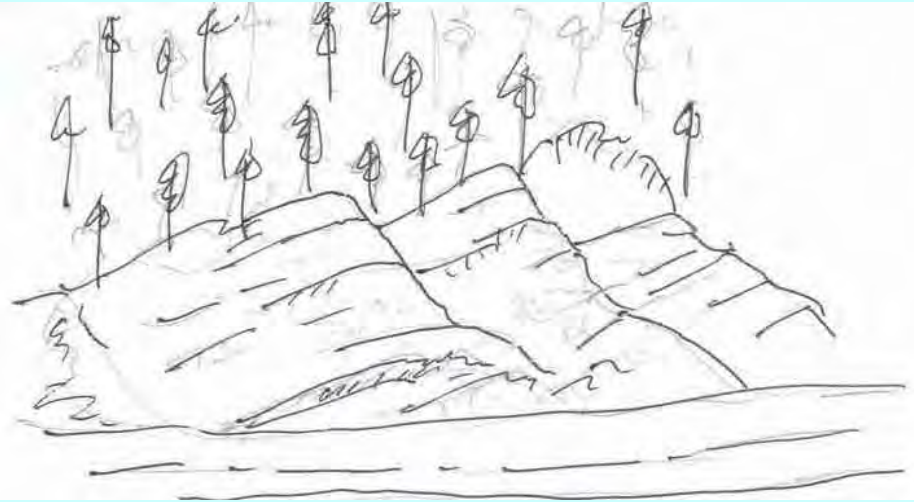



Appendix 3-2 Slope inspection sheets for Rank C and B

General Information Sheet

Management office	Ratnapura												
Management number	A004-134	Route No	A004	Location(m)	134/15	to	134	Distance	200	m			
Disaster	Rock fall	Name of Road		Landmark		latitude	N 06°37'20.18"	longitude	E 080°39'32.17"				
Schematic sketch				Reporter's name :	M. Enokida								
				Date of report :	24-Sep-12								
				Description	<p>Recorded Disaster : Rock Fall (Boulder Size).</p> <p>Failure Type: Rock Fall or Rock Slide (Wedge type slide).</p> <p>Geological Condition: Weathered Gneiss with dyke rich in feldspar,</p> <p>Trigger of Failure: (Supposed) Tremendous rainfall + open cracks,</p> <p>Featured Points: At the beginning part, the slope is rich in cracks and thus rock fall may occur. In contrast, at the ending part, outcrop is rather massive and thus wedge type rock slide can be supposed.</p> <p>Supposed countermeasures: For rock fall, ring net can be applied. For rock slide, removal of unstable part after detailed investigation can be applied.</p>								
				Histry	New failure Movement/extension								
Location map (Scale: 1:10,000)				Estimated disaster volume									
				Proposed countermeasures	Type:								
					Specifi-cation:								
				Quantity									
				Cost (million Birr):									

Management Number	A004-134
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	0	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	✓	Max=12	12
		susceptible to erosion	a little marked	✓		
		fast weathering	None	✓		
	structure	dip slope of bedding plane	It corresponds.	✓	Max=8	8
			None	✓		
		debris on impermeability bedrock	marked	✓	Max=6	4
			The upper part is a hard /the toe of slope is weak.	a little marked		
surface condition	Topsoil, detached rock and unsteady rock	instability	✓	Max=12	12	
		a little unstable	✓			
		stability	✓			
	spring water	notable spring water	✓	Max=8	0	
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	✓	Max=5	5	
		intermediate (bare·grass·tree)	✓			
		mainly structure, mainly tree	✓			
figure	dip (i) , height	height	✓	Max=18	8	
		$H \geq 50m$	✓			
		$30 \leq H < 50m$	✓			
		$15 \leq H < 30m$	✓			
	dip	$H < 15m$	✓	Max=10	10	
		$i \geq 70^\circ$	✓			
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	$45^\circ \leq i < 70^\circ$	✓	Max=5	5	
		$i < 45^\circ$	✓			
		2 or more correspondences·clarity certain·uncertainty	✓			
	None	✓				
sum total		66		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) \times 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	66

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX(B,C)

Score in evaluation from cause	(B)	66
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX(B,C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

--



Full view of the slope at the beginning side



Full view of the slope at the ending side



Old falling rock





Condition of slope, there are a lot of cracks and floatstones.



Mark that comes off rock and fell

General Information Sheet

Management office	Ratnapura												
Management number	A004-154	Route No	A004	Location(m)	154/7	to		Distance	100	m			
Disaster	Slope Failure	Name of Road		Landmark		latitude	N 06°42'07.21"	longitude	E 080°45'18.40"				
Schematic sketch				Reporter's name :		M. Enokida							
				Date of report :		24-Sep-12							
				Description		<p>Recorded Disaster : Damage on the pavement such as cracks and subsidence.</p> <p>Failure Type: Slope failure in the embankment slope, (possible) landslides involving the foundation of the embankment.</p> <p>Geological Condition: Highly Weathered Gneiss, embankment material, (possibly) colluvium or valley deposit at the foundation of the embankment,</p> <p>Trigger of Failure: (Supposed) Raise in ground water, changes in the weight balance for the possible landslide,</p> <p>Featured Points: It is not yet clear whether there is landslide at the foundation of the embankment. Thus further investigation and monitoring are required.</p> <p>According to unconfirmed information, there were some movements at the lower slope under the gabion wall.</p> <p>The landform of the valley where the embankment sits on implies existence of small landslides. If the embankment was put on the head of the possible landslides, the landslide shall start its movement. There lacks however obvious information which supports the movement or existence</p> <p>Supposed countermeasures: For slope failure in embankment, gentler gradient of slope or reinforcement by sorts of geotextile. For landslide, further investigation is required to set up appropriate countermeasures.</p>							
				History		New failure Movement/extension							
Location map (Scale: 1:10,000)				Estimated disaster volume									
				Proposed countermeasures		Type:							
						Specification:							
						Quantity							
						Cost (million Birr):							

Management Number	A004-154
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3 3	
	clear convex break of slope	2 correspondences	✓		
	eroded toe of slope	1 correspondences	✓		
	overhang, water catchment slope	no correspondence	✓		
geological conditions	soil	susceptible to erosion	marked	Max=8 8	
		less strength with water	a little marked		
			None		
	rock	high density of cracks and a weak layer	marked	Max=12 0	
		susceptible to erosion	a little marked		
		fast weathering	None		
structure	dip slope of bedding plane	It corresponds.	Max=8 0		
		None			
	debris on impermeability bedrock	marked			
surface condition	Topsoil, detached rock and unsteady rock	instability	✓	Max=12 12	
		a little unstable	✓		
		stability	✓		
figure	spring water	notable spring water	Max=8 4		
		seepage			
		None			
anomaly	surface condition	bare land with minor vegetation	Max=5 5		
		intermediate (bare·grass·tree)			
		mainly structure, mainly tree			
figure	dip (i), height	height	Max=18 5		
		H ≥ 50m			
		30 ≤ H < 50m			
		15 ≤ H < 30m			
	dip	H < 15m			
	i ≥ 70°	Max=10 5			
45° ≤ i < 70°					
i < 45°					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more correspondences·clarity	Max=5 5		
		certain·uncertainty			
		None			
sum total		51	(A)		

[Main check object]

cut slope	✓
natural slope	

[Main slope disasters]

rockfall	✓
slope failure	

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	

sum total	(B) 51
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[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		
No disaster records		

(C) 点

(D) = MAX(B,C)

Score in evaluation from cause	(B) 51
Score in evaluation from history	(C) 0
Among (B)&(C), large one.	(D)=MAX(B,C) 0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

--



Full view of the slope at the beginning side



Full view of the slope at the ending side



Condition of slope



Situation under slope

Management Number	A004-173
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	6	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
structure	dip slope of bedding plane	It corresponds.	✓	Max=8	8	
		None	✓			
	debris on impermeability bedrock	marked	Max=6	6		
The upper part is a hard /the toe of slope is weak.	a little marked	✓				
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	6		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	0		
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	Max=5	3		
		intermediate (bare·grass·tree)			✓	
		mainly structure, mainly tree			✓	
figure	dip (i) , height	height	Max=18	12		
		$H \geq 50m$			✓	
		$30 \leq H < 50m$				
		$15 \leq H < 30m$				
dip	$H < 15m$	Max=10	10			
	$i \geq 70^\circ$			✓		
	$45^\circ \leq i < 70^\circ$					
$i < 45^\circ$	10					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more correspondences·clarity	Max=5	5		
	certain·uncertainty	✓				
	None	✓				
sum total		66		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) $\times 0$

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	66

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX(B,C)

Score in evaluation from cause	(B)	66
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX(B,C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

--

Management Number **A004-173**

Photo sheet

Date **24-Sep-12**



Full view of the slope from strat side



Full view of the slope from end side



Situation of slope head

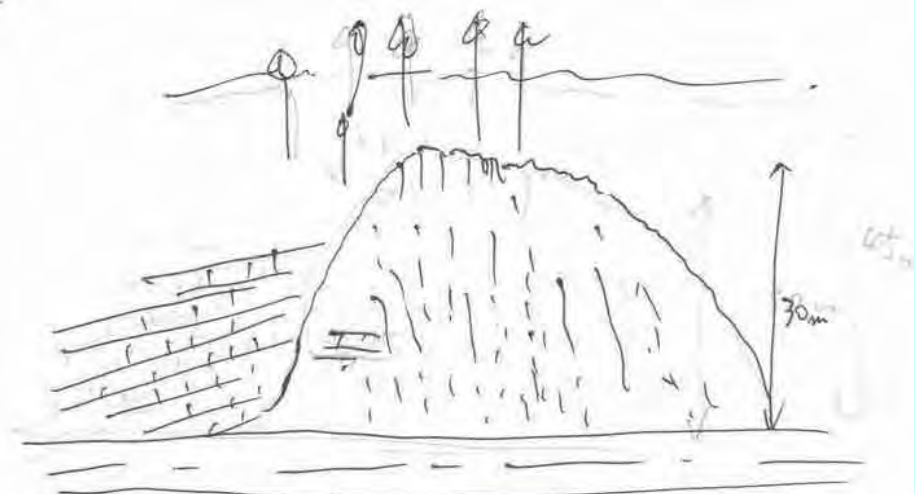
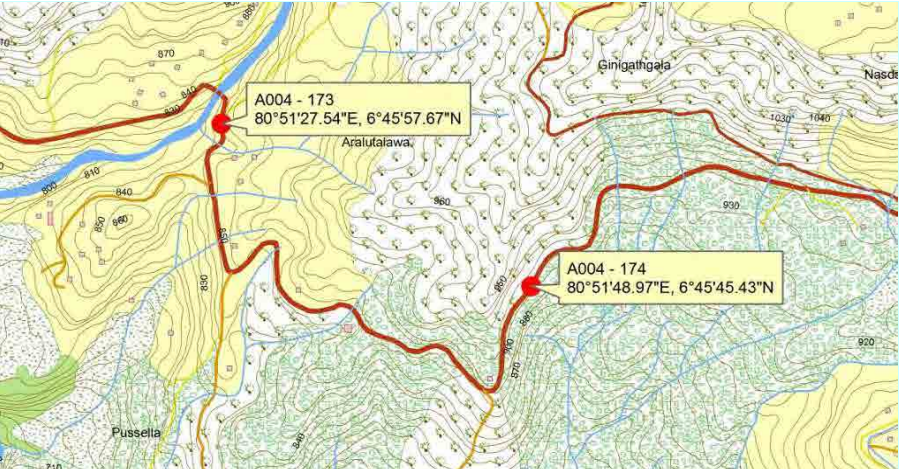


Condition of slope, a loose sedimentary soil is recorded on the base rock.



