESTRUCTURAS DE CONTENCIÓN					
4,1		MURO EN TIERRA ARMADA	M3	4.625,00	58.882,42	272.331.206,75
					<i>TOTAL</i>	<i>\$ 272.331.206,75</i>
5	OBRAS DE DRENAJE					
5,1		PANTALLA DRENANTE	ML	105,00	270.975,90	28.452.469,50
5,2		TRINCHERA DRENANTE	ML	200,00	105.832,28	21.166.455,80
5,3		SUBDRENES HORIZONTALES	ML	1.350,00	167.517,20	226.148.220,00
5,4		POZOS DE INSPECCIÓN	UN	4,00	3.500.000,00	14.000.000,00
5,5		TUBERÍA PVC GERFORD	ML	200,00	45.000,00	9.000.000,00
					<i>TOTAL</i>	<i>\$ 298.767.145,30</i>

GRAN TOTAL \$ 1.843.101.485,38

PROYECTO FOPAE 383/03
GEOCING LTDA.
PRESUPUESTO DE OBRA - PARTE BAJA - ALTERNATIVA 4 - MURO Y PILOTES

ÍTEM	GRUPO DE OBRA	DESCRIPCIÓN	UN	CANTIDAD	VALOR UNITARIO	VALOR TOTAL
1	PRELIMINARES					
1,1		LOCALIZACIÓN Y REPLANTEO	GL	1,00	1.000.000,00	1.000.000,00
1,2		DEMOLICIÓN GAVIÓN EXISTENTE	M3	460,00	2.080,00	956.800,00
					<i>TOTAL</i>	<i>\$ 1.956.800,00</i>
2	EXCAVACIÓN					
2,1		EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD	M3	5.500,00	7.746,67	42.606.666,67
2,2		EXCAVACIÓN MANUAL	M3	310,00	7.300,00	2.263.000,00
					<i>TOTAL</i>	<i>\$ 44.869.666,67</i>
3	RELLENOS GRANULARES					
3,1		RELLENO EN MATERIAL SELECCIONADO	M3	2.150,00	19.151,90	41.176.585,00
					<i>TOTAL</i>	<i>\$ 41.176.585,00</i>
4	ESTRUCTURAS DE CONTENCIÓN					
4,1		MURO DE CONTENCIÓN EN CONCRETO REFORZADO	M3	270,00	815.000,00	220.050.000,00
4,2		PILOTE ϕ 0.25; L = 20.0 M	ML	13.392,00	85.000,00	1.138.320.000,00
					<i>TOTAL</i>	<i>\$ 1.358.370.000,00</i>
5	OBRAS DE DRENAJE					
5,1		PANTALLA DRENANTE	ML	105,00	270.975,90	28.452.469,50
5,2		TRINCHERA DRENANTE	ML	200,00	105.832,28	21.166.455,80
5,3		SUBDRENES HORIZONTALES	ML	1.350,00	167.517,20	226.148.220,00
5,4		POZOS DE INSPECCIÓN	UN	4,00	3.500.000,00	14.000.000,00
5,5		TUBERÍA PVC	ML	200,00	45.000,00	9.000.000,00
					<i>TOTAL</i>	<i>\$ 298.767.145,30</i>

GRAN TOTAL \$ 1.745.140.196,97

PROYECTO FOPAE 383/03
GEOCING LTDA.
PRESUPUESTO DE OBRA - PARTE ALTA - ALTERNATIVA 1 - GAVIÓN

ÍTEM	GRUPO DE OBRA	DESCRIPCIÓN	UN	CANTIDAD	VALOR UNITARIO	VALOR TOTAL
1	PRELIMINARES					
1,1		LOCALIZACION Y REPLANTEO	GL	1,00	1.000.000,00	1.000.000,00
					<i>TOTAL</i>	<i>\$ 1.000.000,00</i>
2	EXCAVACIÓN					
2,1		EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD	M3	3.350,00	7.746,67	25.951.333,33
2,2		EXCAVACIÓN MANUAL	M3	390,00	7.300,00	2.847.000,00
					<i>TOTAL</i>	<i>\$ 28.798.333,33</i>
4	ESTRUCTURAS DE CONTENCIÓN					
4,1		GAVIÓN	M3	1.250,00	87.650,00	109.562.500,00
					<i>TOTAL</i>	<i>\$ 109.562.500,00</i>
5	OBRAS DE DRENAJE					
5,2		TRINCHERA DRENANTE	ML	250,00	105.832,28	26.458.069,75
					<i>TOTAL</i>	<i>\$ 26.458.069,75</i>

GRAN TOTAL \$ 165.818.903,08

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

ANÁLISIS DE PRECIOS UNITARIOS

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM CONCRETO 3000 PSI

Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Concreto 3000 psi	m ³	1,05	320.000	336.000
	Acero de refuerzo, fy = 4200 Mpa	kg	130,00	3.500	455.000
SUBTOTAL MATERIALES					791.000
TOTAL MATERIALES					791.000

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.500
	Formaleta	GL			3.250
	Vibrador a gasolina	hr	1,05	2.610	2.750
TOTAL EQUIPO					7.500

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante clase A	Jornal	0,45	20.000	9.000
	Oficial clase A	Jornal	0,25	30.000	7.500
TOTAL MANO DE OBRA					16.500

TOTAL ITEM	815.000
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM EXCAVACIÓN PARA LA CONFORMACIÓN DEL TALUD Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
					-
					-
<i>SUBTOTAL MATERIALES</i>					-
<i>TOTAL MATERIALES</i>					-

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	Gl			1.000
	Retroexcavadora	hr	0,033	35.000	1.167
<i>TOTAL EQUIPO</i>					2.167

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,21	27.000	5.580
<i>TOTAL MANO DE OBRA</i>					5.580

TOTAL ITEM	7.747
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM EXCAVACIÓN CON EQUIPO Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
					-
					-
SUBTOTAL MATERIALES					-
TOTAL MATERIALES					-

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Cargador frontal 0.28 m3	H-h	0,02	45.000	900
	Bulldozer D-6	H-h	0,06	80.000	4.800
TOTAL EQUIPO					5.700

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,10	27.000	2.700
TOTAL MANO DE OBRA					2.700

TOTAL ITEM	8.400
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM EXCAVACIÓN MANUAL

Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
					-
					-
<i>SUBTOTAL MATERIALES</i>					
<i>TOTAL MATERIALES</i>					

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.000
<i>TOTAL EQUIPO</i>					1.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,10	27.000	2.700
	Oficial	Jornal	0,10	36.000	3.600
<i>TOTAL MANO DE OBRA</i>					6.300

TOTAL ITEM					7.300
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM RELLENO CON MATERIAL SELECCIONADO Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Material de relleno	m ³	1,20	14.252	17.102
SUBTOTAL MATERIALES					17.102
TOTAL MATERIALES					17.102

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			500
	Vibrocompactador tipo rana	hr	0,30	3.500	1.050
TOTAL EQUIPO					1.550

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,02	27.000	500
TOTAL MANO DE OBRA					500

TOTAL ITEM	19.152
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM REVESTIMIENTO EN COLCHACRETO

Unidad: M2

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Colchacreto BAG-300	m2	5,48	4.995	27.353
	Mortero 1:4	m3	0,51	288.000	147.456
SUBTOTAL MATERIALES					174.809
TOTAL MATERIALES					174.809

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			500
TOTAL EQUIPO					500

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,010	27.000	270
	Ayudante	Jornal	0,010	27.000	270
	Oficial	Jornal	0,010	36.000	360
TOTAL MANO DE OBRA					900

TOTAL ITEM					176.209
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM DEMOLICIÓN DE GAVIÓN

Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
					-
					-
<i>SUBTOTAL MATERIALES</i>					-
<i>TOTAL MATERIALES</i>					-

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	Gl			1.000
<i>TOTAL EQUIPO</i>					1.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,020	27.000	540
	Ayudante	Jornal	0,020	27.000	540
<i>TOTAL MANO DE OBRA</i>					1.080

TOTAL ITEM					2.080
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM TIERRA ARMADA

Unidad: M3

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Material de relleno	m ³	1,30	19.152	24.897
	Geomalla Tenax TT 701 SAMP, LTDS KN/m = 42.00	m ²	2,36	9.918	23.384
	Geotextil NT 2000	m ²	0,98	5.000	4.920
	Cespedones	m ²	0,28	6.700	1.876
SUBTOTAL MATERIALES					55.077
TOTAL MATERIALES					55.077

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.000
	Vibrocompactador	hr	0,03	3.500	105
TOTAL EQUIPO					1.105

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,030	36.000	1.080
	Ayudante	Jornal	0,030	27.000	810
	Ayudante	Jornal	0,030	27.000	810
TOTAL MANO DE OBRA					2.700

TOTAL ITEM					58.882
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM MURO DE CONTENCIÓN h=5.40

Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Concreto 3000 psi	m3	1,03	377.821	389.155
	Refuerzo (PDR-60)	Kg	130,00	1.200	156.000
SUBTOTAL MATERIALES					545.155
TOTAL MATERIALES					545.155

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			500
	Formaleta	GL			3.250
TOTAL EQUIPO					3.750

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,100	36.000	3.600
	Ayudante	Jornal	0,100	27.000	2.700
	Ayudante	Jornal	0,100	27.000	2.700
TOTAL MANO DE OBRA					9.000

TOTAL ITEM	557.905
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM PANTALLA DRENANTE

Unidad: ML

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Material granular	m3	7,40	25.000	185.000
	Geomembrana Geoflex 500	m2	10,00	5.000	50.000
	Material de relleno	m3	1,00	19.152	19.152
	Tubería perforada PVC f2 1/2"	ml	2,0	7.597	15.194
SUBTOTAL MATERIALES					269.346
TOTAL MATERIALES					269.346

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.000
TOTAL EQUIPO					1.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,010	36.000	360
	Ayudante	Jornal	0,010	27.000	270
TOTAL MANO DE OBRA					630

TOTAL ITEM	270.976
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM TRINCHERA DRENANTE

Unidad: ML

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Material granular	m3	3,03	25.000	75.850
	Geomembrana Geoflex 500	m2	4,10	5.000	20.500
	Material de relleno	m3	0,41	19.152	7.852
SUBTOTAL MATERIALES					104.202
TOTAL MATERIALES					104.202

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.000
TOTAL EQUIPO					1.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,010	36.000	360
	Ayudante	Jornal	0,010	27.000	270
TOTAL MANO DE OBRA					630

TOTAL ITEM	105.832
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD DE BOGOTÁ D.C.

Fecha: FEBRERO DE 2004

ITEM GAVIÓN Unidad: m³

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Gavión triple torsión calibre 13	m ²	6,00	10.000	60.000
	Piedra rajón	m ³	1,00	14.500	14.500
SUBTOTAL MATERIALES					74.500
TOTAL MATERIALES					74.500

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			1.000
TOTAL EQUIPO					1.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Ayudante	Jornal	0,25	27.000	6.750
	Oficial	Jornal	0,15	36.000	5.400
TOTAL MANO DE OBRA					12.150

TOTAL ITEM	87.650
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM SUBDREN 2"

Unidad: ML

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Tubo perforado 2"	ml	1,00	10.000	10.000
	Material filtrante	m3	0,09	25.000	2.250
	Geotextil no tejido 1600 PAVCO o similar	m2	1,20	2.306	2.767
SUBTOTAL MATERIALES					15.017
TOTAL MATERIALES					15.017

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Equipo de Perforación	Día	0,15	720.000	108.000
	Motobomba	Día	0,15	200.000	30.000
	Herramienta menor	GL			1.000
TOTAL EQUIPO					139.000

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,150	36.000	5.400
	Ayudante	Jornal	0,150	27.000	4.050
	Ayudante	Jornal	0,150	27.000	4.050
TOTAL MANO DE OBRA					13.500

TOTAL ITEM					167.517
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ESTUDIO DE RIESGO POR REMOCIÓN EN MASA, EVALUACIÓN DE ALTERNATIVAS DE MITIGACIÓN Y DISEÑO DETALLADO DE LAS OBRAS DE ESTABILIZACIÓN, PROTECCIÓN Y/O CONTROL RECOMENDADAS PARA LA URBANIZACIÓN NUEVA ROMA ORIENTAL DE LA LOCALIDAD DE CIUDAD BOLÍVAR EN LA CIUDAD

Fecha: FEBRERO DE 2004

ITEM RELLENO EN PIEDRA

Unidad: **M3**

1. MATERIALES

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Piedra Media Zonga	m3	1,06	35.000	37.100
SUBTOTAL MATERIALES					37.100
TOTAL MATERIALES					37.100

2. EQUIPO

Código	Descripción	Unidad	Rendimiento	Valor unitario	Valor total
	Herramientas menores	GL			500
	Vibrocompactador tipo rana	hr	0,30	3.500	1.050
TOTAL EQUIPO					1.550

3. MANO DE OBRA

Código	Descripción	Unidad	Cantidad	Valor unitario	Valor total
	Oficial	Jornal	0,020	36.000	720
	Ayudante	Jornal	0,020	27.000	540
	Ayudante	Jornal	0,020	27.000	540
TOTAL MANO DE OBRA					1.800

TOTAL ITEM	40.450
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FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**ANEXO V
ANÁLISIS DE ESTABILIDAD PROBABILÍSTICO**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**RESULTADOS SLIDE 5
SECCIONES EN ESTADO ACTUAL**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

Sección 2
Bloque – Saturado

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per2_1.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 110
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 20
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.04

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees

Water Surface: Water Table
Custom Hu value: 1

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qalt

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qcl

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: ordinary/fellenius

FS: 0.050278
Axis Location: 11.958, 2748.352
Left Slip Surface Endpoint: 11.789, 2741.378
Right Slip Surface Endpoint: 17.436, 2744.033
Resisting Moment=33.7749 kN-m
Driving Moment=671.766 kN-m

Method: bishop simplified

FS: 0.587979
Axis Location: 10.222, 2767.096

Left Slip Surface Endpoint: 7.815, 2739.586
Right Slip Surface Endpoint: 30.786, 2748.664
Left Slope Intercept: 7.815 2739.745
Right Slope Intercept: 30.786 2748.664
Resisting Moment=5948.91 kN-m
Driving Moment=10117.6 kN-m

Method: janbu simplified

FS: 0.555694
Axis Location: 8.708, 2758.719
Left Slip Surface Endpoint: 7.777, 2739.570
Right Slip Surface Endpoint: 23.469, 2746.485
Left Slope Intercept: 7.777 2739.731
Right Slope Intercept: 23.469 2746.485
Resisting Horizontal Force=143.083 kN
Driving Horizontal Force=257.485 kN

Method: janbu corrected

FS: 0.584714
Axis Location: 10.222, 2767.096
Left Slip Surface Endpoint: 7.815, 2739.586
Right Slip Surface Endpoint: 30.786, 2748.664
Left Slope Intercept: 7.815 2739.745
Right Slope Intercept: 30.786 2748.664
Resisting Horizontal Force=206.464 kN
Driving Horizontal Force=353.103 kN

Method: gle/morgenstern-price

FS: 0.615872
Axis Location: 18.766, 2796.299
Left Slip Surface Endpoint: 10.152, 2740.608
Right Slip Surface Endpoint: 58.150, 2755.993
Resisting Moment=25821.6 kN-m
Driving Moment=41926.9 kN-m
Resisting Horizontal Force=463.593 kN
Driving Horizontal Force=752.743 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 5000
Number of Invalid Surfaces: 0

Method: bishop simplified

Number of Valid Surfaces: 3477
Number of Invalid Surfaces: 1523
Error Codes:
Error Code -108 reported for 80 surfaces
Error Code -111 reported for 269 surfaces
Error Code -112 reported for 1174 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3145
Number of Invalid Surfaces: 1855
Error Codes:
Error Code -108 reported for 131 surfaces

Error Code -111 reported for 434 surfaces
Error Code -112 reported for 1290 surfaces

Method: janbu corrected

Number of Valid Surfaces: 3145

Number of Invalid Surfaces: 1855

Error Codes:

Error Code -108 reported for 131 surfaces

Error Code -111 reported for 434 surfaces

Error Code -112 reported for 1290 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2953

Number of Invalid Surfaces: 2047

Error Codes:

Error Code -108 reported for 289 surfaces

Error Code -111 reported for 498 surfaces

Error Code -112 reported for 1260 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.076898
Factor of Safety, standard deviation: 0.044198
Factor of Safety, minimum: 0.021326
Factor of Safety, maximum: 0.292689
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -20.88572 (assuming normal distribution)
Reliability index: -5.06862 (assuming lognormal distribution) * best fit = Lognormal

Method: bishop simplified

Factor of Safety, mean: 0.559926
Factor of Safety, standard deviation: 0.069540
Factor of Safety, minimum: 0.354448
Factor of Safety, maximum: 0.786179
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -6.32834 (assuming normal distribution) * best fit = Normal
Reliability index: -4.74945 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.532983
Factor of Safety, standard deviation: 0.065169
Factor of Safety, minimum: 0.336582
Factor of Safety, maximum: 0.741104
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -7.16621 (assuming normal distribution) * best fit = Normal
Reliability index: -5.22647 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.571595
Factor of Safety, standard deviation: 0.081392
Factor of Safety, minimum: 0.322696
Factor of Safety, maximum: 0.839763
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -5.26345 (assuming normal distribution) * best fit = Normal
Reliability index: -4.01861 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 0.557485

Factor of Safety, standard deviation: 0.069092

Factor of Safety, minimum: 0.353138

Factor of Safety, maximum: 0.779497

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -6.40474 (assuming normal distribution) * best fit = Normal

Reliability index: -4.79449 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**Sección 2
Bloque – Seco**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per2_2.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 110
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 20
Right Projection Angle (End Angle): 60

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³

Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TBSr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.627344
Axis Location: 11.958, 2748.352
Left Slip Surface Endpoint: 11.789, 2741.378
Right Slip Surface Endpoint: 17.436, 2744.033
Resisting Moment=409.399 kN-m
Driving Moment=652.592 kN-m

Method: bishop simplified

FS: 1.381530
Axis Location: 10.222, 2767.096
Left Slip Surface Endpoint: 7.815, 2739.586
Right Slip Surface Endpoint: 30.786, 2748.664
Resisting Moment=12886.4 kN-m
Driving Moment=9327.64 kN-m

Method: janbu simplified

FS: 1.321640
Axis Location: 10.222, 2767.096
Left Slip Surface Endpoint: 7.815, 2739.586
Right Slip Surface Endpoint: 30.786, 2748.664
Resisting Horizontal Force=424.587 kN

Driving Horizontal Force=321.257 kN

Method: janbu corrected

FS: 1.386690

Axis Location: 10.222, 2767.096

Left Slip Surface Endpoint: 7.815, 2739.586

Right Slip Surface Endpoint: 30.786, 2748.664

Resisting Horizontal Force=445.485 kN

Driving Horizontal Force=321.257 kN

Method: gle/morgenstern-price

FS: 1.439700

Axis Location: 10.222, 2767.096

Left Slip Surface Endpoint: 7.815, 2739.586

Right Slip Surface Endpoint: 30.786, 2748.664

Resisting Moment=12976.3 kN-m

Driving Moment=9013.24 kN-m

Resisting Horizontal Force=431.889 kN

Driving Horizontal Force=299.986 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 4997

Number of Invalid Surfaces: 3

Error Codes:

Error Code -108 reported for 3 surfaces

Method: bishop simplified

Number of Valid Surfaces: 4666

Number of Invalid Surfaces: 334

Error Codes:

Error Code -108 reported for 88 surfaces

Error Code -111 reported for 78 surfaces

Error Code -112 reported for 168 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4419

Number of Invalid Surfaces: 581

Error Codes:

Error Code -108 reported for 223 surfaces

Error Code -111 reported for 159 surfaces

Error Code -112 reported for 199 surfaces

Method: janbu corrected

Number of Valid Surfaces: 4419

Number of Invalid Surfaces: 581

Error Codes:

Error Code -108 reported for 223 surfaces

Error Code -111 reported for 159 surfaces

Error Code -112 reported for 199 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3666

Number of Invalid Surfaces: 1334

Error Codes:

Error Code -108 reported for 922 surfaces
Error Code -111 reported for 212 surfaces
Error Code -112 reported for 200 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1 . This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
 < 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 1.1 (relative minimum: 22.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.653571

Factor of Safety, standard deviation: 0.070539

Factor of Safety, minimum: 0.439437

Factor of Safety, maximum: 0.901837

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -4.91118 (assuming normal distribution)

Reliability index: -4.00586 (assuming lognormal distribution)

* best fit = Gamma

Method: bishop simplified

Factor of Safety, mean: 1.369127

Factor of Safety, standard deviation: 0.172203

Factor of Safety, minimum: 0.876376

Factor of Safety, maximum: 1.966300

Probability of Failure: 1.000% (= 10 failed surfaces / 1000 valid surfaces)

Reliability index: 2.14355 (assuming normal distribution)

Reliability index: 2.44507 (assuming lognormal distribution) * best fit = Lognormal

Method: janbu simplified

Factor of Safety, mean: 1.311631

Factor of Safety, standard deviation: 0.163344

Factor of Safety, minimum: 0.840384

Factor of Safety, maximum: 1.876620

Probability of Failure: 2.000% (= 20 failed surfaces / 1000 valid surfaces)

Reliability index: 1.90782 (assuming normal distribution)

Reliability index: 2.12465 (assuming lognormal distribution) * best fit = Lognormal

Method: janbu corrected

Factor of Safety, mean: 1.438883

Factor of Safety, standard deviation: 0.179780

Factor of Safety, minimum: 0.924002

Factor of Safety, maximum: 2.063560

Probability of Failure: 0.400% (= 4 failed surfaces / 1000 valid surfaces)

Reliability index: 2.44122 (assuming normal distribution)

Reliability index: 2.86133 (assuming lognormal distribution)

* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.376188

Factor of Safety, standard deviation: 0.171384

Factor of Safety, minimum: 0.881747

Factor of Safety, maximum: 1.968980

Probability of Failure: 1.000% (= 10 failed surfaces / 1000 valid surfaces)

Reliability index: 2.19500 (assuming normal distribution)

Reliability index: 2.51194 (assuming lognormal distribution) * best fit = Lognormal

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Sección 4
Mecanismo de falla rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per4_1.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Horizontal, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: Conceto

Strength Type: Undrained

Unit Weight: 20 kN/m³

Cohesion Type: Constant

Cohesion: 75 kPa

Water Surface: None

Material: Qrac

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 0.4 kPa

Friction Angle: 27 degrees

Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 1.028100

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=967.484 kN-m

Driving Moment=941.042 kN-m

Method: bishop simplified

FS: 1.039780

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=978.476 kN-m

Driving Moment=941.042 kN-m

Method: janbu simplified

FS: 1.023500

Center: 8.249, 2789.739

Radius: 11.306

Left Slip Surface Endpoint: 9.775, 2778.537

Right Slip Surface Endpoint: 16.748, 2782.284

Resisting Horizontal Force=29.8325 kN

Driving Horizontal Force=29.1475 kN

Method: janbu corrected

FS: 1.053810

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Horizontal Force=39.2001 kN

Driving Horizontal Force=37.1982 kN

Method: gle/morgenstern-price

FS: 1.036190

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=975.095 kN-m

Driving Moment=941.042 kN-m

Resisting Horizontal Force=38.2845 kN

Driving Horizontal Force=36.9475 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 3937

Number of Invalid Surfaces: 870

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces

Error Code -105 reported for 1 surface

Error Code -106 reported for 164 surfaces

Error Code -107 reported for 250 surfaces

Error Code -108 reported for 17 surfaces

Error Code -109 reported for 23 surfaces

Error Code -1000 reported for 165 surfaces

Method: bishop simplified

Number of Valid Surfaces: 3894

Number of Invalid Surfaces: 913

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces

Error Code -105 reported for 1 surface

Error Code -106 reported for 164 surfaces

Error Code -107 reported for 250 surfaces

Error Code -108 reported for 17 surfaces

Error Code -109 reported for 23 surfaces

Error Code -112 reported for 43 surfaces

Error Code -1000 reported for 165 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3655

Number of Invalid Surfaces: 1152

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 256 surfaces
Error Code -109 reported for 23 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Method: janbu corrected

Number of Valid Surfaces: 3655

Number of Invalid Surfaces: 1152

Error Codes:

Error Code -102 reported for 7 surfaces
Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 256 surfaces
Error Code -109 reported for 23 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3125

Number of Invalid Surfaces: 1682

Error Codes:

Error Code -102 reported for 7 surfaces
Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 260 surfaces
Error Code -109 reported for 23 surfaces
Error Code -111 reported for 526 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections,
but resulting arc is actually outside soil region.

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-105 = More than two surface / slope
intersections with no valid slip surface.

