



ANEXO 3
VARIABLES DEL MODELO DE ANÁLISIS DE RIESGOS POR GEOPELIGROS

variable	Question	Type	description	Mechanism	notes
coating_geo	2	V	What is the pipeline coating?	General	coating
debris_agg	66	P	Are there processes causing temporary aggradation upstream of the pipeline?	DebrisFlow	
debris_cross_design	72	V	How effectively is the pipeline designed in relation to the size of the floodplain?	DebrisFlow	
debris_cross_type	71	V	What is the pipeline design configuration?	DebrisFlow	
debris_destable	67	P	Are there processes happening to destabilize the slope upstream of the pipeline?	DebrisFlow	
debris_evidence	63	P	Is there a river or stream course that might produce a debris torrent?	DebrisFlow	
debris_grad	68	P	What is the maximum gradient of the water course across the pipeline ROW?	DebrisFlow	
debris_monitor	74	V	Is there an effective monitoring program in place?	DebrisFlow	
debris_pipe_loc	70	V	Where is the pipeline located?	DebrisFlow	
debris_protect	73	V	Is the pipeline adequately protected?	DebrisFlow	
debris_rtn_25	64	P	What is the return period of events occupying up to 25% of the floodplain in the vicinity of the pipeline?	DebrisFlow	
debris_rtn_75	65	P	What is the return period of events occupying up to 75% of the floodplain in the vicinity of the pipeline?	DebrisFlow	ha sido eliminada de la base de datos
debris_vol	69	V	What is the estimated volume of the largest debris flow event?	DebrisFlow	
depth_geo	1c	V	If below ground, what is the burial depth?	General	[depth]
fault_activity	128	P	What is the apparent activity level?	TectonicFault	
fault_cross_design	131	V	Is the pipeline adequately designed to accommodate fault movement?	TectonicFault	
fault_dist	130	V	What is the proximity of the pipeline to the fault?	TectonicFault	
fault_evidence	127	P	Is there evidence of active or capable faults within 10 km of the pipeline?	TectonicFault	
fault_type	129	V	What is the type of fault?	TectonicFault	
freeze_thaw	19	P	What is the diurnal freeze thaw index?	General	
geology	18	P	Is the geology of the area generally?	General	
hydro_anthrop	91	P	Is there anthropogenic activity affecting the channel in the vicinity of the pipeline crossing?	HydroCrossing	
hydro_avulsion	95	P	Is there evidence of active or recent channel avulsion?	HydroCrossing	
hydro_bank_erosion	94	P	Is there evidence of active or recent erosion at the left and/or right bank?	HydroCrossing	
hydro_bank_lt	84	P	What is the shape of the left bank?	HydroCrossing	
hydro_bank_rt	83	P	What is the shape of the right bank?	HydroCrossing	
hydro_bedload	97	V	What is the maximum bedload size?	HydroCrossing	
hydro_class	76	P	What is the stream classification?	HydroCrossing	
hydro_confine	77	P	What is the stream confinement?	HydroCrossing	
hydro_cross_design	101	V	How effectively is the pipeline designed in relation to the size of the floodplain?	HydroCrossing	
hydro_cross_type	100	V	What is the pipeline design configuration?	HydroCrossing	
hydro_crossing	75	P	Is the pipeline exposed to a river or stream crossing hazard?	HydroCrossing	
hydro_debris	87	P	Is the floodplain potentially subject to debris flows at the crossing location?	HydroCrossing	
hydro_degrad	93	P	Is there evidence of active or recent channel degradation, or is there a natural or anthropogenic condition that might cause this?	HydroCrossing	
hydro_flow	79	P	What is the flow regime?	HydroCrossing	
hydro_grad	78	P	What is the maximum gradient of the water course across the pipeline ROW?	HydroCrossing	
hydro_monitor	104	V	Is there an effective monitoring program in place?	HydroCrossing	
hydro_nat_bank	81	P	What is the nature of the predominant materials comprising the bank at the edge of the active channel? (refer to Figure 4 to select a grain size distribution that is most representative of soil conditions)	HydroCrossing	
hydro_nat_plain	82	P	What is the nature of the predominant materials comprising the bank at the edge of the active channel?(refer to Figure 4 to select a grain size distribution that is most representative of soil conditions)	HydroCrossing	ha sido eliminada de la base de datos
hydro_obst	89	P	Are there channel obstructions at the pipeline crossing?	HydroCrossing	
hydro_obst_DS	90	P	Are there channel obstructions downstream?	HydroCrossing	
hydro_obst_US	88	P	Are there channel obstructions upstream?	HydroCrossing	