Condition of slope, basement rock of dip slope structure

General Information Sheet

Management office	Ratnapura																
Management number	A004-174		Route No	A004		Location(m)	175/1		to	175/3		Distance	100		m		
Disaster	Slope Failure		Name of Road			Landmark			latitude	N 06°45'45.43"		longitude	E 080°51'48.97"				
Schematic sketch						Reporter's name :		M. Enokida									
						Date of report :		24-Sep-12									
						Description		<p>There are 2 slope failure sites in this section, at 175/1 and 175/3; 175/1 is larger.</p> <p>Recorded Disaster : Not clear but traces of collapse can be seen.</p> <p>Failure Type: Slope failure involving residual soil and weathered rock., Geological Condition: Residual soil, highly weathered rock, Trigger of Failure: (Supposed) Rainfall,</p> <p>Featured Points: Slope failure in weathered rock, remarkable gully erosion.</p> <p>Supposed countermeasures: Gentler gradient of slope, or grating crib works and ground anchors.</p>									
						History		New failure				Movement/extension					
						Estimated disaster volume											
Location map (Scale: 1:10,000)						Proposed countermeasures		Type:									
								Specification:									
								Quantity									
								Cost (million Birr):									

Appendix 3-2
10

Management Number	A004-174
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	6	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
structure	dip slope of bedding plane	It corresponds.	Max=8	0		
		None			✓	
	debris on impermeability bedrock	marked	Max=6	4		
		The upper part is a hard /the toe of slope is weak.			a little marked	✓
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	12		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	0		
		seepage			✓	
	surface condition	surface condition	bare land with minor vegetation	Max=5	5	
intermediate (bare·grass·tree)			✓			
mainly structure, mainly tree			✓			
figure	dip (i) , height	height	Max=18	12		
		H ≥ 50m			✓	
		30 ≤ H < 50m				
		15 ≤ H < 30m				
	H < 15m	✓				
	dip	i ≥ 70°	Max=10	5		
45° ≤ i < 70°		✓				
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more correspondences·clarity	Max=5	5		
		certain·uncertainty			✓	
		None			✓	
sum total		59		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	✓
sum total	(B)	59

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX (B, C)

Score in evaluation from cause	(B)	59
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B, C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

--



Full view of the slope from strat side



Full view of the slope from end side



Condition of slope, many can confirm the mark of erosion



Condition of slope, the slope on the start side is a slope of a steady sedimentary rock

General Information Sheet

Management office	Nuwara Eliya									
Management number	A005-043	Route No	A005	Location(m)	43/8	to	43/9	Distance	50	m
Disaster	Rock Fall, Rock Slide	Name of Road		Landmark	Tall rock escarpment	latitude	N 07°03'53.46"	longitude	E 080°41'23.32"	
Schematic sketch				Reporter's name :		Y Kawamura				
				Date of report :		25-Jul-12				
				Description		<p>Recorded Disaster : unclear, but small rock falls are confirmed during the site visit. Failure Type: Rock slide in weathered rock (feldspar quartzite), toppling may occur under this situation. Geological Condition: Weathered rock rich in vertical open cracks, Trigger of Failure: (Supposed) Rainfall, Featured Points: There are two factors for possible hazards; fragile rock property and vertical open cracks. Feldspar quartzite has relatively poor resistance property against weathering. At the site, outcrops may be seen as sound and strong. However with a hit of a rock hammer, surface of outcrop can be broken easily with muffled sound. Vertical cracks filled with clayey soil can be easily detected on site. Open vertical cracks as well. Supposed countermeasures: Drainage ditches along the shoulder of the slope along with vertical drainage. Fixed with rock bolts or removal of unstable parts.</p>				
				History		New failure Movement/extension				
Location map (Scale: 1:10,000)				Estimated disaster volume		Rock slide: 5m * 5m * 2m * 3 sites, height form the road: 30m Supposed area to be damaged: up to a horizontal distance of 100 meters from the road, or up to the flat space under the lower slope.				
				Proposed countermeasures		Type:				
						Specification:				
						Quantity				
				Cost (million Birr):		Removal of unstable parts (Rock): 5m * 5m * 5m * 3 sites, height from the road: 30m,				

Management Number	A005-043
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Evaluation sheet (rockfall·slope failure)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score		
topography collapsed factor	talus slope	3 or more matches		✓	Max=3 2		
	clear horseshoe break of slope	2 matches					
	eroded toe of slope	1 match					
	overhang, water catchment slope	None					
geological conditions	soil	vulnerable to erosion	marked	✓	Max=8 4		
		less strength with water	a little marked				
	rock	dense cracks / weak layers / foliation	marked			✓	Max=12 12
		vulnerable to erosion	a little marked				
		easy to be weathered	None				
	structure	dip slope of bedding plane or foliation	existing			✓	Max=8 0
		None					
debris on impermeable bedrock		marked					
	cap rock weaker layer	a little marked	✓	Max=6 0			
		None					
surface condition	Topsoil, loose rock and unstable rock	unstable	✓	Max=12 12			
		moderate					
	stable						
	spring water	notable spring waster	✓	Max=8 0			
		seepage					
		None					
	surface condition	bare land with thin vegetation	✓	Max=5 5			
		moderate (bare·grass·tree)					
		mainly structure, mainly tree					
figure	dip (i) , height	height	H ≥ 50m	✓	Max=18 12		
			30 ≤ H < 50m				
			15 ≤ H < 30m				
			H < 15m				
	dip	i ≥ 70°	✓	Max=10 10			
		45° ≤ i < 70°					
		i < 45°					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more matches	✓	Max=5 5			
		1 match					
		None					
sum total		62		(A)			

[Main check object]

cut slope	✓
natural slope	

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	
Potential rockfall and slope failure are moderately prevented, or it is moderately defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	✓
sum total	(B)	62

[History] (C)

Level of disaster history	point	check
There is a history of large rock falls and slope failures that blocked the traffic even after completion of latest countermeasure.	100	
There is a history of large rock falls and slope failures that damaged the road but not blocked the traffic.	70	✓
There is a history about small rock falls and slope failures that did not damage the road.	40	
No disaster records	0	
(C)	点	

$$(D) = \text{MAX}(B, C)$$

Score in evaluation from cause	(B)	62
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D)=MAX(B,C)	0

[Overall judgement]

response	judgment
Countermeasures are necessary.	
Regular inspections are needed, in case countermeasures are not installed.	✓
Countermeasures are not necessary.	

[Description]

--



Full view of the slope at the ending side



Full view of the slope at the beginning side



Condition of the slope, open cracks developed behind the rock mass almost perpendicularly.



Condition of the slope, Rock slide and rock fall are anticipated. Toppling may occur under certain condition.

General Information Sheet

Management office	Nuwara Eliya									
Management number	A005-044	Route No	A005	Location(m)	44/2	to	44/3	Distance	50	m
Disaster	Rock Fall, Rock Slide	Name of Road		Landmark	Tall rock escarpment	latitude	N 07°03'40,77"	longitude	E 080°41'33.79"	
Schematic sketch				Reporter's name :		Y Kawamura				
				Date of report :		25-Jul-12				
				Description		<p>Recorded Disaster : unclear, but small rock falls are confirmed during the site visit. Failure Type: Rock slide in weathered rock (feldspar quartzite), toppling may occur under this situation. Geological Condition: Weathered rock rich in vertical open cracks, Trigger of Failure: (Supposed) Rainfall, Featured Points: There are two factors for possible hazards; fragile rock property and vertical open cracks. Feldspar quartzite has relatively poor resistance property against weathering. At the site, outcrops may be seen as sound and strong. However with a hit of a rock hammer, surface of outcrop can be broken easily with muffled sound. Vertical cracks filled with clayey soil can be easily detected on site. Open vertical cracks as well. Supposed countermeasures: Drainage ditches along the shoulder of the slope along with vertical drainage. Fixed with rock bolts or removal of unstable parts.</p>				
				History		New failure Movement/extension				
Location map (Scale: 1:10,000)				Estimated disaster volume		<p>Rock slide: 5m * 5m * 2m * 3 sites, height form the road: 30m Supposed area to be damaged: up to a horizontal distance of 50 meters from the road.</p>				
				Proposed countermeasures		Type:				
						Specification:				
						Removal of unstable parts (Rock): 5m * 5m * 5m * 3 sites, height from the road: 30m,				
						Quantity				
						Cost (million Birr):				

Management Number	A005-044
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Evaluation sheet (rockfall·slope failure)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more matches		✓	Max=3 1	
	clear horseshoe break of slope	2 matches				
	eroded toe of slope	1 match				
	overhang, water catchment slope	None				
geological conditions	soil	vulnerable to erosion	marked	✓	Max=8 4	
		less strength with water	a little marked			
	rock	dense cracks / weak layers / foliation	marked	✓	Max=12 12	
		vulnerable to erosion	a little marked			
		easy to be weathered	None			
	structure	dip slope of bedding plane or foliation	existing	✓	Max=8 0	
			None			
		debris on impermeable bedrock	marked			
		cap rocked weaker layer	a little marked	✓	Max=6 4	
			None			
surface condition	Topsoil, loose rock and unstable rock	unstable	✓	Max=12 12		
		moderate				
	stable					
	spring water	notable spring waster	✓	Max=8 4		
		seepage				
		None				
	surface condition	bare land with thin vegetation	✓	Max=5 5		
		moderate (bare·grass·tree)				
		mainly structure, mainly tree				
figure	dip (i) , height	height	H ≥ 50m	✓	Max=18 12	
			30 ≤ H < 50m			
			15 ≤ H < 30m			
			H < 15m			
	dip	i ≥ 70°	✓	Max=10 10		
		45° ≤ i < 70°				
		i < 45°				
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more matches	✓	Max=5 5		
		1 match				
		None				
sum total		69		(A)		

[Main check object]

cut slope	✓
natural slope	

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	
Potential rockfall and slope failure are moderately prevented, or it is moderately defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	✓
sum total	(B)	69

[History] (C)

Level of disaster history	point	check
There is a history of large rock falls and slope failures that blocked the traffic even after completion of latest countermeasure.	100	
There is a history of large rock falls and slope failures that damaged the road but not blocked the traffic.	70	✓
There is a history about small rock falls and slope failures that did not damage the road.	40	
No disaster records	0	
(C)	点	

(D) = MAX (B, C)

Score in evaluation from cause	(B)	69
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B, C)	0

[Overall judgement]

response	judgment
Countermeasures are necessary.	
Regular inspections are needed, in case countermeasures are not installed.	✓
Countermeasures are not necessary.	

[Description]

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Full view of the slope at the ending side



Traces of rock slides



Sheeting joints notably developed parallel to the slope.



Full view of the slope at the beginning side



With foliation plunging to the slope, sheeting joints can form slip surfaces for rock slides.



Close up view of the left. The sheeting joints have some aperture, making a rock mass apart from the out crop.

General Information Sheet

Management office	Nuwara Eliya									
Management number	A005-046	Route No	A005	Location(m)	46/5	to	46/6	Distance	200	m
Disaster	Rock Fall, Rock Slide	Name of Road		Landmark	Tall rock escarpment	latitude	N 07°02'53.80"	longitude	E 080°41'55.54"	

<p>Schematic sketch</p>	<p>Reporter's name : Y Kawamura</p> <p>Date of report : 25-Jul-12</p> <p>Description</p> <p>Recorded Disaster : unclear, but traces of rock failure were confirmed during the site visit. Rock fall and small rock slide often occur during heavy rains. Failure Type: Rock slide in weathered rock, rock fall. Geological Condition: Weathered rock rich in vertical open cracks along with foliation, Trigger of Failure: (Supposed) Rainfall, Featured Points: Rock wall with almost perpendicular slope. Well developed foliation and vertical cracks are primary causes of possible failures.. Supposed countermeasures: Drainage ditches along the shoulder of the slope along with vertical drainage. Removal of unstable parts and installation of ring net.</p> <p>History</p> <p style="text-align: center;">New failure Movement/extension</p> <p>Estimated disaster volume</p> <p>Rock slide: 10m * 10m * 1m * 2 sites, height from the road: 50m Supposed area to be damaged: up to the axis of the valley along the lower steep slope.</p>
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<p>Location map (Scale: 1:10,000)</p>	<p>Proposed countermeasures</p> <p>Type:</p> <p>Removal of Hard Rock 100m³ * 2 sites, Height from road:50m, Ring net:1,000m² Drainage ditch (Surrounding the slope + vertical): 300m</p> <p>Quantity</p> <p>Or Deour of the road by a bridge jutting from the existing road (Sponson Type, L=200m). In case a bridge is difficult to apply to this site, rock shed may be considered.</p> <p>Cost (million Birr):</p>
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Management Number	A005-046
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Evaluation sheet (rockfall·slope failure)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score		
topography collapsed factor	talus slope	3 or more matches		✓	Max=3 1		
	clear horseshoe break of slope	2 matches					
	eroded toe of slope	1 match					
	overhang, water catchment slope	None					
geological conditions	soil	vulnerable to erosion	marked	✓	Max=8 4		
		less strength with water	a little marked				
	rock	dense cracks / weak layers / foliation	marked			✓	Max=12 12
		vulnerable to erosion	a little marked				
		easy to be weathered	None				
	structure	dip slope of bedding plane or foliation	existing			✓	Max=8 0
		None					
debris on impermeable bedrock		marked	✓	Max=6 4			
cap rock weaker layer	a little marked						
surface condition	Topsoil, loose rock and unstable rock	unstable	✓	Max=12 12			
		moderate					
	stable						
spring water	notable spring waster		✓	Max=8 4			
	seepage						
surface condition	surface condition	bare land with thin vegetation	✓	Max=5 5			
		moderate (bare·grass·tree)					
		mainly structure, mainly tree					
figure	dip (i) , height	height	✓	Max=18 18			
		$H \geq 50m$					
		$30 \leq H < 50m$					
		$15 \leq H < 30m$					
dip		$H < 15m$	✓	Max=10 10			
		$i \geq 70^\circ$					
		$45^\circ \leq i < 70^\circ$					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree·fallen tree·crack·open crack·anomaly of countermeasure)	$i < 45^\circ$	✓	Max=5 5			
		2 or more matches					
		1 match					
sum total				75	(A)		

[Main check object]

cut slope	✓
natural slope	

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	
Potential rockfall and slope failure are moderately prevented, or it is moderately defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	✓
sum total	(B)	75

[History] (C)

Level of disaster history	point	check
There is a history of large rock falls and slope failures that blocked the traffic even after completion of latest countermeasure.	100	
There is a history of large rock falls and slope failures that damaged the road but not blocked the traffic.	70	✓
There is a history about small rock falls and slope failures that did not damage the road.	40	
No disaster records	0	
(C)	点	

(D) = MAX (B, C)

Score in evaluation from cause	(B)	75
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B, C)	0

[Overall judgement]

response	judgment
Countermeasures are necessary.	✓
Regular inspections are needed, in case countermeasures are not insalled.	
Countermeasures are not necessary.	