-106 = Average slice width is less than

0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-109 = Soiltype for slice base not
located. This error should occur very rarely,
if at all. It may occur if a very low number of
slices is combined with certain soil geometries,
such that the midpoint of a slice base is
actually outside the soil region, even though
the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi)/F)$
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 1.1 (relative minimum: 22.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft
Property: Cohesion
Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient
Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential
Normalized Mean: 0.36

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.957305
Factor of Safety, standard deviation: 0.132016
Factor of Safety, minimum: 0.457563
Factor of Safety, maximum: 1.360890
Probability of Failure: 62.600% (= 626 failed surfaces / 1000 valid surfaces)
Reliability index: -0.32341 (assuming normal distribution) * best fit = Normal
Reliability index: -0.38653 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 0.969013
Factor of Safety, standard deviation: 0.133190
Factor of Safety, minimum: 0.473799
Factor of Safety, maximum: 1.377520
Probability of Failure: 58.000% (= 580 failed surfaces / 1000 valid surfaces)
Reliability index: -0.23265 (assuming normal distribution) * best fit = Normal
Reliability index: -0.29849 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.953194
Factor of Safety, standard deviation: 0.132824
Factor of Safety, minimum: 0.455246
Factor of Safety, maximum: 1.359860
Probability of Failure: 63.600% (= 636 failed surfaces / 1000 valid surfaces)
Reliability index: -0.35239 (assuming normal distribution) * best fit = Normal
Reliability index: -0.41501 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.969267
Factor of Safety, standard deviation: 0.134020
Factor of Safety, minimum: 0.477277
Factor of Safety, maximum: 1.380060

Probability of Failure: 58.000% (= 580 failed surfaces / 1000 valid surfaces)
Reliability index: -0.22932 (assuming normal distribution) * best fit = Normal
Reliability index: -0.29564 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 0.981341

Factor of Safety, standard deviation: 0.135437

Factor of Safety, minimum: 0.475568

Factor of Safety, maximum: 1.395820

Probability of Failure: 54.700% (= 547 failed surfaces / 1000 valid surfaces)

Reliability index: -0.13777 (assuming normal distribution) * best fit = Normal

Reliability index: -0.20580 (assuming lognormal distribution)

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**Sección 4
Bloque**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per4_2.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 110
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Horizontal, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³

Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: Conceto

Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 75 kPa
Water Surface: None

Material: Qrac

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 0.4 kPa
Friction Angle: 27 degrees
Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.454769
Axis Location: 13.525, 2783.668
Left Slip Surface Endpoint: 13.673, 2780.597
Right Slip Surface Endpoint: 16.071, 2781.945
Resisting Moment=125.278 kN-m
Driving Moment=275.476 kN-m

Method: bishop simplified

FS: 1.015350
Axis Location: 8.499, 2789.550
Left Slip Surface Endpoint: 8.731, 2778.000
Right Slip Surface Endpoint: 17.877, 2782.805
Resisting Moment=604.456 kN-m
Driving Moment=595.32 kN-m

Method: janbu simplified

FS: 0.982071
Axis Location: 8.486, 2789.280
Left Slip Surface Endpoint: 8.730, 2778.000
Right Slip Surface Endpoint: 17.656, 2782.708
Resisting Horizontal Force=48.9843 kN

Driving Horizontal Force=49.8786 kN

Method: janbu corrected

FS: 1.015460

Axis Location: 8.499, 2789.550

Left Slip Surface Endpoint: 8.731, 2778.000

Right Slip Surface Endpoint: 17.877, 2782.805

Resisting Horizontal Force=48.7717 kN

Driving Horizontal Force=48.0293 kN

Method: gle/morgenstern-price

FS: 1.002270

Axis Location: 8.499, 2789.550

Left Slip Surface Endpoint: 8.731, 2778.000

Right Slip Surface Endpoint: 17.877, 2782.805

Resisting Moment=603.57 kN-m

Driving Moment=602.2 kN-m

Resisting Horizontal Force=47.5189 kN

Driving Horizontal Force=47.4111 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 1489

Number of Invalid Surfaces: 3516

Error Codes:

Error Code -107 reported for 3395 surfaces

Error Code -108 reported for 121 surfaces

Method: bishop simplified

Number of Valid Surfaces: 1484

Number of Invalid Surfaces: 3522

Error Codes:

Error Code -107 reported for 3395 surfaces

Error Code -108 reported for 63 surfaces

Error Code -111 reported for 10 surfaces

Error Code -112 reported for 54 surfaces

Method: janbu simplified

Number of Valid Surfaces: 1331

Number of Invalid Surfaces: 3674

Error Codes:

Error Code -107 reported for 3395 surfaces

Error Code -108 reported for 193 surfaces

Error Code -111 reported for 25 surfaces

Error Code -112 reported for 61 surfaces

Method: janbu corrected

Number of Valid Surfaces: 1332

Number of Invalid Surfaces: 3674

Error Codes:

Error Code -107 reported for 3395 surfaces

Error Code -108 reported for 193 surfaces

Error Code -111 reported for 25 surfaces

Error Code -112 reported for 61 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 840

Number of Invalid Surfaces: 4166

Error Codes:

Error Code -107 reported for 3395 surfaces

Error Code -108 reported for 556 surfaces

Error Code -111 reported for 155 surfaces

Error Code -112 reported for 60 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$ < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.36

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.547156

Factor of Safety, standard deviation: 0.157740

Factor of Safety, minimum: 0.014916

Factor of Safety, maximum: 0.937536

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -2.87083 (assuming normal distribution) * best fit = Normal

Reliability index: -2.27544 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 0.944278

Factor of Safety, standard deviation: 0.139209

Factor of Safety, minimum: 0.431267

Factor of Safety, maximum: 1.375870

Probability of Failure: 66.200% (= 662 failed surfaces / 1000 valid surfaces)

Reliability index: -0.40027 (assuming normal distribution) * best fit = Normal

Reliability index: -0.46432 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.911114

Factor of Safety, standard deviation: 0.137225

Factor of Safety, minimum: 0.401425

Factor of Safety, maximum: 1.337140

Probability of Failure: 74.700% (= 747 failed surfaces / 1000 valid surfaces)

Reliability index: -0.64774 (assuming normal distribution) * best fit = Normal

Reliability index: -0.69643 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.932019

Factor of Safety, standard deviation: 0.137534

Factor of Safety, minimum: 0.429514

Factor of Safety, maximum: 1.356990

Probability of Failure: 69.300% (= 693 failed surfaces / 1000 valid surfaces)

Reliability index: -0.49428 (assuming normal distribution) * best fit = Normal

Reliability index: -0.55305 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 0.943099

Factor of Safety, standard deviation: 0.139292

Factor of Safety, minimum: 0.422116

Factor of Safety, maximum: 1.372740

Probability of Failure: 66.500% (= 665 failed surfaces / 1000 valid surfaces)

Reliability index: -0.40850 (assuming normal distribution) * best fit = Normal

Reliability index: -0.47225 (assuming lognormal distribution)

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**Sección 8
Bloque – Total**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per8_1.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 150
Right Projection Angle (Start Angle): 20
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 10 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³

Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.202092
Axis Location: 25.691, 2766.355
Left Slip Surface Endpoint: 26.441, 2756.401
Right Slip Surface Endpoint: 34.103, 2760.982
Resisting Moment=484.264 kN-m
Driving Moment=2396.26 kN-m

Method: bishop simplified

FS: 1.089880
Axis Location: 26.269, 2775.824
Left Slip Surface Endpoint: 24.030, 2756.000
Right Slip Surface Endpoint: 40.785, 2762.139
Resisting Moment=8372.22 kN-m
Driving Moment=7681.78 kN-m

Method: janbu simplified

FS: 1.026240

Axis Location: 26.269, 2775.824

Left Slip Surface Endpoint: 24.030, 2756.000

Right Slip Surface Endpoint: 40.785, 2762.139

Resisting Horizontal Force=342.858 kN

Driving Horizontal Force=334.091 kN

Method: janbu corrected

FS: 1.113400

Axis Location: 26.269, 2775.824

Left Slip Surface Endpoint: 24.030, 2756.000

Right Slip Surface Endpoint: 40.785, 2762.139

Resisting Horizontal Force=371.976 kN

Driving Horizontal Force=334.091 kN

Method: gle/morgenstern-price

FS: 1.444550

Axis Location: 31.494, 2790.786

Left Slip Surface Endpoint: 23.476, 2756.000

Right Slip Surface Endpoint: 54.512, 2763.500

Resisting Moment=31275.7 kN-m

Driving Moment=21650.8 kN-m

Resisting Horizontal Force=830.743 kN

Driving Horizontal Force=575.088 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 4582

Number of Invalid Surfaces: 418

Error Codes:

Error Code -107 reported for 7 surfaces

Error Code -108 reported for 404 surfaces

Error Code -110 reported for 7 surfaces

Method: bishop simplified

Number of Valid Surfaces: 3338

Number of Invalid Surfaces: 1662

Error Codes:

Error Code -107 reported for 7 surfaces

Error Code -108 reported for 1184 surfaces

Error Code -110 reported for 7 surfaces

Error Code -111 reported for 464 surfaces

Method: janbu simplified

Number of Valid Surfaces: 2337

Number of Invalid Surfaces: 2663

Error Codes:

Error Code -107 reported for 7 surfaces

Error Code -108 reported for 2113 surfaces

Error Code -110 reported for 7 surfaces

Error Code -111 reported for 536 surfaces

Method: janbu corrected

Number of Valid Surfaces: 2337
Number of Invalid Surfaces: 2663
Error Codes:
Error Code -107 reported for 7 surfaces
Error Code -108 reported for 2113 surfaces
Error Code -110 reported for 7 surfaces
Error Code -111 reported for 536 surfaces

Method: gle/morgenstern-price
Number of Valid Surfaces: 247
Number of Invalid Surfaces: 4753
Error Codes:
Error Code -107 reported for 7 surfaces
Error Code -108 reported for 3693 surfaces
Error Code -110 reported for 7 surfaces
Error Code -111 reported for 1046 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc
Property: Cohesion
Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)

Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential
Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.208961
Factor of Safety, standard deviation: 0.051698
Factor of Safety, minimum: 0.018608
Factor of Safety, maximum: 0.322435
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -15.30107 (assuming normal distribution)
Reliability index: -6.54511 (assuming lognormal distribution)
* best fit = Beta

Method: bishop simplified

Factor of Safety, mean: 1.016481
Factor of Safety, standard deviation: 0.141722
Factor of Safety, minimum: 0.641492
Factor of Safety, maximum: 1.567130
Probability of Failure: 46.000% (= 460 failed surfaces / 1000 valid surfaces)
Reliability index: 0.11629 (assuming normal distribution)
Reliability index: 0.04843 (assuming lognormal distribution)
* best fit = Gamma

Method: janbu simplified

Factor of Safety, mean: 0.952339
Factor of Safety, standard deviation: 0.131747
Factor of Safety, minimum: 0.597266
Factor of Safety, maximum: 1.468280
Probability of Failure: 65.500% (= 655 failed surfaces / 1000 valid surfaces)

Reliability index: -0.36176 (assuming normal distribution)
Reliability index: -0.42352 (assuming lognormal distribution)
* best fit = Gamma

Method: janbu corrected

Factor of Safety, mean: 1.321361
Factor of Safety, standard deviation: 0.181213
Factor of Safety, minimum: 0.837576
Factor of Safety, maximum: 2.046120
Probability of Failure: 3.400% (= 34 failed surfaces / 1000 valid surfaces)
Reliability index: 1.77339 (assuming normal distribution)
Reliability index: 1.97319 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.033219
Factor of Safety, standard deviation: 0.142936
Factor of Safety, minimum: 0.647990
Factor of Safety, maximum: 1.592970
Probability of Failure: 40.900% (= 409 failed surfaces / 1000 valid surfaces)
Reliability index: 0.23241 (assuming normal distribution)
Reliability index: 0.16851 (assuming lognormal distribution)
* best fit = Gamma

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Sección 8
Mecanismo de falla Rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per8_2.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: Conceto

Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 1000 kPa
Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.399509
Center: 18.775, 2765.197
Radius: 11.932
Left Slip Surface Endpoint: 28.206, 2757.887
Right Slip Surface Endpoint: 29.763, 2760.545
Resisting Moment=98.3565 kN-m
Driving Moment=246.193 kN-m

Method: bishop simplified

FS: 0.406892
Center: 18.775, 2765.197
Radius: 11.932
Left Slip Surface Endpoint: 28.206, 2757.887
Right Slip Surface Endpoint: 29.763, 2760.545
Resisting Moment=100.174 kN-m
Driving Moment=246.193 kN-m

Method: janbu simplified

FS: 0.398434

Center: 18.775, 2765.197

Radius: 11.932

Left Slip Surface Endpoint: 28.206, 2757.887

Right Slip Surface Endpoint: 29.763, 2760.545

Resisting Horizontal Force=4.30107 kN

Driving Horizontal Force=10.7949 kN

Method: janbu corrected

FS: 0.404596

Center: 18.775, 2765.197

Radius: 11.932

Left Slip Surface Endpoint: 28.206, 2757.887

Right Slip Surface Endpoint: 29.763, 2760.545

Resisting Horizontal Force=4.36759 kN

Driving Horizontal Force=10.7949 kN

Method: gle/morgenstern-price

FS: 0.420201

Center: 13.283, 2769.747

Radius: 19.029

Left Slip Surface Endpoint: 28.229, 2757.971

Right Slip Surface Endpoint: 29.949, 2760.564

Resisting Moment=174.919 kN-m

Driving Moment=416.275 kN-m

Resisting Horizontal Force=5.16317 kN

Driving Horizontal Force=12.2874 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 19159

Number of Invalid Surfaces: 278

Error Codes:

Error Code -105 reported for 3 surfaces

Error Code -106 reported for 219 surfaces

Error Code -109 reported for 12 surfaces

Error Code -1000 reported for 44 surfaces

Method: bishop simplified

Number of Valid Surfaces: 19018

Number of Invalid Surfaces: 419

Error Codes:

Error Code -105 reported for 3 surfaces

Error Code -106 reported for 219 surfaces

Error Code -109 reported for 12 surfaces

Error Code -112 reported for 141 surfaces

Error Code -1000 reported for 44 surfaces

Method: janbu simplified

Number of Valid Surfaces: 17994

Number of Invalid Surfaces: 1443

Error Codes:

Error Code -105 reported for 3 surfaces

Error Code -106 reported for 219 surfaces

Error Code -108 reported for 973 surfaces
Error Code -109 reported for 12 surfaces
Error Code -111 reported for 178 surfaces
Error Code -112 reported for 14 surfaces
Error Code -1000 reported for 44 surfaces

Method: janbu corrected

Number of Valid Surfaces: 17994

Number of Invalid Surfaces: 1443

Error Codes:

Error Code -105 reported for 3 surfaces
Error Code -106 reported for 219 surfaces
Error Code -108 reported for 973 surfaces
Error Code -109 reported for 12 surfaces
Error Code -111 reported for 178 surfaces
Error Code -112 reported for 14 surfaces
Error Code -1000 reported for 44 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 15713

Number of Invalid Surfaces: 3724

Error Codes:

Error Code -105 reported for 3 surfaces
Error Code -106 reported for 219 surfaces
Error Code -108 reported for 874 surfaces
Error Code -109 reported for 12 surfaces
Error Code -111 reported for 2429 surfaces
Error Code -112 reported for 143 surfaces
Error Code -1000 reported for 44 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region, even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
< 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient
Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location
Distribution: Exponential
Normalized Mean: 0.14

Correlation Coefficients
Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.378073

Factor of Safety, standard deviation: 0.044458

Factor of Safety, minimum: 0.185965

Factor of Safety, maximum: 0.505886

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -13.98915 (assuming normal distribution) * best fit = Normal

Reliability index: -8.35873 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 0.386995

Factor of Safety, standard deviation: 0.043972

Factor of Safety, minimum: 0.199813

Factor of Safety, maximum: 0.516286

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -13.94092 (assuming normal distribution) * best fit = Normal

Reliability index: -8.43868 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.377077

Factor of Safety, standard deviation: 0.044670

Factor of Safety, minimum: 0.185453

Factor of Safety, maximum: 0.505035

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -13.94502 (assuming normal distribution) * best fit = Normal

Reliability index: -8.32074 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.401776

Factor of Safety, standard deviation: 0.045021

Factor of Safety, minimum: 0.282029

Factor of Safety, maximum: 0.502382

Probability of Failure: 100.000% (= 126 failed surfaces / 126 valid surfaces), 874 invalid surfaces

Reliability index: -13.28779 (assuming normal distribution)

Reliability index: -8.21900 (assuming lognormal distribution)

* best fit = Triangular

Method: gle/morgenstern-price

Factor of Safety, mean: 0.382909

Factor of Safety, standard deviation: 0.045361

Factor of Safety, minimum: 0.188321

Factor of Safety, maximum: 0.512846

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)

Reliability index: -13.60403 (assuming normal distribution) * best fit = Normal

Reliability index: -8.19072 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

Sección 8
Perfil socavado – Mecanismo de falla traslacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per8soc.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³

Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.231522
Axis Location: 20.353, 2768.487
Left Slip Surface Endpoint: 23.993, 2752.373
Right Slip Surface Endpoint: 35.428, 2761.730
Resisting Moment=936.825 kN-m
Driving Moment=4046.38 kN-m

Method: bishop simplified

FS: 0.156410
Axis Location: 20.316, 2768.969
Left Slip Surface Endpoint: 23.873, 2752.273
Right Slip Surface Endpoint: 35.807, 2761.797
Resisting Moment=766.604 kN-m
Driving Moment=4901.26 kN-m

Method: janbu simplified

FS: 0.177465
Axis Location: 20.316, 2768.969
Left Slip Surface Endpoint: 23.873, 2752.273
Right Slip Surface Endpoint: 35.807, 2761.797
Resisting Horizontal Force=36.8871 kN

Driving Horizontal Force=207.856 kN

Method: janbu corrected

FS: 0.184439

Axis Location: 20.316, 2768.969

Left Slip Surface Endpoint: 23.873, 2752.273

Right Slip Surface Endpoint: 35.807, 2761.797

Resisting Horizontal Force=38.3368 kN

Driving Horizontal Force=207.856 kN

Method: gle/morgenstern-price

FS: 0.181134

Axis Location: 20.316, 2768.969

Left Slip Surface Endpoint: 23.873, 2752.273

Right Slip Surface Endpoint: 35.807, 2761.797

Resisting Moment=880.329 kN-m

Driving Moment=4860.1 kN-m

Resisting Horizontal Force=37.8434 kN

Driving Horizontal Force=208.925 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 4999

Number of Invalid Surfaces: 1

Error Codes:

Error Code -1000 reported for 1 surface

Method: bishop simplified

Number of Valid Surfaces: 4808

Number of Invalid Surfaces: 192

Error Codes:

Error Code -112 reported for 191 surfaces

Error Code -1000 reported for 1 surface

Method: janbu simplified

Number of Valid Surfaces: 4592

Number of Invalid Surfaces: 408

Error Codes:

Error Code -108 reported for 1 surface

Error Code -111 reported for 201 surfaces

Error Code -112 reported for 205 surfaces

Error Code -1000 reported for 1 surface

Method: janbu corrected

Number of Valid Surfaces: 4592

Number of Invalid Surfaces: 408

Error Codes:

Error Code -108 reported for 1 surface

Error Code -111 reported for 201 surfaces

Error Code -112 reported for 205 surfaces

Error Code -1000 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2192

Number of Invalid Surfaces: 2808

Error Codes:

Error Code -108 reported for 1963 surfaces

Error Code -111 reported for 634 surfaces

Error Code -112 reported for 210 surfaces

Error Code -1000 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$ < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient
Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location
Distribution: Exponential
Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBSr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.403303
Factor of Safety, standard deviation: 0.060297
Factor of Safety, minimum: 0.138758
Factor of Safety, maximum: 0.634881
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -9.89602 (assuming normal distribution) * best fit = Normal
Reliability index: -6.18180 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 0.556668
Factor of Safety, standard deviation: 0.068096
Factor of Safety, minimum: 0.334001
Factor of Safety, maximum: 0.807622
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -6.51040 (assuming normal distribution) * best fit = Normal
Reliability index: -4.86743 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.517508
Factor of Safety, standard deviation: 0.065660
Factor of Safety, minimum: 0.293327
Factor of Safety, maximum: 0.758535
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -7.34839 (assuming normal distribution) * best fit = Normal
Reliability index: -5.27589 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.612093
Factor of Safety, standard deviation: 0.069817
Factor of Safety, minimum: 0.400098
Factor of Safety, maximum: 0.863243
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -5.55601 (assuming normal distribution) * best fit = Normal
Reliability index: -4.37428 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 0.537847
Factor of Safety, standard deviation: 0.068240
Factor of Safety, minimum: 0.304855
Factor of Safety, maximum: 0.788346

Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -6.77246 (assuming normal distribution) * best fit = Normal
Reliability index: -4.97084 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

**Sección 13
Bloque**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per13_2.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 150
Right Projection Angle (Start Angle): 35
Right Projection Angle (End Angle): 55

Loading

Seismic Load Coefficient (Horizontal): 0.04

Material Properties

Material: TBSr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: Tqt

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 3 kPa

Friction Angle: 26 degrees

Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 0.828561

Axis Location: 6.853, 2749.434

Left Slip Surface Endpoint: 5.871, 2737.689

Right Slip Surface Endpoint: 15.660, 2741.602

Resisting Moment=2333.49 kN-m

Driving Moment=2816.31 kN-m

Method: bishop simplified

FS: 1.340690

Axis Location: 1.885, 2755.707

Left Slip Surface Endpoint: 0.235, 2734.591

Right Slip Surface Endpoint: 17.787, 2741.717

Resisting Moment=12118.1 kN-m

Driving Moment=9038.72 kN-m

Method: janbu simplified

FS: 1.257410

Axis Location: 1.885, 2755.707

Left Slip Surface Endpoint: 0.235, 2734.591

Right Slip Surface Endpoint: 17.787, 2741.717

Resisting Horizontal Force=491.71 kN

Driving Horizontal Force=391.051 kN

Method: janbu corrected

FS: 1.337740

Axis Location: 1.885, 2755.707

Left Slip Surface Endpoint: 0.235, 2734.591

Right Slip Surface Endpoint: 17.787, 2741.717

Resisting Horizontal Force=523.125 kN

Driving Horizontal Force=391.051 kN

Method: gle/morgenstern-price

FS: 1.517330

Axis Location: 1.885, 2755.707

Left Slip Surface Endpoint: 0.235, 2734.591

Right Slip Surface Endpoint: 17.787, 2741.717

Resisting Moment=12433.8 kN-m

Driving Moment=8194.48 kN-m
Resisting Horizontal Force=513.038 kN
Driving Horizontal Force=338.118 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius
Number of Valid Surfaces: 5000
Number of Invalid Surfaces: 0

Method: bishop simplified
Number of Valid Surfaces: 4937
Number of Invalid Surfaces: 63
Error Codes:
Error Code -108 reported for 38 surfaces
Error Code -111 reported for 25 surfaces

Method: janbu simplified
Number of Valid Surfaces: 4825
Number of Invalid Surfaces: 175
Error Codes:
Error Code -108 reported for 106 surfaces
Error Code -111 reported for 69 surfaces

Method: janbu corrected
Number of Valid Surfaces: 4825
Number of Invalid Surfaces: 175
Error Codes:
Error Code -108 reported for 106 surfaces
Error Code -111 reported for 69 surfaces

Method: gle/morgenstern-price
Number of Valid Surfaces: 3897
Number of Invalid Surfaces: 1103
Error Codes:
Error Code -108 reported for 1004 surfaces
Error Code -111 reported for 99 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: Off

Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 1.1 (relative minimum: 22.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Material: Tqt
Property: Cohesion
Distribution: Normal
Minimum: 1.3 (relative minimum: 1.7)
Mean: 3
Maximum: 7.3 (relative maximum: 4.3)
Standard Deviation: 0.8

Material: Tqt
Property: Phi
Distribution: Normal
Minimum: 9.1 (relative minimum: 16.9)
Mean: 26
Maximum: 61.1 (relative maximum: 35.1)
Standard Deviation: 5.54

Horizontal Seismic Coefficient
Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location
Distribution: Exponential
Normalized Mean: 0.27

Correlation Coefficients
Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.756932
Factor of Safety, standard deviation: 0.186452
Factor of Safety, minimum: 0.153371
Factor of Safety, maximum: 1.381810
Probability of Failure: 90.700% (= 907 failed surfaces / 1000 valid surfaces)
Reliability index: -1.30365 (assuming normal distribution) * best fit = Normal
Reliability index: -1.26875 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 1.218233
Factor of Safety, standard deviation: 0.287085
Factor of Safety, minimum: 0.478627
Factor of Safety, maximum: 2.264480
Probability of Failure: 22.800% (= 228 failed surfaces / 1000 valid surfaces)
Reliability index: 0.76017 (assuming normal distribution) * best fit = Normal
Reliability index: 0.73287 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.141048
Factor of Safety, standard deviation: 0.268936
Factor of Safety, minimum: 0.484626
Factor of Safety, maximum: 2.115680
Probability of Failure: 29.930% (= 299 failed surfaces / 999 valid surfaces), 1 invalid surfaces
Reliability index: 0.52447 (assuming normal distribution) * best fit = Normal
Reliability index: 0.45122 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 1.406196
Factor of Safety, standard deviation: 0.315397
Factor of Safety, minimum: 0.643054
Factor of Safety, maximum: 2.596610
Probability of Failure: 11.311% (= 113 failed surfaces / 999 valid surfaces), 1 invalid surfaces
Reliability index: 1.28789 (assuming normal distribution) * best fit = Normal
Reliability index: 1.42792 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 1.213948
Factor of Safety, standard deviation: 0.286118
Factor of Safety, minimum: 0.515588
Factor of Safety, maximum: 2.250850
Probability of Failure: 23.323% (= 233 failed surfaces / 999 valid surfaces), 1 invalid surfaces
Reliability index: 0.74776 (assuming normal distribution) * best fit = Normal
Reliability index: 0.71758 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

Sección 13
Mecanismo de falla rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per13_1.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program

Failure Direction: Right to Left

Units of Measurement: SI Units

Pore Fluid Unit Weight: 9.81 kN/m³

Groundwater Method: Water Surfaces

Data Output: Standard

Random Numbers: Pseudo-random Seed

Random Number Seed: 10116

Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:

Bishop simplified

GLE/Morgenstern-Price with interslice force function: Half Sine

Janbu simplified

Janbu corrected

Ordinary/Fellenius

Number of slices: 25

Tolerance: 0.005

Maximum number of iterations: 50

Surface Options

Surface Type: Circular

Radius increment: 10

Minimum Elevation: Not Defined

Composite Surfaces: Disabled

Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04

Material Properties

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: Tqt
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 3 kPa
Friction Angle: 26 degrees
Water Surface: None

Global Minimums

Method: ordinary/fellenius
FS: 1.122780
Center: -0.745, 2753.994
Radius: 19.402
Left Slip Surface Endpoint: 0.312, 2734.621
Right Slip Surface Endpoint: 14.113, 2741.518
Resisting Moment=4207.83 kN-m
Driving Moment=3747.7 kN-m

Method: bishop simplified
FS: 1.158720
Center: -0.745, 2753.994
Radius: 19.402
Left Slip Surface Endpoint: 0.312, 2734.621
Right Slip Surface Endpoint: 14.113, 2741.518
Resisting Moment=4342.53 kN-m
Driving Moment=3747.7 kN-m

Method: janbu simplified
FS: 1.116850
Center: -0.745, 2753.994
Radius: 19.402
Left Slip Surface Endpoint: 0.312, 2734.621
Right Slip Surface Endpoint: 14.113, 2741.518
Resisting Horizontal Force=195.304 kN
Driving Horizontal Force=174.871 kN

Method: janbu corrected
FS: 1.166340
Center: -0.745, 2753.994
Radius: 19.402
Left Slip Surface Endpoint: 0.312, 2734.621
Right Slip Surface Endpoint: 14.113, 2741.518
Resisting Horizontal Force=203.959 kN
Driving Horizontal Force=174.871 kN

Method: gle/morgenstern-price
FS: 1.155460
Center: -0.745, 2753.994
Radius: 19.402
Left Slip Surface Endpoint: 0.312, 2734.621

Right Slip Surface Endpoint: 14.113, 2741.518
Resisting Moment=4330.33 kN-m
Driving Moment=3747.7 kN-m
Resisting Horizontal Force=197.568 kN
Driving Horizontal Force=170.986 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 4682
Number of Invalid Surfaces: 268
Error Codes:
Error Code -103 reported for 268 surfaces

Method: bishop simplified

Number of Valid Surfaces: 4656
Number of Invalid Surfaces: 294
Error Codes:
Error Code -103 reported for 268 surfaces
Error Code -112 reported for 26 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4667
Number of Invalid Surfaces: 283
Error Codes:
Error Code -103 reported for 268 surfaces
Error Code -108 reported for 10 surfaces
Error Code -112 reported for 5 surfaces

Method: janbu corrected

Number of Valid Surfaces: 4667
Number of Invalid Surfaces: 283
Error Codes:
Error Code -103 reported for 268 surfaces
Error Code -108 reported for 10 surfaces
Error Code -112 reported for 5 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 4646
Number of Invalid Surfaces: 304
Error Codes:
Error Code -103 reported for 268 surfaces
Error Code -108 reported for 10 surfaces
Error Code -112 reported for 26 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 1.1 (relative minimum: 22.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Material: Tqt
Property: Cohesion
Distribution: Normal
Minimum: 1.3 (relative minimum: 1.7)
Mean: 3
Maximum: 7.3 (relative maximum: 4.3)
Standard Deviation: 0.8

Material: Tqt
Property: Phi
Distribution: Normal
Minimum: 9.1 (relative minimum: 16.9)
Mean: 26
Maximum: 61.1 (relative maximum: 35.1)
Standard Deviation: 5.54

Horizontal Seismic Coefficient
Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location
Distribution: Exponential
Normalized Mean: 0.27

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBSr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 1.037777
Factor of Safety, standard deviation: 0.231173
Factor of Safety, minimum: 0.455760
Factor of Safety, maximum: 1.839250
Probability of Failure: 44.300% (= 443 failed surfaces / 1000 valid surfaces)
Reliability index: 0.16342 (assuming normal distribution) * best fit = Normal
Reliability index: 0.05847 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 1.073497
Factor of Safety, standard deviation: 0.238871
Factor of Safety, minimum: 0.476660
Factor of Safety, maximum: 1.904590
Probability of Failure: 37.900% (= 379 failed surfaces / 1000 valid surfaces)
Reliability index: 0.30769 (assuming normal distribution) * best fit = Normal
Reliability index: 0.21270 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.031786
Factor of Safety, standard deviation: 0.230244
Factor of Safety, minimum: 0.456852
Factor of Safety, maximum: 1.828860
Probability of Failure: 45.500% (= 455 failed surfaces / 1000 valid surfaces)
Reliability index: 0.13805 (assuming normal distribution) * best fit = Normal
Reliability index: 0.03172 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 1.073685
Factor of Safety, standard deviation: 0.239103
Factor of Safety, minimum: 0.478107
Factor of Safety, maximum: 1.905420
Probability of Failure: 37.700% (= 377 failed surfaces / 1000 valid surfaces)
Reliability index: 0.30817 (assuming normal distribution) * best fit = Normal
Reliability index: 0.21316 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 1.077507
Factor of Safety, standard deviation: 0.240447
Factor of Safety, minimum: 0.477097

Factor of Safety, maximum: 1.909900

Probability of Failure: 37.400% (= 374 failed surfaces / 1000 valid surfaces)

Reliability index: 0.32235 (assuming normal distribution) * best fit = Normal

Reliability index: 0.22841 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

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**RESULTADOS SLIDE 5
SECCIONES CON OBRAS**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

Estudio de Riesgo por Remoción en Masa, Evaluación de Alternativas de Mitigación y Diseños Detallados de las Obras de Estabilización, Protección y/o Control Recomendadas para la Urbanización Nueva Roma Oriental de la Localidad de San Cristóbal en la Ciudad de Bogotá D.C.