ANEXO 3
VARIABLES DEL MODELO DE ANÁLISIS DE RIESGOS POR GEOPELIGROS

variable	Question	Type	description	Mechanism	notes
hydro_par	105	P	Is the pipeline exposed to an encroachment or avulsion (parallel) river or stream crossing hazard?	HydroParallel	
hydro_par_bank	112	P	What is the shape of the bank closest to the pipeline, or avulsion hazard?	HydroParallel	
hydro_par_bedload	119	V	What is the maximum bedload size?	HydroParallel	
hydro_par_class	106	P	What is the stream classification?	HydroParallel	
hydro_par_confine	107	P	What is the stream confinement?	HydroParallel	
hydro_par_cross_design	124	V	How effectively is the pipeline designed in relation to the size of the floodplain?	HydroParallel	
hydro_par_cross_type	123	V	What is the pipeline design configuration?	HydroParallel	
hydro_par_debris	114	P	Is the floodplain potentially subject to debris flows?	HydroParallel	
hydro_par_dist	122	V	How many channel widths between the pipeline and the active stream channel where the encroachment or avulsion hazard is greatest?	HydroParallel	
hydro_par_eros_avul	118	P	Is there evidence that river action in the vicinity of the pipeline is now or has recently caused bank erosion or avulsion?	HydroParallel	
hydro_par_flow	109	P	What is the flow regime?	HydroParallel	
hydro_par_grad	108	P	What is the maximum gradient of the water course closest to the pipeline ROW, or where the avulsion hazard is greatest?	HydroParallel	
hydro_par_monitor	126	V	Is there an effective monitoring program in place?	HydroParallel	
hydro_par_nat	111	P	What is the nature of the predominant materials comprising the bank closest to the pipeline, or avulsion hazard? (refer to Figure 4 to select a grain size distribution that is most representative of soil conditions)	HydroParallel	
hydro_par_obst	116	P	Are there natural or anthropogenic channel obstructions that could increase the likelihood of an encroachment or avulsion hazard?	HydroParallel	
hydro_par_plain_active	117	P	Based on air photo interpretation, does the channel show evidence of a high degree of flood plain activity (movement)?	HydroParallel	
hydro_par_protect	125	V	Is the pipeline adequately protected?	HydroParallel	
hydro_par_ROW	115	P	Is there slope instability affecting the ROW such that the encroachment or avulsion hazard could worsen the present condition?	HydroParallel	
hydro_par_size	120	V	What is the river or stream size class?	HydroParallel	
hydro_par_slide	113	P	Are there landslides upstream affecting the supply of sediment?	HydroParallel	
hydro_par_veg	110	P	What is the bank vegetation at the edge of the active floodplain, closest to the pipeline, or avulsion hazard?	HydroParallel	
hydro_par_vegetal	121	V	Is there evidence that the river transports large quantities of vegetal debris during floods?	HydroParallel	
hydro_pipe_buoy	102	V	What is the nature of buoyancy control?	HydroCrossing	
hydro_plain_active	96	P	Based on air photo interpretation, does the channel show evidence of a high degree of flood plain activity (movement)?	HydroCrossing	
hydro_protect	103	V	Is the pipeline adequately protected?	HydroCrossing	
hydro_scour	92	P	Is there evidence of active or recent scour?	HydroCrossing	
hydro_size	98	V	What is the river or stream size class?	HydroCrossing	
hydro_slide	86	P	Are there landslides upstream affecting the supply of sediment?	HydroCrossing	
hydro_slope_ROW	85	P	Is river action contributing to slope instability along the lower portion of one or both approach slopes?	HydroCrossing	
hydro_veg	80	P	What is the bank vegetation at the edge of the active floodplain?	HydroCrossing	
hydro_vegetal	99	V	Is there evidence that the river transports large quantities of vegetal debris during floods?	HydroCrossing	
landslide_potential	12	P	Is there a slope above, across or below the ROW that might produce landslides with the potential to damage the pipeline?	General	
liq_design	134	V	Has the pipeline been adequately designed for the potential liquefaction hazard?	TectonicLiq	
liq_evidence	132b	P	Is there evidence of liquefaction?	TectonicLiq	
liq_free_face	133	V	Is there a free face or does the ground slope at more than 5 degrees?	TectonicLiq	
liq_soil_moist	132a	P	Are there loose granular soils present that are saturated at least 1 month per year?	TectonicLiq	
matl_nature	6	V	What is the nature of near surface material (refer to Figure 3 to select a grain size distribution that is most representative of the soil conditions)?	General	
matl_origin	5	P	What is the origin (genesis) of near surface material?	General	