[Description]

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Full view of the slope at the beginning side



Debris cleared up to the shoulder of the road



Condition of the lower slope. From the shoulder of the road, very steep lower slope descends downward.



Full view of the slope at the ending side



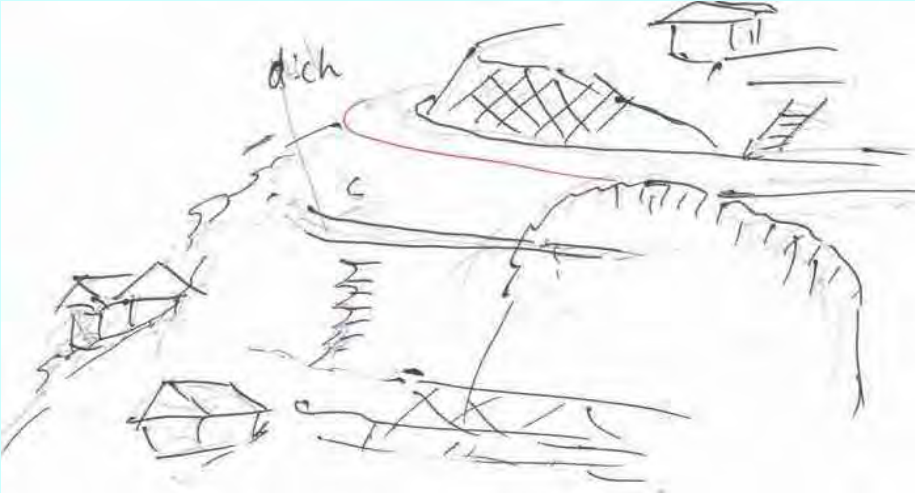

Traces of rock fall or minor rock slides which occurred recently. The height from the road is around 30 meters.



Close up view of the left. With foliation plunging to the slope, vertical cracks can form slip surfaces for rock slides.

General Information Sheet

Management office	Nuwara Eliya		
Management number	A005-063	Route No	A005
Disaster	Slope Failure	Name of Road	
		Location(m)	63/3
		Landmark	
		to	
		Distance	100 m
		latitude	N 06°59'36.78"
		longitude	E 080°44'53.13"

<p>Schematic sketch</p> 	<p>Reporter's name : M. Enokida</p> <p>Date of report : 25-Sep-12</p> <p>Description</p> <p>Same situation can be seen at Km 46/5.</p> <p>Recorded Disaster : unclear, but small rock falls are confirmed during the site visit.</p> <p>Failure Type: Rock slide in weathered rock (feldspar quartzite), toppling may occur under this situation.</p> <p>Geological Condition: Weathered rock rich in vertical open cracks,</p> <p>Trigger of Failure: (Supposed) Rainfall,</p> <p>Featured Points: There are two factors for possible hazards; fragile rock property and vertical open cracks.</p> <p>Feldspar quartzite has relatively poor resistance property against weathering. At the site, outcrops may be seen as sound and strong. However with a hit of a rock hammer, surface of outcrop can be broken easily with muffled sound.</p> <p>Vertical cracks filled with clayey soil can be easily detected on site. Open vertical cracks as well.</p> <p>Supposed countermeasures: Drainage ditches along the shoulder of the slope along with vertical drainage. Fixed with rock bolts or removal of unstable parts.</p> <p>History</p> <p style="text-align: center;">New failure Movement/extension</p> <p>Estimated disaster volume</p>
<p>Location map (Scale: 1:15,000)</p> 	<p>Proposed countermeasures</p> <p>Type:</p> <p>Specification:</p> <p>Quantity</p> <p>Cost (million Birr):</p>

Management Number	A005-063
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	0	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
structure	dip slope of bedding plane	It corresponds.	Max=8	0		
		None			✓	
	debris on impermeability bedrock	marked			Max=6	0
The upper part is a hard /the toe of slope is weak.	a little marked	✓				
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	6		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	8		
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	Max=5	5		
		intermediate (bare·grass·tree)			✓	
		mainly structure, mainly tree			✓	
figure	dip (i) , height	height	Max=18	8		
		H ≥ 50m			✓	
		30 ≤ H < 50m			✓	
		15 ≤ H < 30m			✓	
	dip	H < 15m	✓			
	i ≥ 70°	Max=10	10			
45° ≤ i < 70°	✓					
i < 45°	✓					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more correspondences·clarity certain·uncertainty	Max=5	5		
		None	✓			
sum total		52		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	✓

sum total	(B)
	52

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓

(C)	点
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(D) = MAX (B, C)

Score in evaluation from cause	(B)
	52
Score in evaluation from history	(C)
	0
Among (B)&(C), large one.	(D) = MAX (B, C)
	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

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Management Number **A005-063**

Photo sheet

Date 25-Sep-12



Full view of the slope from strat side



Full view of the slope from end side



Crack of retaining wall on part slope on road



Condition of slope, state of road lower slope



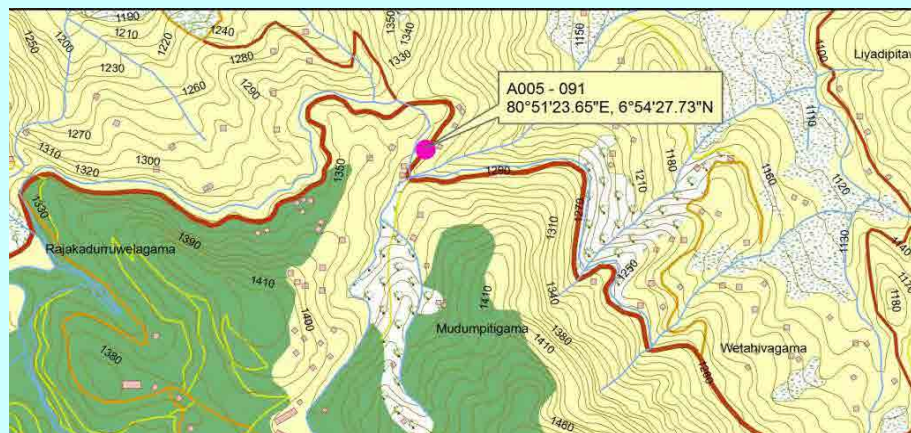
Condition of slope, house under slope

General Information Sheet

Management office	Badulla									
Management number	A005-091	Route No	A005	Location(m)	91+019	to		Distance	30	m
Disaster	Slope Failure (Collapse)		Name of Road		Landmark	Signboard "caution landslide"	latitude	N 06°54'12.76"	longitude	E 080°51'39.19"

<p>Schematic sketch</p>	<p>Reporter's name : Y Kawamura</p> <p>Date of report : 25-Jul-12</p> <p>Description</p> <p>Recorded Disaster : Every rainy season, slope failures have occurred. In January 2007, the road was closed for 2 days due to the debris from the failure. Failure Type: Slope failure in residual soil and weathered rock. Geological Condition: Residual soil and weathered rock. Trigger of Failure: Rainfall, rise in ground water level, Topographic Condition: Water collecting vally, Featured Points: Gradient of slope is apparently too steep for the heavily weathered rock and residual soil confirmed at the site. The actual gradient of slope at the section is 80 - 90 degrees. Gully erosion was also confirmed. In addition, many open cracks were confirmed behind the head scarp. Successive slope failures which can entail retrogressive development of failures behind the shoulder of the slope are anticipated. Supposed countermeasures: Reshaping the slope with stable angle or grating cribs with ground anchors. Removal of unstable parts behind the shoulder. Drainage ditches along the shoulder of the slope along with vertical drainage.</p> <p>History</p> <p style="text-align: center;">New failure Movement/extension</p> <p>Estimated disaster volume</p> <p>Slope failure (collapse) : 30m * 15m Supposed area to be damaged: up to the small river running along the lower slope.</p>
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Location map (Scale: 1:10,000)



Proposed countermeasures	Type:	
	Specification:	Removal of Soil + Weathered Rock: 375 m3 Concrete Crib + Anchor(L=20m): 510m2 + Vegetation:510m2 Drainage ditch (Surrounding slope + vertical): 81m
	Quantity	
	Cost (million Birr):	

Management Number	A005-091
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Evaluation sheet (rockfall·slope failure)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more matches		✓	Max=3 2	
	clear horseshoe break of slope	2 matches				
	eroded toe of slope	1 match				
	overhang, water catchment slope	None				
geological conditions	soil	vulnerable to erosion	marked	✓	Max=8 8	
		less strength with water	a little marked			
			None			
	rock	dense cracks / weak layers / foliation	marked	✓	Max=12 12	
		vulnerable to erosion	a little marked			
		easy to be weathered	None			
	structure	dip slope of bedding plane or foliation	existing	✓	Max=8 8	
			None			
		debris on impermeable bedrock	marked			✓
	cap rock weaker layer	a little marked				
surface condition	Topsoil, loose rock and unstable rock	unstable	✓	Max=12 12		
		moderate				
		stable				
spring water	notable spring waster	seepage	✓	Max=8 0		
		None				
surface condition	bare land with thin vegetation	moderate (bare·grass·tree)	✓	Max=5 5		
		mainly structure, mainly tree				
figure	dip (i) , height	height	H ≥ 50m	✓	Max=18 5	
			30 ≤ H < 50m			
			15 ≤ H < 30m			
			H < 15m			
	dip	i ≥ 70°	✓	Max=10 10		
		45° ≤ i < 70°				
	i < 45°					
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree·fallen tree·crack·open crack·anomaly of countermeasure)	2 or more matches	✓	Max=5 5		
		1 match				
		None				
sum total					71	(A)

[Main check object]

cut slope	✓
natural slope	

[Main slope disasters]

rockfall	
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) × 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	×0	
Potential rockfall and slope failure are moderately prevented, or it is moderately defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	±0	
sum total		(B) 71

[History] (C)

Level of disaster history	point	check
There is a history of large rock falls and slope failures that blocked the traffic even after completion of latest countermeasure.	100	
There is a history of large rock falls and slope failures that damaged the road but not blocked the traffic.	70	✓
There is a history about small rock falls and slope failures that did not damage the road.	40	
No disaster records	0	
(C) 点		

(D) = MAX (B, C)

Score in evaluation from cause	(B) 71
Score in evaluation from history	(C) 0
Among (B)&(C), large one.	(D)=MAX(B,C) 0

[Overall judgement]

response	judgment
Countermeasures are necessary.	✓
Regular inspections are needed, in case countermeasures are not installed.	
Countermeasures are not necessary.	

[Description]



Full view of the site



Condition of the slope. Heavily weathered condition are understood. Foliation and cracks developed densely and helped weathering proceed.



Open cracks seen at the terraces on the upper slope.



Open cracks along with subsidence seen at the terraces .