Parte Alta
Sección 4 – Mecanismo de falla rotacional – Alternativa B1

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per4_1.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
GLE/Morgenstern-Price with interslice force function: Half Sine
Janbu simplified
Janbu corrected
Ordinary/Fellenius

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Horizontal, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: Conceto

Strength Type: Undrained

Unit Weight: 20 kN/m³

Cohesion Type: Constant

Cohesion: 75 kPa

Water Surface: None

Material: Qrac

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 0.4 kPa

Friction Angle: 27 degrees

Water Surface: None

Global Minimums

Method: ordinary/fellenius

FS: 1.028100

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=967.484 kN-m

Driving Moment=941.042 kN-m

Method: bishop simplified

FS: 1.039780

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=978.476 kN-m

Driving Moment=941.042 kN-m

Method: janbu simplified

FS: 1.023500

Center: 8.249, 2789.739

Radius: 11.306

Left Slip Surface Endpoint: 9.775, 2778.537

Right Slip Surface Endpoint: 16.748, 2782.284

Resisting Horizontal Force=29.8325 kN

Driving Horizontal Force=29.1475 kN

Method: janbu corrected

FS: 1.053810

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Horizontal Force=39.2001 kN

Driving Horizontal Force=37.1982 kN

Method: gle/morgenstern-price

FS: 1.036190

Center: 3.314, 2799.884

Radius: 22.530

Left Slip Surface Endpoint: 8.788, 2778.030

Right Slip Surface Endpoint: 18.140, 2782.920

Resisting Moment=975.095 kN-m

Driving Moment=941.042 kN-m

Resisting Horizontal Force=38.2845 kN

Driving Horizontal Force=36.9475 kN

Valid / Invalid Surfaces

Method: ordinary/fellenius

Number of Valid Surfaces: 3937

Number of Invalid Surfaces: 870

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces

Error Code -105 reported for 1 surface

Error Code -106 reported for 164 surfaces

Error Code -107 reported for 250 surfaces

Error Code -108 reported for 17 surfaces

Error Code -109 reported for 23 surfaces

Error Code -1000 reported for 165 surfaces

Method: bishop simplified

Number of Valid Surfaces: 3894

Number of Invalid Surfaces: 913

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces

Error Code -105 reported for 1 surface

Error Code -106 reported for 164 surfaces

Error Code -107 reported for 250 surfaces

Error Code -108 reported for 17 surfaces

Error Code -109 reported for 23 surfaces

Error Code -112 reported for 43 surfaces

Error Code -1000 reported for 165 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3655

Number of Invalid Surfaces: 1152

Error Codes:

Error Code -102 reported for 7 surfaces

Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 256 surfaces
Error Code -109 reported for 23 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Method: janbu corrected

Number of Valid Surfaces: 3655

Number of Invalid Surfaces: 1152

Error Codes:

Error Code -102 reported for 7 surfaces
Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 256 surfaces
Error Code -109 reported for 23 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3144

Number of Invalid Surfaces: 1663

Error Codes:

Error Code -102 reported for 7 surfaces
Error Code -103 reported for 243 surfaces
Error Code -105 reported for 1 surface
Error Code -106 reported for 164 surfaces
Error Code -107 reported for 250 surfaces
Error Code -108 reported for 257 surfaces
Error Code -109 reported for 23 surfaces
Error Code -111 reported for 510 surfaces
Error Code -112 reported for 43 surfaces
Error Code -1000 reported for 165 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections,
but resulting arc is actually outside soil region.

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-105 = More than two surface / slope
intersections with no valid slip surface.

-106 = Average slice width is less than

0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-109 = Soiltype for slice base not
located. This error should occur very rarely,
if at all. It may occur if a very low number of
slices is combined with certain soil geometries,
such that the midpoint of a slice base is
actually outside the soil region, even though
the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 1.1 (relative minimum: 22.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft
Property: Cohesion
Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient
Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: ordinary/fellenius

Factor of Safety, mean: 0.960483
Factor of Safety, standard deviation: 0.128638
Factor of Safety, minimum: 0.554105
Factor of Safety, maximum: 1.360890
Probability of Failure: 62.400% (= 624 failed surfaces / 1000 valid surfaces)
Reliability index: -0.30719 (assuming normal distribution) * best fit = Normal
Reliability index: -0.36905 (assuming lognormal distribution)

Method: bishop simplified

Factor of Safety, mean: 0.972178
Factor of Safety, standard deviation: 0.129876
Factor of Safety, minimum: 0.564591
Factor of Safety, maximum: 1.377520
Probability of Failure: 57.800% (= 578 failed surfaces / 1000 valid surfaces)
Reliability index: -0.21422 (assuming normal distribution) * best fit = Normal
Reliability index: -0.27865 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 0.956744
Factor of Safety, standard deviation: 0.129157
Factor of Safety, minimum: 0.555147
Factor of Safety, maximum: 1.359860
Probability of Failure: 63.400% (= 634 failed surfaces / 1000 valid surfaces)
Reliability index: -0.33491 (assuming normal distribution) * best fit = Normal
Reliability index: -0.39624 (assuming lognormal distribution)

Method: janbu corrected

Factor of Safety, mean: 0.972668
Factor of Safety, standard deviation: 0.130806
Factor of Safety, minimum: 0.560785
Factor of Safety, maximum: 1.380450
Probability of Failure: 57.600% (= 576 failed surfaces / 1000 valid surfaces)
Reliability index: -0.20895 (assuming normal distribution) * best fit = Normal
Reliability index: -0.27394 (assuming lognormal distribution)

Method: gle/morgenstern-price

Factor of Safety, mean: 0.984557

Factor of Safety, standard deviation: 0.132056

Factor of Safety, minimum: 0.568571

Factor of Safety, maximum: 1.395820

Probability of Failure: 54.200% (= 542 failed surfaces / 1000 valid surfaces)

Reliability index: -0.11694 (assuming normal distribution) * best fit = Normal

Reliability index: -0.18332 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

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Parte Alta
Sección 4 – Mecanismo de falla rotacional – Alternativa B2

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec4.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft
Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: CONCRETO
Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 650 kPa
Water Surface: None

Material: GAVIÓN
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 100 kPa
Friction Angle: 30 degrees
Water Surface: None

Material: RELLENO SELECCIONADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 0 kPa
Friction Angle: 30 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201
GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1000 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees

Global Minimums

Method: bishop simplified

FS: 1.606970

Center: 17.258, 2792.979

Radius: 13.890

Left Slip Surface Endpoint: 12.649, 2779.877

Right Slip Surface Endpoint: 29.517, 2786.450

Resisting Moment=6592.74 kN-m

Driving Moment=4102.59 kN-m

Method: janbu simplified

FS: 1.445520

Center: 17.258, 2792.979

Radius: 13.890

Left Slip Surface Endpoint: 12.649, 2779.877

Right Slip Surface Endpoint: 29.517, 2786.450

Resisting Horizontal Force=415.062 kN

Driving Horizontal Force=287.138 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 7591

Number of Invalid Surfaces: 2276

Error Codes:

Error Code -103 reported for 1316 surfaces

Error Code -105 reported for 3 surfaces

Error Code -106 reported for 529 surfaces

Error Code -107 reported for 3 surfaces

Error Code -109 reported for 4 surfaces

Error Code -112 reported for 421 surfaces

Method: janbu simplified

Number of Valid Surfaces: 7204

Number of Invalid Surfaces: 2663

Error Codes:

Error Code -103 reported for 1316 surfaces

Error Code -105 reported for 3 surfaces

Error Code -106 reported for 529 surfaces

Error Code -107 reported for 3 surfaces

Error Code -108 reported for 325 surfaces

Error Code -109 reported for 4 surfaces

Error Code -111 reported for 79 surfaces

Error Code -112 reported for 404 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-105 = More than two surface / slope

intersections with no valid slip surface.

-106 = Average slice width is less than $0.0001 * (\text{maximum horizontal extent of soil region})$. This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region, even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$ < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 6.1 (relative minimum: 17.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft
Property: Cohesion
Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr
Property: Phi
Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient
Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential
Normalized Mean: 0.33

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.521077
Factor of Safety, standard deviation: 0.270252
Factor of Safety, minimum: 0.803809
Factor of Safety, maximum: 2.521470
Probability of Failure: 2.900% (= 29 failed surfaces / 1000 valid surfaces)
Reliability index: 1.92811 (assuming normal distribution) * best fit = Normal
Reliability index: 2.29095 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.367227
Factor of Safety, standard deviation: 0.242027
Factor of Safety, minimum: 0.731462
Factor of Safety, maximum: 2.260050
Probability of Failure: 6.900% (= 69 failed surfaces / 1000 valid surfaces)
Reliability index: 1.51730 (assuming normal distribution) * best fit = Normal
Reliability index: 1.69283 (assuming lognormal distribution)

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**Parte Alta
Sección 4 – Bloque 1**

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec4tr.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 180
Left Projection Angle (End Angle): 125
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 20

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: CONCRETO

Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 650 kPa
Water Surface: None

Material: GAVIÓN

Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 30 degrees
Water Surface: None

Material: RELLENO SELECCIONADO

Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 10 kPa
Friction Angle: 30 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201

GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 42 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees

and Material Dependent

Global Minimums

Method: bishop simplified

FS: 1.797220

Axis Location: 15.555, 2798.823

Left Slip Surface Endpoint: 14.133, 2780.139

Right Slip Surface Endpoint: 29.649, 2786.474

Resisting Moment=8626.79 kN-m

Driving Moment=4800.07 kN-m

Method: janbu simplified

FS: 1.693030

Axis Location: 15.555, 2798.823

Left Slip Surface Endpoint: 14.133, 2780.139

Right Slip Surface Endpoint: 29.649, 2786.474

Resisting Horizontal Force=403.281 kN

Driving Horizontal Force=238.202 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4996

Number of Invalid Surfaces: 4

Error Codes:

Error Code -108 reported for 4 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4964

Number of Invalid Surfaces: 36

Error Codes:

Error Code -108 reported for 15 surfaces

Error Code -111 reported for 21 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 6.1 (relative minimum: 17.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.33

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.709168

Factor of Safety, standard deviation: 0.262059

Factor of Safety, minimum: 1.043540

Factor of Safety, maximum: 2.661740

Probability of Failure: 0.000% (= 0 failed surfaces / 1000 valid surfaces)

Reliability index: 2.70614 (assuming normal distribution) * best fit = Normal

Reliability index: 3.44006 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.608747

Factor of Safety, standard deviation: 0.241021

Factor of Safety, minimum: 1.004050

Factor of Safety, maximum: 2.476620

Probability of Failure: 0.000% (= 0 failed surfaces / 1000 valid surfaces)

Reliability index: 2.52570 (assuming normal distribution) * best fit = Normal

Reliability index: 3.11673 (assuming lognormal distribution)

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Parte Alta
Sección 4 – Bloque 2

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec4tr2.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 180
Left Projection Angle (End Angle): 125
Right Projection Angle (Start Angle): 85
Right Projection Angle (End Angle): 20

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: CONCRETO

Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 650 kPa
Water Surface: None

Material: GAVIÓN

Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 30 degrees
Water Surface: None

Material: RELLENO SELECCIONADO

Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 10 kPa
Friction Angle: 30 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201

GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 42 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees

and Material Dependent

Global Minimums

Method: bishop simplified

FS: 1.726730

Axis Location: 19.010, 2795.377

Left Slip Surface Endpoint: 18.131, 2781.654

Right Slip Surface Endpoint: 29.462, 2786.440

Resisting Moment=4017.89 kN-m

Driving Moment=2326.88 kN-m

Method: janbu simplified

FS: 1.608540

Axis Location: 19.010, 2795.377

Left Slip Surface Endpoint: 18.131, 2781.654

Right Slip Surface Endpoint: 29.462, 2786.440

Resisting Horizontal Force=245.894 kN

Driving Horizontal Force=152.868 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4379

Number of Invalid Surfaces: 621

Error Codes:

Error Code -108 reported for 234 surfaces

Error Code -111 reported for 114 surfaces

Error Code -112 reported for 273 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3826

Number of Invalid Surfaces: 1174

Error Codes:

Error Code -108 reported for 840 surfaces

Error Code -111 reported for 226 surfaces

Error Code -112 reported for 108 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 6.1 (relative minimum: 17.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27

Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.33

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.658956

Factor of Safety, standard deviation: 0.269106

Factor of Safety, minimum: 0.943494

Factor of Safety, maximum: 2.634560

Probability of Failure: 0.200% (= 2 failed surfaces / 1000 valid surfaces)

Reliability index: 2.44869 (assuming normal distribution) * best fit = Normal

Reliability index: 3.06029 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.543327

Factor of Safety, standard deviation: 0.250843

Factor of Safety, minimum: 0.885775

Factor of Safety, maximum: 2.447060

Probability of Failure: 1.600% (= 16 failed surfaces / 1000 valid surfaces)

Reliability index: 2.16601 (assuming normal distribution) * best fit = Normal

Reliability index: 2.60661 (assuming lognormal distribution)

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Parte Baja
Sección 8 - Alternativa 1– Mecanismo de falla rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec8.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Normal to boundary, Magnitude: 25 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft
Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qalt
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TBSr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TB
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: COLCHACRETO
Strength Type: Undrained
Unit Weight: 22 kN/m³
Cohesion Type: Constant
Cohesion: 350 kPa
Water Surface: None

Material: CONCRETO
Strength Type: Undrained
Unit Weight: 20 kN/m³
Cohesion Type: Constant
Cohesion: 650 kPa
Water Surface: None

Material: TIERRA ARMADA
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 25 degrees
Water Surface: None

Material: ENROCADO
Strength Type: Mohr-Coulomb

Unit Weight: 21 kN/m³
Cohesion: 0 kPa
Friction Angle: 30 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201
GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 42 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees
and Material Dependent

Global Minimums

Method: bishop simplified
FS: 1.629610
Center: 28.407, 2766.295
Radius: 13.237
Left Slip Surface Endpoint: 20.197, 2755.912
Right Slip Surface Endpoint: 41.227, 2763.000
Resisting Moment=13554.6 kN-m
Driving Moment=8317.69 kN-m

Method: janbu simplified
FS: 1.435490
Center: 28.407, 2766.295
Radius: 13.237
Left Slip Surface Endpoint: 20.197, 2755.912
Right Slip Surface Endpoint: 41.227, 2763.000
Resisting Horizontal Force=843.208 kN
Driving Horizontal Force=587.4 kN

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 5870
Number of Invalid Surfaces: 3645
Error Codes:
Error Code -102 reported for 1 surface
Error Code -103 reported for 426 surfaces
Error Code -105 reported for 2 surfaces
Error Code -106 reported for 223 surfaces
Error Code -107 reported for 1699 surfaces
Error Code -108 reported for 1 surface
Error Code -109 reported for 6 surfaces
Error Code -110 reported for 1238 surfaces
Error Code -112 reported for 49 surfaces

Method: janbu simplified

Number of Valid Surfaces: 5511

Number of Invalid Surfaces: 4004

Error Codes:

Error Code -102 reported for 1 surface

Error Code -103 reported for 426 surfaces

Error Code -105 reported for 2 surfaces

Error Code -106 reported for 223 surfaces

Error Code -107 reported for 1699 surfaces

Error Code -108 reported for 282 surfaces

Error Code -109 reported for 6 surfaces

Error Code -110 reported for 1238 surfaces

Error Code -111 reported for 78 surfaces

Error Code -112 reported for 49 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections,
but resulting arc is actually outside soil region.

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-105 = More than two surface / slope
intersections with no valid slip surface.

-106 = Average slice width is less than
 $0.0001 * (\text{maximum horizontal extent of soil region})$.
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-108 = Total driving moment
or total driving force < 0.1 . This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-109 = Soiltype for slice base not
located. This error should occur very rarely,
if at all. It may occur if a very low number of
slices is combined with certain soil geometries,
such that the midpoint of a slice base is

actually outside the soil region, even though the slip surface is wholly within the soil region.

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi)/F)$ < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 6.1 (relative minimum: 17.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.523386
Factor of Safety, standard deviation: 0.154445
Factor of Safety, minimum: 0.988002
Factor of Safety, maximum: 2.059660
Probability of Failure: 0.100% (= 1 failed surfaces / 1000 valid surfaces)
Reliability index: 3.38882 (assuming normal distribution) * best fit = Normal
Reliability index: 4.11202 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.327449
Factor of Safety, standard deviation: 0.137712
Factor of Safety, minimum: 0.837362
Factor of Safety, maximum: 1.795900
Probability of Failure: 1.800% (= 18 failed surfaces / 1000 valid surfaces)
Reliability index: 2.37778 (assuming normal distribution)
Reliability index: 2.68601 (assuming lognormal distribution)
* best fit = Beta

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

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Parte Baja
Sección 8 - Alternativa 1– Mecanismo de falla traslacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec8-tr.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³

Cohesion: 2 kPa

Friction Angle: 24 degrees

Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: COLCHACRETO

Strength Type: Undrained

Unit Weight: 22 kN/m³

Cohesion Type: Constant

Cohesion: 350 kPa

Water Surface: None

Material: CONCRETO

Strength Type: Undrained

Unit Weight: 20 kN/m³

Cohesion Type: Constant

Cohesion: 650 kPa

Water Surface: None

Material: TIERRA ARMADA

Strength Type: Mohr-Coulomb

Unit Weight: 21 kN/m³

Cohesion: 5 kPa

Friction Angle: 25 degrees

Water Surface: None

Material: ENROCADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 0 kPa
Friction Angle: 30 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201
GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 47 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees
and Material Dependent

Global Minimums

Method: bishop simplified
FS: 1.469690
Axis Location: 27.655, 2774.625
Left Slip Surface Endpoint: 26.800, 2756.389
Right Slip Surface Endpoint: 41.731, 2763.000
Resisting Moment=13393.2 kN-m
Driving Moment=9112.94 kN-m

Method: janbu simplified
FS: 1.376440
Axis Location: 27.655, 2774.625
Left Slip Surface Endpoint: 26.800, 2756.389
Right Slip Surface Endpoint: 41.731, 2763.000
Resisting Horizontal Force=588.423 kN
Driving Horizontal Force=427.496 kN

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4996
Number of Invalid Surfaces: 4
Error Codes:
Error Code -108 reported for 4 surfaces

Method: janbu simplified
Number of Valid Surfaces: 4395
Number of Invalid Surfaces: 605
Error Codes:
Error Code -108 reported for 24 surfaces
Error Code -111 reported for 581 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 6.1 (relative minimum: 17.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.366692

Factor of Safety, standard deviation: 0.136922

Factor of Safety, minimum: 0.951748

Factor of Safety, maximum: 1.899930

Probability of Failure: 0.300% (= 3 failed surfaces / 1000 valid surfaces)

Reliability index: 2.67811 (assuming normal distribution) * best fit = Normal

Reliability index: 3.07600 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.276363

Factor of Safety, standard deviation: 0.126905

Factor of Safety, minimum: 0.922455

Factor of Safety, maximum: 1.773200

Probability of Failure: 1.702% (= 17 failed surfaces / 999 valid surfaces), 1 invalid surfaces

Reliability index: 2.17771 (assuming normal distribution) * best fit = Normal

Reliability index: 2.41066 (assuming lognormal distribution)

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Parte Baja
Sección 8 - Alternativa 2– Mecanismo de falla rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec8.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 10
Minimum Elevation: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft
Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qalt
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TBsr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: Qcl
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 1.8 kPa
Friction Angle: 27 degrees
Water Surface: None

Material: TB
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: COLCHACRETO
Strength Type: Undrained
Unit Weight: 22 kN/m³
Cohesion Type: Constant
Cohesion: 350 kPa
Water Surface: None

Material: CONCRETO REFORZADO
Strength Type: Undrained
Unit Weight: 24 kN/m³
Cohesion Type: Constant
Cohesion: 650 kPa
Water Surface: None

Material: RELLENO SELECCIONADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 25 degrees
Water Surface: None

Material: ENROCADO
Strength Type: Mohr-Coulomb

Unit Weight: 21 kN/m³
Cohesion: 0 kPa
Friction Angle: 30 degrees
Water Surface: None

Global Minimums

Method: bishop simplified

FS: 1.865540

Center: 28.854, 2764.942

Radius: 12.403

Left Slip Surface Endpoint: 20.352, 2755.912

Right Slip Surface Endpoint: 40.971, 2762.293

Resisting Moment=12144 kN-m

Driving Moment=6509.65 kN-m

Method: janbu simplified

FS: 1.634290

Center: 28.854, 2764.942

Radius: 12.403

Left Slip Surface Endpoint: 20.352, 2755.912

Right Slip Surface Endpoint: 40.971, 2762.293

Resisting Horizontal Force=798.738 kN

Driving Horizontal Force=488.739 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3487

Number of Invalid Surfaces: 1529

Error Codes:

Error Code -103 reported for 388 surfaces

Error Code -106 reported for 138 surfaces

Error Code -107 reported for 52 surfaces

Error Code -109 reported for 2 surfaces

Error Code -110 reported for 661 surfaces

Error Code -112 reported for 288 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3169

Number of Invalid Surfaces: 1847

Error Codes:

Error Code -103 reported for 388 surfaces

Error Code -106 reported for 138 surfaces

Error Code -107 reported for 52 surfaces

Error Code -108 reported for 258 surfaces

Error Code -109 reported for 2 surfaces

Error Code -110 reported for 661 surfaces

Error Code -111 reported for 68 surfaces

Error Code -112 reported for 280 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than $0.0001 \times$ (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1 . This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region, even though the slip surface is wholly within the soil region.

