

CHAPTER 5

RESULTS OF PILOT INVENTORY SURVEY

5.1 Results of Preliminary Inventory Survey

5.1.1 Selection of Road Sections for PIS

The Road Sections to be surveyed were selected before the conduct of the PIS (Stage I) based on the information from the preparatory study, the initial field reconnaissance survey conducted by the Study Team together with the Counterpart Team from the 4th to the 12th of April 2006 and suggestions from the DPWH. Selected Road Sections for PIS are listed in Table 5.1.

The selection of Road Sections for the Inventory Survey was carried out considering the following criteria:

- 1) Security in the area,
- 2) Accessibility;
- 3) Coverage of all kinds of disaster types;
- 4) Equitable regional distribution;
- 5) Suggestions from DPWH; and
- 6) Present condition of the road.

Table 5.1 Road Sections Selected for the Preliminary Inventory Survey

Region	Road Section	Section (km)	Length (km)	DEO in Charge	Road Classification	AADT	Disaster Types
CAR	Kennon Rd	241-244	3	Baguio City	S	6,880/ 5,014	RS, RC, RE, SC, DF
		214-241	27	Benguet 1st			
	Baguio- Bontoc Rd (Halsema Highway)	263-341	78	Benguet 2nd	A(OT)	953	RS, SC, RC, DF, LS
	Nueva Vizcaya- Ifugao-Mt Province Rd (Lagawe- Banaue)	301-333	32	Ifugao	S	275/ 3,116	SC, RS, DF, RC, LS
	Subtotal Length(km)		140				
II	Daang Maharlika (LZ) (Dalton Pass)	208-220	12	Nueva Vizcaya Sub	A(NS)	3,769	RS, SC, RC, DF, RE
	Subtotal Length(km)		12				
VII	Cebu- Balamban Transcentral	5-30	25	Cebu City	A(EW)	1,001/ 1,305	RS, SC, RC, DF
		30-42	12	Cebu 3rd			
	Toledo-Baliri- Santander Rd (Ginatilan- Alegria)	143-179	36	Cebu 4th	A(NS)	500/ 12,000	CE, RC, RE, SC, RS
	Subtotal Length(km)		73				
VIII	Wright-Taft-Borongan Rd	843-859	16	Samar 2nd	A(EW)	500/ 1,374	RS, SC, RC, DF
	Daang Maharlika (LT) (Mahaplag- Sugod)	995-1003	8	Leyte 5th	A(NS)	659/ 1,581	RS, SC, RC, DF, RE, LS
		1003- 1018	15	Southern Leyte			
Subtotal Length(km)		39					
X	Misamis Oriental- Bukidnon-Agusan Road	1428-1464	36	Bukidnon 3rd	A(NS)	3,421	RS, SC, RC
	Bukidnon-Davao City Rd	1605-1607	2	Bukidnon 2nd	A(NS)	3,340	SC, RS, RC
	Subtotal Length (km)		38				
XI	Davao-Cotabato Road	1525-1555	30	Davao-Del Sur 1st	A(NS)	3,486/ 6,517	RE, RS, SC
	Subtotal Length (km)		30				
	Total Length (km)		332				

Disaster Types; SC: Soils Slope Collapse; RC: Rock Slope Collapse; LS: Landslide; RS: Road Slip; DF: Debris Flow; RE: River Erosion; CE: Coastal Erosion; In each Road Section, the disaster type is listed in the order of dominance

Road Classification; A(NS) Arterial (North-South Backbone), A(EW): Arterial (East-West Lateral), A(OT): Arterial (Other Road of Strategic Importance), S: Secondary National Road,

5.1.2 Result of Preliminary Inventory Survey

Sixteen National Highway road sections in six Regions were selected for the pilot PIS. A total length of 332 km had been surveyed by mid-January 2007.

Along the 332 km of road sections, 1933 slopes were surveyed based on the PIS Criteria.

Results indicate that around 61% of the slopes had a high risk level that required a DIS. The distribution of the disaster types and number of slopes in the PIS and the DIS are shown in Table 5.2. A summary of the PIS results is shown in Table 5.3 and Figure 5.4.

Table 5.2 Distribution of Disaster Types in PIS Sections

Disaster Type	PIS Slopes	Selected DIS Slopes
Soil Slope Collapse	533 (28%)	387 (73% of PIS)
Rock Slope Collapse	301 (16%)	268 (89% of PIS)
Landslides	8 (0%)	8 (100% of PIS)
Road Slips	784 (41%)	334 (44% of PIS)
Debris Flow	147 (8%)	60 (41% of PIS)
River Erosion	84 (4%)	46 (55% of PIS)
Costal Erosion	76 (4%)	58 (76% of PIS)
Total	1933 (100%)	1170 (61% of PIS)

Source: PIS results for the 332 km of sections surveyed in 16 selected road sections.

Table 5.3 PIS Result of Study Road Sections

Region	Road Section	Section (km)	Length (km)	Office in Charge (DEO)	Preliminary Inventory Survey								Detailed Inventory Survey							
					Disaster Type								Disaster Type							
					SC	RC	LS	RS	DF	RE	CE	Total	SC	RC	LS	RS	DF	RE	CE	Total
CAR	Kennon Rd	241 - 244	3	Baguio City	8	15	0	9	12	0	0	44	5	5	0	7	0	0	0	17
		214 - 241	27	Benguet 1st	31	54	0	88	9	34	0	216	15	51	0	27	5	20	0	118
	Baguio-Bontoc Rd	263 - 341	78	Benguet 2nd	125	76	2	153	30	0	0	386	113	70	2	116	17	0	0	318
	Nueva Vizcaya-Ifugao-Mt. Province Rd	301 - 333	32	Ifugao	91	24	4	72	54	0	0	245	72	22	4	22	18	0	0	138
	Sub-total		140		255	169	6	322	105	34	0	891	205	148	6	172	40	20	0	591
II	Daang Maharlika (LZ)	208 - 220	12	Nueva Vizcaya Sub	31	27	0	37	17	6	0	118	11	23	0	9	5	2	0	50
	Sub-total		12		31	27	0	37	17	6	0	118	11	23	0	9	5	2	0	50
VII	Cebu-Balamban Transcentral Highway	5 - 30	25	Cebu City	59	29	0	92	2	0	0	182	30	25	0	28	2	0	0	85
		30 - 42	12	Cebu 3rd	21	10	0	68	9	0	0	108	15	10	0	16	4	0	0	45
	Toledo-Baliri-Santander Rd	143 - 179	36	Cebu 4th	11	18	0	4	0	14	76	123	6	18	0	0	0	7	58	89
	Sub-total		73		91	57	0	164	11	14	76	413	51	53	0	44	6	7	58	219
VIII	Wright-Taft-Borongan Rd	843 - 859	16	Samar 2nd	18	9	0	34	4	0	0	65	10	7	0	17	2	0	0	36
	Daang Maharlika (LT)	995 - 1003	8	Leyte 5th	20	0	0	26	0	8	0	54	9	0	0	6	0	5	0	20
		1003 - 1018	15	Southern Leyte	41	18	2	38	9	0	0	108	33	18	2	20	7	0	0	80
	Sub-total		39		79	27	2	98	13	8	0	227	52	25	2	43	9	5	0	136
X	Misamis Or-Bukidnon-Agusan Rd	1428 - 1464	36	Bukidnon 3rd	69	20	0	157	1	1	0	248	60	18	0	71	0	0	0	149
	Bukidnon-Davao City Rd	1605 - 1607	2	Bukidnon 2nd	6	1	0	2	0	0	0	9	6	1	0	2	0	0	0	9
	Sub-total		38		75	21	0	159	1	1	0	257	66	19	0	73	0	0	0	158
XI	Davao-Cotabato Rd	1525 - 1555	30	Davao Del Sur 1st	2	0	0	4	0	21	0	27	2	0	0	2	0	12	0	16
	Sub-total		30		2	0	0	4	0	21	0	27	2	0	0	2	0	12	0	16
TOTAL			332		533	301	8	784	147	84	76	1933	387	268	8	343	60	46	58	1170

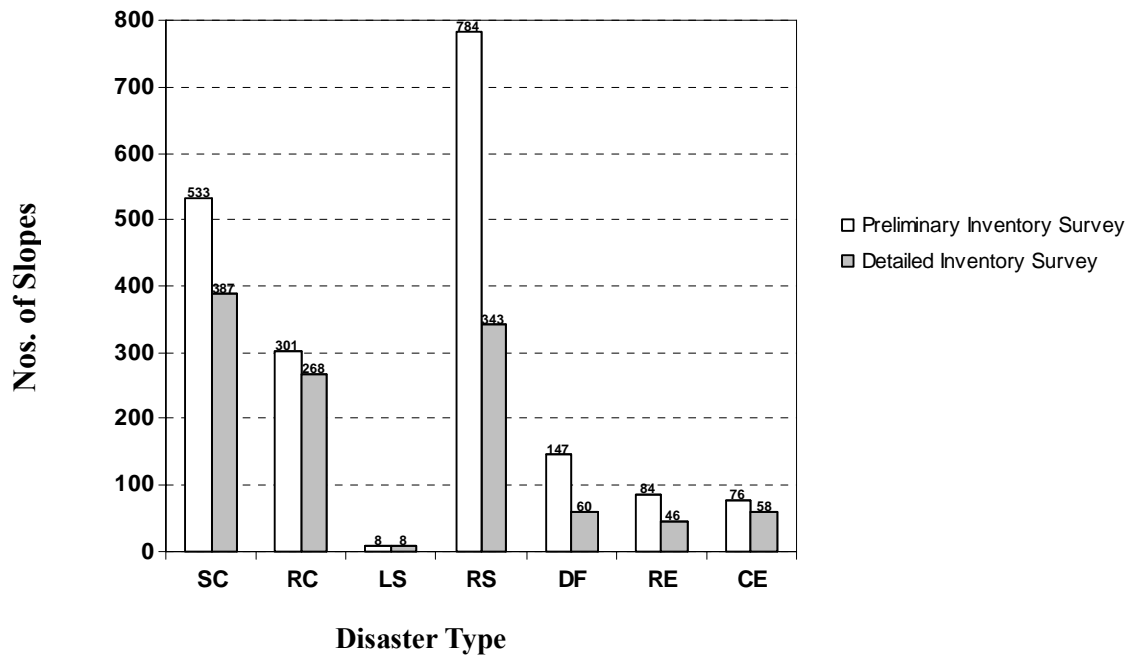


Figure 5.1 Nos. of PIS Slopes/Selected DIS Slopes of Pilot Inventory Survey

5.1.3 Results of the PIS by Region

(1) Cordillera Autonomous Region (CAR)

Three roads in CAR were included in this study. Those were Kennon Road, Baguio-Bontoc Road (Halsema Highway) and Nueva Vizcaya-Ifugao-Mt Province Road (Lagawe-Banaue Road). Those three roads mostly traverse the steep slopes of valleys and ridges in the mountainous areas of the Cordillera Region, and are therefore prone to road slope and sediment-related disasters.

Kennon Road is being managed by two District Offices of DPWH, namely; Baguio City DEO (km 241 to km 244 for PIS) and Benguet 1st DEO (km 241 to km 244 for PIS). The Nueva Vizcaya-Ifugao-Mt. Province Road (Lagawe-Banaue Road) is managed by the Ifugao DEO, and the Baguio-Bontoc Road (Halsema Highway) is managed by the Benguet 2nd DEO (km 263 to km 341 for PIS).