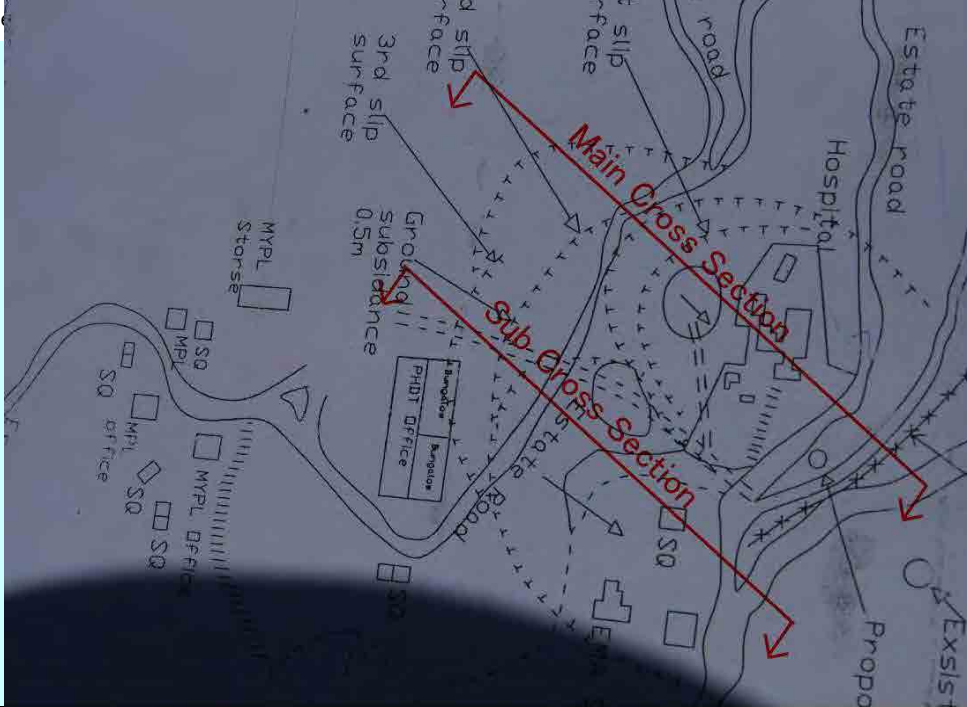



Seen from the shoulder of the failure



Signboard warning the landslide

General Information Sheet

Management office	Badulla																																																	
Management number	A005-135	Route No	A005	Location(m)	135+100	to		Distance	200	m																																								
Disaster	Landslide	Name of Road		Landmark		latitude	N 06°58'43.93"	longitude	E 081°04'56.33"																																									
Schedule				Reporter's name :	Y Kawamura																																													
				Date of report :	27-Jul-12																																													
				Description	<p>Recorded Disaster : From December 2010 when an accumulated precipitation recorded 400 mm, cracks related to one of head scarps appeared at the house of the regional director for the plantation. (This plantation is rehabilitated by PRPII project supported by JICA). In every rainy season, movements of the landslides are observed.</p> <p>As for the damage, severe damage has affected many buildings including a hospital for the plantation and a government office. A005 itself is not included in the landslide mass; the road is just beside the toe of the landslides. Thus when the landslides moved, debris from the toe of the landslides cover the road and RDA shall remove the debris.</p> <p>Failure Type: Landslide. Geological Condition: Colluvium, Trigger of Failure: (Supposed) Rise in groundwater, Featured Points: The type of landslide can be categorized as multiple landslide. The landslide mass was divided into more than 2 subdivided landslides. Head scarps were confirmed not only at the upper part but at middle of the landslide mass. The landslides are under investigation by NBRO. Based on its initial investigation, NBRO estimated a cost for mitigation Supposed countermeasures: Surface drainage system and underground drainage system.</p>																																													
				History	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; text-align: center;">New failure</td> <td style="width: 50%; text-align: center;">Movement/extension</td> </tr> </table>									New failure	Movement/extension																																			
New failure	Movement/extension																																																	
	Estimated disaster volume	<p>Landslide (L=200~300m)</p> <p>Supposed area to be damaged: up to a horizontal distance of 500 meters from the road, or up to a concave knick line, including villages.</p>																																																
	Proposed countermeasures	<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: center;">Type:</td> <td colspan="9">Horizontal Draiange Drilling: 70m * 8 pipes * 4 sites = 2240m</td> </tr> <tr> <td style="text-align: center;">Specification:</td> <td colspan="9">Surface Draiange Ditch: 1000m</td> </tr> <tr> <td style="text-align: center;">Quantity</td> <td colspan="9">Reshaping by soil removal: 200m3 Reshaping by embankment: 200m3</td> </tr> <tr> <td style="text-align: center;">Cost (million Birr):</td> <td colspan="9">Steel Pile (D1000*t60@3400,L=50m), Lenth of Pile Array :200m * 2 lines (Zig zag alignment)</td> </tr> </table>									Type:	Horizontal Draiange Drilling: 70m * 8 pipes * 4 sites = 2240m									Specification:	Surface Draiange Ditch: 1000m									Quantity	Reshaping by soil removal: 200m3 Reshaping by embankment: 200m3									Cost (million Birr):	Steel Pile (D1000*t60@3400,L=50m), Lenth of Pile Array :200m * 2 lines (Zig zag alignment)								
Type:	Horizontal Draiange Drilling: 70m * 8 pipes * 4 sites = 2240m																																																	
Specification:	Surface Draiange Ditch: 1000m																																																	
Quantity	Reshaping by soil removal: 200m3 Reshaping by embankment: 200m3																																																	
Cost (million Birr):	Steel Pile (D1000*t60@3400,L=50m), Lenth of Pile Array :200m * 2 lines (Zig zag alignment)																																																	
<p>Location map (Scale: 1:10,000)</p> 																																																		

Mangement number	A005-135
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Evaluation sheet (landslide)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Category		Check	score
Topographical factor	Photo interpretation	clearly indentified	
		identified partially or unclearly	✓
		unclearly identified	
	Surface anomalies	large and new cracks, steps and subsidence	✓
		small and old cracks, steps and subsidence	
		slight deformation	
no anomalies			
			Max=30 15
Geological conditions	Geological structure	fault, fracture zone, shear zone	✓
		dip slope	
		undip slope/ no characteristic feature	
	Main rock formation of landslide body	colluvium	✓
		Gneiss	
		Charnokite	
		Quartzite	
		Marble	
		Schist	
		Serpentite	
	Granite		
	Hydrological feature	much springs / much seepage	
little springs /little seepage		✓	
trace of water			
no water observed			
			Max=18 18
			Max=7 7
			Max=10 7
sum total		77	(A)

[History] (B)

Category		Check	score
Records of Landslide	Existing record (documents or patrimony)	obvious	✓
		slight	
		none	
	Damage on road facilities and houses	obvious	✓
		slight	
		none	

[Countermeasure] (c)

Category		Check	score
There is no countermeasure		✓	±0
Effectiveness of countermeasure	not working		±0
	partially working		-20
	completely working		×0
Score in evaluation from cause		77	(B)

Monitoring		Check	score
There is monitoring for landslide			
Monitoring devices			
Organization			

[Description]

0



At the middle of the landslide.
A head scarp of a divided landslide developed along the paved road.



Toe of the landslide.
Hospitals and houses were destroyed by the landslide movement.



Toe of the landslide.
Debris from the landslide accumulated and closed the road when the landslide was activated.



Cracks at the middle of landslide.



Seeing downward from the middle of the landslide.
Houses may be affected by the landslide movements.



Escarpment of a divided landslide.

General Information Sheet

Management office	Badulla									
Management number	A005-167	Route No	A005	Location(m)	168/8	to	168/9	Distance	200	m
Disaster	Landslide	Name of Road		Landmark	Bridge at 168/9	latitude	N 07°00'31.54"	longitude	E 081°11'52.19"	

<p>Site sketch</p>	Reporter's name :	Y Kawamura
	Date of report :	27-Jul-12
Description	<p>Recorded Disaster : For more than 10 years, in every rainy season, the landslides moved toward A005 and the debris from the toe covered the road. Against each blockade by the debris, RDA needs to remove it from the road surface.</p> <p>Failure Type: Landslide.</p> <p>Geological Condition: Mainly weathered rock along with colluvium, Trigger of Failure: (Supposed) Rise in groundwater, Topographic Condition: Water collecting valley, a stream is running along the road.</p> <p>Featured Points: The affecting landslide seems to be one of divided landslide from much wider landslide which was moved far past. The affecting landslide is mainly composed of weathered rock which seems to be low resistant against weathering and prone to alter into clay. At the head scarps at the shoulder and upper-middle of the affecting landslide, outcrops of weathered rocks can be observed. At the toe of the landslide, a spring was observed.</p> <p>Supposed countermeasures: Surface drainage system and underground drainage system. Ground anchor at the toe. Relocation of the bridge passing the stream can be an option.</p>	
History	New failure Movement/extension	
Estimated disaster volume	Landslide (L=150m) Supposed area to be damaged: up to the small river and the opposite river bank (will not reach the house).	
Proposed countermeasures	Type:	Horizontal Draiange Drilling: 70m * 8 pipes * 2 sites = 1120m Surface Draiange Ditch: 500m Reshaping by soil removal: 100m3 Reshaping by embankment: 100m3 Concrete Crib + Anchor(L=50m,@1500, 600KN/anchor) at the toe: 100m * 12m
	Specification:	
	Quantity	
	Cost (million Birr):	

Location map (Scale: 1:10,000)

Mangement number	A005-167
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Evaluation sheet (landslide)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Category		Check	score	
Topographical factor	Photo interpretation	clearly indentified	✓	
		identified partially or unclearly		
		unclearly identified		
	Surface anomalies	large and new cracks, steps and subsidence	✓	
		small and old cracks, steps and subsidence		
		slight deformation		
no anomalies				
			Max=30 30	
Geological conditions	Geological structure	fault, fracture zone, shear zone	✓	
		dip slope		
		undip slope/ no characteristic feature		
				Max=18 18
	Main rock formation of landslide body	colluvium	✓	
		Gneiss	✓	
		Charnokite		
		Quartzite		
		Marble		
		Schist		
		Serpentite		
	Granite			
				Max=18 10
Hydrological feature	much springs / much seepage	✓		
	little springs /little seepage			
	trace of water			
	no water observed			
			Max=10 10	
sum total		98	(A)	

[History] (B)

Category		Check	score
Records of Landslide	Existing record (documents or patrimony)	obvious	✓
		slight	
		none	
	Damage on road facilities and houses	obvious	✓
		slight	
		none	

[Countermeasure] (c)

Category		Check	score
There is no countermeasure		✓	±0
Effectiveness of countermeasure	not working		±0
	partially working		-20
	completely working		×0
Score in evaluation from cause		98	(B)

Monitoring		Check	score
There is monitoring for landslide			
Monitoring devices			
Organization			

[Description]

0



Full view of the landslide



At the toe of the landslide, seepage of water was confirmed



Head scarp
Along the main head scarp, several divided head scarps were confirmed.



Open cracks were seen at the middle of the landslide.

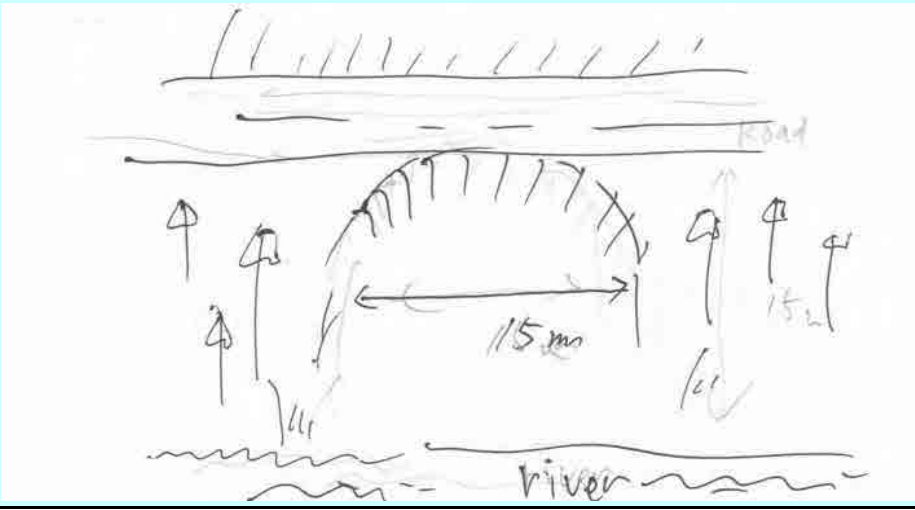
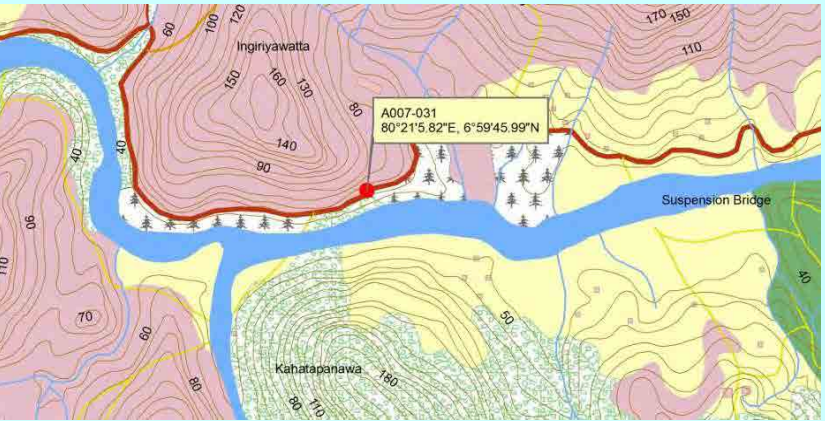


Seen from the opposite side of the small river.
Remaining mounds were clearly seen.