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi))/F$ < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 6.1 (relative minimum: 17.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.733193

Factor of Safety, standard deviation: 0.180081

Factor of Safety, minimum: 1.088100

Factor of Safety, maximum: 2.311640

Probability of Failure: 0.000% (= 0 failed surfaces / 1000 valid surfaces)

Reliability index: 4.07145 (assuming normal distribution) * best fit = Normal

Reliability index: 5.25557 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.504202

Factor of Safety, standard deviation: 0.159735

Factor of Safety, minimum: 0.924516

Factor of Safety, maximum: 2.004740

Probability of Failure: 0.500% (= 5 failed surfaces / 1000 valid surfaces)

Reliability index: 3.15649 (assuming normal distribution)

Reliability index: 3.80241 (assuming lognormal distribution)

* best fit = Beta

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Parte Baja

Sección 8 - Alternativa 2 – Mecanismo de falla traslacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec8tr.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 160
Left Projection Angle (End Angle): 120
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 15

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³

Cohesion: 2 kPa

Friction Angle: 24 degrees

Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: COLCHACRETO

Strength Type: Undrained

Unit Weight: 22 kN/m³

Cohesion Type: Constant

Cohesion: 350 kPa

Water Surface: None

Material: CONCRETO REFORZADO

Strength Type: Undrained

Unit Weight: 24 kN/m³

Cohesion Type: Constant

Cohesion: 650 kPa

Water Surface: None

Material: RELLENO SELECCIONADO

Strength Type: Mohr-Coulomb

Unit Weight: 21 kN/m³

Cohesion: 5 kPa

Friction Angle: 25 degrees

Water Surface: None

Material: ENROCADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 0 kPa
Friction Angle: 30 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.728580
Axis Location: 27.759, 2776.201
Left Slip Surface Endpoint: 25.963, 2755.970
Right Slip Surface Endpoint: 42.866, 2762.626
Resisting Moment=15783.1 kN-m
Driving Moment=9130.66 kN-m

Method: janbu simplified
FS: 1.614390
Axis Location: 27.759, 2776.201
Left Slip Surface Endpoint: 25.963, 2755.970
Right Slip Surface Endpoint: 42.866, 2762.626
Resisting Horizontal Force=663.953 kN
Driving Horizontal Force=411.271 kN

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4985
Number of Invalid Surfaces: 15
Error Codes:
Error Code -108 reported for 11 surfaces
Error Code -111 reported for 4 surfaces

Method: janbu simplified
Number of Valid Surfaces: 4760
Number of Invalid Surfaces: 240
Error Codes:
Error Code -108 reported for 106 surfaces
Error Code -111 reported for 134 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal
Minimum: 6.1 (relative minimum: 17.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.572102

Factor of Safety, standard deviation: 0.176890

Factor of Safety, minimum: 0.986287

Factor of Safety, maximum: 2.217880

Probability of Failure: 0.100% (= 1 failed surfaces / 1000 valid surfaces)

Reliability index: 3.23422 (assuming normal distribution) * best fit = Normal

Reliability index: 3.97739 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.463134

Factor of Safety, standard deviation: 0.164980

Factor of Safety, minimum: 0.907690

Factor of Safety, maximum: 2.060700

Probability of Failure: 0.600% (= 6 failed surfaces / 1000 valid surfaces)

Reliability index: 2.80722 (assuming normal distribution) * best fit = Normal

Reliability index: 3.32970 (assuming lognormal distribution)

FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS DE BOGOTÁ D.C. – FOPAE

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Parte Baja
Sección 8 - Alternativa 3 – Mecanismo de falla en bloque

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: sec8tr.sli

Project Settings

Project Title: PROYECTO FOPAE 383/03
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 170
Left Projection Angle (End Angle): 120
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0.04
1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 20 kN/m

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb

Unit Weight: 18 kN/m³

Cohesion: 2 kPa

Friction Angle: 24 degrees

Water Surface: None

Material: Qalt

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TBsr

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 5 kPa

Friction Angle: 28 degrees

Water Surface: None

Material: Qcl

Strength Type: Mohr-Coulomb

Unit Weight: 19 kN/m³

Cohesion: 1.8 kPa

Friction Angle: 27 degrees

Water Surface: None

Material: TB

Strength Type: Mohr-Coulomb

Unit Weight: 20 kN/m³

Cohesion: 84 kPa

Friction Angle: 35 degrees

Water Surface: None

Material: CONCRETO REFORZADO

Strength Type: Undrained

Unit Weight: 24 kN/m³

Cohesion Type: Constant

Cohesion: 650 kPa

Water Surface: None

Material: RELLENO SELECCIONADO

Strength Type: Mohr-Coulomb

Unit Weight: 21 kN/m³

Cohesion: 5 kPa

Friction Angle: 25 degrees

Water Surface: None

Support Properties

Support: PILOTE

PILOTE

Support Type: Micro-Pile

Force Application: Passive

Out-of-Plane Spacing: 1 m
Pile Shear Strength: 650 kN

Global Minimums

Method: bishop simplified

FS: 1.945940

Axis Location: 33.052, 2773.165

Left Slip Surface Endpoint: 31.093, 2758.440

Right Slip Surface Endpoint: 43.657, 2762.763

Resisting Moment=6342.21 kN-m

Driving Moment=3259.19 kN-m

Method: janbu simplified

FS: 1.855700

Axis Location: 33.275, 2773.649

Left Slip Surface Endpoint: 31.192, 2758.440

Right Slip Surface Endpoint: 44.193, 2762.857

Resisting Horizontal Force=346.573 kN

Driving Horizontal Force=186.761 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4965

Number of Invalid Surfaces: 35

Error Codes:

Error Code -108 reported for 24 surfaces

Error Code -111 reported for 11 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4285

Number of Invalid Surfaces: 715

Error Codes:

Error Code -108 reported for 376 surfaces

Error Code -111 reported for 339 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo
Number of Samples: 1000
Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)

Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 6.1 (relative minimum: 17.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal
Minimum: 7.7 (relative minimum: 20.3)
Mean: 28
Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential
Normalized Mean: 0.14

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.767376
Factor of Safety, standard deviation: 0.253367
Factor of Safety, minimum: 1.089110
Factor of Safety, maximum: 2.777280
Probability of Failure: 0.000% (= 0 failed surfaces / 999 valid surfaces), 1 invalid surfaces
Reliability index: 3.02871 (assuming normal distribution)
Reliability index: 3.92152 (assuming lognormal distribution)
* best fit = Gamma

Method: janbu simplified

Factor of Safety, mean: 1.666541
Factor of Safety, standard deviation: 0.240184
Factor of Safety, minimum: 0.982028
Factor of Safety, maximum: 2.629590
Probability of Failure: 0.107% (= 1 failed surfaces / 936 valid surfaces), 64 invalid surfaces
Reliability index: 2.77513 (assuming normal distribution) * best fit = Normal
Reliability index: 3.49050 (assuming lognormal distribution)

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Parte Baja

Sección 8 - Alternativa 4 – Mecanismo de falla rotacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per8_3a.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.04

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: RELLENO SELECCIONADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 25 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201
GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 42 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees
and Material Dependent

Global Minimums

Method: bishop simplified
FS: 1.586320
Axis Location: 28.019, 2776.466
Left Slip Surface Endpoint: 24.706, 2758.440
Right Slip Surface Endpoint: 40.452, 2763.000
Resisting Moment=12945 kN-m
Driving Moment=8160.41 kN-m

Method: janbu simplified
FS: 1.504280
Axis Location: 27.004, 2777.470
Left Slip Surface Endpoint: 23.189, 2758.440

Right Slip Surface Endpoint: 39.939, 2763.000
Resisting Horizontal Force=535.17 kN
Driving Horizontal Force=355.765 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3397

Number of Invalid Surfaces: 1603

Error Codes:

Error Code -107 reported for 54 surfaces

Error Code -108 reported for 1129 surfaces

Error Code -111 reported for 419 surfaces

Error Code -1000 reported for 1 surface

Method: janbu simplified

Number of Valid Surfaces: 2581

Number of Invalid Surfaces: 2419

Error Codes:

Error Code -107 reported for 54 surfaces

Error Code -108 reported for 1862 surfaces

Error Code -111 reported for 502 surfaces

Error Code -1000 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc
Property: Cohesion
Distribution: Normal
Minimum: 0.3 (relative minimum: 0.7)
Mean: 1
Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc
Property: Phi
Distribution: Normal
Minimum: 6.1 (relative minimum: 17.9)
Mean: 24
Maximum: 54.1 (relative maximum: 30.1)
Standard Deviation: 3.7

Material: Qft
Property: Cohesion
Distribution: Normal
Minimum: 1.6 (relative minimum: 0.4)
Mean: 2
Maximum: 5.6 (relative maximum: 3.6)
Standard Deviation: 1

Material: Qft
Property: Phi
Distribution: Normal
Minimum: 5.8 (relative minimum: 18.2)
Mean: 24
Maximum: 53.8 (relative maximum: 29.8)
Standard Deviation: 3.5

Material: Qalt
Property: Cohesion
Distribution: Normal
Minimum: 1.8 (relative minimum: 0)
Mean: 1.8
Maximum: 7.7 (relative maximum: 5.9)
Standard Deviation: 2.5

Material: Qalt
Property: Phi
Distribution: Normal
Minimum: 4.1 (relative minimum: 22.9)
Mean: 27
Maximum: 58.1 (relative maximum: 31.1)
Standard Deviation: 2.5

Material: TBSr
Property: Cohesion
Distribution: Normal
Minimum: 5 (relative minimum: 0)
Mean: 5
Maximum: 15.9 (relative maximum: 10.9)
Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)

Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential

Minimum: 0.04 (relative minimum: 0)

Mean: 0.04

Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential

Normalized Mean: 0.3

Correlation Coefficients

Material: Qranc

Correlation: -0.5

Material: Qft

Correlation: -0.5

Material: Qalt

Correlation: -0.5

Material: TBsr

Correlation: -0.5

Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.457213

Factor of Safety, standard deviation: 0.204020

Factor of Safety, minimum: 0.939055

Factor of Safety, maximum: 2.260820

Probability of Failure: 0.800% (= 8 failed surfaces / 1000 valid surfaces)

Reliability index: 2.24102 (assuming normal distribution)

Reliability index: 2.63277 (assuming lognormal distribution)

* best fit = Gamma

Method: janbu simplified

Factor of Safety, mean: 1.373820

Factor of Safety, standard deviation: 0.188990

Factor of Safety, minimum: 0.863883

Factor of Safety, maximum: 2.119670

Probability of Failure: 2.800% (= 28 failed surfaces / 1000 valid surfaces)

Reliability index: 1.97798 (assuming normal distribution) * best fit = Normal

Reliability index: 2.25108 (assuming lognormal distribution)

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Parte Baja

Sección 8 - Alternativa 4 – Mecanismo de falla traslacional

APROBÓ: CIVILES LTDA. - FOPAE	ELABORÓ: GEOCING LTDA.	INFORME EJECUTIVO PROYECTO GE-103	FECHA: 15/03/04	REVISIÓN N° 0
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Slide Analysis Information

Document Name

File Name: per8_3b.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m³
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.04

Material Properties

Material: Qranc
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 1 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: Qft

Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 2 kPa
Friction Angle: 24 degrees
Water Surface: None

Material: TBsr
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Friction Angle: 28 degrees
Water Surface: None

Material: TB
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 84 kPa
Friction Angle: 35 degrees
Water Surface: None

Material: RELLENO SELECCIONADO
Strength Type: Mohr-Coulomb
Unit Weight: 21 kN/m³
Cohesion: 5 kPa
Friction Angle: 25 degrees
Water Surface: None

Support Properties

Support: GEOMALLA TENAX TT201
GEOMALLA TENAX TT201
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 42 kN/m
Pullout Strength Adhesion: 5 kN/m²
Pullout Strength Friction Angle: 35 degrees
and Material Dependent

Global Minimums

Method: bishop simplified
FS: 1.542490
Axis Location: 28.331, 2781.756
Left Slip Surface Endpoint: 22.373, 2758.440
Right Slip Surface Endpoint: 43.409, 2763.000
Resisting Moment=19660.4 kN-m
Driving Moment=12745.8 kN-m

Method: janbu simplified
FS: 1.457310
Axis Location: 27.562, 2778.585
Left Slip Surface Endpoint: 23.190, 2758.440

Right Slip Surface Endpoint: 41.055, 2763.000
Resisting Horizontal Force=576.335 kN
Driving Horizontal Force=395.48 kN

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4865

Number of Invalid Surfaces: 135

Error Codes:

Error Code -107 reported for 9 surfaces

Error Code -108 reported for 78 surfaces

Error Code -111 reported for 48 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4656

Number of Invalid Surfaces: 344

Error Codes:

Error Code -107 reported for 9 surfaces

Error Code -108 reported for 198 surfaces

Error Code -111 reported for 137 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Probabilistic Analysis Input

Project Settings

Sensitivity Analysis: Off

Probabilistic Analysis: On

Sampling Method: Monte-Carlo

Number of Samples: 1000

Analysis Type: Global Minimum

Material: Qranc

Property: Cohesion

Distribution: Normal

Minimum: 0.3 (relative minimum: 0.7)

Mean: 1

Maximum: 2.3 (relative maximum: 1.3)
Standard Deviation: 0.2

Material: Qranc

Property: Phi

Distribution: Normal

Minimum: 6.1 (relative minimum: 17.9)

Mean: 24

Maximum: 54.1 (relative maximum: 30.1)

Standard Deviation: 3.7

Material: Qft

Property: Cohesion

Distribution: Normal

Minimum: 1.6 (relative minimum: 0.4)

Mean: 2

Maximum: 5.6 (relative maximum: 3.6)

Standard Deviation: 1

Material: Qft

Property: Phi

Distribution: Normal

Minimum: 5.8 (relative minimum: 18.2)

Mean: 24

Maximum: 53.8 (relative maximum: 29.8)

Standard Deviation: 3.5

Material: Qalt

Property: Cohesion

Distribution: Normal

Minimum: 1.8 (relative minimum: 0)

Mean: 1.8

Maximum: 7.7 (relative maximum: 5.9)

Standard Deviation: 2.5

Material: Qalt

Property: Phi

Distribution: Normal

Minimum: 4.1 (relative minimum: 22.9)

Mean: 27

Maximum: 58.1 (relative maximum: 31.1)

Standard Deviation: 2.5

Material: TBsr

Property: Cohesion

Distribution: Normal

Minimum: 5 (relative minimum: 0)

Mean: 5

Maximum: 15.9 (relative maximum: 10.9)

Standard Deviation: 3.6

Material: TBsr

Property: Phi

Distribution: Normal

Minimum: 7.7 (relative minimum: 20.3)

Mean: 28

Maximum: 63.7 (relative maximum: 35.7)
Standard Deviation: 4.7

Horizontal Seismic Coefficient

Distribution: Exponential
Minimum: 0.04 (relative minimum: 0)
Mean: 0.04
Maximum: 0.34 (relative maximum: 0.3)

Water Table Location

Distribution: Exponential
Normalized Mean: 0.3

Correlation Coefficients

Material: Qranc
Correlation: -0.5

Material: Qft
Correlation: -0.5

Material: Qalt
Correlation: -0.5

Material: TBsr
Correlation: -0.5

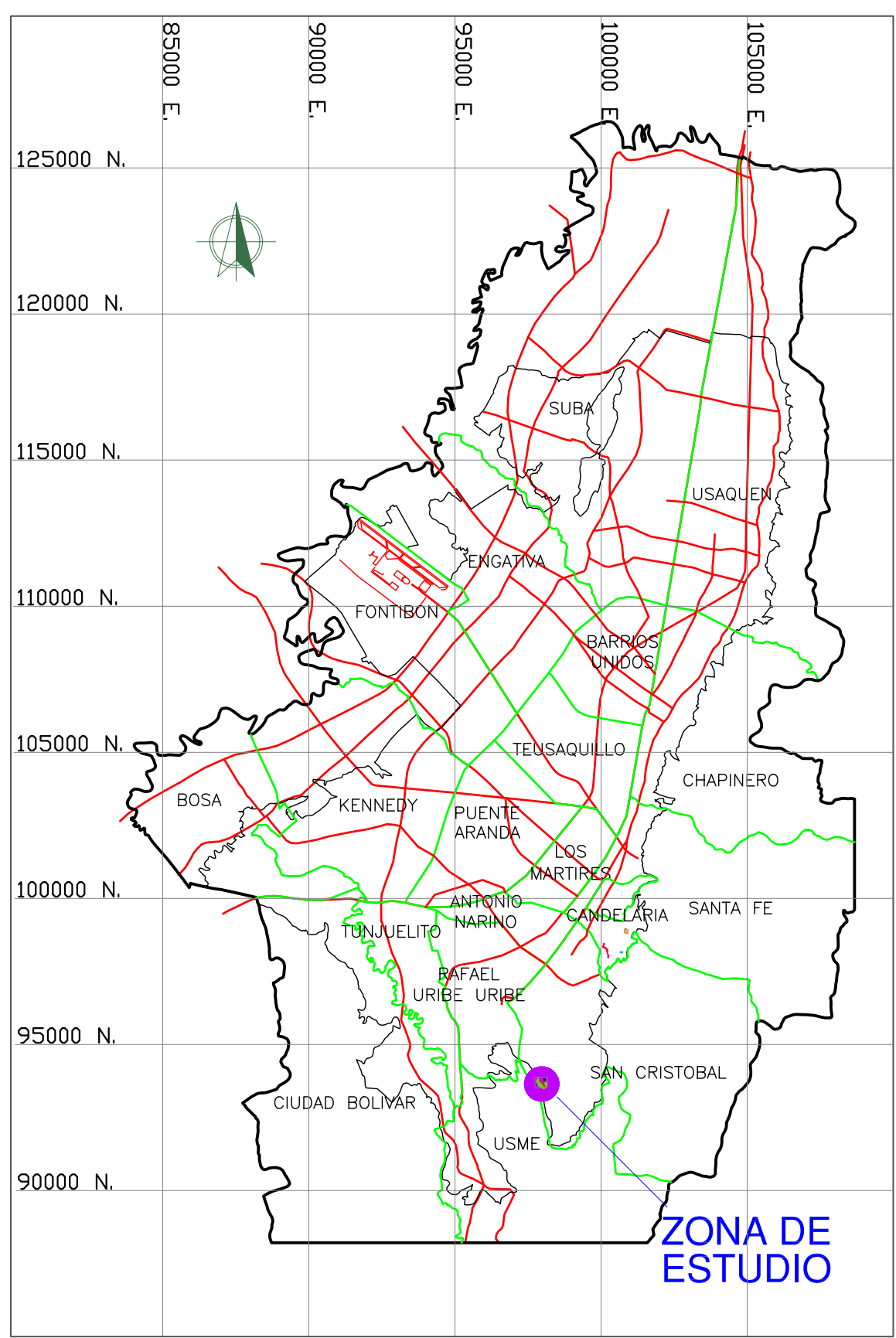
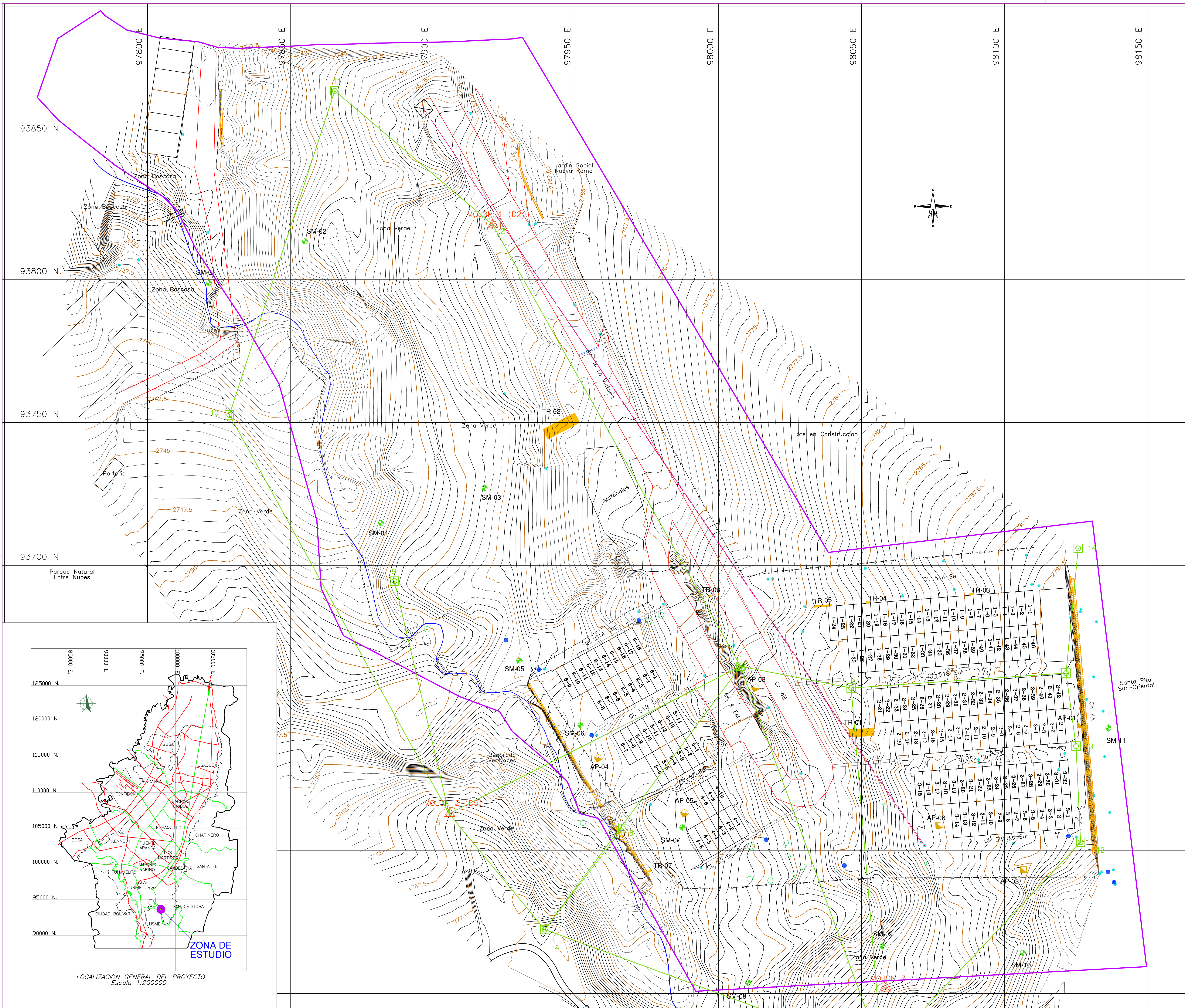
Probabilistic Analysis Results (Global Minimum)

Method: bishop simplified

Factor of Safety, mean: 1.395106
Factor of Safety, standard deviation: 0.196358
Factor of Safety, minimum: 0.850865
Factor of Safety, maximum: 2.161940
Probability of Failure: 2.500% (= 25 failed surfaces / 1000 valid surfaces)
Reliability index: 2.01217 (assuming normal distribution) * best fit = Normal
Reliability index: 2.30735 (assuming lognormal distribution)

Method: janbu simplified

Factor of Safety, mean: 1.322909
Factor of Safety, standard deviation: 0.183564
Factor of Safety, minimum: 0.816537
Factor of Safety, maximum: 2.042140
Probability of Failure: 4.000% (= 40 failed surfaces / 1000 valid surfaces)
Reliability index: 1.75911 (assuming normal distribution) * best fit = Normal
Reliability index: 1.95731 (assuming lognormal distribution)



ESCALA GRAFICA

ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA
PLACA BARRIO SOLEDAD	99870.715	102522.016	2568.313

• Amarré a la Placa Barrio Soledad con GPS

COORDENADAS DE MOJONES

PUNTO	ESTE	NORTE	COTA
MOJON 1 (D2)	97920.884	93819.280	2760.721
MOJON 2 (D5)	97920.815	93813.056	2763.333
MOJON 3	98058.625	93551.865	2787.500

CONVENCIONES GENERALES

- CURVA INDICE
- CURVA SECUNDARIA
- AREA DE ESTUDIO
- POLIGONAL DEL LEVANTAMIENTO
- CERCA
- LINEA DE ALTA TENSION
- MOJON
- DELTA
- GAVION
- POZO
- ARBOL
- POSTE DE ENERGIA
- TORRE DE ALTA TENSION
- AP-## APIQUE
- TR-## TRINCHERA
- SM-## SONDEO MECANICO

REV	FECHA	DESCRIPCION	POR	APROBADO
2	15/03/04	Para Aprobación de Interventoria	F.S.	F.S.
1	15/01/04	Revisión de Interventoria	R.F	F.S.

ALCALDIA MAYOR DE BOGOTÁ D.C.
DIRECCION DE PROYECTOS Y ATENCION DE EMERGENCIAS
SECRETARIA DE COORDINACION

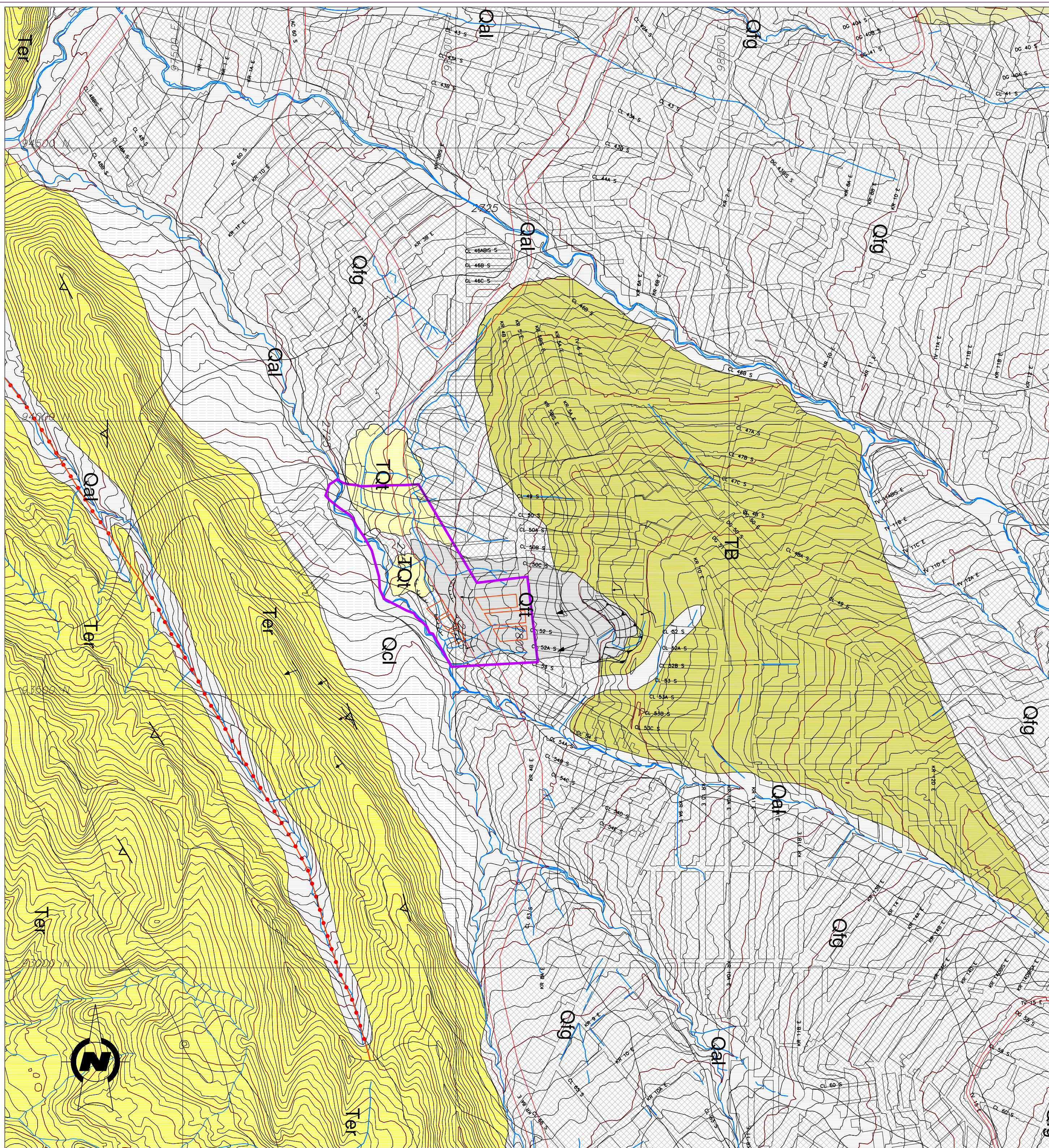
CONTRATISTA: **GE CING**

DESCRIPCION:
ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

LEVANTAMIENTO TOPOGRAFICO

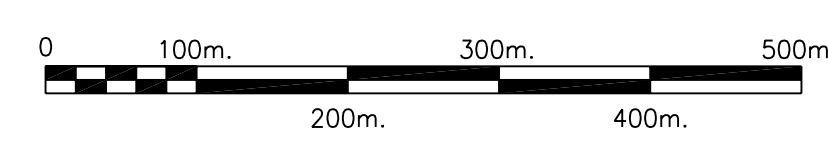
ELABORO:	INTERVENTORIA:
ING. EDWIN GAITAN	CIVILES LTDA