(a) Kennon Road

A total of 216 slopes along 30 km of road sections were surveyed along Kennon Road. The percentages for the various disaster types were: 41% Road Slip; 25% Rock Slope Collapse; 16% River Erosion; 14% Soil Slope Collapse; and 4% Debris Flow. Around 55% of the PIS slopes were judged to require a DIS. The PIS Results along Kennon Road are shown in Figures 5.2 and 5.4

(b) Baguio Bontoc Rd (Halsema Highway)

A total of 386 slopes were surveyed along the Baguio Bontoc Rd, with the following percentages for each disaster type: 40% Road Slip, 32% Soil Slope Collapse, 20% Rock Slope Collapse, 8% Debris Flow, 11% Rock Slope Collapse and 1 % Landslide. Around 66% of the slopes in the PIS will be subjected to DIS.

The PIS results along the Baguio-Bontoc Rd are shown in Figures 5.3 and 5.5.

(c) Nueva Vizcaya-Ifugao-Mt. Province Road (Lagawe-Banaue Road)

A total of 245 slopes were surveyed along the Nueva Vizcaya-Ifugao-Mt. Province Road, with the following percentages for each disaster type: 37% Soil Collapse; 29% Road Slip, 22% Debris Flow, 10% Rock Slope Collapse and 2 % Landslide. In this road section, about 56% of the slopes in the PIS will be subjected to DIS.

The PIS results along the Nueva Vizcaya-Ifugao-Mt. Province Road are shown in Figure 5.6.

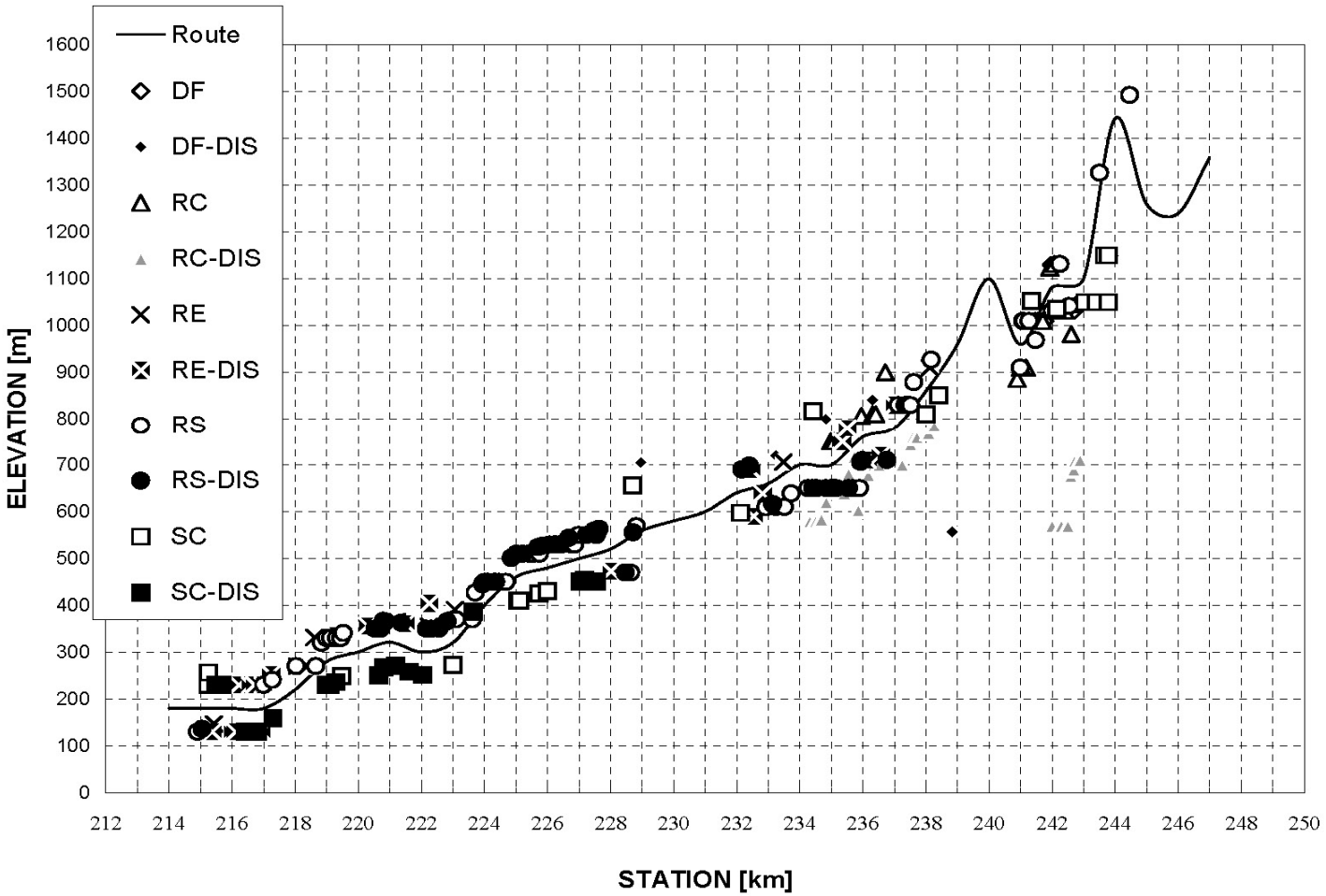


Figure 5.2 PIS Results Profile for Kennon Road

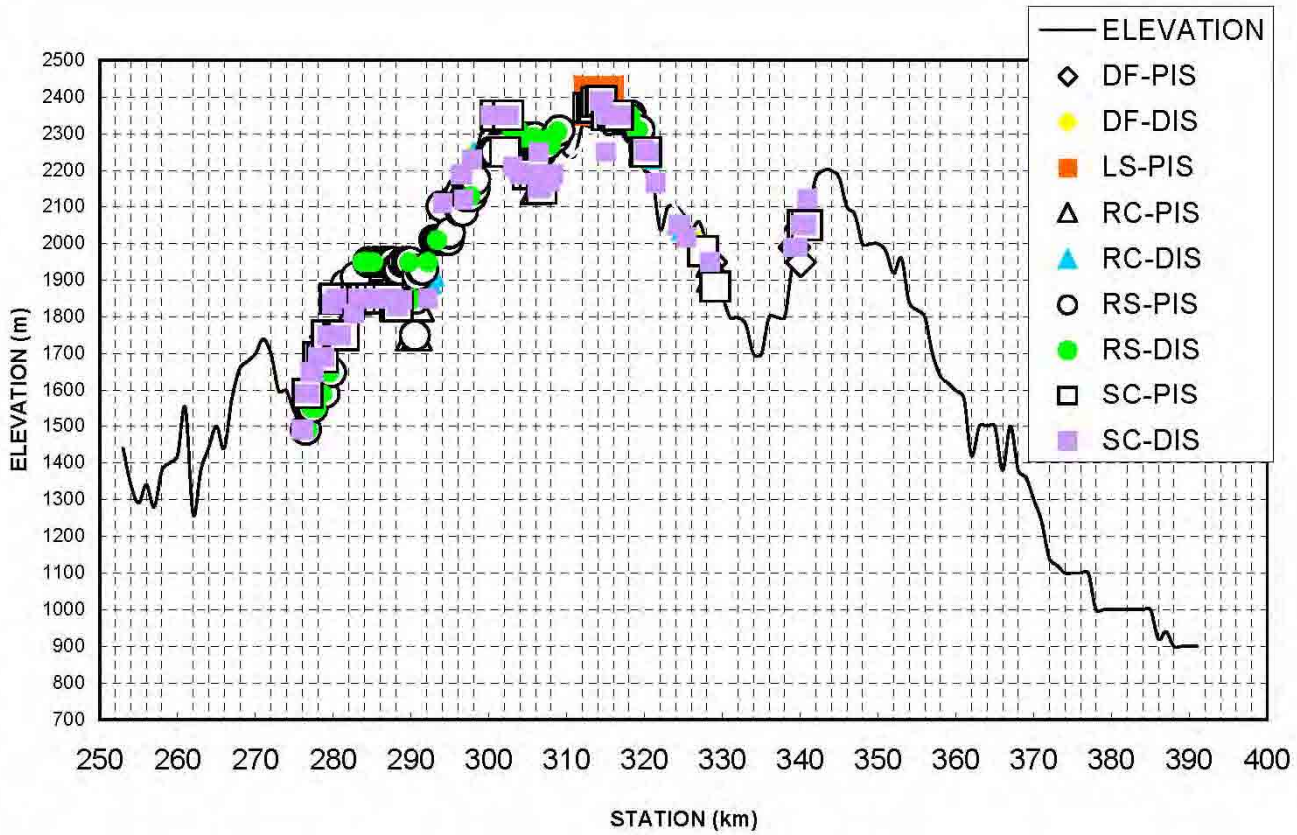


Figure 5.3 PIS Results Profile for Baguio –Bontoc Road(Halsema Highway)

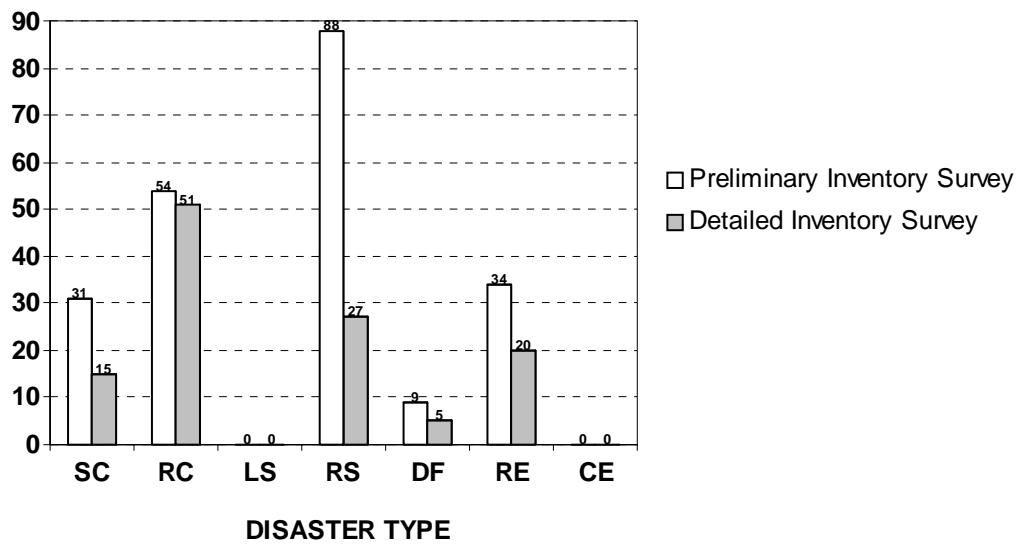


Figure 5.4 PIS Results for Kennon Road

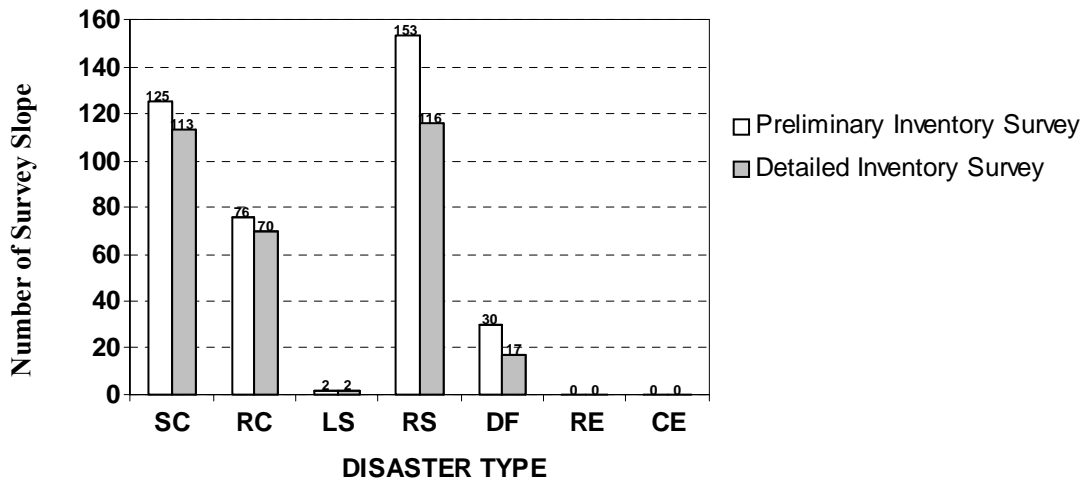


Figure 5.5 PIS Results for Baguio Bontoc Road (Halsema Highway)