The bridge and the cleaned up debris.
Amount of the debris is so big that the river course is about to be closed.

General Information Sheet

Management office	Kegalle													
Management number	A007-031	Route No	A007	Location(m)	31/1	to	31/2	Distance	100	m				
Disaster	Slope Failure		Name of Road		Landmark	latitude	N 06°59'45.99"		longitude	E 080°21'05.82"				
Schematic sketch				Reporter's name :		M. Enokida								
				Date of report :		25-Sep-12								
				Description		<p>Recorded Disaster : Slope failure in lower slope moved away the shoulder. Cracks appeared on the pavement.</p> <p>Failure Type: Slope failure in residual soil and weathered rock. Geological Condition: Residual soil and weathered rock. Trigger of Failure: (Supposed) Erosion of toe of the slope by Kelani River, and steeper gradient of slope.</p> <p>Featured Points: Slope failure by river erosion.</p> <p>Supposed countermeasures: Retaining wall against the erosion as well as to reinforce the slope.</p>								
				History		New failure Movement/extension								
				Estimated disaster volume										
Location map (Scale: 1:10,000)				Proposed countermeasures		Type: Specification: Quantity: Cost (million Birr):								
														

Management Number	A007-031
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	0	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
structure	dip slope of bedding plane	It corresponds.	Max=8	0		
		None			✓	
	debris on impermeability bedrock	marked	Max=6	0		
The upper part is a hard /the toe of slope is weak.	a little marked	✓				
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	6		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	0		
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	Max=5	3		
		intermediate (bare·grass·tree)			✓	
		mainly structure, mainly tree			✓	
figure	dip (i) , height	height	Max=18	8		
		$H \geq 50m$			✓	
		$30 \leq H < 50m$			✓	
		$15 \leq H < 30m$			✓	
	dip	$H < 15m$	Max=10	10		
		$i \geq 70^\circ$			✓	
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	$45^\circ \leq i < 70^\circ$	Max=5	5		
		$i < 45^\circ$			✓	
		2 or more correspondences·clarity certain·uncertainty			✓	
	None	✓				
sum total		42		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) \times 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	42

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX (B, C)

Score in evaluation from cause	(B)	42
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B, C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

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Full view of the slope from strat side



Full view of the slope from end side



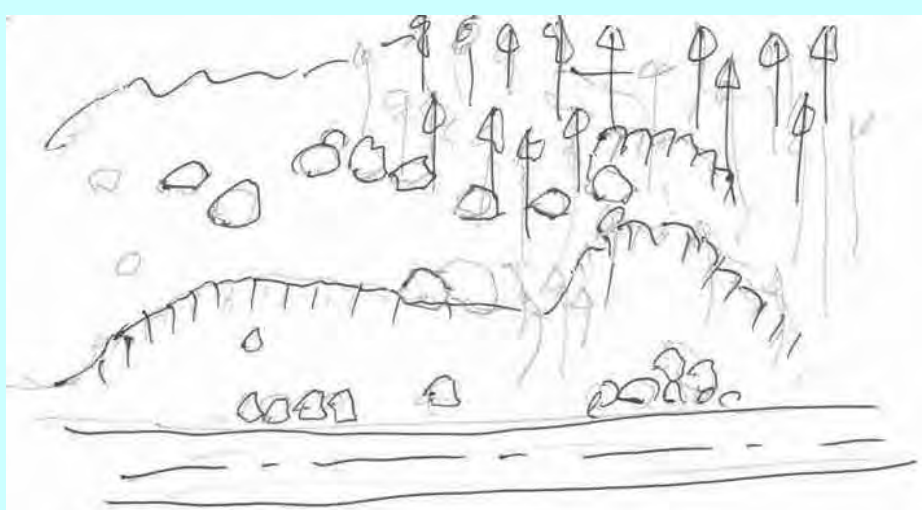
Condition of slope, state of road lower slope

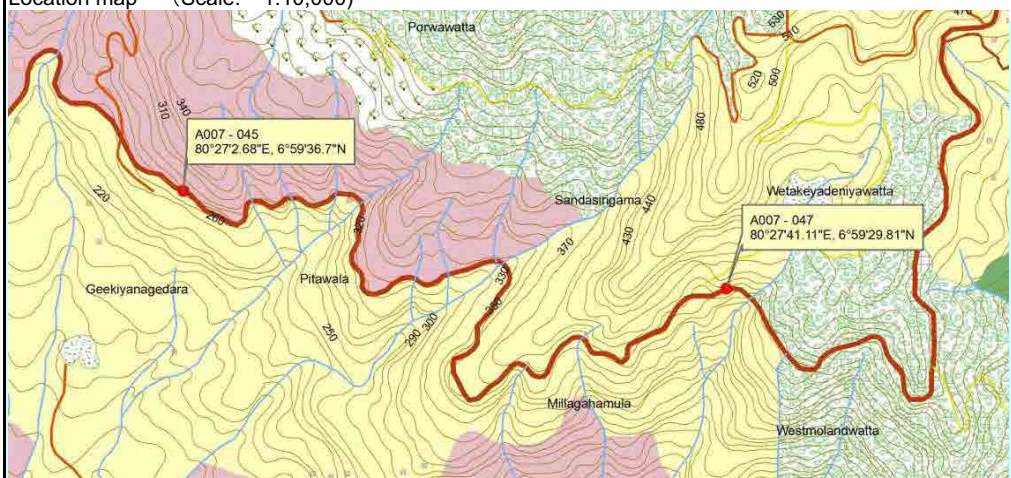


Condition of slope, state of road upper slope

General Information Sheet

Management office	Nuwara Eliya	Route No	A007	Location(m)	45	to		Distance	200	m
Disaster	Slope Failure	Name of Road		Landmark		latitude	N 06°59'36.70"	longitude	E 080°27'02.68"	

<p>Schematic sketch</p> 	<p>Reporter's name : M. Enokida</p> <p>Date of report : 25-Sep-12</p> <p>Recorded Disaster : Unclear. Fallen boulders, however, were seen on site.</p> <p>Description</p> <p>Failure Type: Rock fall, slope failure in colluvium. Geological Condition: At the ending part, massive rock with cracks, at the beginning part, colluvium.. Trigger of Failure: (Supposed) Rainfall, erosion, and development of open cracks..</p> <p>Featured Points: Boulders were seen at the shoulder of cutting slope composed of colluvium. Boulders were also seen in the upper slopes. In addition, unstable parts of outcrop with cracks were seen at the shoulder of rocky slope.</p> <p>Supposed countermeasures: Further investigation is required to set up appropriate countermeasures. Based on the site situation, however, removal of boulders and unstable parts of rock can be amongst countermeasures along with fixing unstable parts with rock bolts or other fixing methods.</p> <p>History</p> <p style="text-align: center;">New failure Movement/extension</p> <p>Estimated disaster volume</p>
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<p>Location map (Scale: 1:10,000)</p> 	<p>Proposed countermeasures</p> <p>Type:</p> <p>Specification:</p> <p>Quantity</p> <p>Cost (million Birr):</p>
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Management Number	A007-045
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	1	
	clear convex break of slope	2 correspondences				
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence				
geological conditions	soil	susceptible to erosion	marked	✓	Max=8	
		less strength with water	a little marked			
			None			
	rock	high density of cracks and a weak layer	marked	✓	Max=12	6
		susceptible to erosion	a little marked			
		fast weathering	None			
structure	dip slope of bedding plane	It corresponds.	✓	Max=8	0	
		None				
	debris on impermeability bedrock	marked	✓	Max=6	4	
		The upper part is a hard /the toe of slope is weak.	a little marked			
surface condition	Topsoil, detached rock and unsteady rock	instability	✓	Max=12	12	
		a little unstable				
		stability				
	spring water	notable spring water	✓	Max=8	0	
		seepage				
	surface condition	surface condition	bare land with minor vegetation	✓	Max=5	5
intermediate (bare·grass·tree)						
mainly structure, mainly tree						
figure	dip (i) , height	height	✓	Max=18	5	
		$H \geq 50m$				
		$30 \leq H < 50m$				
		$15 \leq H < 30m$				
	dip	$H < 15m$	✓	Max=10	10	
		$i \geq 70^\circ$				
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	$45^\circ \leq i < 70^\circ$	✓	Max=5	5	
		$i < 45^\circ$				
		2 or more correspondences·clarity certain·uncertainty	✓			
		None				
sum total		56		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) \times 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	56

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX (B, C)

Score in evaluation from cause	(B)	56
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B, C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

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Full view of the slope from strat side



Full view of the slope from end side



Condition of slope, house under slope

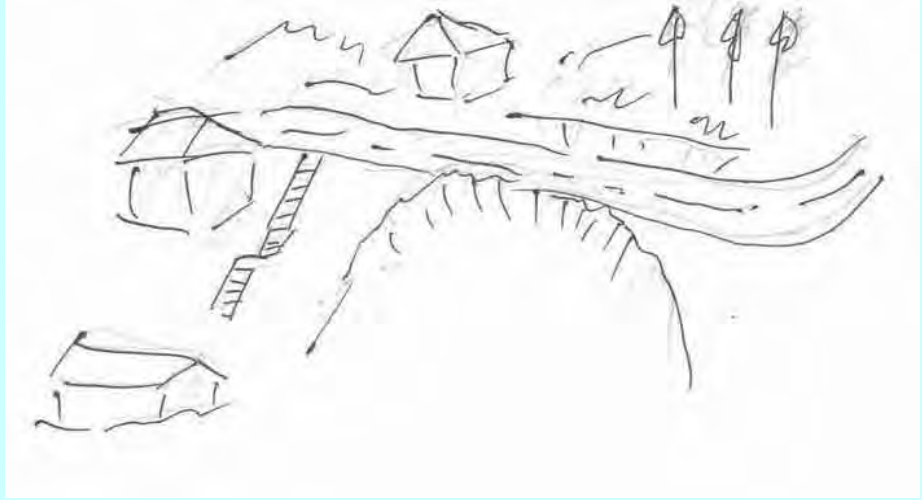



Condition of slope, state of road upper slope



Condition of slope, state of road upper slope

General Information Sheet

Management office	Nuwara Eliya		
Management number	A007-054	Route No	A007
Disaster	Slope Failure	Name of Road	
Location(m)		54/1	to
Distance		100	m
Landmark		latitude	N 06°59'15.85"
		longitude	E 080°29'45.50"
Schematic sketch		Reporter's name :	M. Enokida
		Date of report :	25-Sep-12
		Description	<p>Recorded Disaster : Shoulder of the road collapsed. Cracks developed on the nearby pavement.</p> <p>Failure Type: Slope failure in residual soil. Geological Condition: Residual soil. Trigger of Failure: (Supposed) Rainfall, erosion, and steeper gradient of slope.</p> <p>Featured Points: There were 2 slope failures; one was under the shoulder and another was in the upper slope.</p> <p>Supposed countermeasures: Further investigation is required to set up appropriate countermeasures. Based on the site situation, however, grating cribs with ground anchors can be amongst the supposed.</p>
		Histry	<p style="text-align: center;">New failure Movement/extension</p>
Location map (Scale: 1:10,000)		Estimated disaster volume	
		Proposed countermeasures	Type:
			Specifi-cation:
			Quantity
			Cost (million Birr):