REVISOR: ING. RODRIGO RINCON P. ARCHIVO ACAD: GE103/PLANOS/DE103-01.DWG
 APROBADO: ING. FLAVIO SOLER ESCALA: 1 : 500 FECHA: ENERO-2004
 PLANO No: GE103-PL-01 REVISION: R1



MAPA GEOLOGICO REGIONAL MODIFICADO DE FOPAE (1998)
 ZONIFICACION DE RIESGO POR INESTABILIDAD DEL TERRENO PARA DIFERENTES LOCALIDADES DE SANTA FE DE BOGOTÁ

ESCALA GRAFICA



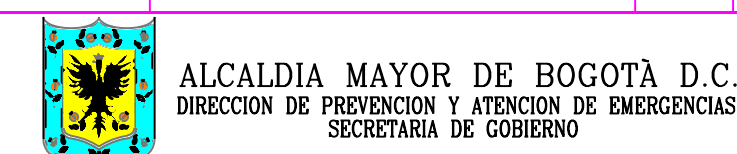
CONVENCIONES GENERALES

LEYENDA GEOLOGICAS		ESTRUCTURAS GEOLOGICAS	
Qal	Depositos Aluviales	—	Fallo Definido
Qrl	Depositos de Puzos de Tierra	- - -	Fallo con Posicion aproximada
Qcl	Depositos de Coluvión	•••••	Fallo Cuberto
Qlg	Depositos Fluvio Glaciares	—	Fallo de Cabalgamiento
Tol	Formación Tota	—	Fallo de Rumbo
Ter	Suelos de Sabana	—	Fallo indicando bloque levantado(L) bloque hundido(H)
Tbl	Formación La Regenera	↑	Anticlinal
TB	Formación Bogotá	↓	Anticlinal Invertido
		↕	Sinclinal
		↕	Sinclinal Invertido
		↕	Plegue con Inclinación de plano axial indicada
		•••••	Eje de Plegue Cuberto

POSICION DE LA ESTRATIFICACION

↗	Rumbo y buzamiento medios
↖	Buzamiento invertido
→	Estratificación horizontal
↕	Estratificación Vertical
▲	45° <= Buzamiento <= 90°
▲▲	28° <= Buzamiento <= 44°
▲▲▲	11° <= Buzamiento <= 25°
▲▲▲▲	4° <= Buzamiento <= 10°
▲▲▲▲▲	1° <= Buzamiento <= 3°
↔	Escarpe de Deslizamiento
—	Area de Estudio

2	15/03/04	Para Aprobación de Interventoría	F.S.	F.S.
1	15/01/04	Revisión de Interventoría	R.F.	F.S.
REV	FECHA	DESCRIPCION	POR	APROBO



CONTRATISTA:

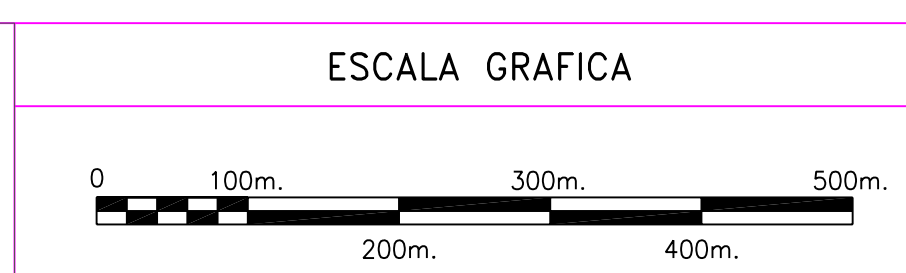
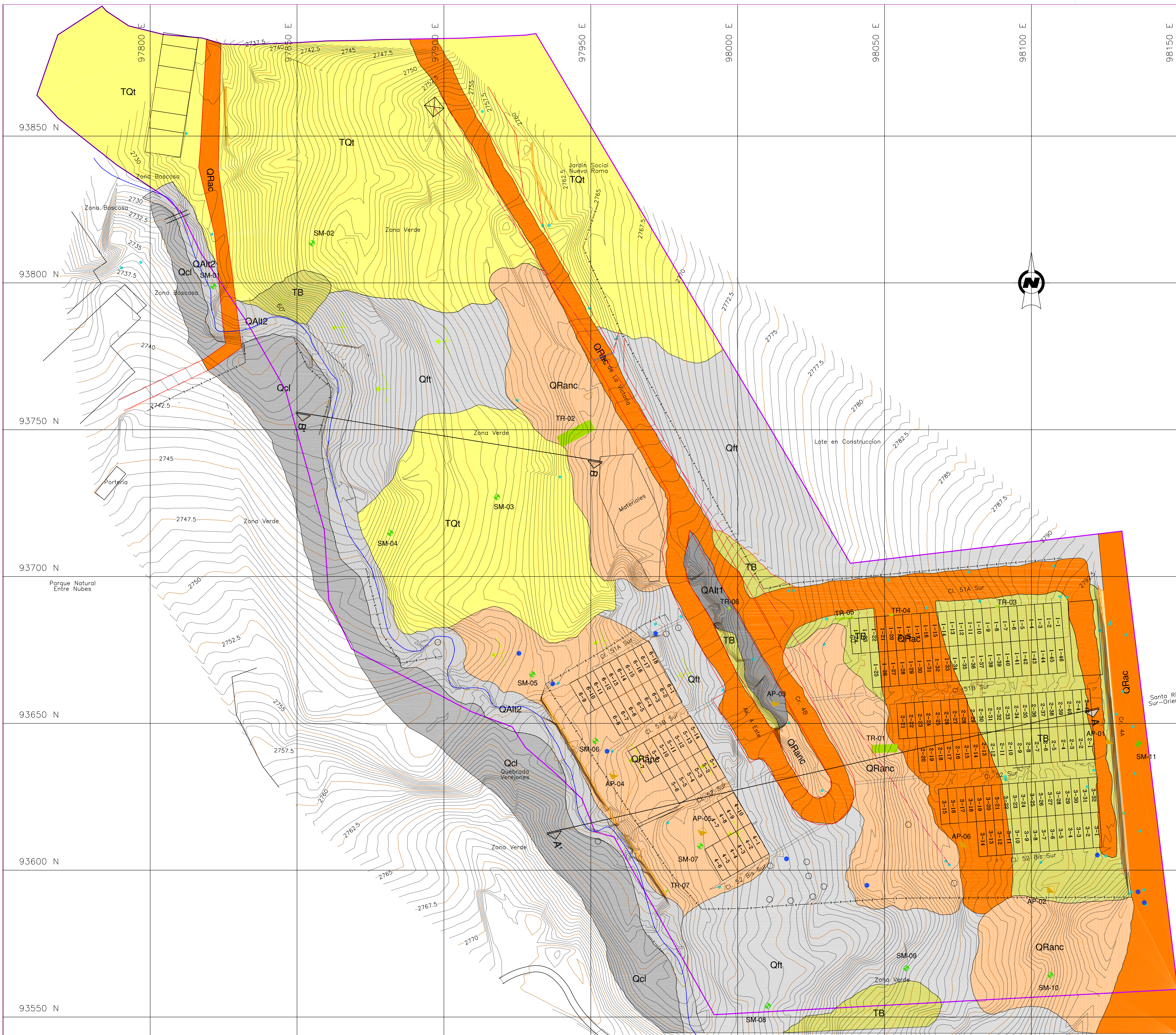


DESCRIPCION:

ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

GEOLOGIA REGIONAL

ELABORADO: GEOL. RODOLFO FRANCO	INTERVENTORIA: CIVILES LTDA
DIBUJADO: ING. ROCIO RINCÓN P.	ARCHIVO ACAD: GE103/PLANOS/GE103-02.DWG
REVISOR: ING. FLAVIO SOLER	ESCALA: 1 : 5,000
APROBADO: ING. FLAVIO SOLER	FECHA: ENERO - 2004
	PLANO No. GE103-PL-02
	REVISION: R1



ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA
PLAZA BARRIO SILECIA	98873.718	10332.016	2586.313

* Amore a la Plaza Barrio Silecía con GPS

COORDENADAS DE MOLUNES	PUNTO	ESTE	NORTE	COTA
MOLUN 1	1031	2725.888	25819.200	2105.012
MOLUN 2	1031	2720.815	25813.200	2106.231
MOLUN 3	1008	2625.135	25813.200	2107.501

- CONVENCIONES GENERALES**
- CURVA INDICE
 - CURVA SECUNDARIA
 - AREA DE ESTUDIO
 - SECCION GEOLOGICA
 - LIMITE LITOLOGICO
 - CERCA
 - LINEA DE ALTA TENSION
 - GAVION
 - POZO
 - ARBOL
 - POSTE DE ENERGIA
 - TORRE DE ALTA TENSION
 - SONDEO
 - APRIQUE
 - TRINCHERA
 - BUZAMIENTO
 - REPTACION

LEYENDA

	ALUVION TORRENCIAL RECIENTE
	ALUVION TORRENCIAL RECIENTE
	DEPOSITOS COLUVIALES
	FLUJOS DE TIERRA Y DETRITOS
	RELLENOS ANTROPICOS COMPACTADOS
	RELLENOS ANTROPICOS NO COMPACTADOS
	FORMACION TILITA
	FORMACION BOGOTA

2	15/03/04	Para Aprobación de Interventoría	F.S.	F.S.
1	15/01/04	Revisión de Interventoría	R.F.	F.S.
REV	FECHA	DESCRIPCION	FOR	APROBADO

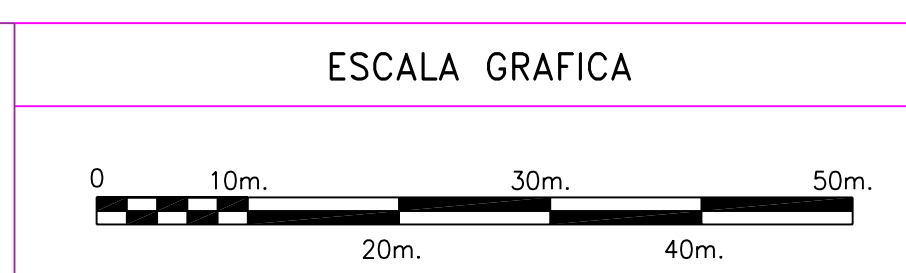
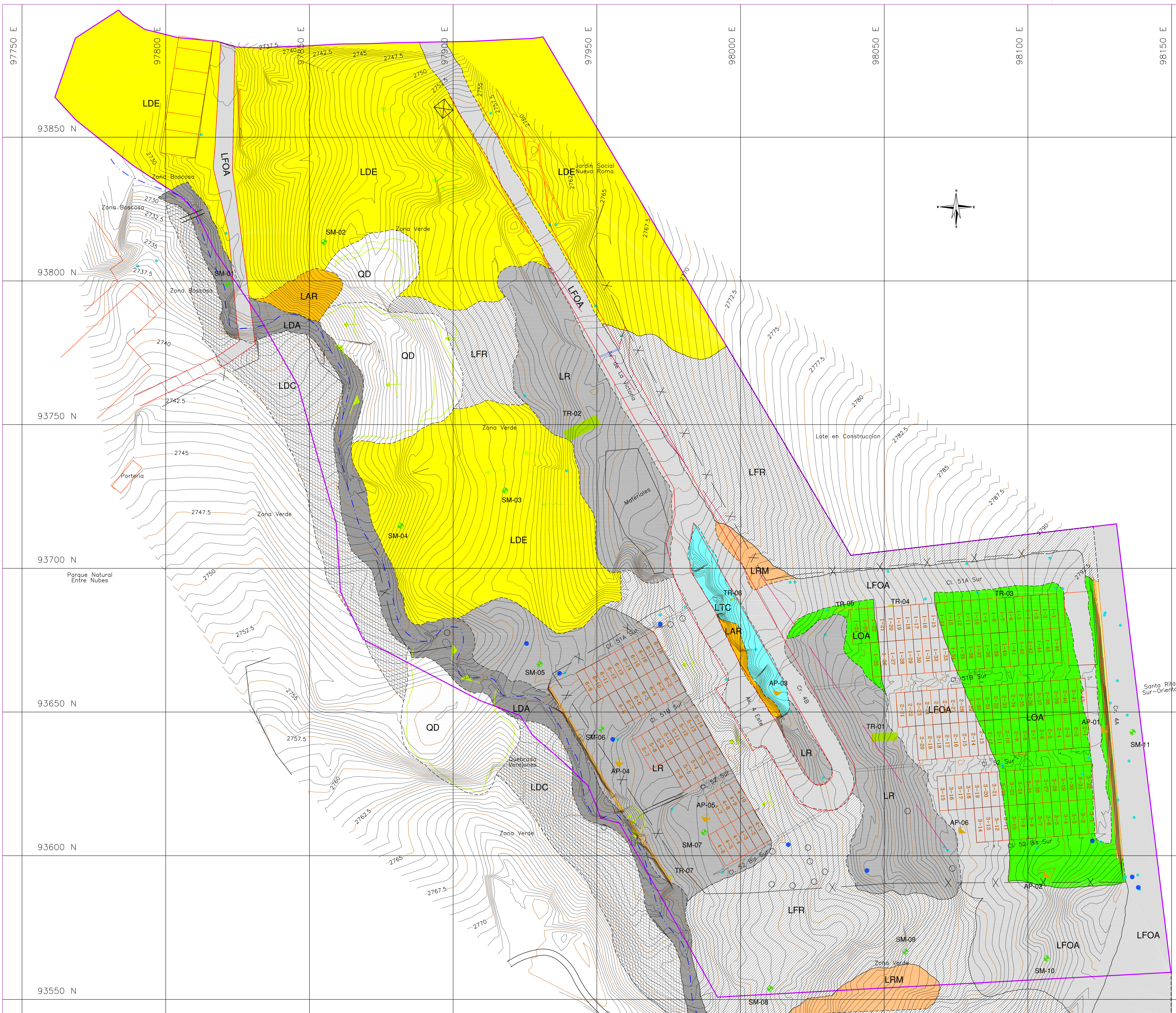
ALCALDIA MAYOR DE BOGOTÁ D.C.
 DIRECCION DE REGULACION Y CONTROL DE EMERGENCIAS
 SECRETARIA DE GOBIERNO

CONTRATISTA: **GE CING S.A.S.**

DESCRIPCION:
ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

GEOLOGIA LOCAL

ELABORO:	RODOLFO FRANCO	INTERVENTORIA:	CIVILSUTUA
REVISOR:	JACARUS TARAZONA	ARCHIVO ADO:	GE103/PLANS/CE103-03.DWG
RECIBIÓ:	FLAVIO SOLÍS	ESCALA:	1 : 500
APROBÓ:	FLAVIO SOLÍS	FECHA:	ENERO-2004
		PLANO No:	GE103-PL-03
		REVISION:	RI1



ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA
PLAZA BLANCO	98873.718	10332.016	2586.313

* Anexo a la Plaza Barris Sotolud con GPS

COORDENADAS DE MOLJONES	PUNTO	ESTE	NORTE	COTA
MOLJON 1	1001	2725.888	26819.200	2705.212
MOLJON 2	1002	2725.815	26813.298	2706.232
MOLJON 3	1003	2682.825	26821.863	2727.502

- CONVENCIONES GENERALES**
- CURVA INDICE
 - CURVA SECUNDARIA
 - AREA DE ESTUDIO
 - LIMITE LITOLÓGICO
 - CERCA
 - LINEA DE ALTA TENSION
 - GAVION
 - POZO
 - ARBOL
 - POSTE DE ENERGIA
 - TORRE DE ALTA TENSION
 - SM-01 SONDEO
 - AP-01 APIQUE
 - TR-01 TRINCHERA
 - DESLIZAMIENTOS
 - FLUJOS EN REPTACION
 - EROSION EN SURCOS CON TENDENCIA A CAJAS
 - SOKANACION

- LEYENDA**
- LDA SEGMENTO DE LADERA DEPOSICIONAL ALUVIAL
 - LDC SEGMENTO DE LADERA DEPOSICIONAL COLUVIAL
 - LFR SEGMENTO DE LADERA DE TALUDES DE CORTE
 - LQA SEGMENTO DE LADERA FLUJOS EN REPTACION
 - LDE SEGMENTO DE LADERA DEPOSICIONAL AFECTADA POR EROSION
 - LR SEGMENTO DE LADERAS RECUBIERTAS CON RELLENOS
 - LFOA FRANJAS EN LADERAS DE ORIGEN ANTROPICO
 - LAR SEGMENTO DE LADERA ESTRUCTURAL
 - LDA LADERAS DE ORIGEN ANTROPICO
 - LRM SEGMENTO DE LADERA DE ROCA METEORIZADA

2	15/03/04	Para Aprobación de Interventoria	F.S.	F.S.
1	15/01/04	Revisión de Interventoria	R.F.	F.S.
REV	FECHA	DESCRIPCION	POR	APROBADO

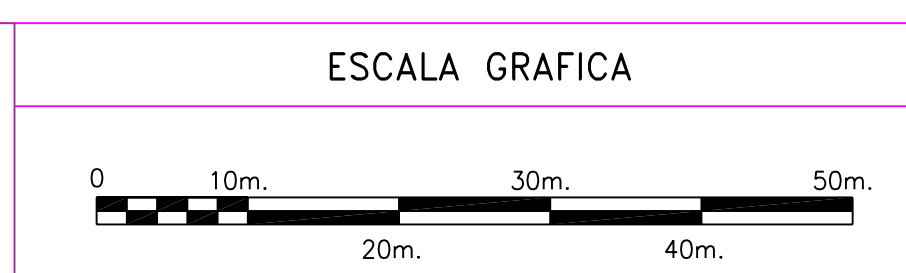
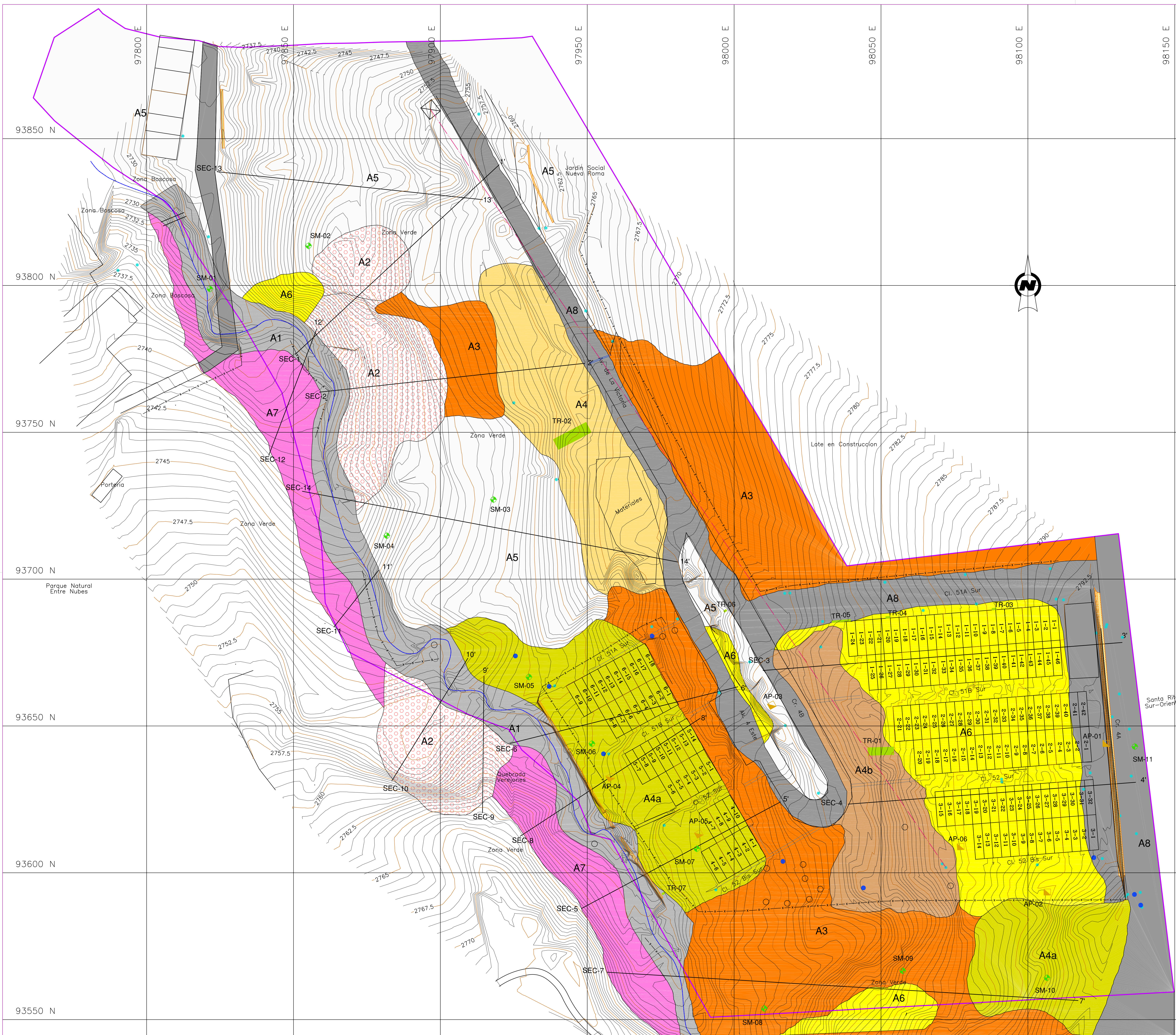
ALCALDIA MAYOR DE BOGOTÁ D.C.
DIRECCION DE PREVISION Y ATENCION DE EMERGENCIAS
SECRETARIA DE GOBIERNO

CONTRATISTA: **GE CING S.A.S.**

DESCRIPCION:
ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

GEOMORFOLOGIA LOCAL

ELABORO: RODOLFO FRANCO	INTERVENTORIA: CIVILSUTUDA
DISEÑO: CARLOS TARAZONA	ARCHIVO ADO: GE103/PLANS/RE103-04.DWG
REVISOR: FLAVIO SOLÍS	ESCALA: 1 : 500
APROBADO: FLAVIO SOLÍS	FECHA: ENERO-2004
	PLANO No: GE103-PL-04
	REVISION: R1



ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA
PLAZA BARRIO	98873.718	103922.016	2586.313
* Amore a la Plaza Barrio. Señalado con GPS			

PUNTO	ESTE	NORTE	COTA
MOLINO 1	97923.888	93619.200	2705.013
MOLINO 2	97920.813	93613.200	2706.333
MOLINO 3	98008.825	93551.803	2727.503

- CONVENCIONES GENERALES**
- CURVA INDICE
 - CURVA SECUNDARIA
 - AREA DE ESTUDIO
 - SECCION DE ANALISIS
 - CERCA
 - LINEA DE ALTA TENSION
 - GAVION
 - POZO
 - ARBOL
 - POSTE DE ENERGIA
 - TORRE DE ALTA TENSION
 - SONDEO
 - APIQUE
 - TRINCHERA

- LEYENDA**
- A1 ALUVIONES SUSCEPTIBLES A SOCIAVACION
 - A2 ZONA ALTAMENTE INESTABLE (DESPLAZAMIENTOS)
 - A3 ZONA EN REPTACION
 - A4 RELLENOS
 - A4a RELLENOS SOBRE FILLLOS
 - A4b RELLENOS SOBRE SUELO RESIDUAL
 - A5 ZONA SUSCEPTIBLE A EROSION
 - A6 SUELOS RESIDUALES CON RECONFORMACION
 - A7 DEPOSITOS POTENCIALMENTE INESTABLES
 - A8 AFIRMADO Y PAVIMENTO DE VAS

2	15/03/04	Para Aprobación de Interventoria	F.S.	F.S.
1	15/01/04	Revisión de Interventoria	R.F.	F.S.
REV	FECHA	DESCRIPCION	FOR	APROBADO