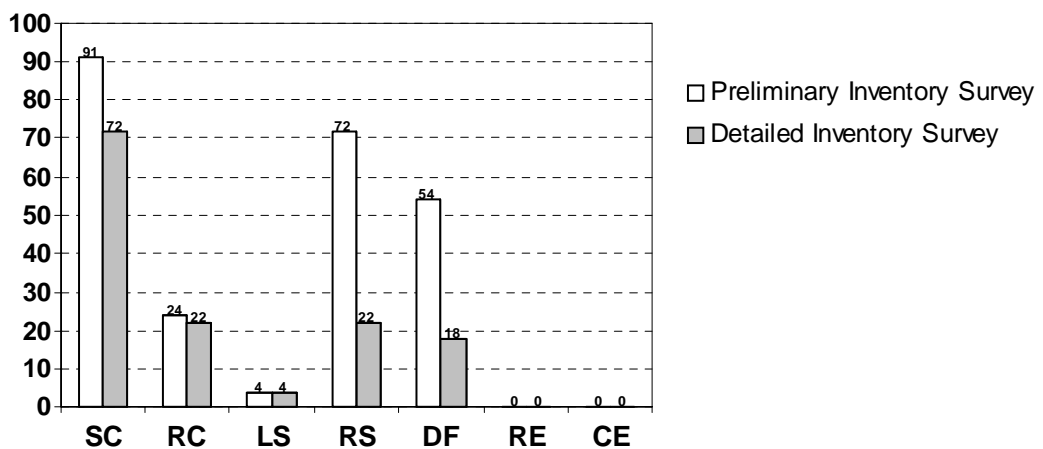


Figure 5.6 PIS Results for Nueva Vizcaya – Ifugao - Mt. Province Road

(2) Region II

The section of the Daang Maharlika (LZ) (km 208+000 to km 220+000) was surveyed.

(a) Daang Maharlika (LZ) (Dalton Pass)

A total of 118 slopes along a road length of 12 km (km 208+000 to km 220+000) were surveyed along Daang Maharlika (LZ). Of these, 31% were Road Slips; 26% Soil Slope Collapse; 23% Rock Slope Collapse; 14% Debris Flow; and the remaining 5% River Erosion. Around 42% of the PIS slopes meet the DIS selection criteria. The PIS result along Daang Maharlika (LZ) is shown in Figures 5.7. and 5.8.

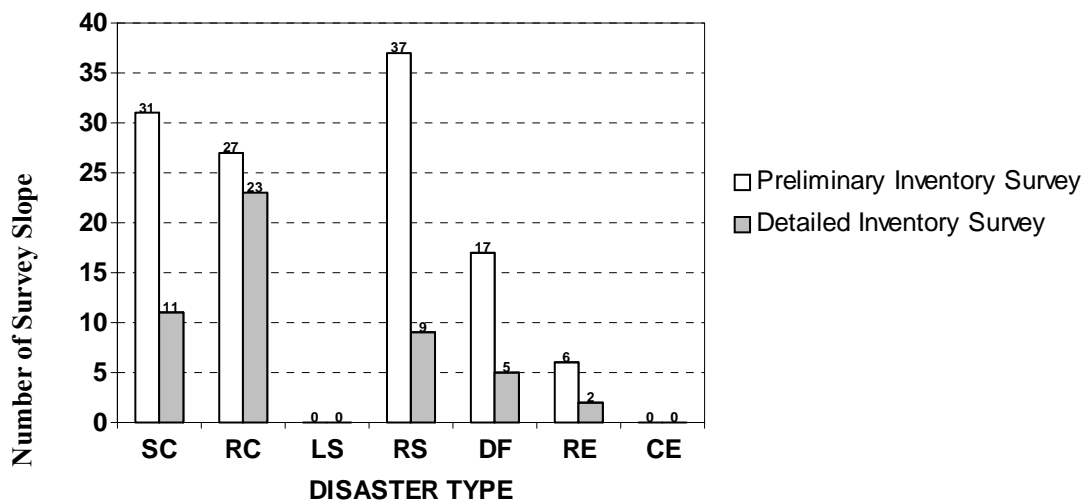


Figure 5.7 PIS Results for Daang Maharlika (LZ)

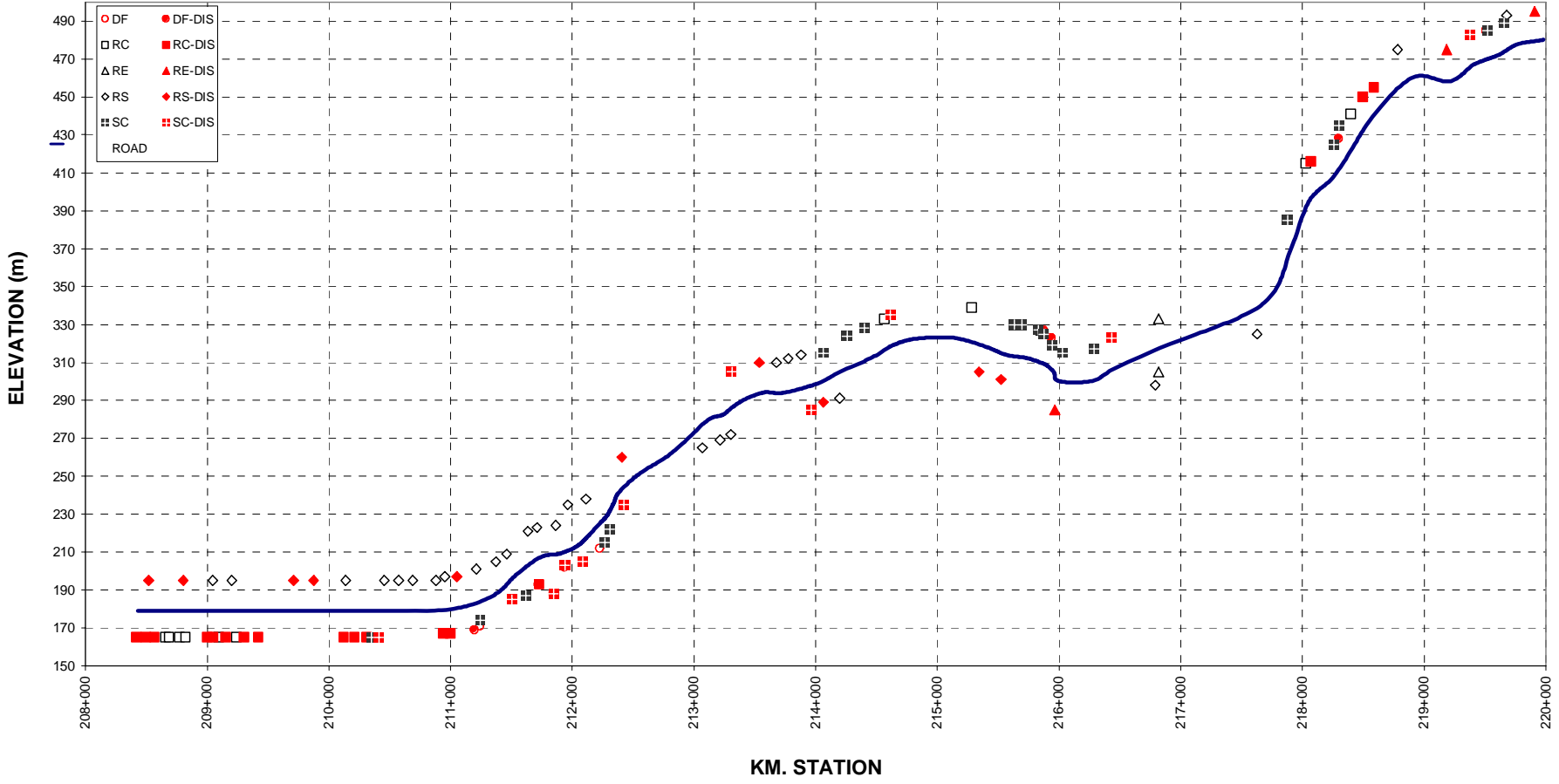


Figure 5.8 PIS Results Profile for Daang Maharlika (LZ)

(3) Region VII

Two Road Sections were surveyed in the PIS for Region VII, namely: Cebu Balamban Transcentral Highway and the Ginatilan Alegria Section of Toledo-Baliri-Santander Rd. The former is under the management of and maintained by two DEOs, the Cebu City DEO (km 5 to km 30) and Cebu 3rd DEO (km 30 to km 42) and the later is under the Cebu 4th DEO.

(a) Cebu-Balamban Transcentral Highway

The Cebu-Balamban Transcentral Highway traverses the mountainous area of Cebu province with a total of 279 sub-sections meeting the PIS criteria. The disaster types observed were Road Slips (55%); Soil Slope Collapse (28%); Rock Slope Collapse (13%); and Debris Flow (4%). Considering the present conditions along this route, around 45% qualify for DIS.

The PIS results of the Cebu-Balamban Transcentral Highway are shown in Figure 5.9.

(b) Ginatilan Alegria Section of Toledo-Baliri-Santander Rd

The total length of surveyed sections along Ginatilan Alegria Section of Toledo-Baliri-Santander Rd is 36 km, starting from km 143 to km 179. The most common disaster type was Coastal Erosion (62%) caused by tidal action. The remaining 38% is distributed into combinations of Soil Slope Collapse, Rock Slope Collapse and River Erosion. Around 72% of PIS slopes require a DIS.

The PIS results along Ginatilan Alegria Section are shown in Figure 5.10.