Management Number	A007-054
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	0	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
structure	dip slope of bedding plane	It corresponds.	Max=8	0		
		None			✓	
	debris on impermeability bedrock	marked	Max=6	0		
The upper part is a hard /the toe of slope is weak.	a little marked	✓				
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	12		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	0		
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	Max=5	3		
		intermediate (bare·grass·tree)			✓	
		mainly structure, mainly tree			✓	
figure	dip (i) , height	height	Max=18	8		
		$H \geq 50m$			✓	
		$30 \leq H < 50m$			✓	
		$15 \leq H < 30m$			✓	
dip	$H < 15m$	Max=10	10			
	$i \geq 70^\circ$			✓		
	$45^\circ \leq i < 70^\circ$			✓		
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	$i < 45^\circ$	Max=5	5		
		2 or more correspondences·clarity			✓	
		certain·uncertainty			✓	
		None				
sum total		48		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) \times 0

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	48

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX (B,C)

Score in evaluation from cause	(B)	48
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D) = MAX (B,C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

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Management Number **A007-031**

Photo sheet

Date **25-Sep-12**



Full view of the slope from strat side



Full view of the slope from end side




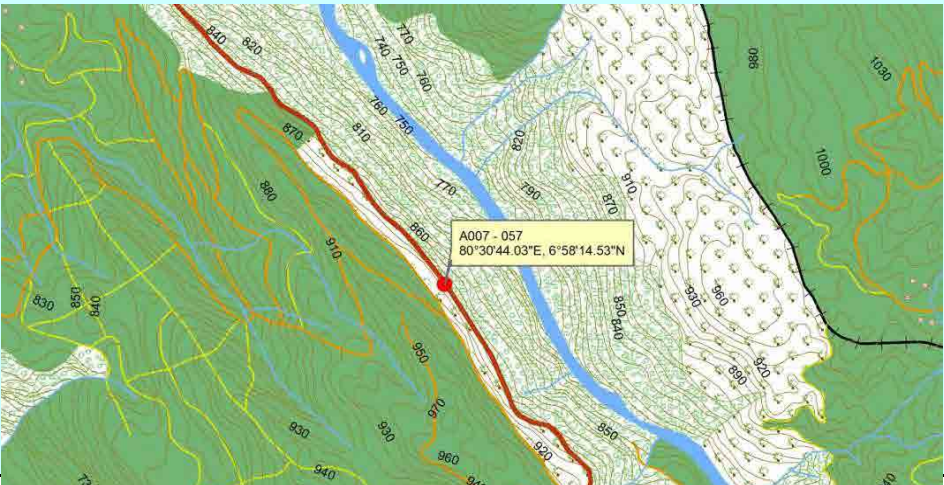
Condition of slope, state of road lower slope



Condition of slope, house under slope

General Information Sheet

Management office	Nuwara Eliya									
Management number	A007-057	Route No	A007	Location(m)	57/9	to		Distance	200	m
Disaster	Slope Failure	Name of Road		Landmark		latitude	N 06°58'14.53"		longitude	E 080°30'44.03"

<p>Schematic sketch</p> 	<p>Reporter's name : M. Enokida</p> <p>Date of report : 25-Sep-12</p> <p>Description</p> <p>Recorded Disaster : Debris provided from the slope failure closed the road.</p> <p>Failure Type: Slope failure in residual soil and weathered rock. Geological Condition: Residual soil and weathered gneiss rich in cracks. Vertical cracks attract the attention. Trigger of Failure: (Supposed) Rainfall, erosion, and steeper gradient of slope.</p> <p>Featured Points: Springs were confirmed in the middle of the slope at the beginning side.</p> <p>Supposed countermeasures: Further investigation is required to set up appropriate countermeasures. Based on the site situation, however, draiange system and grating cribs with ground anchors can be amongst the supposed.</p> <p>Histrory</p> <p style="text-align: center;">New failure Movement/extension</p> <p>Estimated disaster volume</p>
<p>Location map (Scale: 1:10,000)</p> 	<p>Proposed countermeasures</p> <p>Type:</p> <p>Specifi-cation:</p> <p>Quantity</p> <p>Cost (million Birr):</p>

Appendix 3-2
43

Mangement number	A007-057
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Evaluation sheet (landslide)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Category		Check	score	
Topographical factor	Result of photo interpretation	exist clearly		
		exist but partial and not clear	✓	
		exist but not clear		
	Surface anomalies	large and new cracks, steps and subsidence		Max=30
		small and old cracks, steps and subsidence	✓	
		slight deformation		20
no anomalies				
Geological conditions	Geological structure	fault, fracture zone		
		dip slope		
		undip slope/ no characteristic feature	✓	
	Main rock formation of landslide body	colluvium	✓	Max=18
		Gneiss		
		Charnokite		
		Quartzite		
		Marble		
		Schist		
		Serpentite		
		Granite		
	Hydrological feature	much springs / much seepage		Max=10
		little springs / little seepage		
		trace of water		
		no water observed	✓	
sum total		42	(A)	

[History] (B)

Category		Check	score
Records of Landslide	Existing record (documents or patrimony)	obvious	
		slight	✓
		none	
	Damage on road facilities and houses	obvious	
		slight	✓
		none	

[Countermeasure] (c)

Category		Check	score
There is no countermeasure		✓	±0
Effectiveness of countermeasure	No effect		±0
	Some effect		-20
	High effect		×0
Score in evaluation from cause		42	(B)

Monitoring		Check	score
There is monitoring for landslide			
Monitoring devices			
Organization			

[Description]

Management Number	A007-057
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Evaluation sheet (rockfall·slope failure)

Evaluator	M.Enokida
Organization	JICA Study Team

[Causes] (A)

Item	factor	category of score		point	score	
topography collapsed factor	talus slope	3 or more correspondences	✓	Max=3	2	
	clear convex break of slope	2 correspondences	✓			
	eroded toe of slope	1 correspondences	✓			
	overhang, water catchment slope	no correspondence	✓			
geological conditions	soil	susceptible to erosion	marked	Max=8	8	
		less strength with water	a little marked			✓
			None			✓
	rock	high density of cracks and a weak layer	marked	Max=12	0	
		susceptible to erosion	a little marked			✓
		fast weathering	None			✓
	structure	dip slope of bedding plane	It corresponds.	Max=8	0	
			None			✓
		debris on impermeability bedrock	marked			Max=6
	The upper part is a hard /the toe of slope is weak.	a little marked	✓			
surface condition	Topsoil, detached rock and unsteady rock	instability	Max=12	12		
		a little unstable			✓	
		stability			✓	
	spring water	notable spring water	Max=8	0		
seepage		✓				
surface condition	surface condition	bare land with minor vegetation	Max=5	5		
		intermediate (bare·grass·tree)			✓	
		mainly structure, mainly tree			✓	
figure	dip (i) , height	height	Max=18	8		
		$H \geq 50m$			✓	
		$30 \leq H < 50m$			✓	
		$15 \leq H < 30m$			✓	
	dip	$H < 15m$	Max=10	5		
		$i \geq 70^\circ$			✓	
anomaly	targeted slope (surface collapse·small fallen rock·gully·erosion·piping hole·subsidence·heaving·bending of tree root·fallen tree·crack·open crack·anomaly of countermeasure)	$45^\circ \leq i < 70^\circ$	Max=5	5		
		$i < 45^\circ$			✓	
		2 or more correspondences·clarity certain·uncertainty			✓	
	None	✓				
sum total		49		(A)		

[Main check object]

cut slope	✓
natural slope	✓

[Main slope disasters]

rockfall	✓
slope failure	✓

[Countermeasure] (B) = (A) + α or (A) $\times 0$

effectiveness of existing countermeasures	point (α)	check
Potential rockfall and slope failure are prevented enough, or, it is defended enough when it is generated.	$\times 0$	✓
Potential rockfall and slope failure are considerably prevented, or it is considerably defended when it is generated.	-20	✓
Potential rockfall and slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	-10	✓
There is no countermeasure, or there is not effective even if countermeasures are not performed.	± 0	✓
sum total	(B)	49

[History] (C)

Level of disaster history	point	check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.		✓
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.		✓
There is a history about small fallen rocks and slope failures that did not get to the road.		✓
No disaster records		✓
(C)	点	

(D) = MAX (B,C)

Score in evaluation from cause	(B)	49
Score in evaluation from history	(C)	0
Among (B)&(C), large one.	(D)=MAX(B,C)	0

[Overall judgement]

response	judgment
The countermeasure work is necessary.	✓
Though the urgent countermeasure is not necessary, regular inspections are needed.	
The countermeasure work is not necessary.	

[Description]

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Management Number A007-057

Photo sheet

Date 25-Sep-12



Full view of the slope from strat side



Full view of the slope from end side



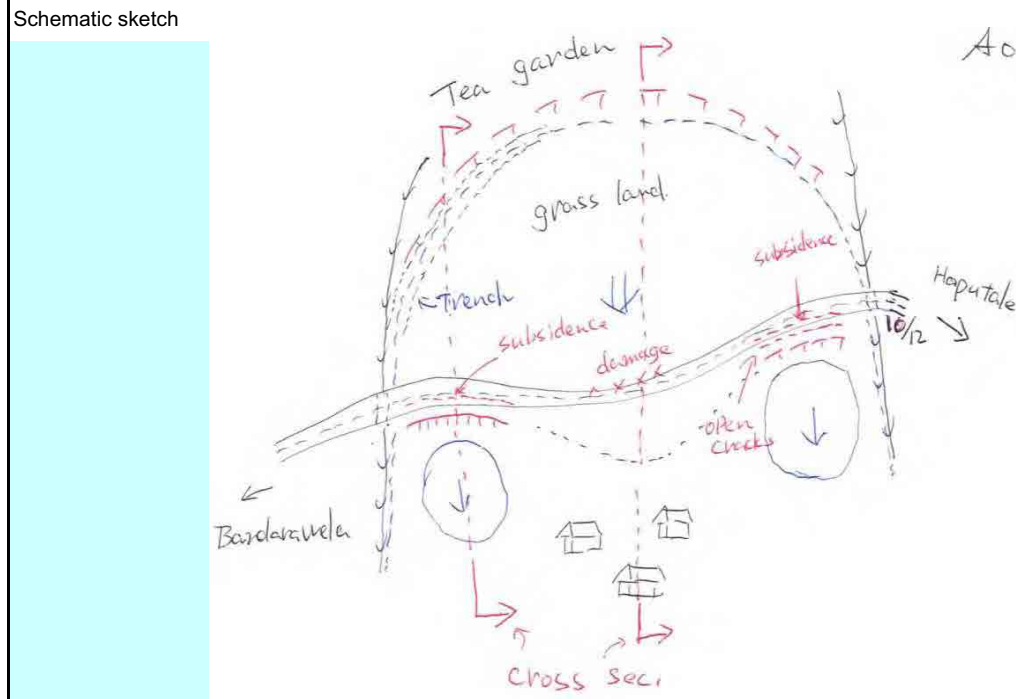
Condition of slope, state of road upper slope



Adjoining old collapse ground

General Information Sheet

Management office	Badulla	Route No	A016	Location(m)	10/12	to	11/2	Distance	200	m		
Disaster	Landslide	Name of Road		Landmark	Alley of drum cans along the shoulder		latitude	N 06°47'33.30"		longitude	E 080°58'24.67"	



Reporter's name :	Y Kawamura
Date of report :	27-Jul-12

Description

Recorded Disaster : From 1996, landslide activities have been observed every 2 years. This landslide affects the road running at its middle and houses located downstream of its toe.
 Failure Type: Landslide.
 Geological Condition: Colluvium,
 Trigger of Failure: (Supposed) Rise in groundwater,
 Featured Points: When the toe of the landslide moves triggered by a rainfall , the body of landslide at the toe turns into fluid and strikes the houses with a high speed movement. A head scarp of a devided landslide locates just beside the road shoulder and poses a threat of subsidence or collapse of the foundation of the road.
 The initial investigation by NBRO was done in 2001 or 2002. The 2nd investigation was in 2011. The thickness of the landslide is said to be 20 meters or more.
 An improvement of the road was completed in 2009 -2010.
 Supposed countermeasures: Surface drainage system and underground drainage system. Ground anchor or pile works to support the sholder affected by the devided landslide..

Histry	New failure	Movement/extension
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Estimated disaster volume

Landslide (L=500m)
 Supposed area to be damaged: up to the axis of the valley along the lower slope, including the village up to the church locating at the centre of the village.