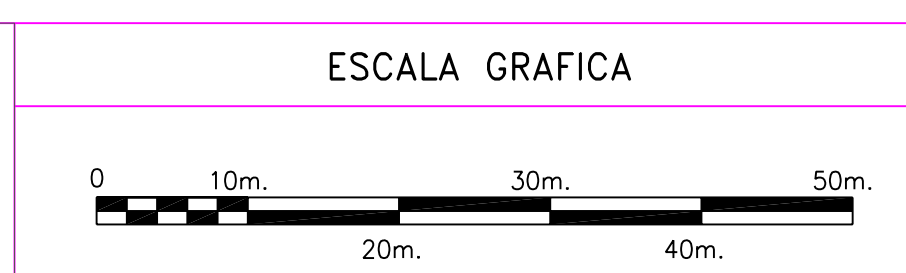
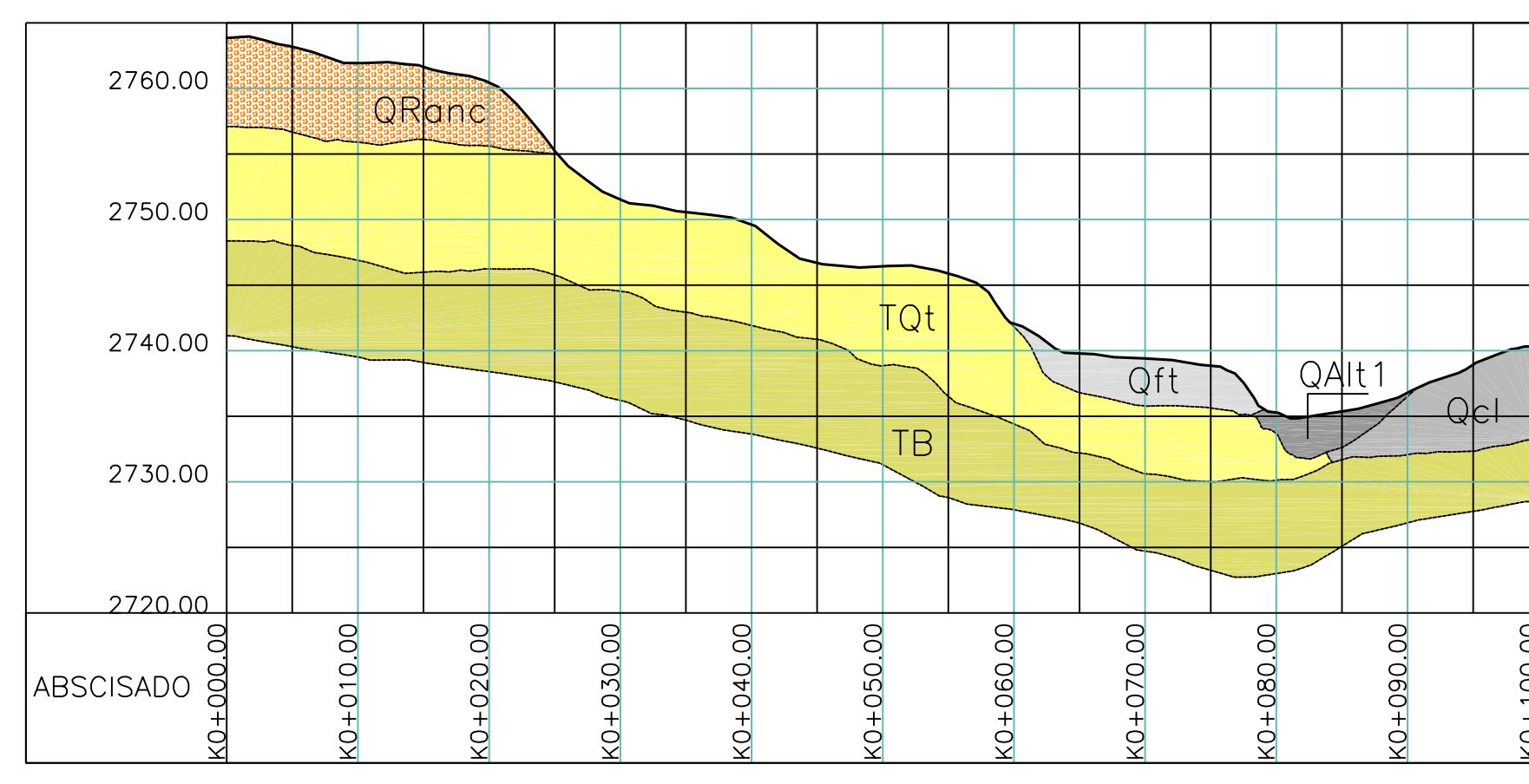
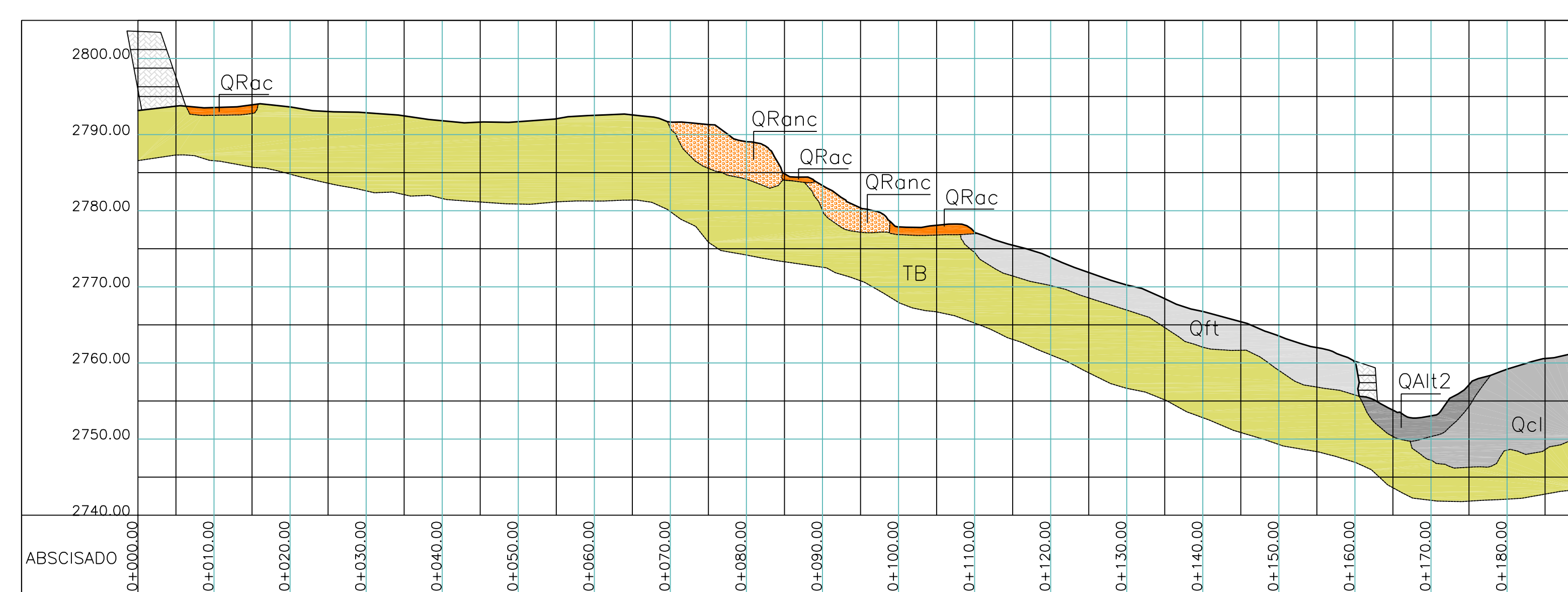
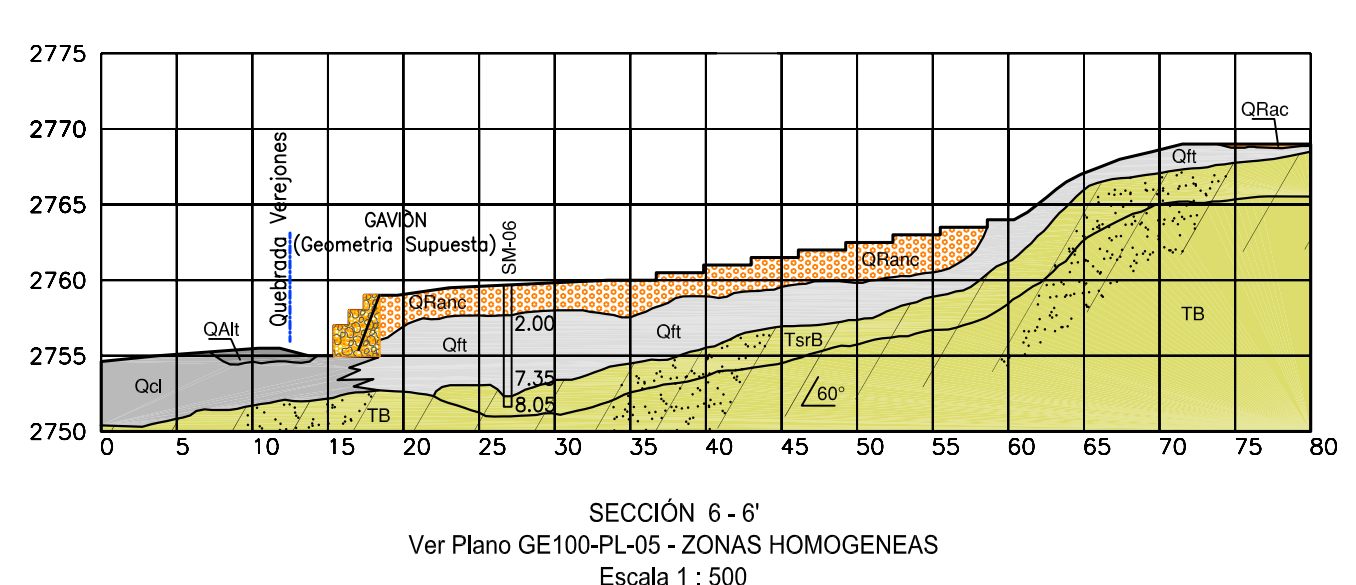
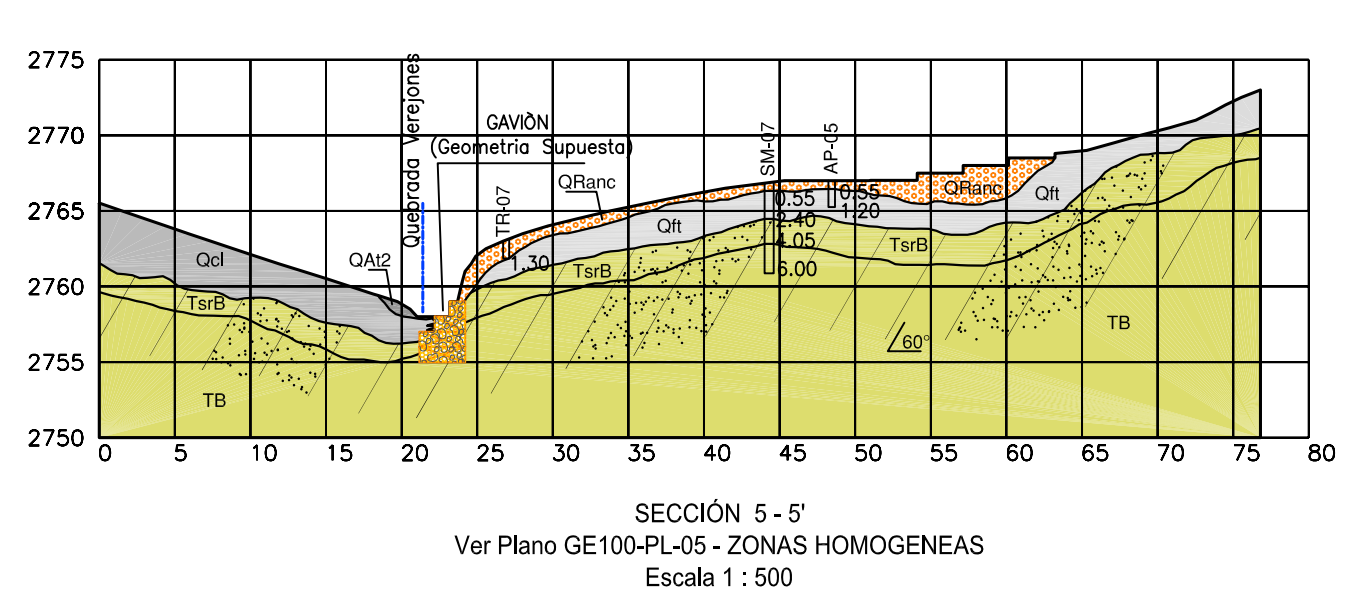
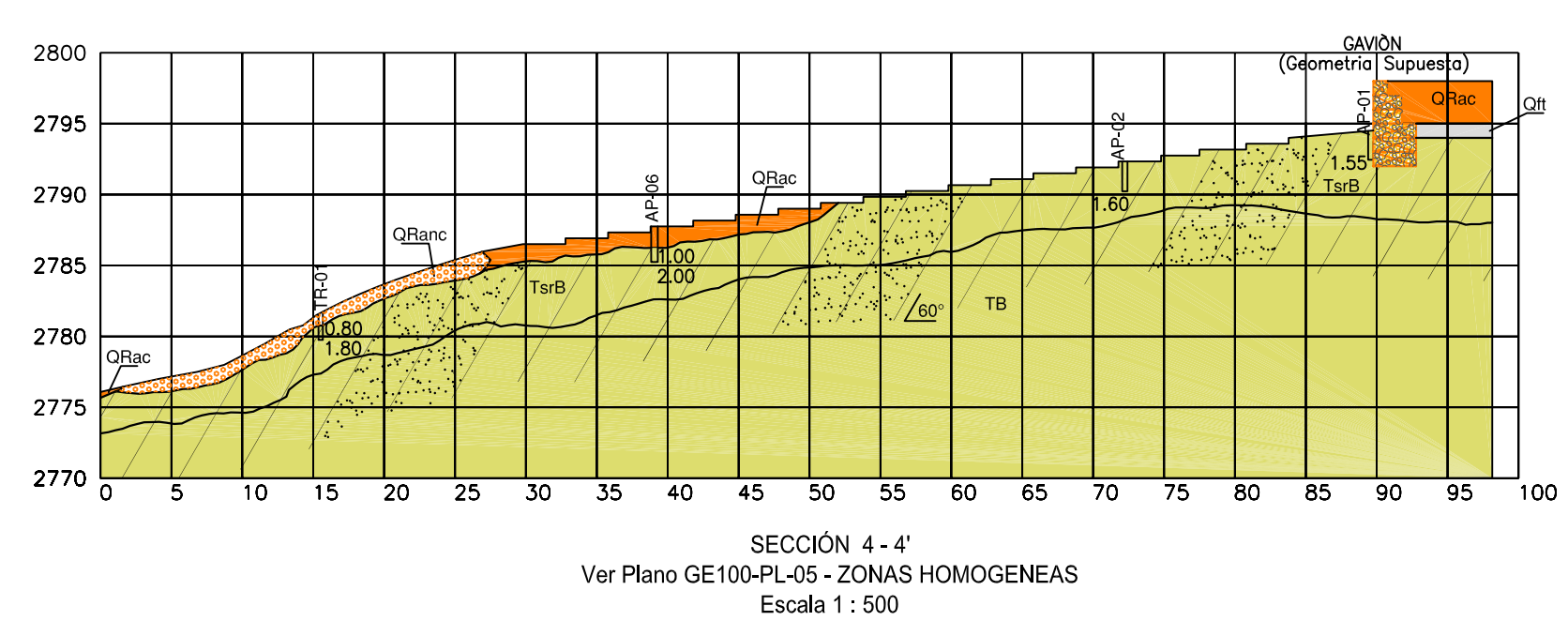
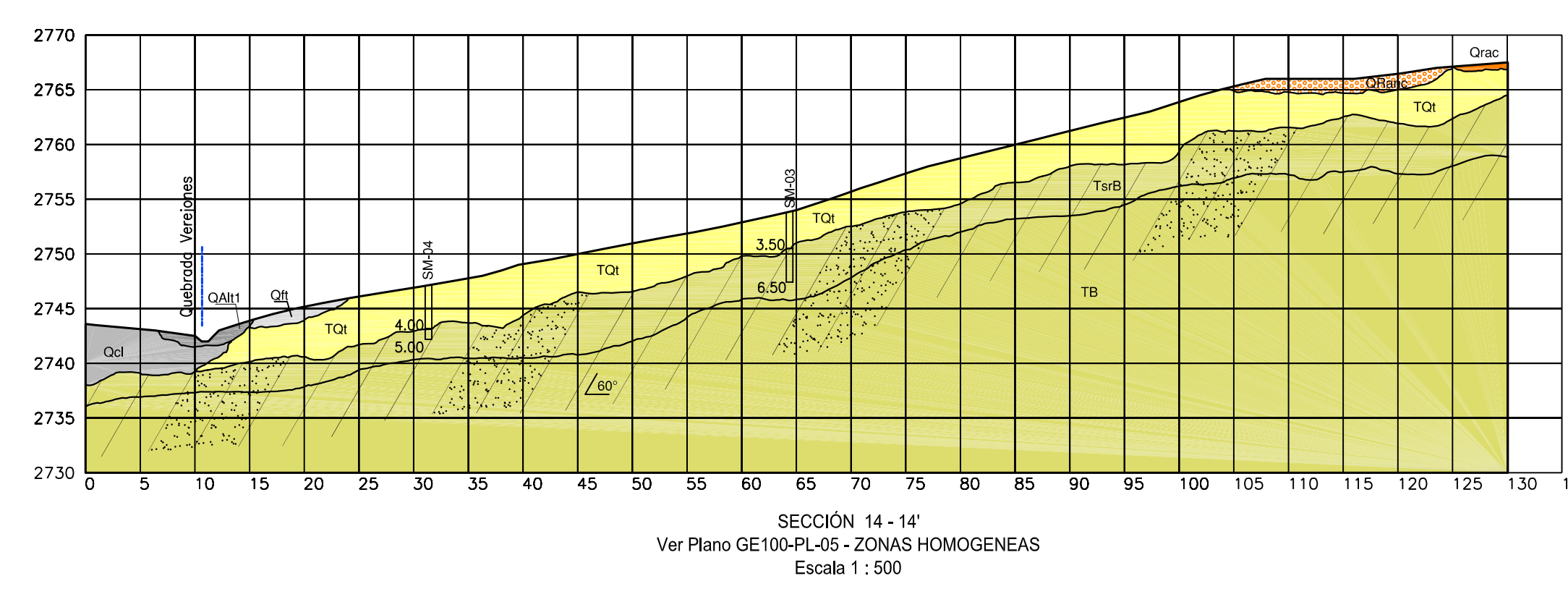
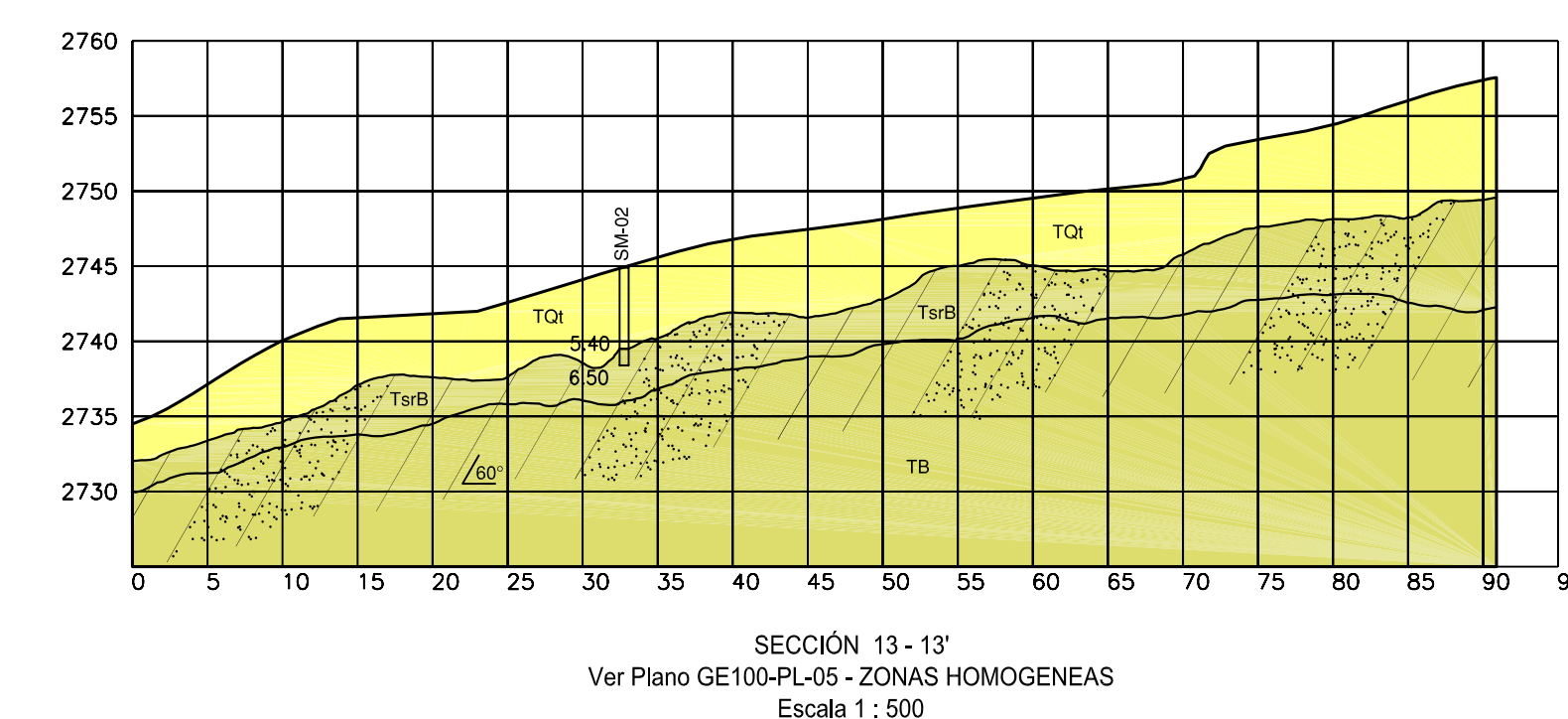
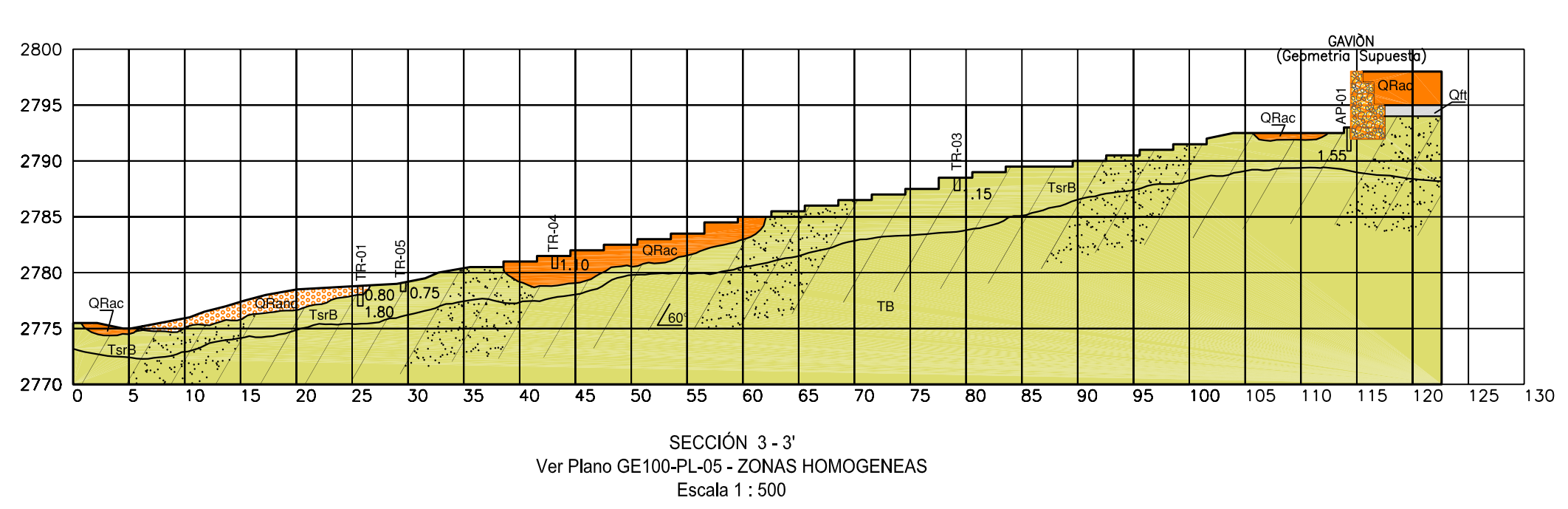
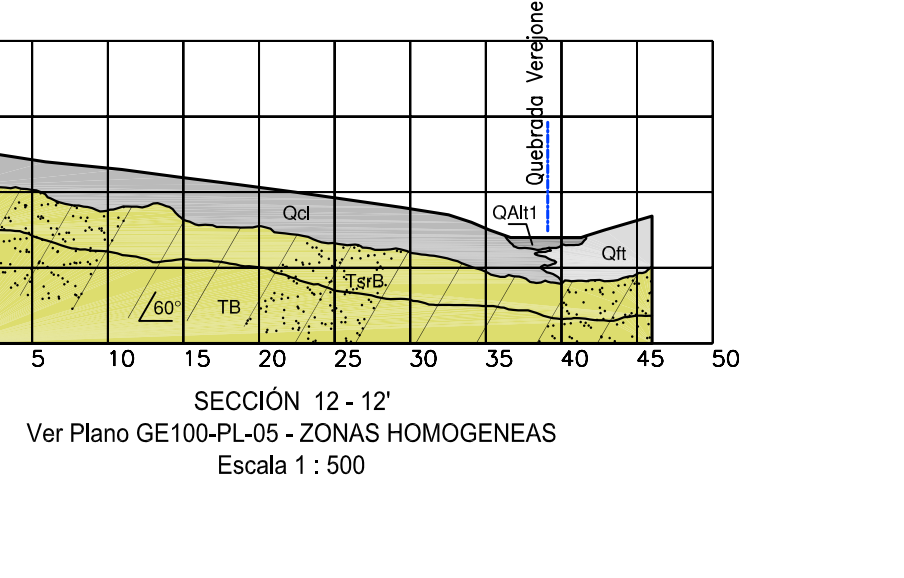
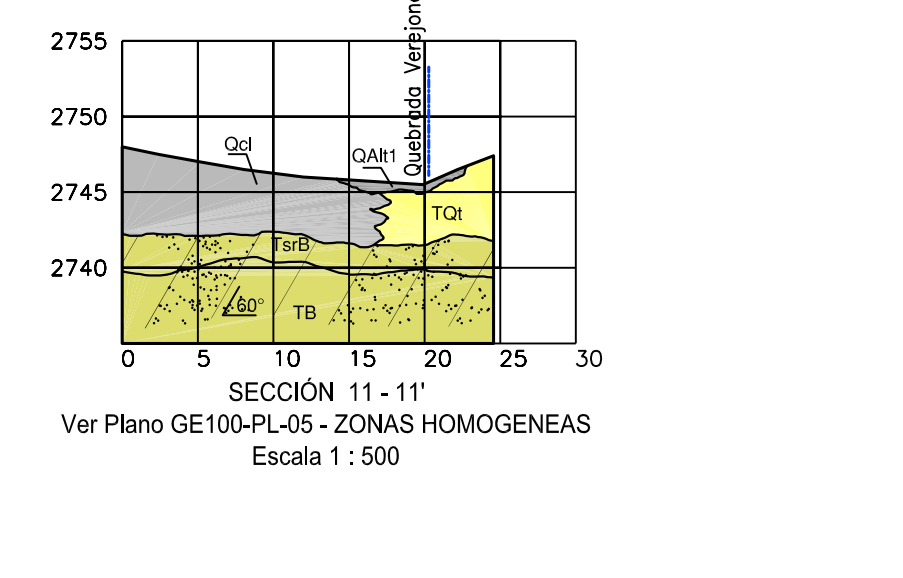
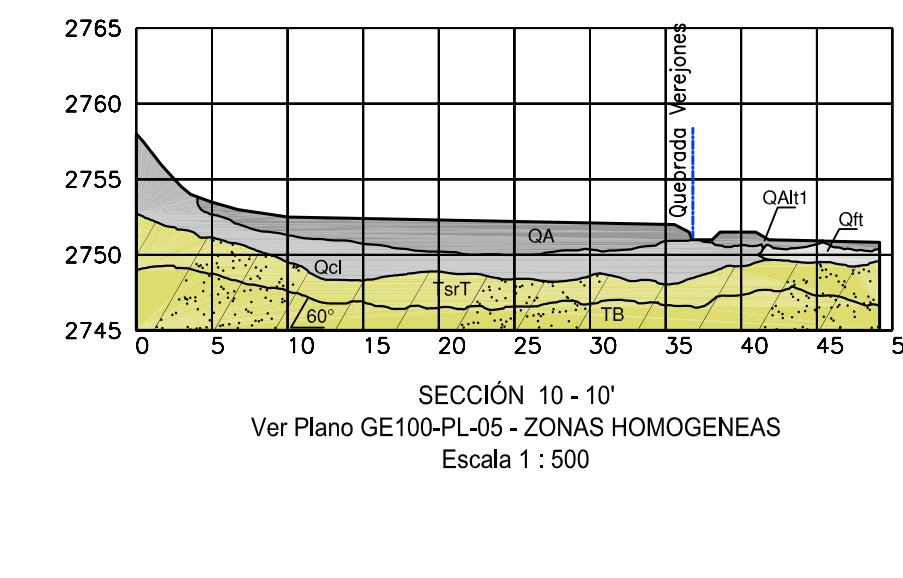
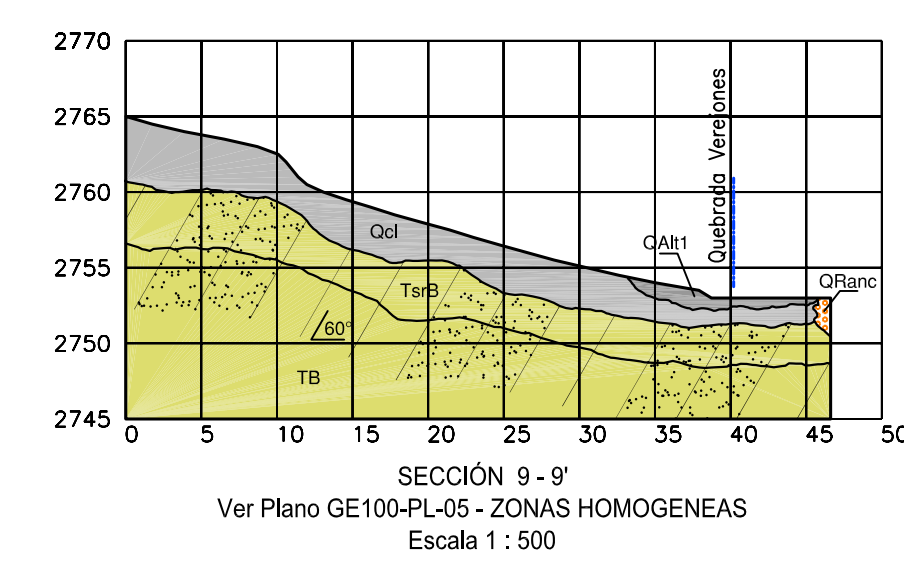
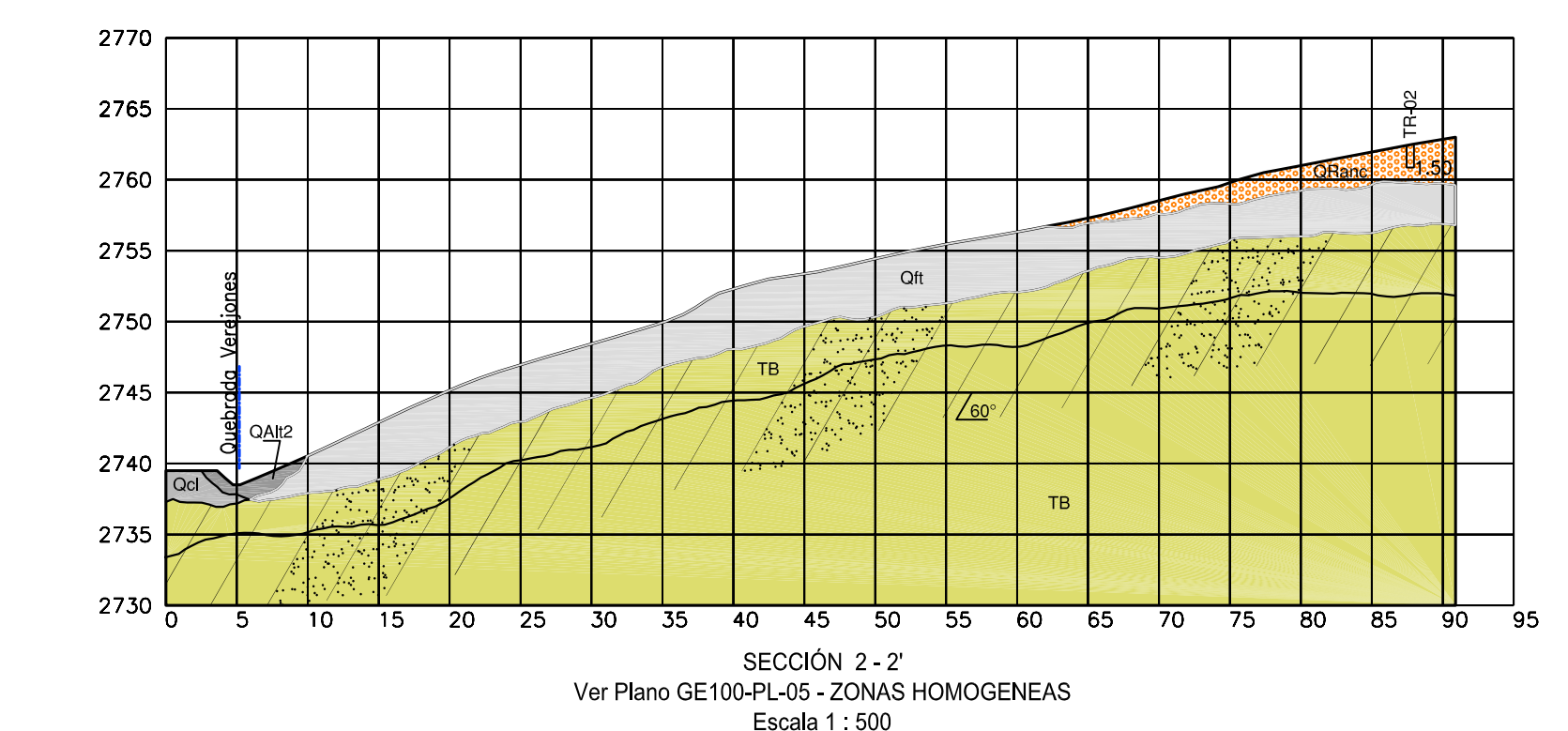
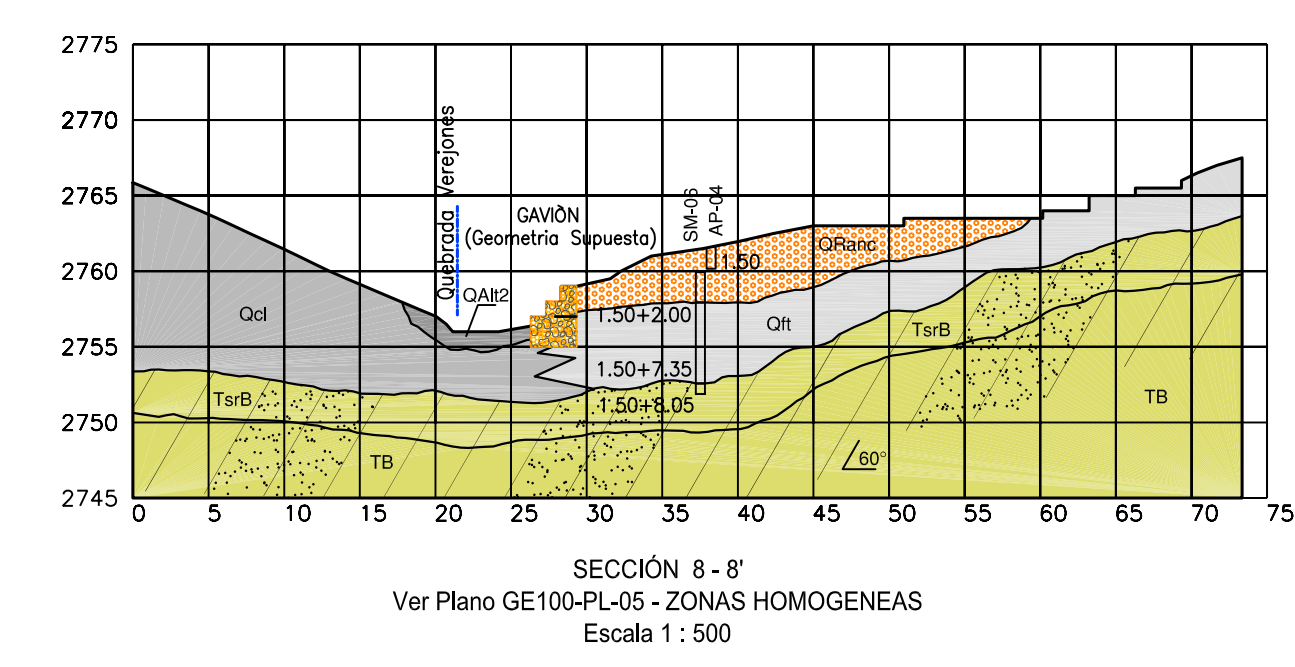
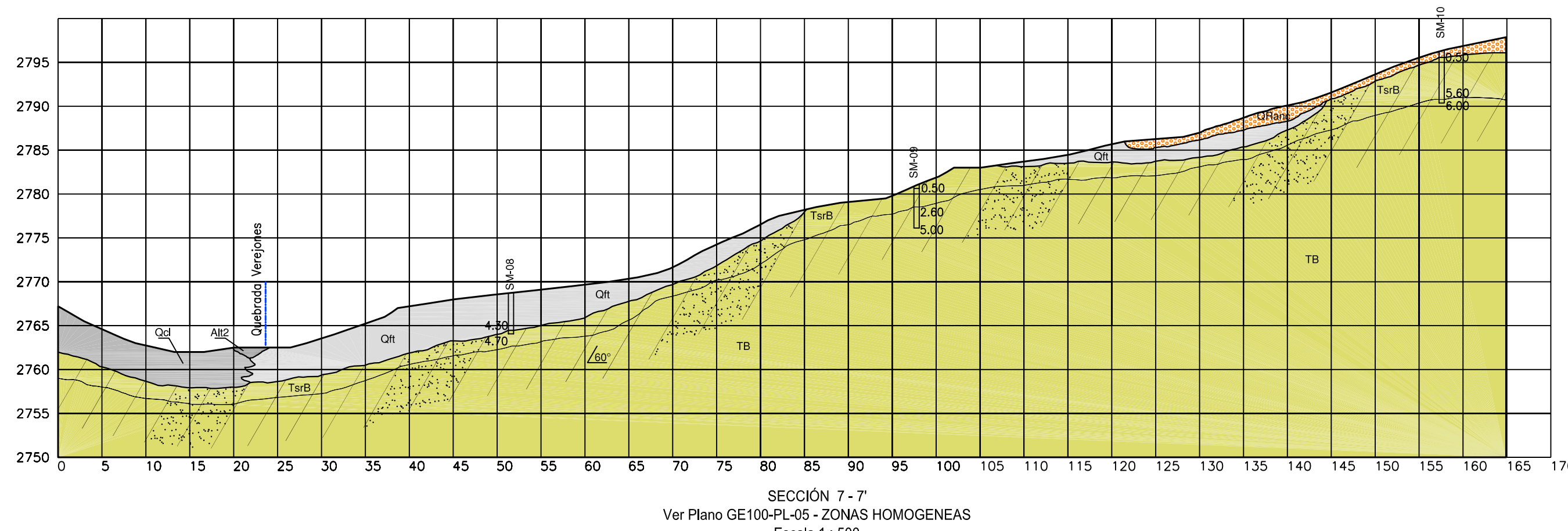
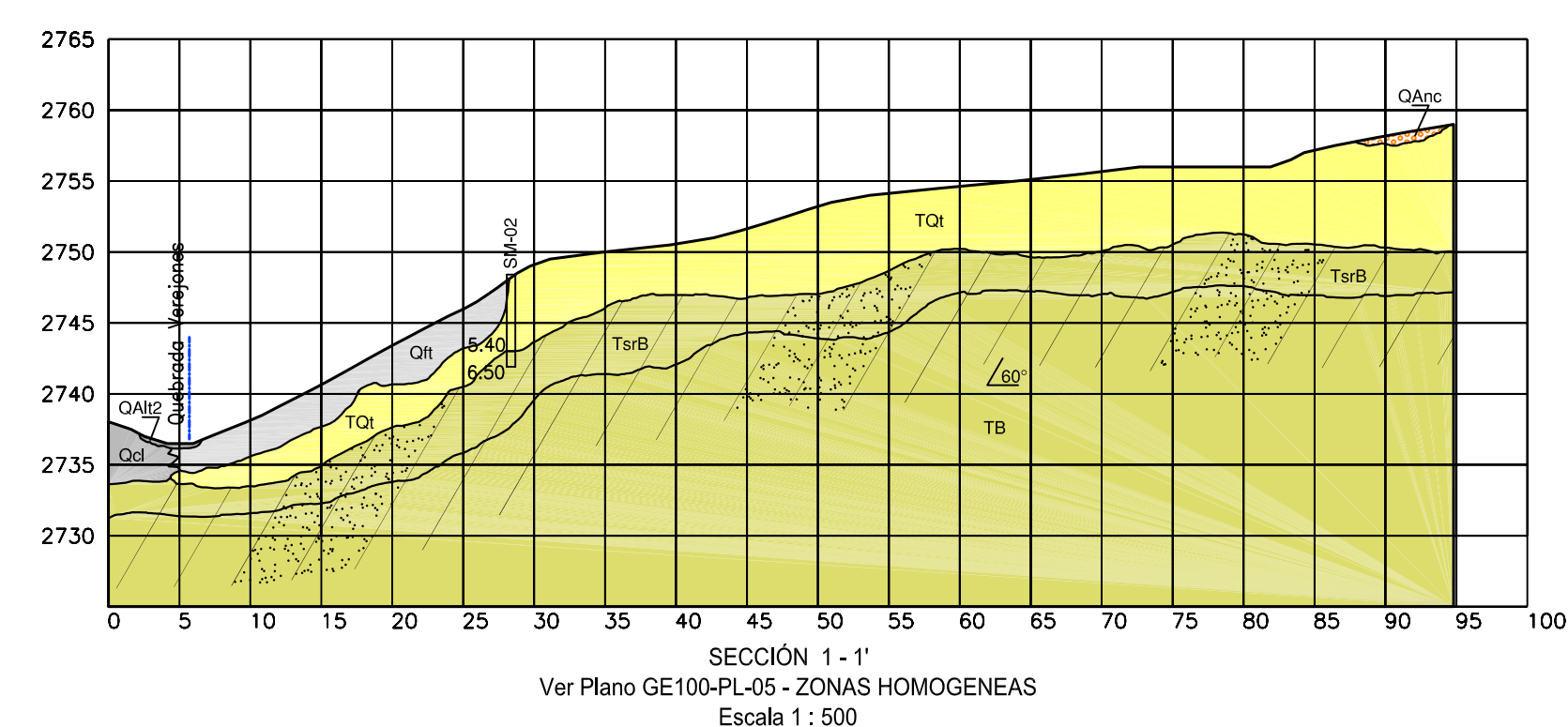
ALCALDIA MAYOR DE BOGOTÁ D.C.
 DIRECCION DE INGENIERIA Y SERVICIOS DE EMERGENCIAS
 SECRETARIA DE GOBIERNO