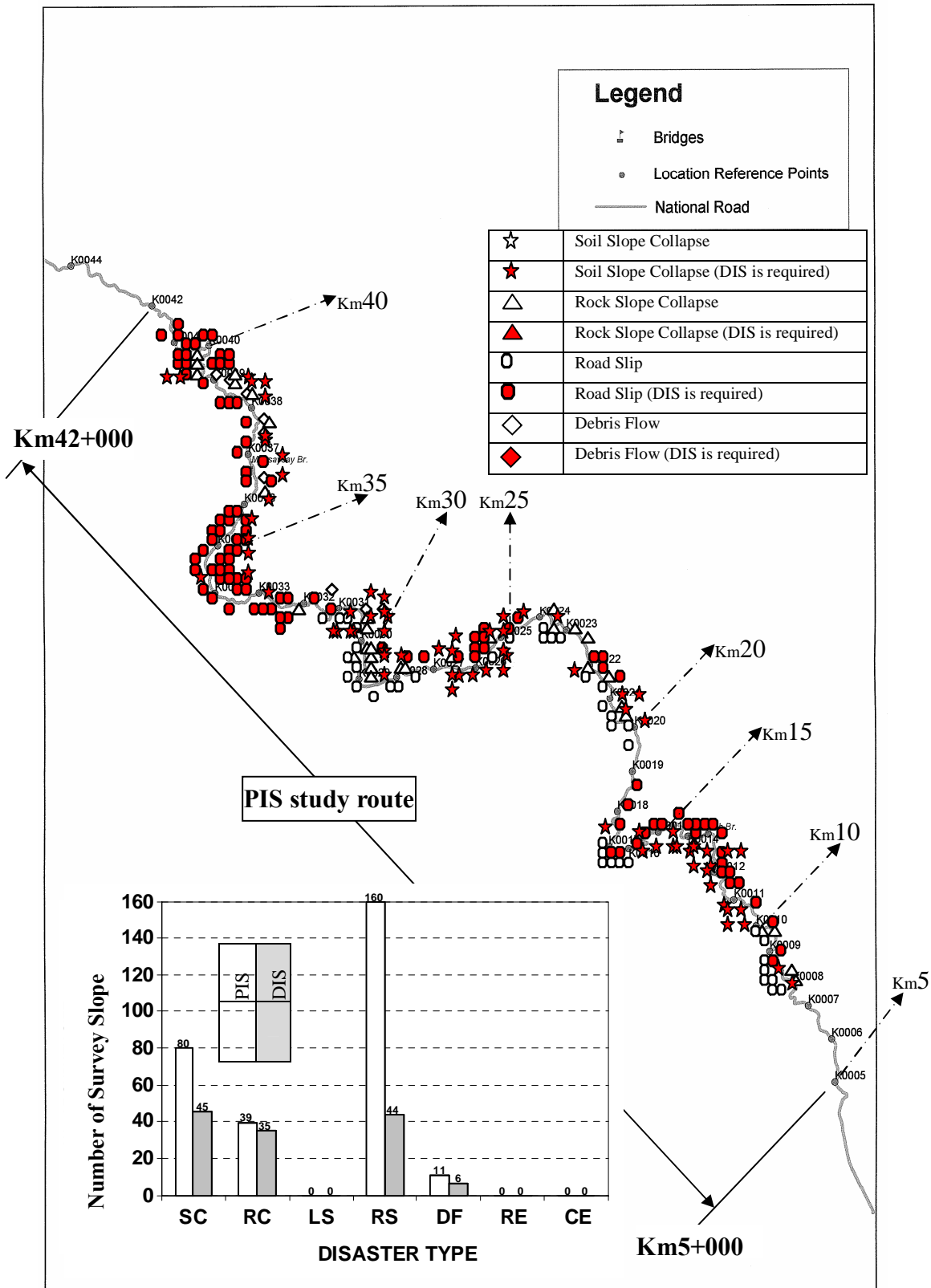


Figure 5.9 PIS results for Cebu-Balamban Transcentral Highway

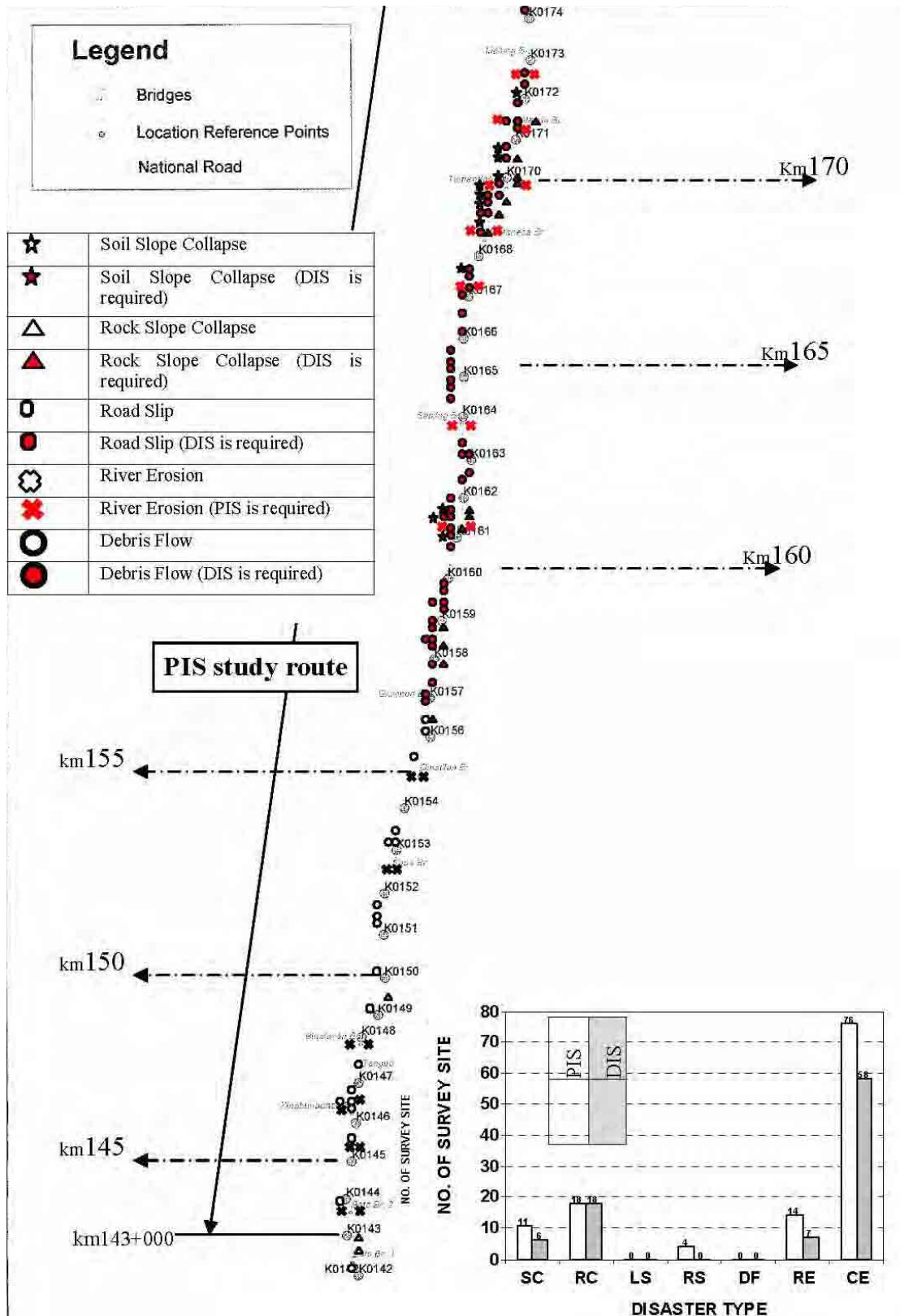


Figure 5.10 PIS Results along Ginatilan - Alegria Section of Toledo-Baliri-Santander Road

(4) Region VIII

There are two Road Sections for Pilot PIS in Region VIII, namely: the Wright-Taft-Borongon Road, which is under the responsibility of the Samar 2nd DEO; and the Mahaplag-Sugod Section of Daang Maharlika (LT) under the Leyte 5th DEO and Southern Leyte DEO.

(a) Wright - Taft - Borongan Rd

PIS in Wright-Taft road started at km 843+000 and ended at km 859+000.

A total of 65 slopes were surveyed along the Wright-Taft-Borongon Road, which traverses a mountainous area. The disaster types observed were: 52% Road Slips; 28%, Soil Slope Collapse; 14% Rock Slope Collapse; and 6% Debris Flow. About 55% of the 65 PIS slopes conform to the DIS criteria.

The PIS results for Wright- Taft- Borongan Rd are shown in Figure 5.11.

(b) Daang Maharlika (LT) (Mahaplag-Sugod Section)

Daang Maharlika (LT) (Mahaplag - Sugod Section) from km 995 – km 1003 under the Leyte 5th DEO and from km 1103 – km 1018 under Southern Leyte DEO was surveyed.

The Daang Maharlika Highway(LT) (Mahaplag-Sugod Section) traverses the steep slopes of a mountainous area, and 162 slopes were surveyed. The two most common disaster types observed were Road Slips (40%) and Soil Slope Collapse (38%). Other types were Rock Slope Collapse (11%); Debris Flow (6%); River Erosion (5%); and Landslides (1%). Out of the 162 slopes surveyed, 60% of qualify for the conduct of a DIS.

The PIS results of the Daang Maharlika Highway (LT) (Mahaplag-Sugod Road) are shown in Figure 5.12.