Location map (Scale: 1:10,000)



Proposed countermeasures	Type:	Horizontal Draiange Drilling: 70m * 8 pipes * 3 sites = 1680m Surface Draiange Ditch: 1500m Reshaping by soil removal: 100m3 Reshaping by embankment: 100m3 Steel Pile (D1200*t60@2600,L=50m), Lenth of Pile Array :200m * 2 lines (Zig zag alignment)
	Specifi-cation:	
	Quantity	
	Cost (million Birr):	

Mangement number	A016-010
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Evaluation sheet (landslide)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Category		Check	score
Topographical factor	Photo interpretation	clearly indentified	✓
		identified partially or unclearly	
		unclearly identified	
	Surface anomalies	large and new cracks, steps and subsidence	✓
		small and old cracks, steps and subsidence	
		slight deformation	
no anomalies			
sum total		74	(A)

[Countermeasure] (c)

Category		Check	score
There is no countermeasure		✓	±0
Effectiveness of countermeasure	not working		±0
	partially working		-20
	completely working		×0
Score in evaluation from cause		74	(B)

Monitoring		Check	score
There is monitoring for landslide			
Monitoring devices			
Organization			

[Description]

0

[History] (B)

Category		Check	score
Records of Landslide	Existing record (documents or patrimony)	obvious	✓
		slight	
		none	
	Damage on road facilities and houses	obvious	✓
		slight	
		none	



Damage on the road at the middle of the landslide



Headscarp along the road shoulder at the ending side



Condition of the road around the head scarp at the ending side.



Subsidence on the road at the beginning side.



Tension cracks along the shoulder of the road at the beginning side.



Village developed downward of the toe of the landslide
The debris is said to turn into mud flow when the landslide is activated, so the supposed affected area of the landslide can reach to the middle of the village, around the church.

General Information Sheet

Management office	Kandy												
Management number	A113-015	Route No	A113	Location(m)	16/5	to	16/6	Distance	50	m			
Disaster	Landslide	Name of Road		Landmark	Alley of drum cans along the shoulder		latitude	N 07°03'42.53"		longitude	E 080°32'15.27"		
Schematic sketch				Reporter's name :	Y Kawamura								
				Date of report :	24-Jul-12								
				Description	<p>Recorded Disaster : Periodical records of landslide activity. In every rainy season, especially in December, gaps have developed on the pavement with an aperture of 4 - 6 inches (10 - 15cm). The gaps correspond to the head scarp of lower landslide.</p> <p>Failure Type: Landslide.</p> <p>Geological Condition: Colluvium,</p> <p>Trigger of Failure: (Supposed) Rise of groundwater,</p> <p>Featured Points: The landslides at this location involve not only road, but houses and railway. Two landslides are confirmed so far. The upper landslide is said to have been stabilized by the retaining wall constructed along the railway. The head scarp of the upper landslide may be located under the passage paved with concrete slab. The lower landslide still shows periodical movement during rainy seasons and damages the A-113 road with subsidence and open gaps which reaches 15cm.</p> <p>3 piezometers were placed and observed by RDA.</p> <p>Supposed countermeasures: Surface drainage system and underground drainage system. Pile works or ground anchors to retain the road. Retaining wall against erosion by the Mahaweli river.</p>								
				History	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">New failure</td> <td style="width: 50%;">Movement/extension</td> </tr> </table>							New failure	Movement/extension
New failure	Movement/extension												
Location map (Scale: 1:10,000)				Estimated disaster volume	<p>Landslide (L=50+m)</p> <p>Supposed area to be damaged: up to the Mahaweli River.</p>								
				Proposed countermeasures	Type:	Horizontal Draiage Drilling: 50m * 8 pipes * 3 sites = 1200m							
					Specification:	Surface Draiage Ditch: 500m Reshaping by soil removal: 100m ³ Reshaping by embankment: 100m ³ Concrete Crib + Anchor(L=50m,@1500, 600KN/anchor) at the toe: 100m * 12m							
				Quantity	Retaining wall along the river: 500m ³								
				Cost (million Birr):									

Appendix 3-2
50

Mangement number	A113-015
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Evaluation sheet (landslide)

Evaluator	Y Kawamura
Organization	JICA Study Team

[Causes] (A)

Category		Check	score	
Topographical factor	Photo interpretation	clearly indentified		
		identified partially or unclearly	✓	
		unclearly identified		
	Surface anomalies	large and new cracks, steps and subsidence	✓	
		small and old cracks, steps and subsidence		
		slight deformation		
no anomalies				
			Max=30 15	
Geological conditions	Geological structure	fault, fracture zone, shear zone	✓	
		dip slope		
		undip slope/ no characteristic feature		
				Max=18 18
	Main rock formation of landslide body	colluvium	✓	
		Gneiss		
		Charnokite		
		Quartzite		
		Marble		
		Schist		
		Serpentite		
		Granite		
				Max=18 7
Hydrological feature	much springs / much seepage			
	little springs /little seepage			
	trace of water	✓		
	no water observed			
			Max=10 5	
sum total		75	(A)	

[History] (B)

Category		Check	score
Records of Landslide	Existing record (documents or patrimony)	obvious	✓
		slight	
		none	
	Damage on road facilities and houses	obvious	✓
		slight	
		none	

[Countermeasure] (c)

Category		Check	score
There is no countermeasure		✓	±0
Effectiveness of countermeasure	not working		±0
	partially working		-20
	completely working		×0
Score in evaluation from cause		75	(B)

Monitoring		Check	score
There is monitoring for landslide		✓	
Monitoring devices	Piezometer		
Organization	RDA		

[Description]

0

Management Number A113-015

Photo sheet

Date July 24, 2012



Damage on the road at the middle of the landslide



Piezometer installed at the lower part of the landslide.



Condition of the lower part of the landslide.



Cracks appeared on the road surface. Cracks seem to follow the shape of a head scarp under the pavement.

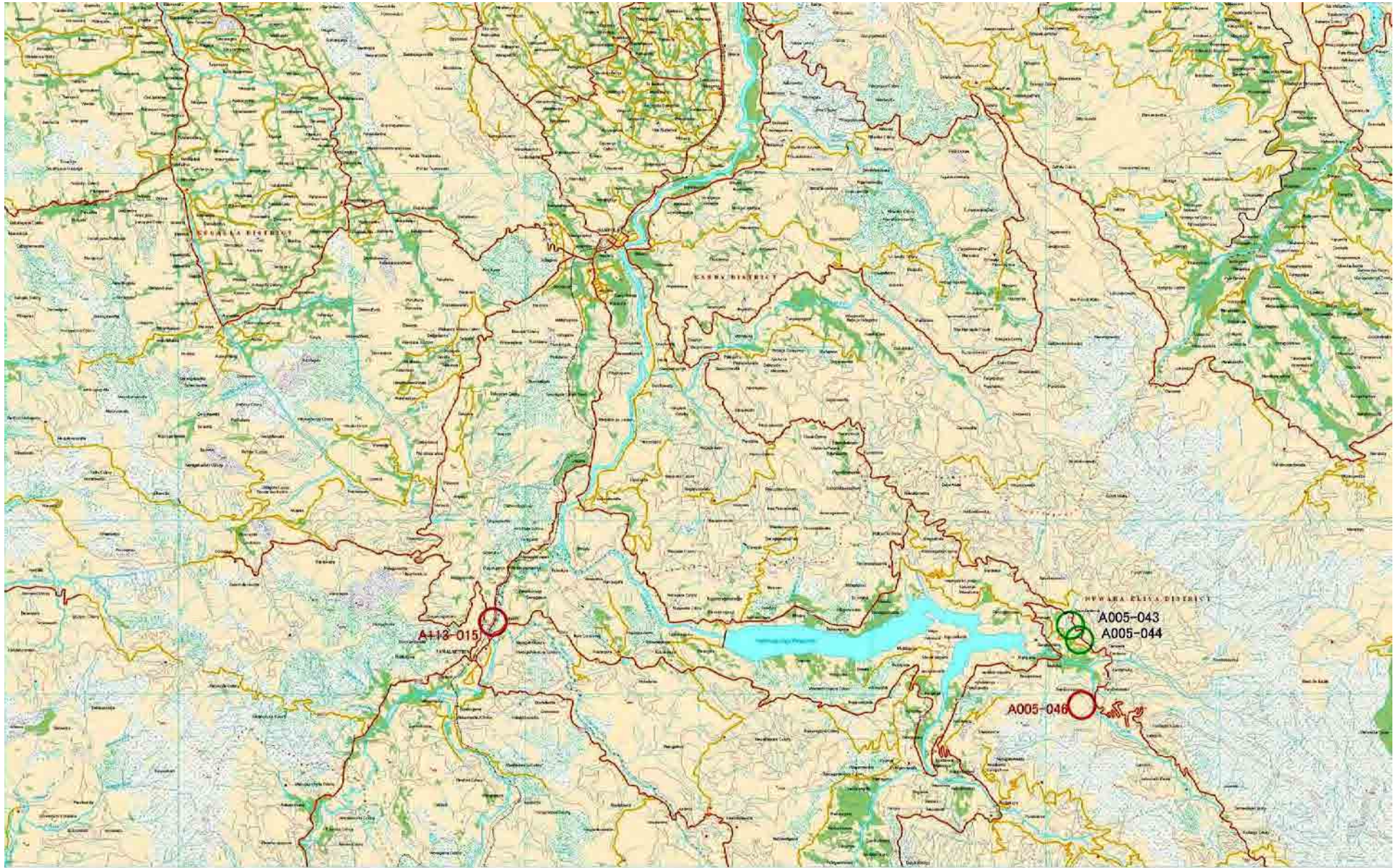


Colluvium is distributed in the site.