CONTRATISTA:
GE CING

DESCRIPCION:
 ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

ZONAS HOMOGENEAS

ELABORO:	RODOLFO FRANCO	INTERVENTORIA:	CIVILSUTUA
DISEÑO:	ING. RODOLFO FRANCO	ARCHIVO CAD:	GE103/PLANS/GE103-05.DWG
REVISOR:	ING. ELVAO SOLÍS	ESCALA:	1 : 500
APROBADO:	ING. ELVAO SOLÍS	FECHA:	ENERO-2004
		PLANO No.:	GE103-PL-05
		REVISION:	RI1



ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA
PLAZA BARRIO SILECIO	999870.718	1003302.016	2568.313
* Amore a la Plaza Barrio. Señalado con GPS			

PUNTO	ESTE	NORTE	COTA
MON. 1	999713.275	1003179.888	2561.700
MON. 2	999713.275	1003179.888	2561.700
MON. 3	999713.275	1003179.888	2561.700
MON. 4	999713.275	1003179.888	2561.700
MON. 5	999713.275	1003179.888	2561.700

CONVENCIONES GENERALES

LEYENDA

- QAlt1** ALUVIÓGENO RECIENTE
- QAlt2** ALUVIÓGENO RECIENTE
- Qcl** DEPOSITOS COLUVIALES
- Qt** FLUJOS DE TIERRA Y DEBRIDOS
- QRnc** RELLENOS ANTRÓPICOS COMPACTADOS
- QRanc** RELLENOS ANTRÓPICOS NO COMPACTADOS
- Tc** FORMACIÓN TILATA
- Tb** FORMACIÓN BOGOTÁ