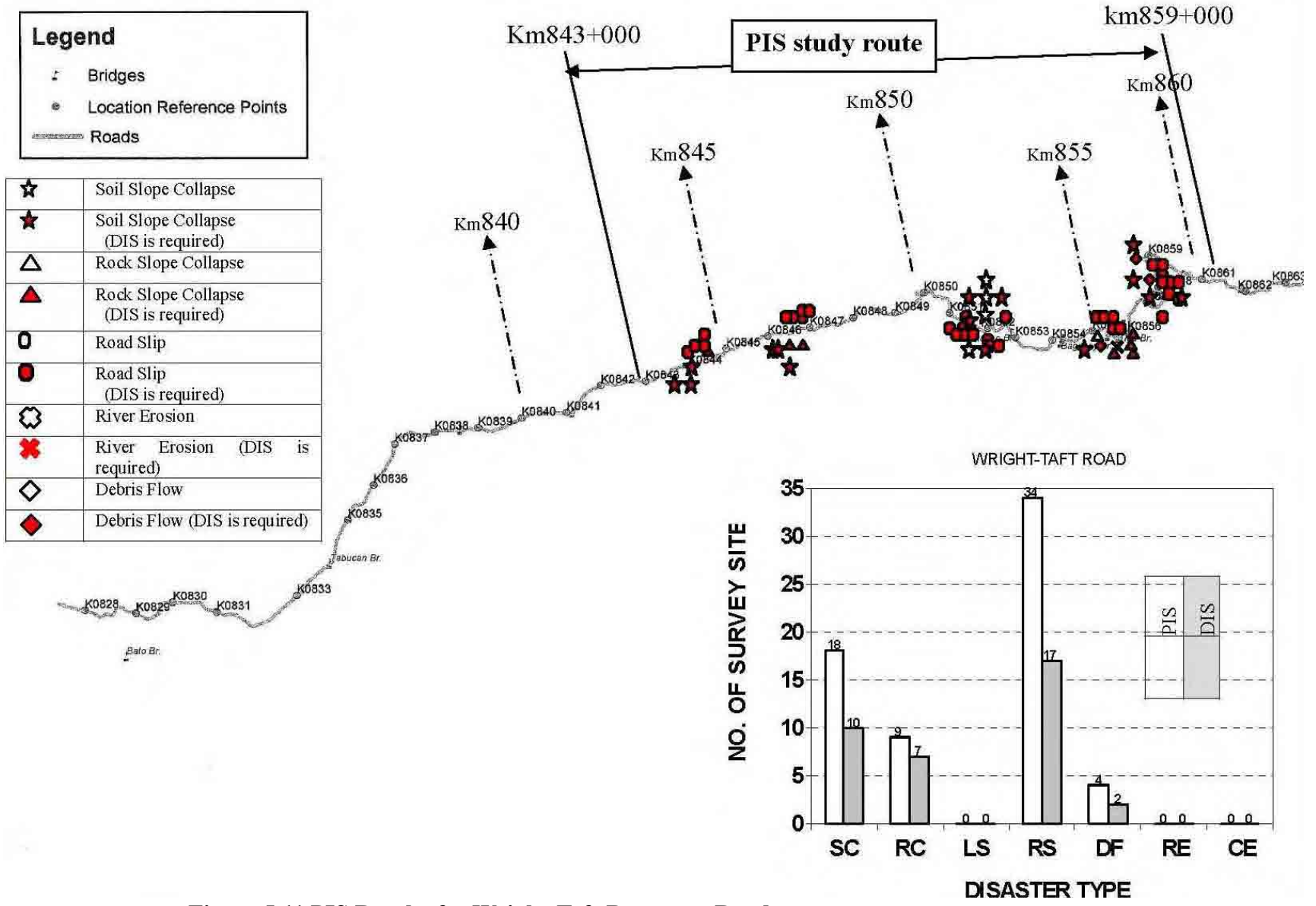


Figure 5.11 PIS Results for Wright-Taft-Borong Road

^

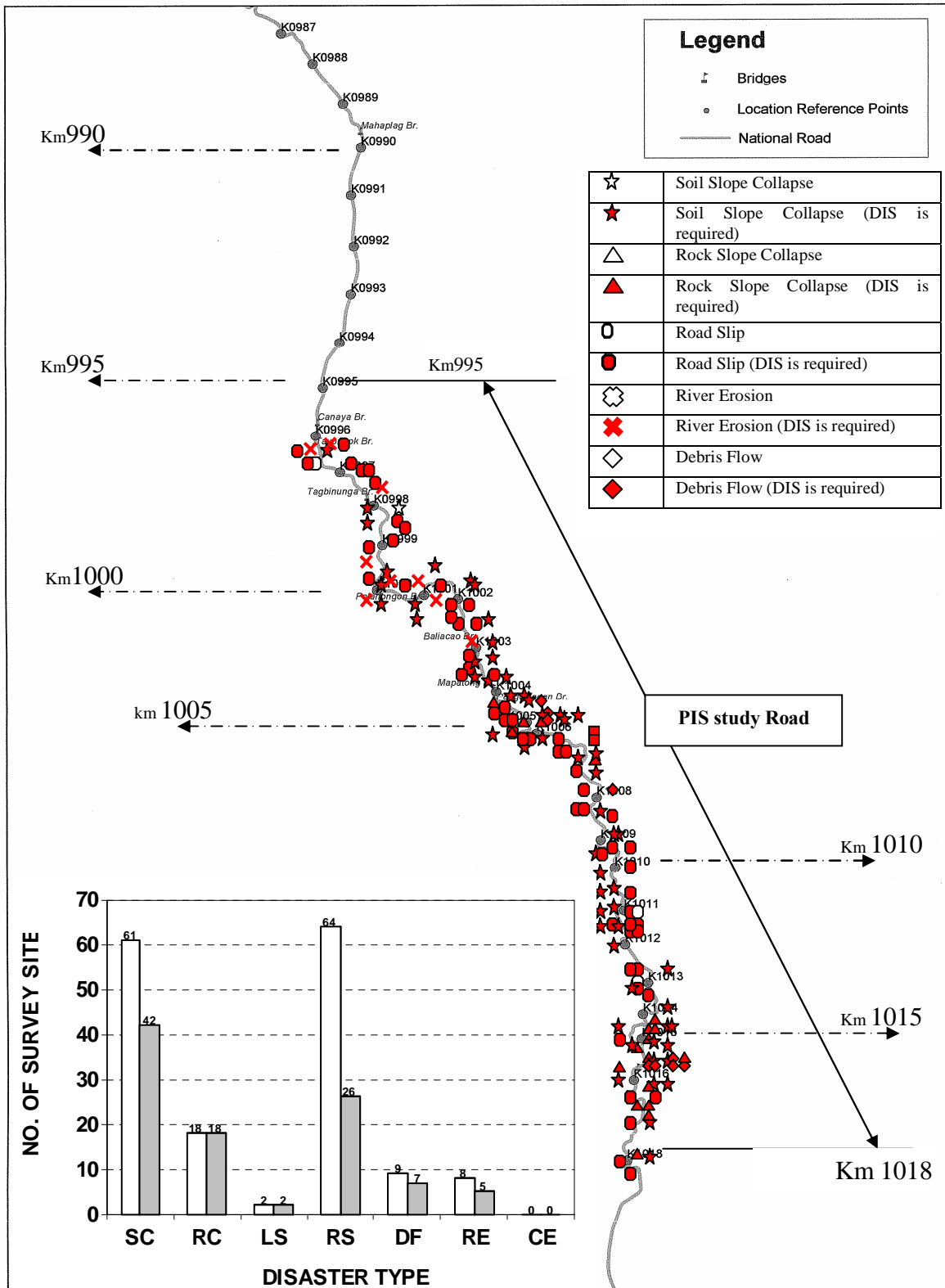


Figure 5.12 PIS Results for Daang Maharlika Highway (LT) (Mahaplag-Sugod Section)

(5) Region X

The original scope of this study did not include any Road Sections in Mindanao. However, with the strong recommendation of the DPWH, the Study Team added two Road Sections for Region X as pilot survey sections and one route for Region XI. The Region X routes were Sayre Highway (Misamis Oriental-Bukidnon-Agusan Road) and the Bukidnon-Davao City Road.

The PIS was undertaken jointly by the Central Office (CO) counterpart personnel and the field engineers from Bukidnon's 2nd and 3rd DEOs. The surveyed section starts from km 1427+717 and runs to km 1463+500 traversing mostly mountainous areas. The surveyed section of Bukidnon–Davao City Road, which starts at km 1605+685 and runs to km 1607+000, was also undertaken jointly by CO counterpart personnel and DEO representatives and was found to have terrain characteristics similar to the Sayre Highway.

(a) Sayre Highway (Misamis Oriental-Bukidnon-Agusan Road)

Sayre Highway has a total of 248 slopes meeting the PIS criteria. The disaster types observed are Road Slips (63%); Soil Slope Collapse (28%); Rock Slope Collapse (8%); and River Erosion (0%). A total of 72% of those PIS slopes require DIS.

PIS results for Sayre Highway are shown in Figure 5.13.

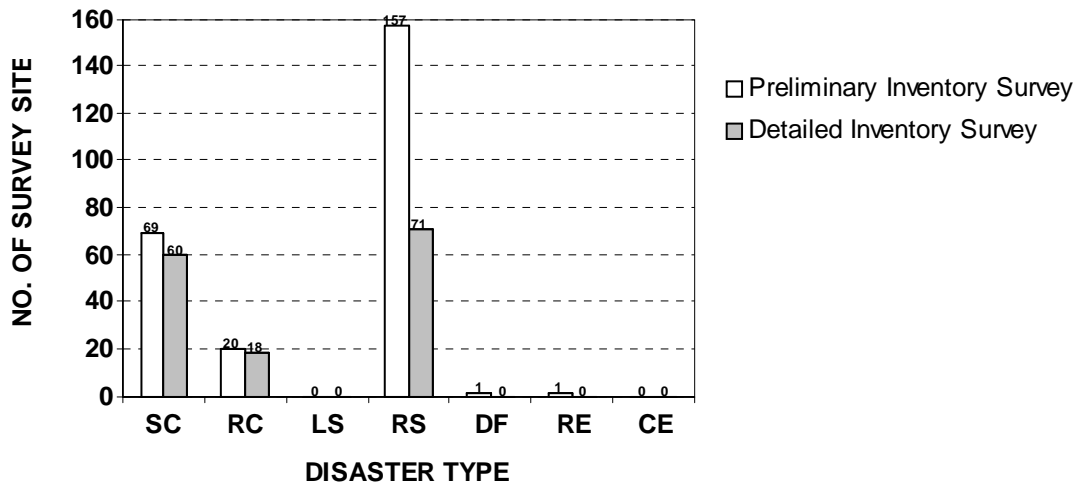


Figure 5.13 PIS Result for Sayre Highway (Misamis Oriental-Bukidnon-Agusan Road)

(b) Bukidnon-Davao City Road

Along this road, nine slopes were surveyed, and the prevalent disaster types observed were Soil Slope Collapse (67%); Road Slips (22%); and Rock Slope Collapse (11%). Results

show that all of the slopes need to be included in the DIS.

The PIS results for the Bukidnon-Davao City Road are shown in Figure 5.14.

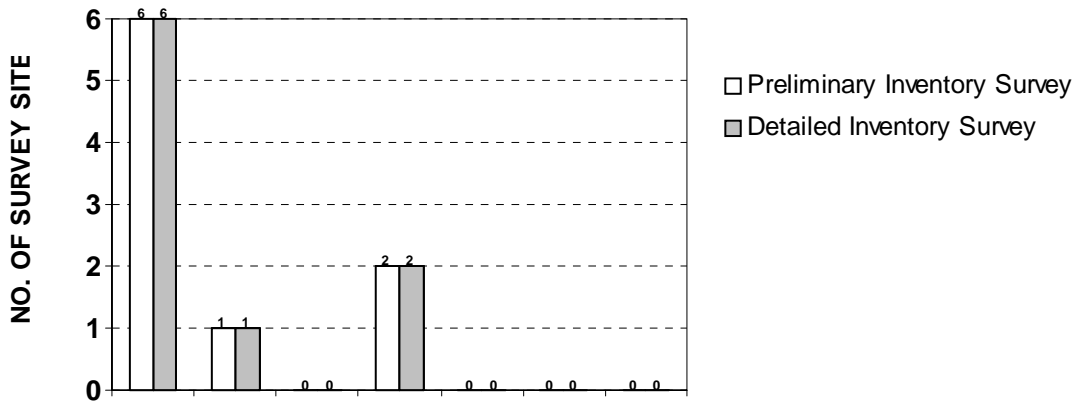


Figure 5.14 PIS Result for Bukidnon-Davao City Road

(6) Region XI

The route identified for Region XI was the Davao-Cotabato road from km 1525 to km 1555. During the survey headed by the Davao del Sur DEO, it was found that most of the route traverses flat terrain with agricultural plantations. However, 27 slopes were identified during the PIS.

(a) Davao - Cotabato Road

The disaster types observed were River Erosion (78%); Road Slips (15%); and Soil Slope Collapse (7%), of which, 60% of the PIS slopes require DIS.

The PIS results for the Davao-Cotabato Road are shown in Figure 5.15.

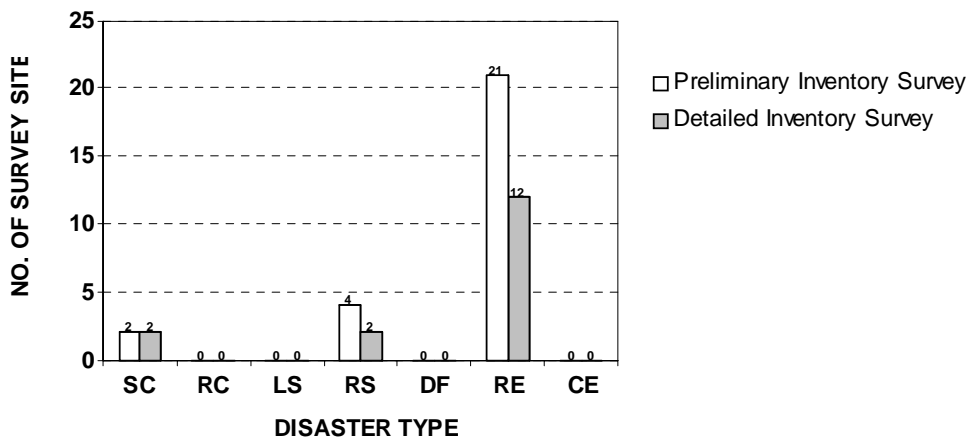


Figure 5.15 PIS Result for Davao-Cotabato Road

5.2 Result of Detailed Inventory Survey

5.2.1 Selection of Road Sections for DIS

Road Sections surveyed for the DIS were selected from the PIS Road Sections according to the criteria listed in Table 5.4. Selection flow is shown in Figure 5.16.