ANEXO 3
VARIABLES DEL MODELO DE ANÁLISIS DE RIESGOS POR GEPELIGROS

variable	Question	Type	description	Mechanism	notes
photo_scale	10		What is the scale of the aerial photographs?	General	no ha sido tomada en cuenta
pipe_above_below	1a	V	What is the position of the pipeline?	General	[aerial]
pipe_position	17	V	The location of the pipeline in relationship to the slope is best described as:	General	
pipe_restrained	1b	V	If above ground surface, is it restrained?	General	en puentes
pipe_slope	4	P	What is the maximum gradient of the pipeline ROW?	General	xyz - altura
pipe_wall_geo	3	V	Is the pipeline wall thickness upgraded (to heavy walled)?	General	[pipe_wall_nom]
precip	7	P	What is the mean annual precipitation?	General	
seismic_acc_horz	8	P	What is the seismic zonation based on 1:475 peak horizontal ground acceleration?	General	
seismic_acc_vert	9	P	What is the seismic zonation based on 1:475 peak vertical ground acceleration?	General	no ha sido tomada en cuenta
slide_abv_activity	22	P	What is the activity level?	SlideAbove	
slide_abv_destable	24	P	Are there processes happening to destabilize the slope?	SlideAbove	
slide_abv_evidence	20	P	Is there a slope above the pipeline where rockfalls or slide/slumps have occurred?	SlideAbove	
slide_abv_grad_back	25	P	What is the maximum gradient of the cut backslope?	SlideAbove	
slide_abv_ht_back	26	P	Is the height of the backslope cut 8 m or more?	SlideAbove	
slide_abv_monitor	32	V	Is there an effective monitoring program in place?	SlideAbove	
slide_abv_nat_back	27	P	Which of the following best describes the nature of the backslope?	SlideAbove	
slide_abv_protect	31	V	Is the pipeline effectively protected from the expected movement?	SlideAbove	
slide_abv_type	21	V	Which of the following best describes the type of hazard observed?	SlideAbove	
slide_abv_vector_mvmt	30	V	What is the vector movement of rockfall or slide/slump in relation to the long axis of the pipe?	SlideAbove	ha sido eliminada de la base de datos
slide_abv_vel	29	V	What is the maximum velocity?	SlideAbove	
slide_abv_vol	28	V	What is the volume of the largest event?	SlideAbove	
slide_abv_water	23	P	Is there evidence of an elevated water table condition?	SlideAbove	
slide_blw_activity	49	P	What is the activity level?	SlideBelow	
slide_blw_destable	51	P	Are there processes happening to destabilize the slope?	SlideBelow	
slide_blw_evidence	48	P	Is there a slide/slump below the pipeline ROW?	SlideBelow	
slide_blw_grad_back	55	P	What is the maximum gradient of the cut backslope?	SlideBelow	
slide_blw_grad_side	52	P	What is the maximum gradient of the fill side slope?	SlideBelow	
slide_blw_ht_back	56	P	Is the height of the backslope cut 8 m or more?	SlideBelow	
slide_blw_ht_side	53	P	Is the height of the side slope cut 8 m or more?	SlideBelow	
slide_blw_monitor	62	V	Is there an effective monitoring program in place?	SlideBelow	
slide_blw_nat_back	57	P	Which of the following best describes the nature of the backslope?	SlideBelow	
slide_blw_nat_side	54	P	Which of the following best describes the nature of the side slope?	SlideBelow	
slide_blw_protect	61	V	Is the pipeline effectively protected from the expected movement?	SlideBelow	
slide_blw_vector_mvmt	60	V	What is the vector movement of the slide/slump in relation to the long axis of the pipe?	SlideBelow	ha sido eliminada de la base de datos
slide_blw_vel	59	V	What is the maximum velocity?	SlideBelow	
slide_blw_vol	58	V	What is the volume of the largest event?	SlideBelow	
slide_blw_water	50	P	Is there evidence of an elevated water table condition?	SlideBelow	
slide_thr_activity	34	P	What is the activity level?	SlideThrough	
slide_thr_destable	36	P	Are there processes happening to destabilize the slope?	SlideThrough	
slide_thr_evidence	33	P	Is there a slide/slump through the pipeline ROW?	SlideThrough	
slide_thr_grad_back	37	P	What is the maximum gradient of the cut backslope?	SlideThrough	
slide_thr_grad_side	39	P	What is the maximum gradient of the fill side slope?	SlideThrough	
slide_thr_ht_back	38	P	Is the height of the backslope cut 8 m or more?	SlideThrough	
slide_thr_ht_side	40	P	Is the height of the side slope fill 8 m or more?	SlideThrough	
slide_thr_monitor	47	V	Is there an effective monitoring program in place?	SlideThrough	
slide_thr_nat_back	41	P	Which of the following best describes the nature of the backslope?	SlideThrough	
slide_thr_nat_side	42	P	Which of the following best describes the nature of the side slope?	SlideThrough	
slide_thr_protect	46	V	Is the pipeline effectively protected from the expected movement?	SlideThrough	



ANEXO 3
VARIABLES DEL MODELO DE ANÁLISIS DE RIESGOS POR GEOPELIGROS

variable	Question	Type	description	Mechanism	notes
slide_thr_vector_mvmt	45	V	What is the vector movement of the slide/slump in relation to the long axis of the pipe?	SlideThrough	ha sido eliminada de la base de datos
slide_thr_vel	44	V	What is the maximum velocity?	SlideThrough	
slide_thr_vol	43	V	What is the volume of the largest event?	SlideThrough	
slide_thr_water	35	P	Is there evidence of an elevated water table condition?	SlideThrough	
spatial_dist_large	13	P	What is the spatial distribution of natural landslides greater than 1 million m3?	General	ha sido eliminada de la base de datos
spatial_dist_medium	14	P	What is the spatial distribution of natural landslides greater than 100,000 m3 and less than 1 million m3?	General	
spatial_dist_small	15	P	What is the spatial distribution of natural landslides less than 100,000 m3?	General	
terrain	16	P	The steepness of terrain across the ROW is predominantly described as:	General	
water_table	11	P	What is the water table condition?	General	