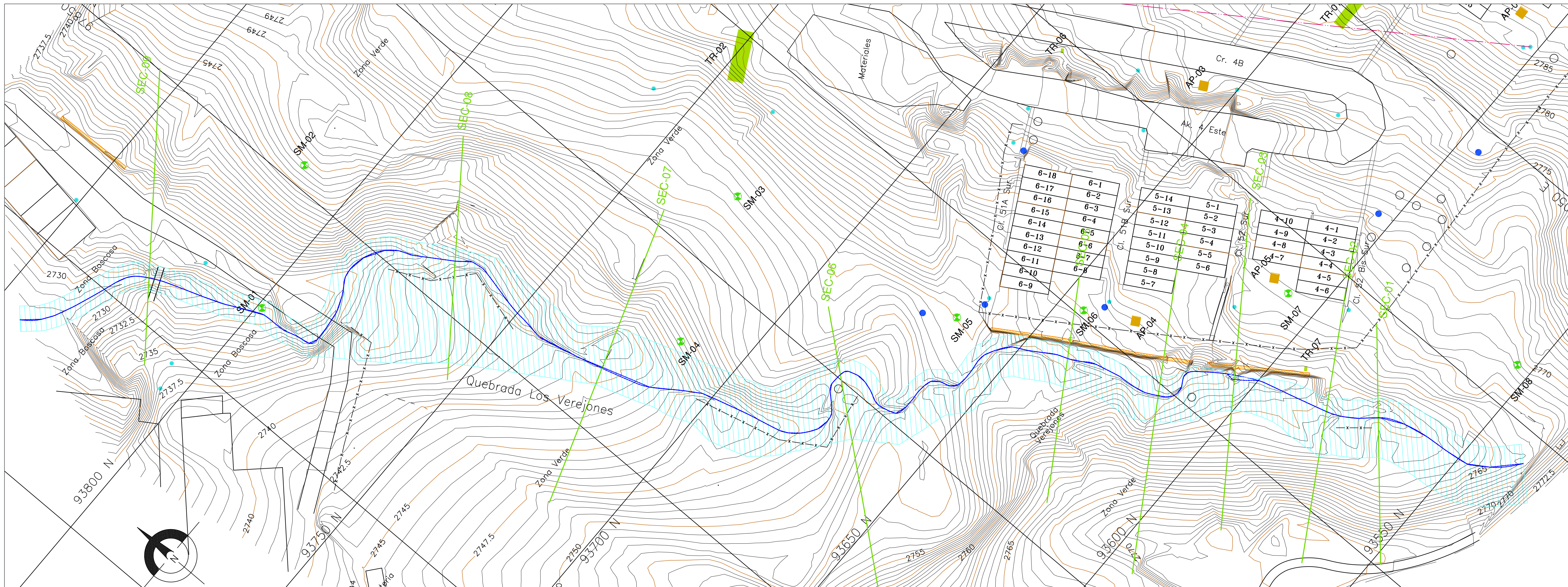
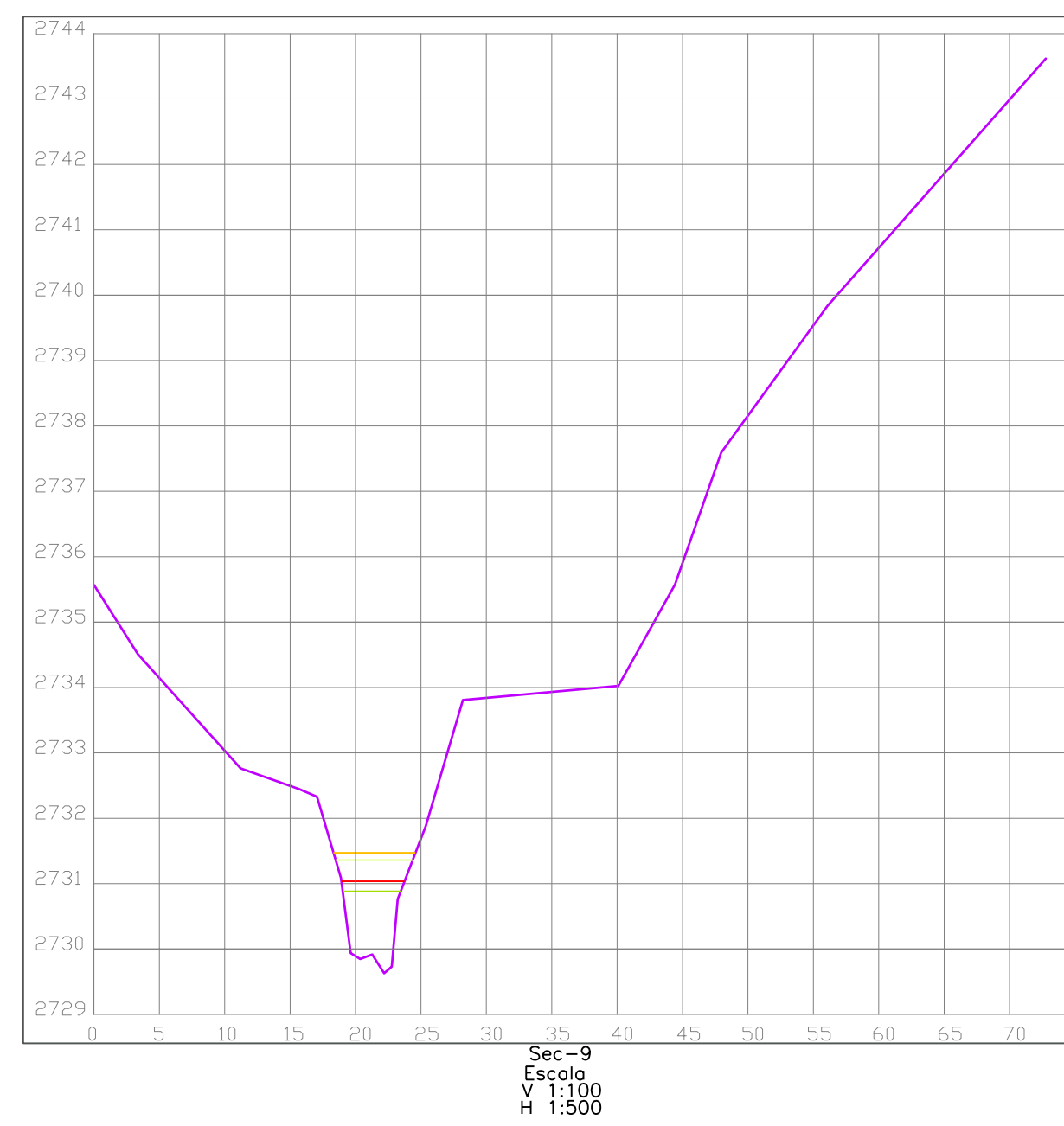
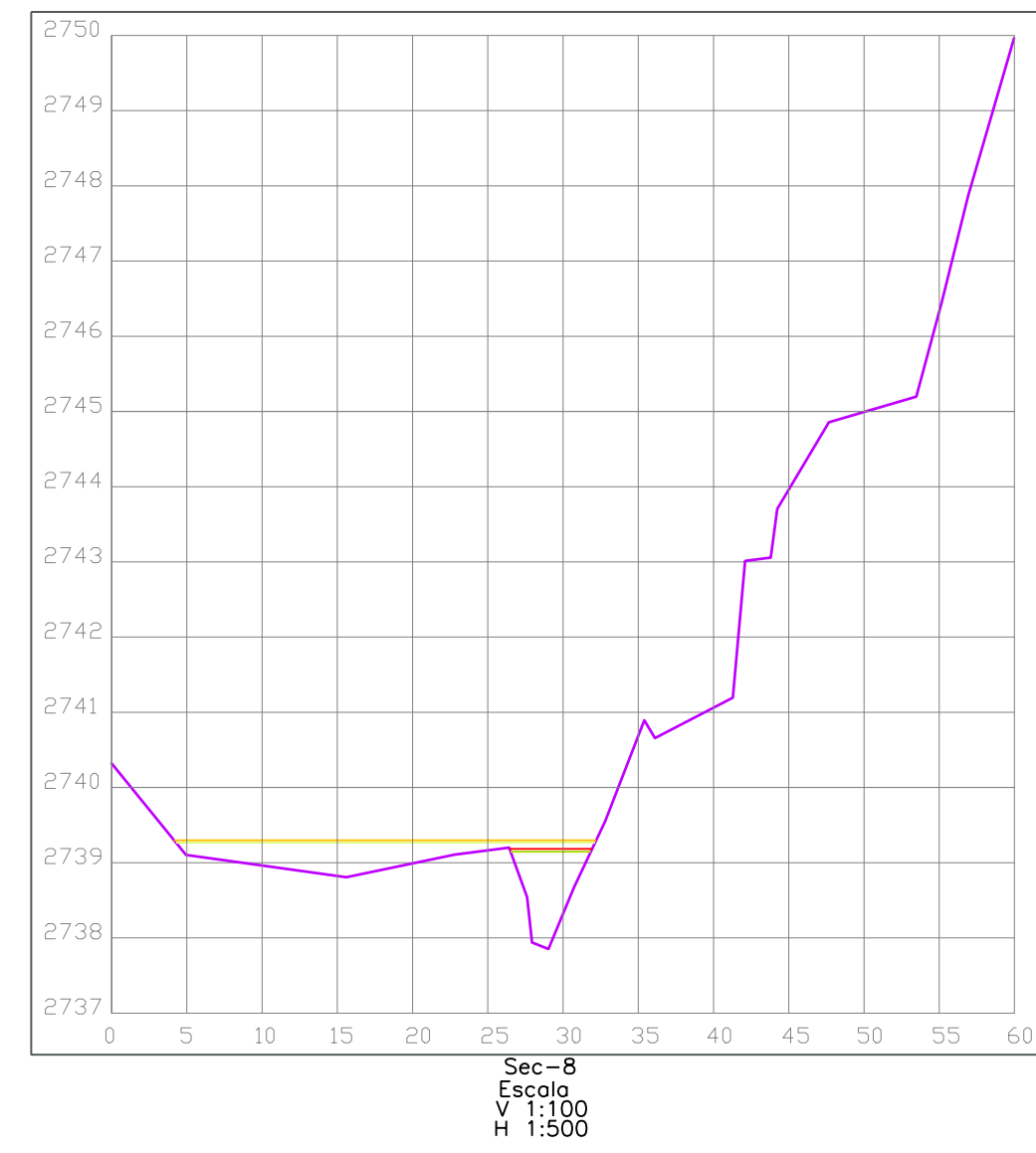
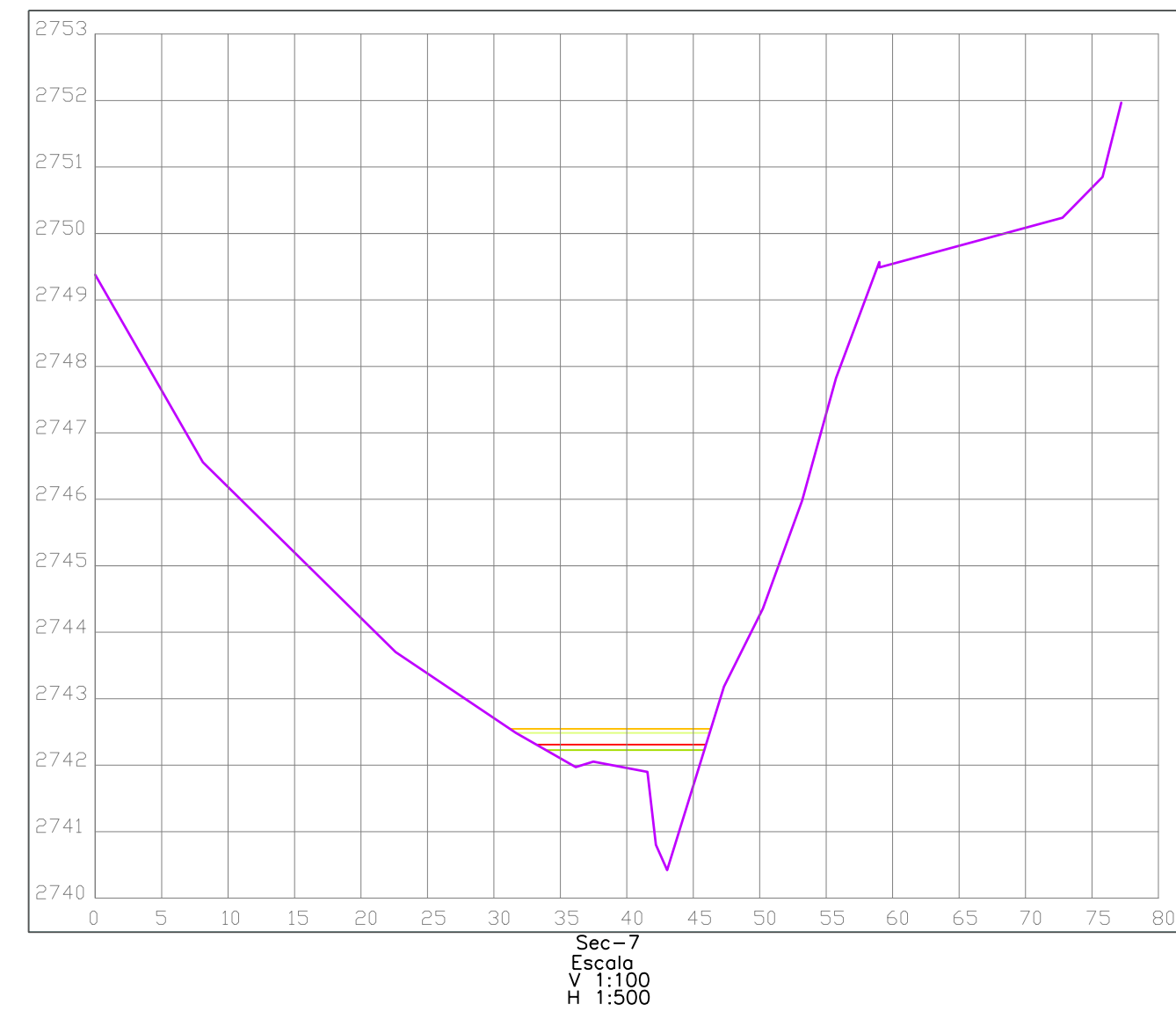
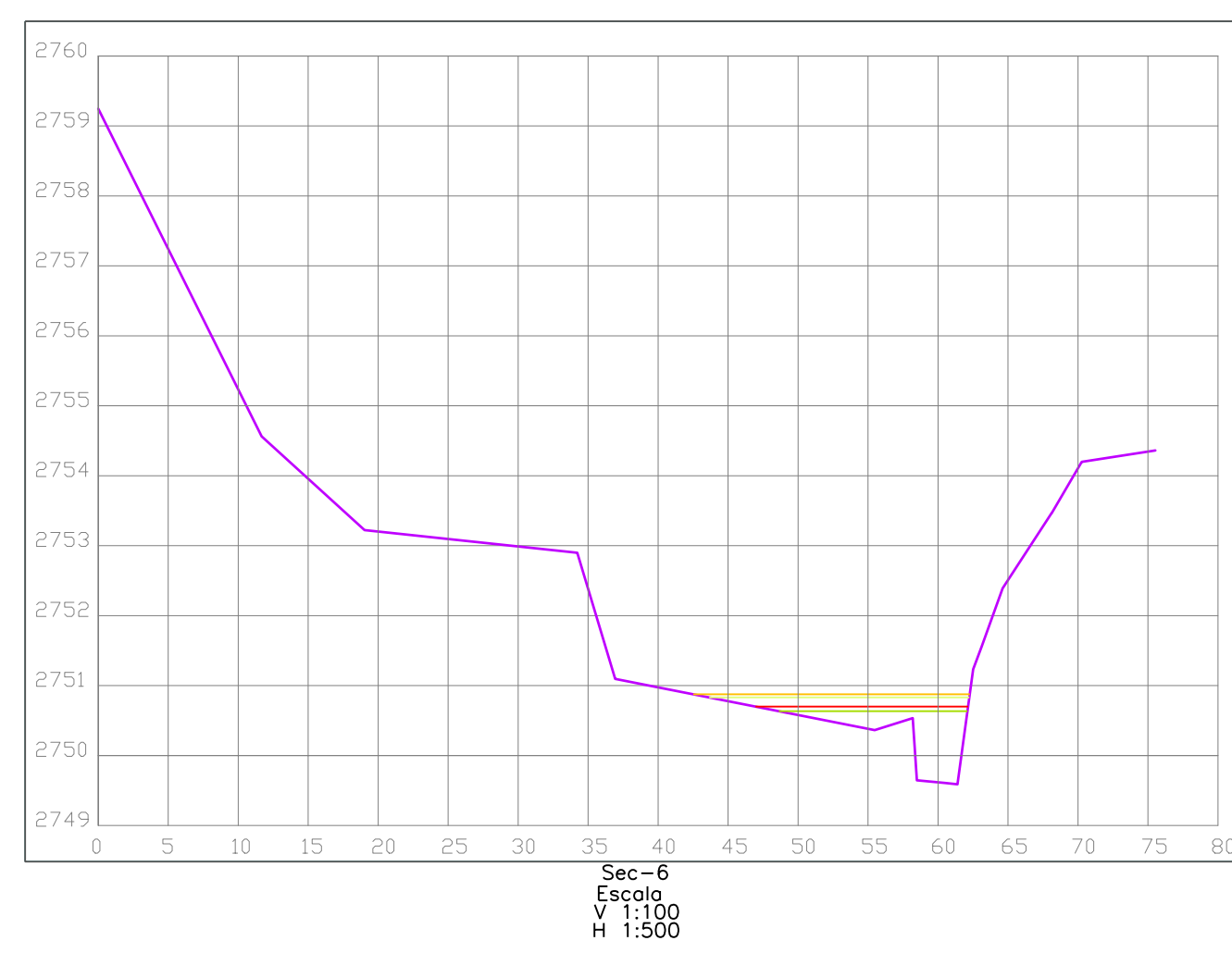
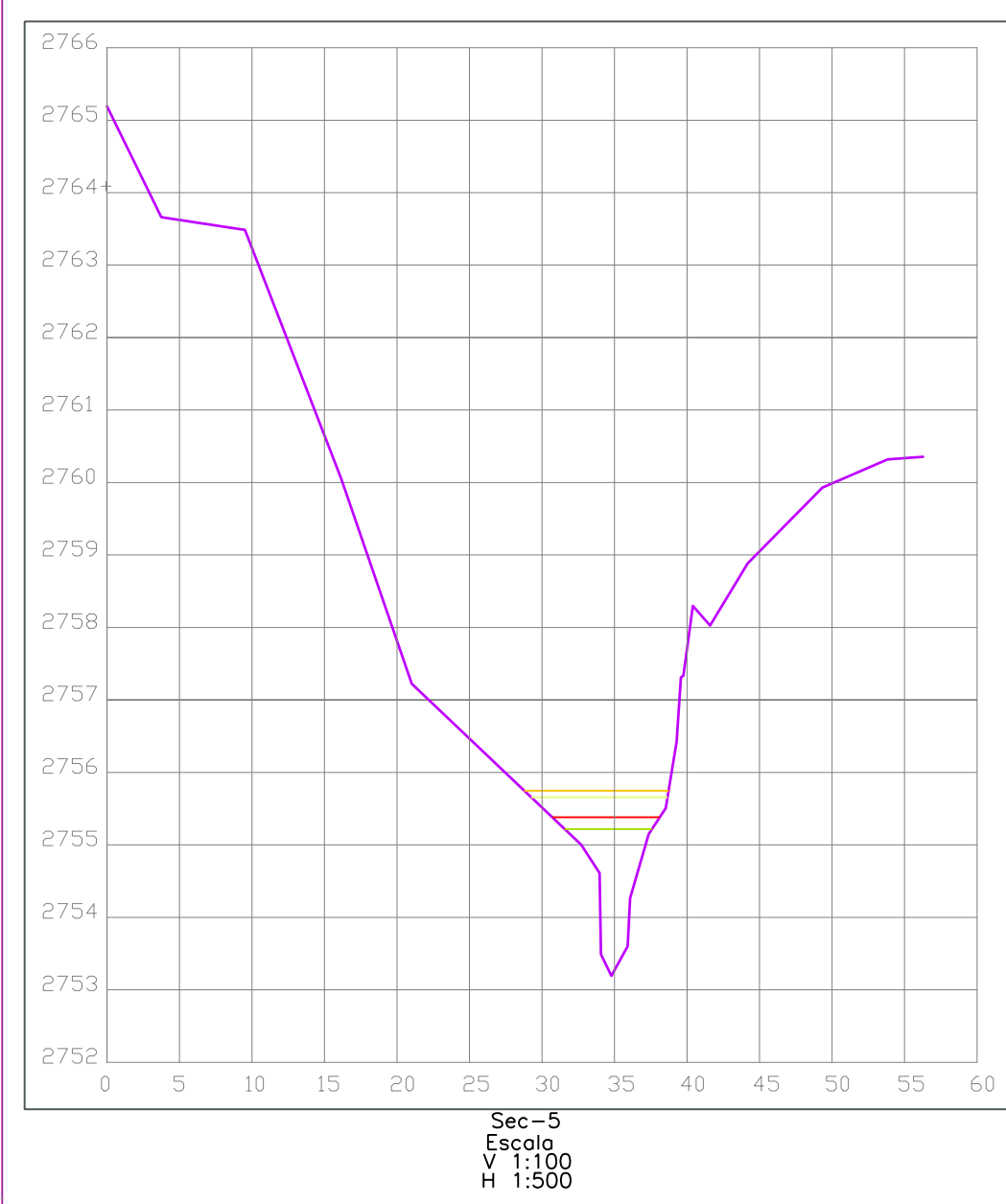
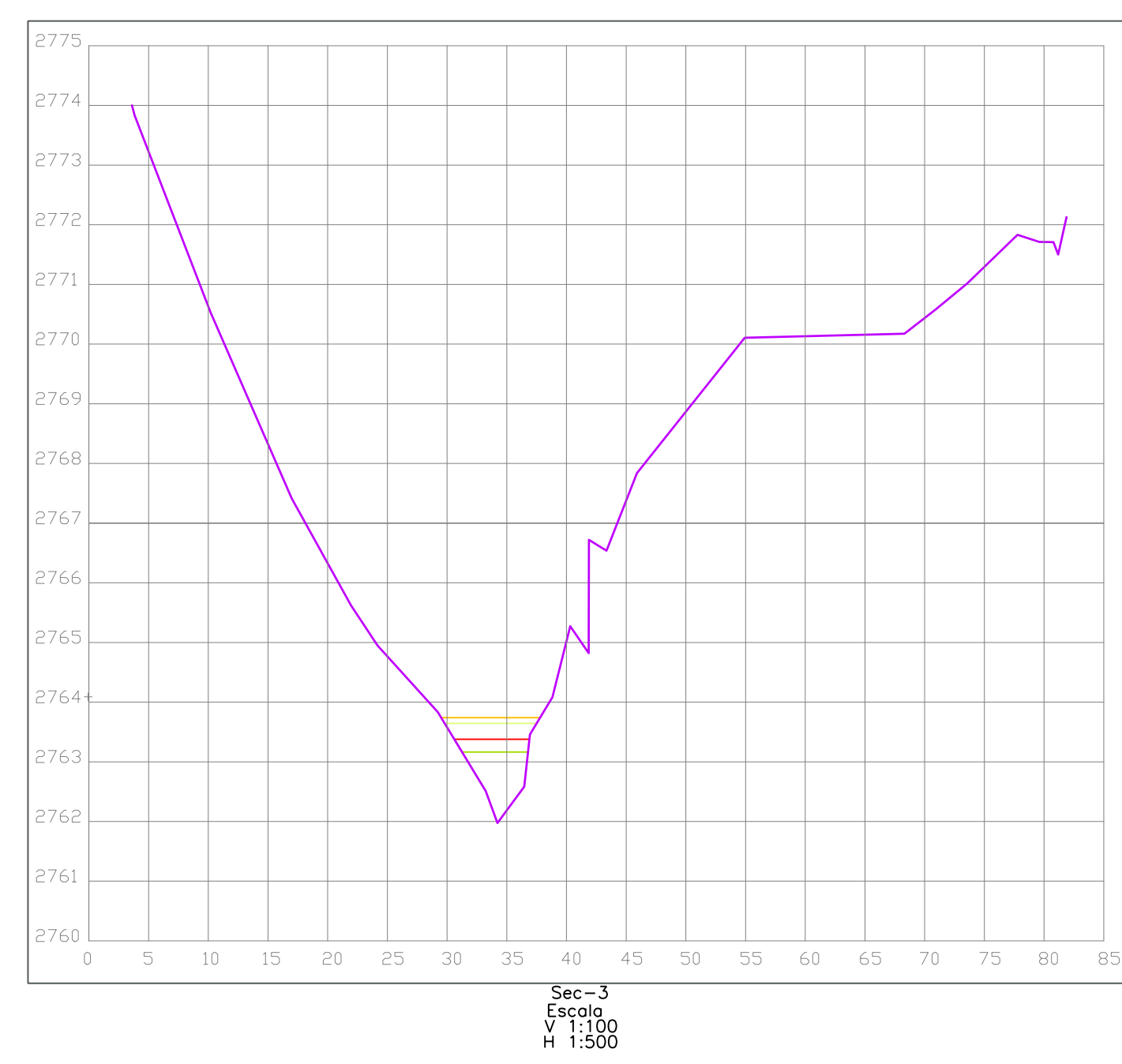
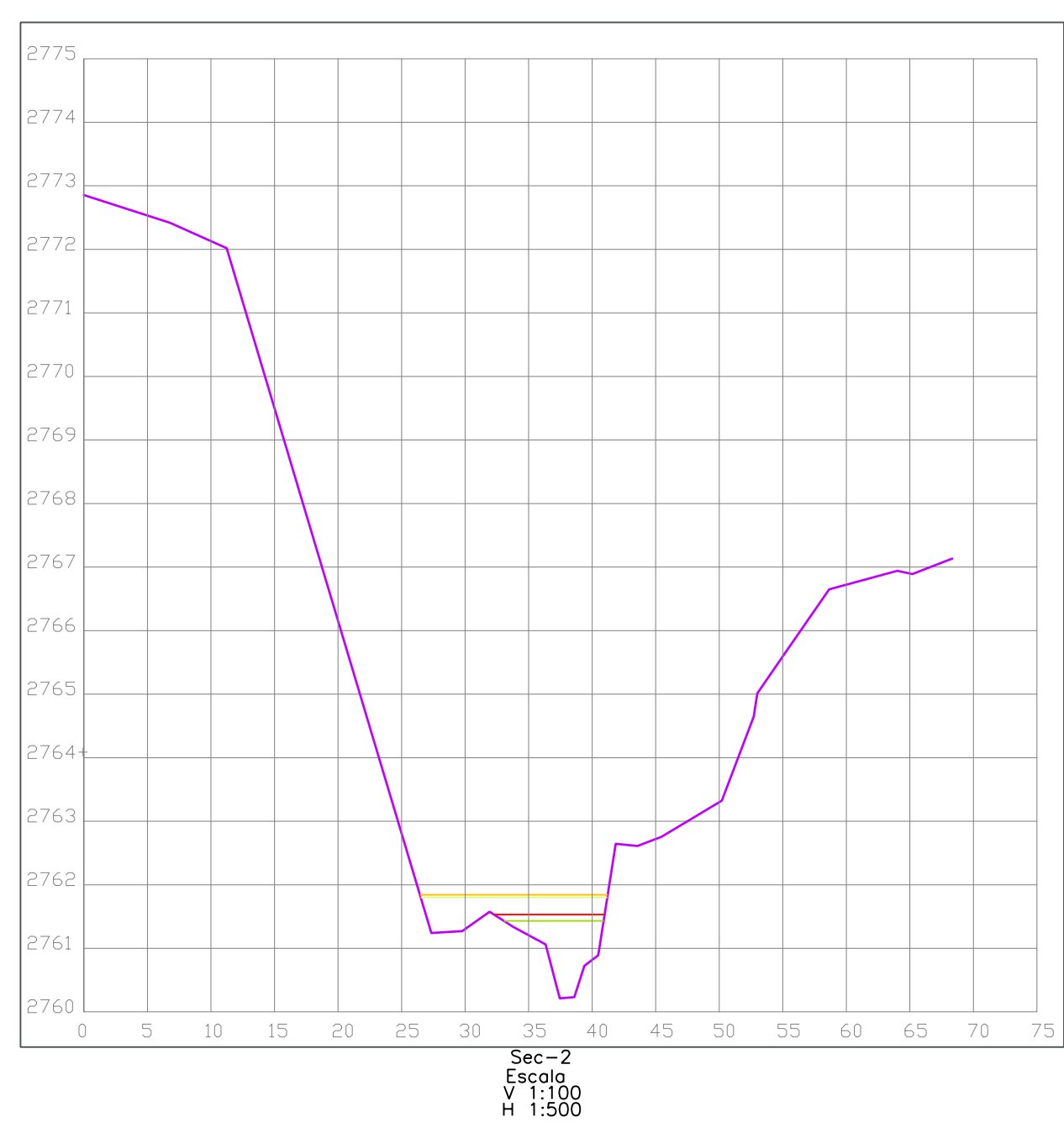
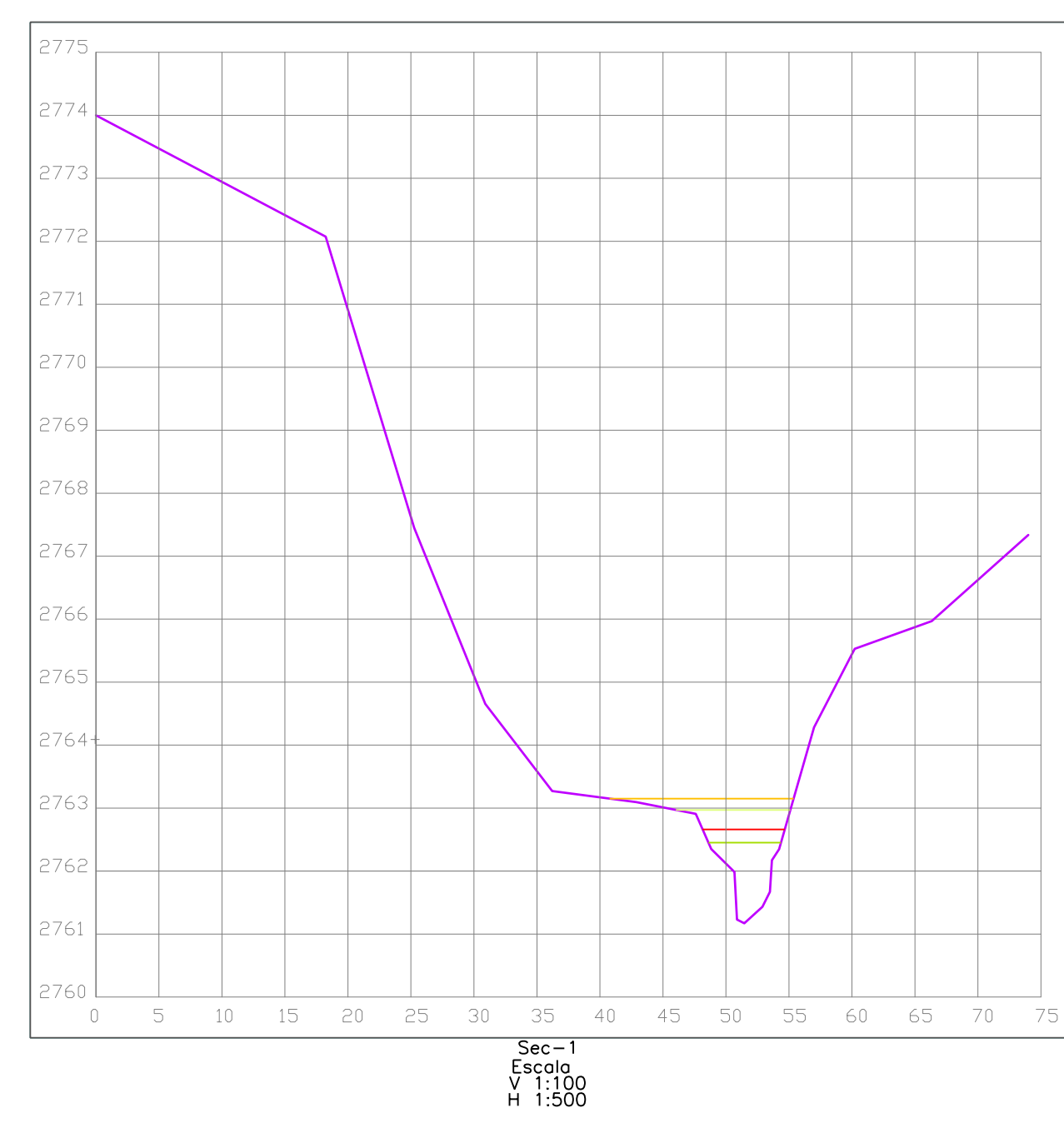
2	15/03/04	Para Aprobación de Interventoría	F.S.	F.S.
1	15/01/04	Revisión de Interventoría	R.F.	F.S.
REV	FECHA	DESCRIPCION	POR	APROBO



DESCRIPCION:
ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTA D.C. CONTRATO 383/03

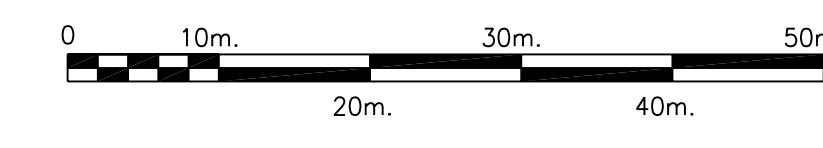
SECCIONES GEOLOGICAS Y DE ANALISIS

ELABORO:	RODOLFO FRANCO	INTERVENTORIA:	CIVILESUTIA
REVISOR:	JACARLOS TARAZONA	ARCHIVO ADO:	GE103/PLANS/GE103-06.DWG
APROBO:	FLAVIO SOLTE	ESCALA:	1 : 500
		FECHA:	ENERO-2004
		PLANO No:	GE103-PL-06
		REVISION:	RI1



RONDA HIDRAULICA PARA PERIODO DE RETORNO DE 100 AÑOS
Escala 1 : 500

ESCALA GRAFICA



ORIGEN DE COORDENADAS

PUNTO	ESTE	NORTE	COTA	
PLAZA BLANCO	99970.715	103332.016	2568.313	
* Anclados a la Plaza Blanca Señalada con GPS				
COORDENADAS DE MOLONES				
MOLON 1	10213.275	886	25819.200	2705.213
MOLON 2	10213.275	881	25819.200	2705.213
MOLON 3	10208.825	33551.865	1727.500	

CONVENCIONES GENERALES

- CURVA INDICE
- CURVA SECUNDARIA
- AREA DE ESTUDIO
- POLIGONAL DEL LEVANTAMIENTO
- CERCA
- GAVION
- POZO
- ARBOL
- POSTE DE ENERGIA
- RONDA HIDRAULICA PARA PERIODO DE RETORNO DE 100 AÑOS

SECCION	Perfiles de Muestra			
	3 Años	10 Años	50 Años	100 Años
Cotas Llama de Agua m.s.n.m				
1	2762.45	2762.88	2762.97	2763.15
2	2761.43	2761.53	2761.80	2761.84
3	2763.16	2763.30	2763.65	2763.74
4	2767.60	2767.62	2767.76	2767.81
5	2765.22	2765.30	2765.66	2765.75
6	2760.63	2760.70	2760.83	2760.88
7	2742.23	2742.31	2742.49	2742.55
8	2738.15	2738.18	2738.27	2738.30
9	2730.88	2731.04	2731.36	2731.47

2	15/03/04	Para Aprobación de Interventoría	F.S.	F.S.
1	15/01/04	Revisión de Interventoría	D.O.	F.S.
REV	FECHA	DESCRIPCION	POR APROBADO	

ALCALDIA MAYOR DE BOGOTÁ D.C.
DIRECCION DE PREVISION Y ATENCION DE EMERGENCIAS
SECRETARIA DE GOBIERNO



DESCRIPCION:
ESTUDIO DE RIESGO POR REMOCION EN MASA, EVALUACION DE ALTERNATIVAS DE MITIGACION Y DISEÑOS DETALLADOS DE LAS OBRAS DE ESTABILIZACION, PROTECCION Y/O CONTROL RECOMENDADAS PARA LA URBANIZACION NUEVA ROMA ORIENTAL, DE LA LOCALIDAD DE SAN CRISTOBAL EN LA CIUDAD DE BOGOTÁ D.C. CONTRATO 383/03

SECCIONES HIDRAULICAS	
ELABORO:	INTERVENTORIA:
ING. DANWIN J. ORTIZ	CIVILSUTUA
DISEÑO:	ARCHIVO ADO:
ING. RICO RINCON P.	GE103/PLANS/GE103-07.DWG
REVISOR:	ESCALA:
ING. ELIADO SOLÍS	1 : 500
APROBADO:	FECHA:
ING. ELIADO SOLÍS	ENERO - 2004
	PLANO No:
	GE103-PL-07
	REVISOR:
	RI