Road sections from Regions X and XI were added to the original 50 km stipulated in the Inception Report, as recommended and executed by DPWH officials and local counterparts.

Table 5.4 Criteria for Selection of Detailed Inventory Survey Sections

Primary Criteria		
1)	Equitable Regional Distribution	At least one section will be selected in CAR, Region II and Region VII, Region VIII-Samar Region VIII-Leyte, Region X, and Region XI (Minimum length per region is 3 km)
Secondary Criteria		
2)	To be Conducted by Many Responsible DEOs	All concerned DEOs conducting Preliminary inventory surveys will be selected Minimum section is 3 km and max length section is 10 km
Tertiary Criteria		
3)	Priority sections recommended by RO/DEO	Potential frequency of road slope disasters is high Disasters have occurred in the past Visible disturbances are recognized
4)	Disaster type	Most of disaster types shall be surveyed on each section All of the disaster types shall be surveyed

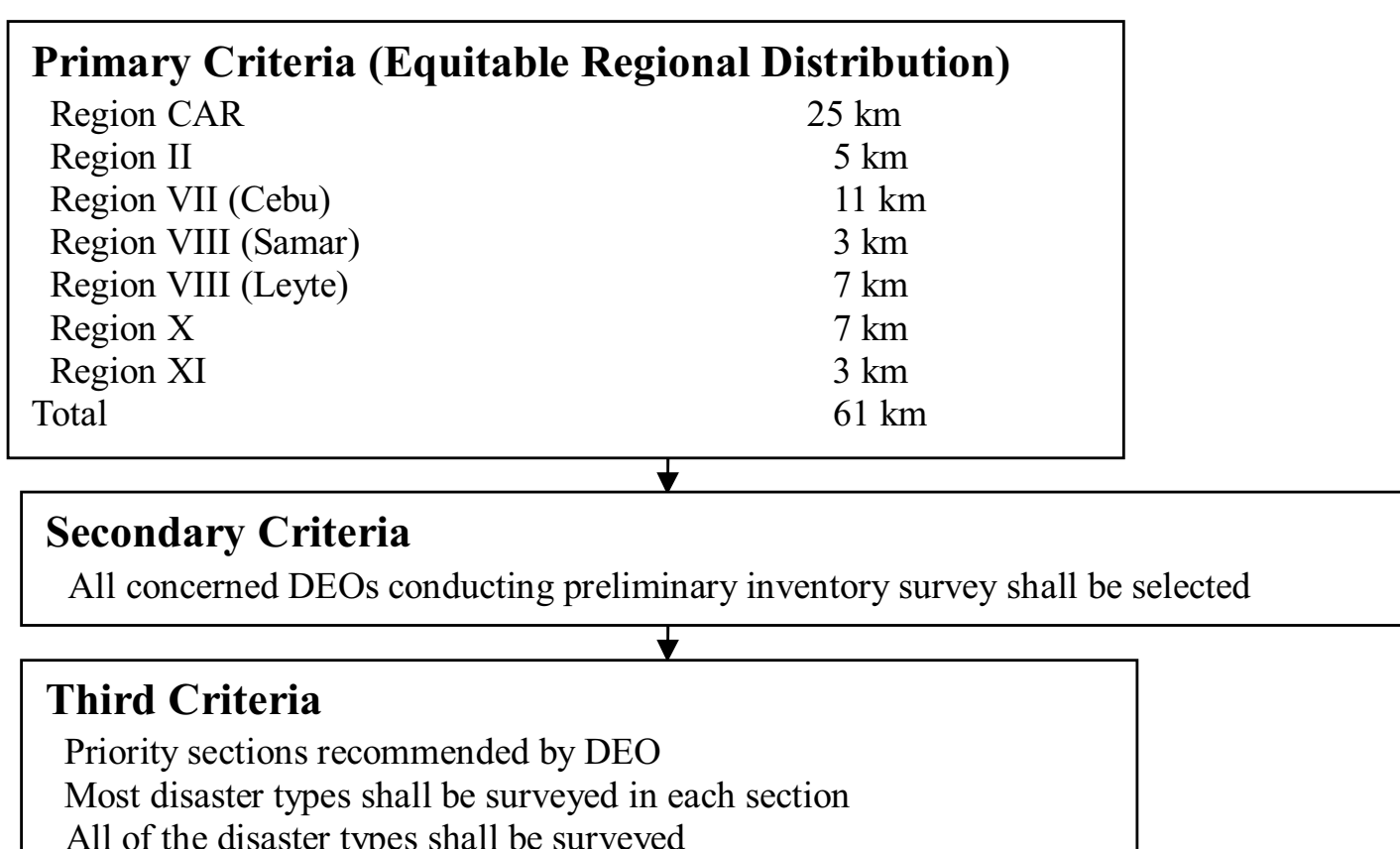


Figure 5.16 Selection flow of DIS

Table 5.5 Selected Length of PIS and DIS

Region	PIS Section length (km)	DIS Section length (km)	DIS/PIS length (%)
Region CAR	140	25	18
Region II	12	5	41
Region VII (Cebu)	73	11	15
Region VIII(Samaur)	16	3	19
Region VIII(Layrte)	23	7	30
Region X	38	7	18
Region XI	30	3	10
Total	332	61	18

Table 5.6 Selected Road Sections for Detailed Inventory Survey

Region	Road Sections	PIS		DIS			DEO in Charge	Road Classification	AADT	Disaster Type
		Section	Length km	Section	Length km	No. of Slopes				
CAR	Kennon Rd	241-244	3	241-244	3	10	Baguio City	S	6,880/ 5,014	SC, RC, RE, DF, RS
		214-241	27	227-234	7	32	Benguet 1st			
	Baguio- Bontoc Rd [Halsema Highway]	263-341	78	275-280	5	43	Benguet 2nd	A(OT)	953	SC, RC, LS, RE, DF, RS
	Nueva Vizcaya- Ifugao-Mt Province Rd [Lagawe - Banaue]	301-333	32	301-306 318-323	10	33	Ifugao	S	275/ 3,116	SC, RC, LS, DF, RS
	Subtotal		140		25	118				
II	Daang Maharlika (LZ) [Dalton Pass]	208-220	12	208-213	5	27	Nueva Vizcaya Sub	A(NE)	3,769	SC, RC, RS, DF, RE
	Subtotal		12		5	27				
VII	Cebu- Balamban Transcentral Highway	5-30	25	27-30	3	19	Cebu City	A(EW)	1,001/ 1,305	SC, RC, RS, DF
		30-42	12	33-37	4	28	Cebu 3rd			
	Toledo-Baliri-Santander Rd [Ginatilan- Alegria]	143-179	36	172-176	4	4	Cebu 4th	A(NS)	500/ 12,000	SC, RC, RE, CE, RS
	Subtotal		73		11	51				
VIII	Wright-Taft-Borongnan Rd	843-859	16	844-847	3	13	Samar 2nd	A(EW)	500/ 1,374	SC, RC, RS, DF
	Daang Maharlika (LT) [Mahaplag- Sugod]	995-1003	8	1000-1003	3	9	Leyte 5th	A(NS)	659/ 1,581	SC, RC, LS, RE, RS, DF
		1003- 1018	15	1003-1007	4	26	Southern Leyte			
	Subtotal		39		10	48				
X	Sayre Highway [Misamis Oriental - Bukidnon - Agusan Road]	1428-1464	36	1444-1449	5	33	Bukidnon 3rd	A(NS)	3,421	SC, RC, RS, RE
	Bukidnon - Davao City Rd	1605-1607	2	1605-1607	2	9	Bukidnon 2nd	A(NS)	3,340	SC, RC, RS
	Subtotal		38		7	42				
XI	Davao - Cotabato Rd	1525-1555	30	1532-1535	3	4	Davao-del Sur 1st	A(NS)	3,486/ 6,517	SC, RS, RE
	Subtotal		30		3	4				
	Total Length (km)		332		61	290				

Disaster Types; SC: Soils Slope Collapse; RC: Rock Slope Collapse; LS: Landslide; RS: Road Slip; DF: Debris Flow; RE: River Erosion; CE: Coastal Erosion;

Road Classification; A(NS) Arterial (North-South Backbone), A(EW): Arterial (East-West Lateral), A(OT): Arterial (Other Road of Strategic Importance), S: Secondary National Road,

5.2.2 Experimental Detailed Inventory Survey

Experimental Detailed Inventory Surveys (DIS) were conducted in Region VII and Region CAR in October 2006 with the purpose of reviewing DIS technique. The said experimental DIS were executed as a collaborative activity involving the Study Team, the Counterpart Team, and the staff of the DEO concerned. The DIS procedure has been improved through this activity.

Table 5.7 Experimental Detailed Inventory Survey

Region	Road	Station	Disaster Type	Responsible DEO	Execution Date	
VII	Cebu- Transcentral	Balamban	32 km 939 m 33 km 035 m	RC: Rock Slope Collapse	Cebu 3 rd	17 OCT 2006
			36 km 945 m 37 km 058 m	SC: Soil Slope Collapse		
	Toledo-Baliri-Santander Rd (Ginatilan- Alegria)		170 km 710 m 170 km 867 m	CE: Coastal Erosion	Cebu 4 th	
			171 km 624 m 171 km 664 m 171 km 960 m 172 km 066 m			
	Cebu- Transcentral	Balamban	32 km 846 m 32 km 906 m	SC: Soil Slope Collapse	Cebu City	19 OCT 2006
CAR	Kennon Rd		215 km 130 m 215 km 200 m	RE: River Erosion	Benguet 1st	25 OCT 2006
			241 km 50 m 241 km 80 m	SC: Soil Slope Collapse	Baguio City	

5.2.3 Results of the Detailed Inventory Survey

(1) Summary

Results of the DIS are summarized in Table 5.9.

Of the total length of 61 km of planned DIS, the surveys of the 10 km sections in Region X and Region XI were not completed by the 20th of Feb 2007. DIS in Regions X and XI will be subsequently conducted by the Counterpart Team and ROs and DEOs of Region X and XI. In this summary, countermeasure alternatives are set in Table 5.8.

Table 5.8 Countermeasure Alternative Policy

Alternative	Effectiveness	Risk Reduction Ratio
Alternative-I	High Effectiveness: Permanent countermeasures to prevent disasters	0.7-1.0 (70%-100%)
Alternative-II	Moderate Effectiveness: Mitigating the disasters to some extent	0.3- 0.7 (30%- 70%)
Alternative-III	Low Effectiveness: Limited treatment	0.0-0.3 (0-30%)

Table 5.9 Result of Detailed Inventory Survey

REGION	ROAD NAME	SECTION	LENGTH (km)	DEO IN CHARGE	Nos. of Slopes	ANNUAL LOSS		COUNTERMEASURE ALTERNATIVE I		COUNTERMEASURE ALTERNATIVE II		COUNTERMEASURE ALTERNATIVE III	
						Total (Pesos per year)	IALp* [pesos per (year x km)]	Cost (Pesos)	Annual Benefit [pesos per year]	Cost (Pesos)	Annual Benefit [pesos per year]	Cost (in Pesos)	Annual Benefit [pesos per year]
CAR	Kennon Rd	240 - 243	3	Baguio City	10	3,884,667	1,294,889	33,849,028	3,496,200	21,438,940	2,344,037	466,755	39,711
		227 - 234	7	Benguet 1st	32	647,656,677	92,522,382	421,111,616	582,891,009	141,435,398	388,594,006	1,910,237	97,130,336
	Baguio-Bontoc Rd	275 - 280	5	Benguet 2nd	43	111,415,484	22,283,097	113,199,129	98,087,744	63,918,843	60,055,398	10,850,230	17,605,308
	Nueva Vizcaya-Ifugao-Mt. Province	301 - 306	10	Ifugao	33	62,580,132	6,258,013	126,665,797	54,274,332	104,979,029	34,619,864	45,782,520	8,548,919
		318 - 323											
Sub-total			25		118	825,536,960	-	694,825,570	738,749,286	331,772,210	485,613,305	59,009,742	123,324,274
Average							4,894,335						
II	Daang Maharlika (LZ)	208 - 213	5	Nueva Vizcaya Sub	27	67,798,037	13,559,607	109,056,992	58,029,762	96,463,084	42,975,857	64,585,880	10,101,673
Sub-total			5		27	67,798,037	-	109,056,992	58,029,762	96,463,084	42,975,857	64,585,880	10,101,673
Average							2,711,921						
VII	Cebu-Balamban Transcentral Highway	27 - 30	3	Cebu City	19	26,334,624	8,778,208	75,112,940	23,640,758	36,622,925	16,755,175	23,719,898	7,794,244
		33 - 37	4	Cebu 3rd	28	9,966,200	2,491,550	117,084,822	8,965,457	63,210,941	5,955,050	12,211,684	985,578
	Toledo-Barili-Santander Rd	172 - 176	4	Cebu 4th	4	86,002	21,501	14,543,780	82,127	10,799,738	56,768	3,238,464	16,883
Sub-total			11		51	36,386,826	-	206,741,542	32,688,341	110,633,604	22,766,993	39,170,046	8,796,705
Average							1,026,478						
VIII	Wright-Taft-Borongan Rd	844 - 847	3	Samar 2nd	13	356,663,974	118,887,991	53,321,928	262,444,500	33,039,454	252,465,598	8,833,304	3,241,651
	Daang Maharlika (LT)	1000 - 1003	3	Leyte 5th	9	23,808,217	7,936,072	38,145,615	22,842,493	35,775,453	16,452,079	25,785,383	7,142,465
		1003 - 1007	4	Southern Leyte	26	56,322,764	14,080,691	113,501,738	45,433,985	320,527,157	29,972,682	68,440,980	13,265,301
Sub-total			10		48	436,794,955	-	204,969,281	330,720,977	389,342,064	298,890,358	103,059,667	23,649,417
Average							14,090,475						
TOTAL			51		244	1,366,516,778	-	1,215,593,385	1,160,188,366	928,210,962	850,246,514	265,825,335	165,872,069

(2) Example of DIS Results

1) Soil Slope Collapse

As an example, the DIS results for Cebu-Balamban Transcentral Highway (29 km 714m-839m) for Soil Slope Collapse are shown in Figure 5.17 to 5.22

Considering field conditions, the countermeasure alternatives were planned as summarized in Table 5.10.

Based on the outputs from Sheets 1 to 4, an indicative feasibility assessment was undertaken, as shown in Figure 5.22.

Table 5.10 Example of Countermeasure Alternative Planning for Soil Slope Collapse

Alternative	Effectiveness	Risk Reduction Ratio
Alternative-I	High Effectiveness: Permanent countermeasures to prevent disasters - Shotcrete - Concrete Retaining Wall	0.9
Alternative-II	Moderate Effectiveness: Mitigating the disasters to some extent - Grouted Riprap Retaining Wall	0.6
Alternative-III	Low Effectiveness: Limited treatment -Vegetation/Tree Planting	0.3



Figure 5.17 General View of Example DIS Slope for Soil Slope Collapse

Inventory Sheet 3 Sketches

Road Name	Cebu-Balamban Transcentral Highway									
Station from	km 29	m 714	Side of survey	Right side of road						
Name of Inspector/ Coordinator for detailed inventory survey; sheet 3, 4, 5	Survey date (d/m/y):			Date	Month	Year				
Name of surveyor				Judefer Castaño	28	Nov.	2006			
3-1 Front view sketches										
3-1 Front view sketches										
3-2 Cross section sketches										
3-2 Cross section sketches										
<p>Note</p> <table border="1"> <tr> <td style="background-color: #FFB6C1;"></td> <td>Numerical value or terms should be inputted.</td> </tr> <tr> <td style="background-color: #ADD8E6;"></td> <td>Numerical value is automatically inputted.</td> </tr> </table>								Numerical value or terms should be inputted.		Numerical value is automatically inputted.
	Numerical value or terms should be inputted.									
	Numerical value is automatically inputted.									

Figure 5.18 Example of Inventory Sheet 3: Sketches for Soil Slope Collapse

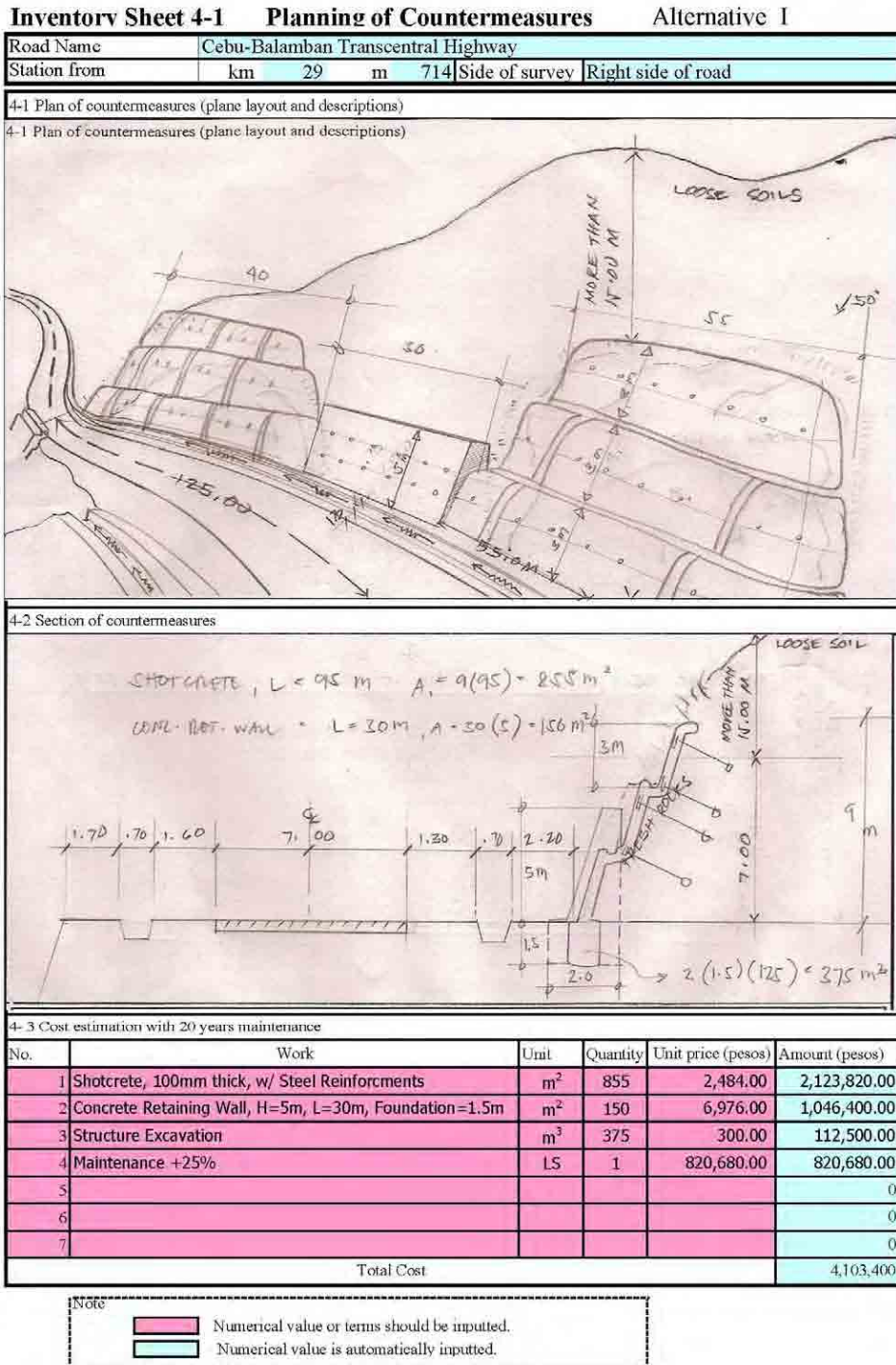


Figure 5.19 Example of Inventory Sheet 4-1: Planning of Countermeasure Alternative I for Soil Slope Collapse

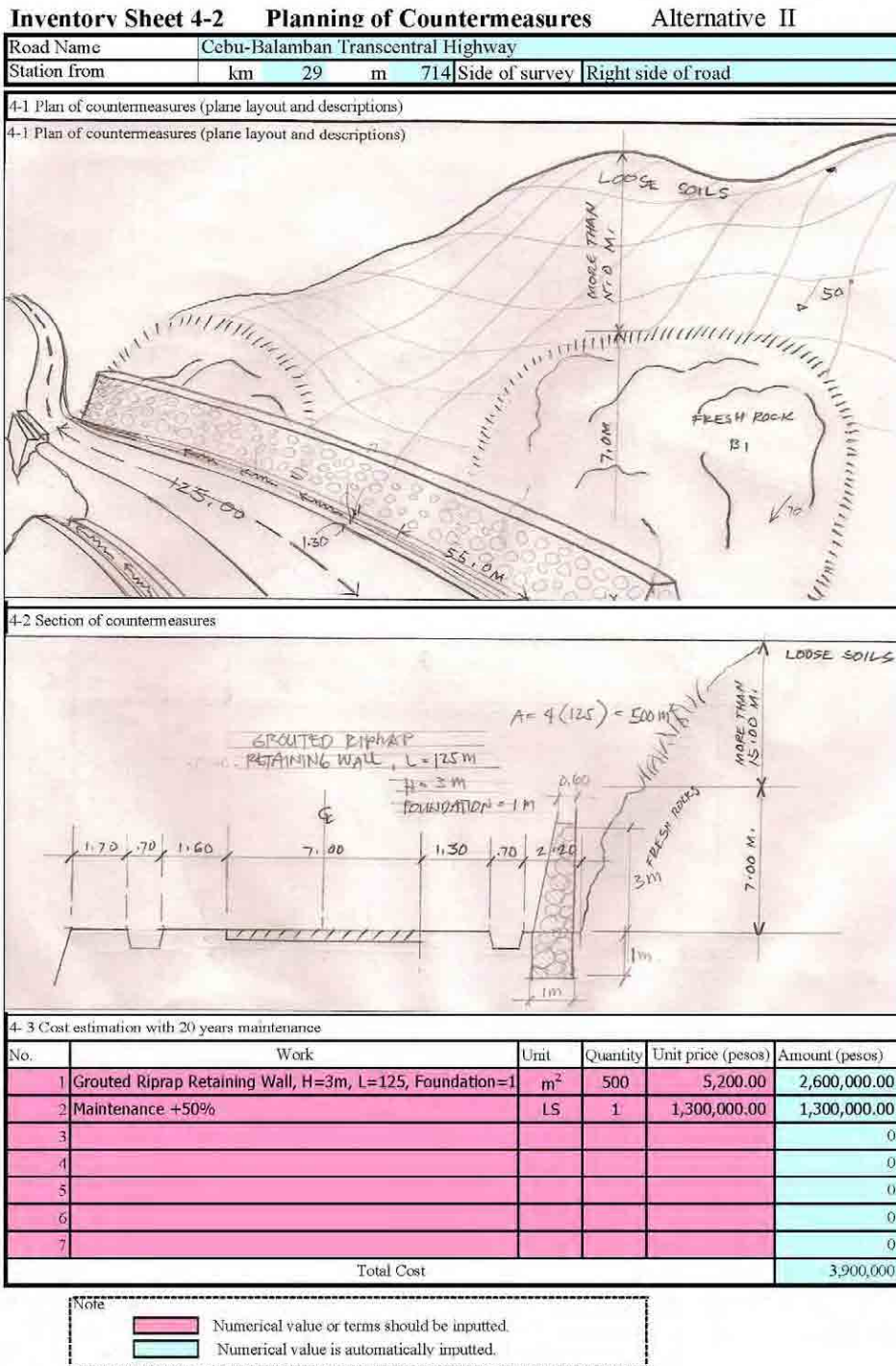


Figure 5.20 Example of Inventory Sheet 4-2: Planning of Countermeasure Alternative II for Soil Slope Collapse

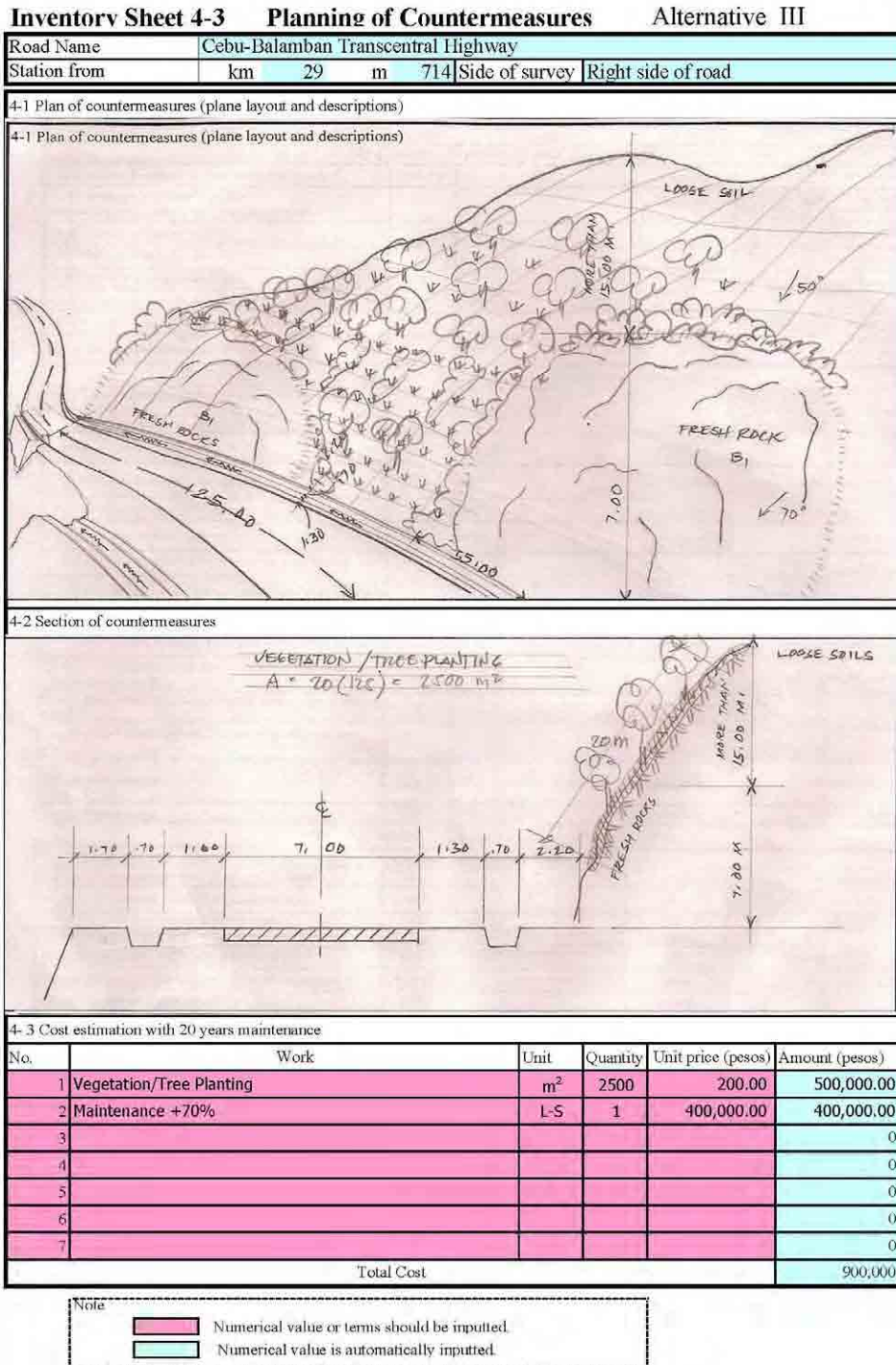


Figure 5.21 Example of Inventory Sheet 4-3: Planning of Countermeasure Alternative III for Soil Slope Collapse

Inventory Sheet 5-1		Indicative Feasibility Assessment for SC			
Road Name	Cebu-Balamban Transcentral Highway				
Km station from	km	29	m	714	
Side of Survey	Right side of road				
Items	symbol	equation	Unit	Quantity	Remarks
(1) Disaster Frequency and Magnitude					
1-1) Potential frequency of road closure disasters					
1-1-1) Coefficient for volume estimation (method of dimension setting for collapsible material)	a			Max	1-2-1) When assessment of collapsible materials cannot be predicted, "no input" should be indicated. And "Volume of collapsible material" is estimated by Figure 3.4.2 in the Guide and is directly inputted in the column below.
1-2-2) Length of collapsible materials	b		m	30.0	
1-2-3) Width of collapsible materials	c		m	125.0	
1-2-4) Depth of collapsible materials	d		m	2.0	
1-2-5) Volume of collapsible materials per RCD	e	$e=a*b*c*d$	m ³ per RCD	5,250	
1-2-6) Ratio of accumulation to collapsible materials	f		ratio	0.45	
1-2) Accumulation volume on the road per RCD	g	$g=e*f$	m ³ per RCD	2,363	1-2-6) Evaluated by the Figure 3.4.3 of the Guide
(2) Annual Losses without Countermeasure					
2-1-1) Reopening cost per accumulation volume of road closure site (excluding fixed cost)	h		pesos per m ³	410	refer 3.4.4 (f) (1) of the Guide
Fixed cost for reopening per RCD	i		pesos per RCD	600,000	
2-1) Annual reopening cost	j	$j=FRCDp*h*g$	pesos per year	206,784	refer 3.4.2 (1) of the Guide
2-2-1) Average number of human deaths per RCD	k	$k=g/100$	ave. deaths per RCD	0.006	refer 3.4.2 (2) (1) of the Guide
2-2-2) Unit value of human life lost (death)	l		pesos per human life	2,000,000	refer 3.4.2 (2) (2) of the Guide
2-2) Annual value of human lives lost	m	$m=FRCDp*k*l$	pesos per year	1,766	refer 3.4.2 (2) (2) of the Guide
2-3-1) Length of survey road (from entry to exit point of detour road in avoid road closure site on survey road)	n		km	42	refer 3.4.2 (3) (1) of the Guide
Length of detour road (from entry to exit point of survey road to avoid road closure site on survey road)	o		km	49	refer 3.4.2 (3) (2) of the Guide
2-3-2) AADT: Annual Average Daily Traffic on the survey site	p		vehicles per day	3,253	refer 3.4.2 (3) (3) of the Guide
2-3-3) Nos. of predicted closure days of the whole width of the road on the survey site per RCD	q		days	5.0	refer 3.4.2 (3) (4) of the Guide
2-3-4) Average Vehicle Operating Cost per km on survey road	r		pesos per vehicle*km	8.00	refer 3.4.2 (3) (5) of the Guide
Average Vehicle Operating Cost per km on detour road	s		pesos per vehicle*km	10.00	
2-3) Annual detour cost	t	$t=FRCDp*p*q*(o*s+n*r)$	pesos per year	932,700	refer 3.4.2 (3) (6) of the Guide
Total Annual Loss	u	$u=j+m+t$	pesos per year	1,135,254	refer 3.4.2 (4) of the Guide
(3) Feasibility Indicators of Countermeasures					
Countermeasure alternative I					
3-1) Cost of countermeasure with 20 years maintenance	v I		pesos	4,103,400	evaluated in sheet 4
3-2) Risk reduction ratio in RCD due to countermeasure	w I		ratio	0.9	refer 3.4.2 (5) (1) of the Guide
3-3) Decrease in annual loss due to countermeasure	x I	$x I = u * w I$	pesos per year	1,021,226	refer 3.4.2 (5) (2) of the Guide
Potential frequency of road closure disaster with countermeasure	FRCDpwc I	$FRCDpwc I = FRCDp*(1 - w I)$	ratio	0.013	
Benefit/cost ratio at 15% discount rate	BCR I		ratio	1.79	refer 3.4.2 (5) (3) of the Guide
Economic net present value at 15% discount rate	ENPV I		pesos	1,992,973	
Economic internal rate of return	EIRR I		percent	25%	
Countermeasure alternative II					
3-1) Cost of countermeasure with 20 years maintenance	v II		pesos	3,500,000	evaluated in sheet 4
3-2) Risk reduction ratio in RCD due to countermeasure	w II		ratio	0.6	refer 3.4.2 (5) (1) of the Guide
3-3) Decrease in annual loss due to countermeasure	x II	$x II = u * w II$	pesos per year	681,150	refer 3.4.2 (5) (2) of the Guide
Potential frequency of road closure disaster with countermeasure	FRCDpwc II	$FRCDpwc II = FRCDp*(1 - w II)$	nos. per year	0.051	
Benefit/cost ratio at 15% discount rate	BCR II		ratio	1.26	refer 3.4.2 (5) (3) of the Guide
Economic net present value at 15% discount rate	ENPV II		pesos	-316,127	
Economic internal rate of return	EIRR II		percent	17%	
Countermeasure alternative III					
3-1) Cost of countermeasure with 20 years maintenance	v III		pesos	900,000	evaluated in sheet 4
3-2) Risk reduction ratio in RCD due to countermeasure	w III		ratio	0.3	refer 3.4.2 (5) (1) of the Guide
3-3) Decrease in annual loss due to countermeasure	x III	$x III = u * w III$	pesos per year	340,575	refer 3.4.2 (5) (2) of the Guide
Potential frequency of road closure disaster with countermeasure	FRCDpwc III	$FRCDpwc III = FRCDp*(1 - w III)$	nos. per year	0.090	
Benefit/cost ratio at 15% discount rate	BCR III		ratio	2.72	refer 3.4.2 (5) (3) of the Guide
Economic net present value at 15% discount rate	ENPV III		pesos	1,071,107	
Economic internal rate of return	EIRR III		percent	307%	

Note

	Numerical value or terms should be inputted.
	Numerical value is automatically inputted.

Figure 5.22 Example of Inventory Sheet 5: Indicative Feasibility Assessment for Soil Slope Collapse