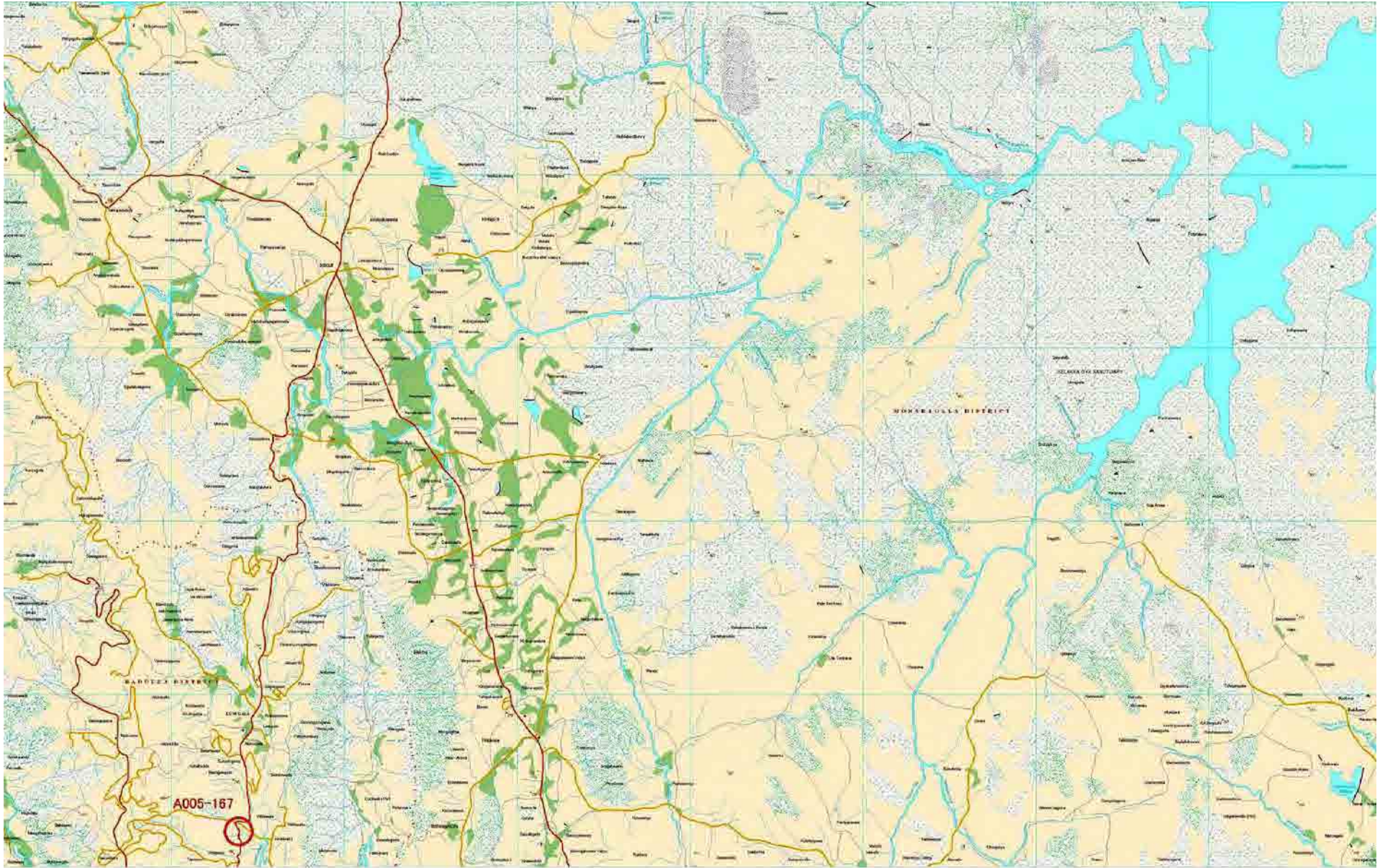


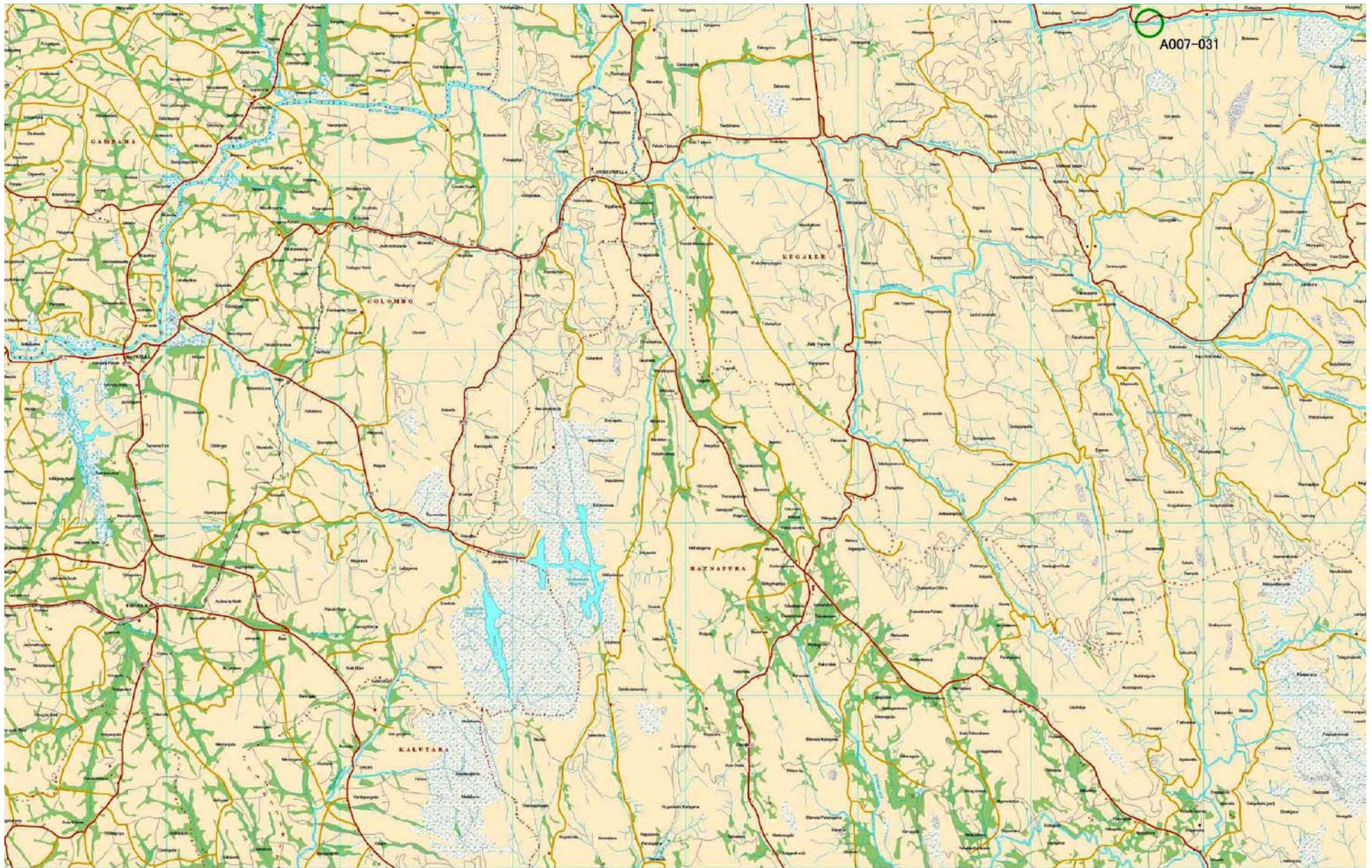
Retaining wall along the road. After the construction of this retaining wall, landslide of upper slope was said to be eased.

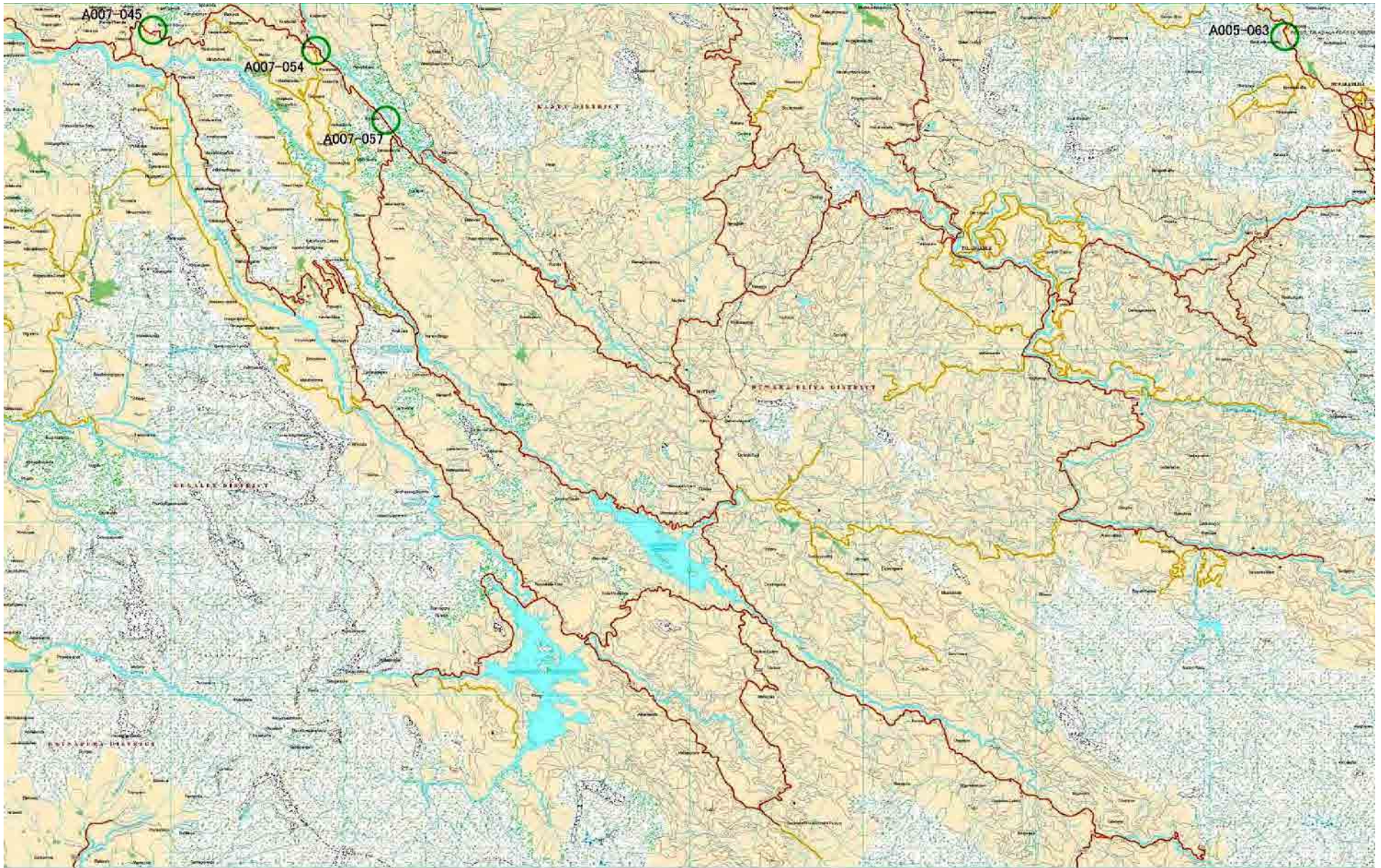
Appendix 3-3 Maps of prioritized section

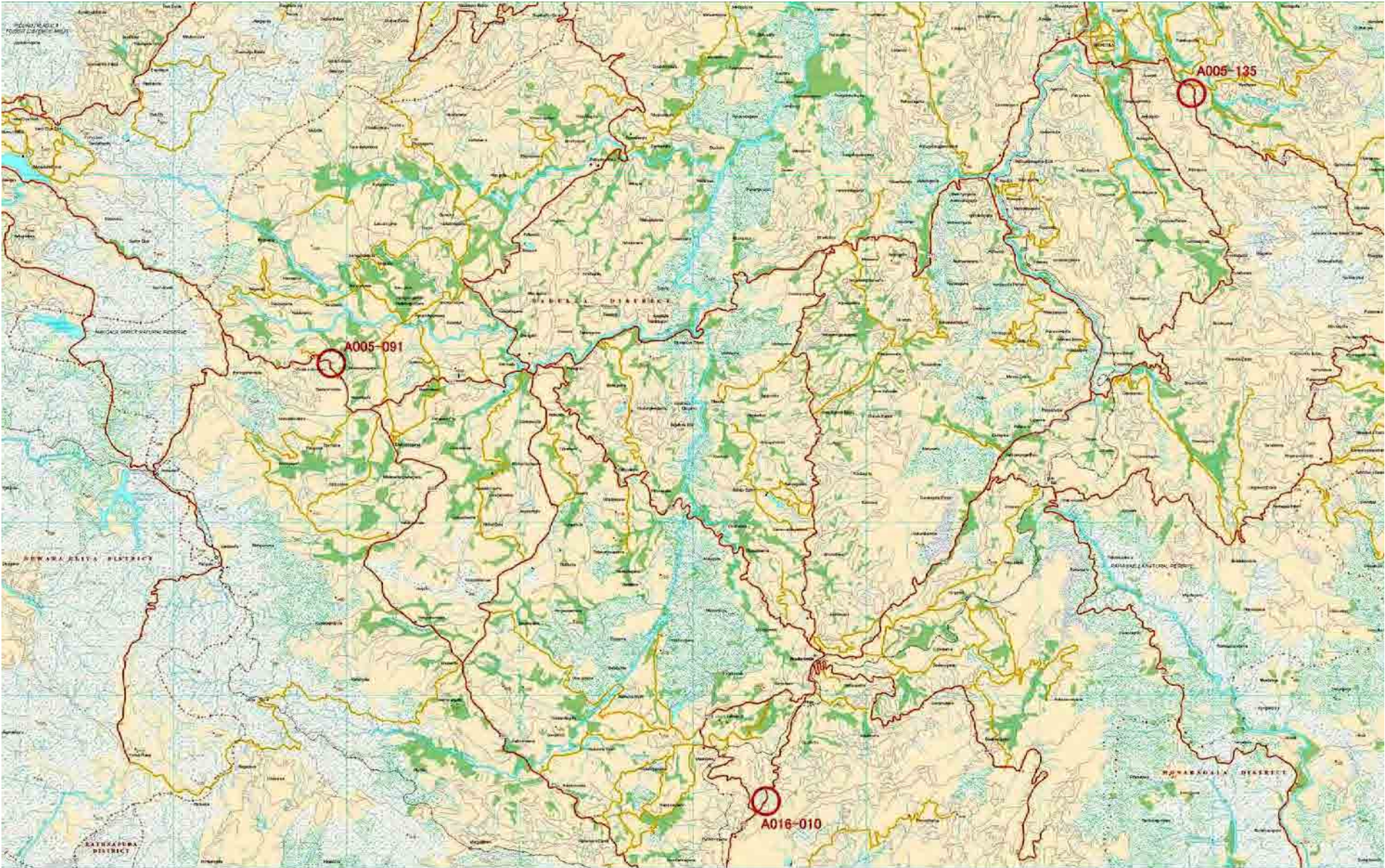


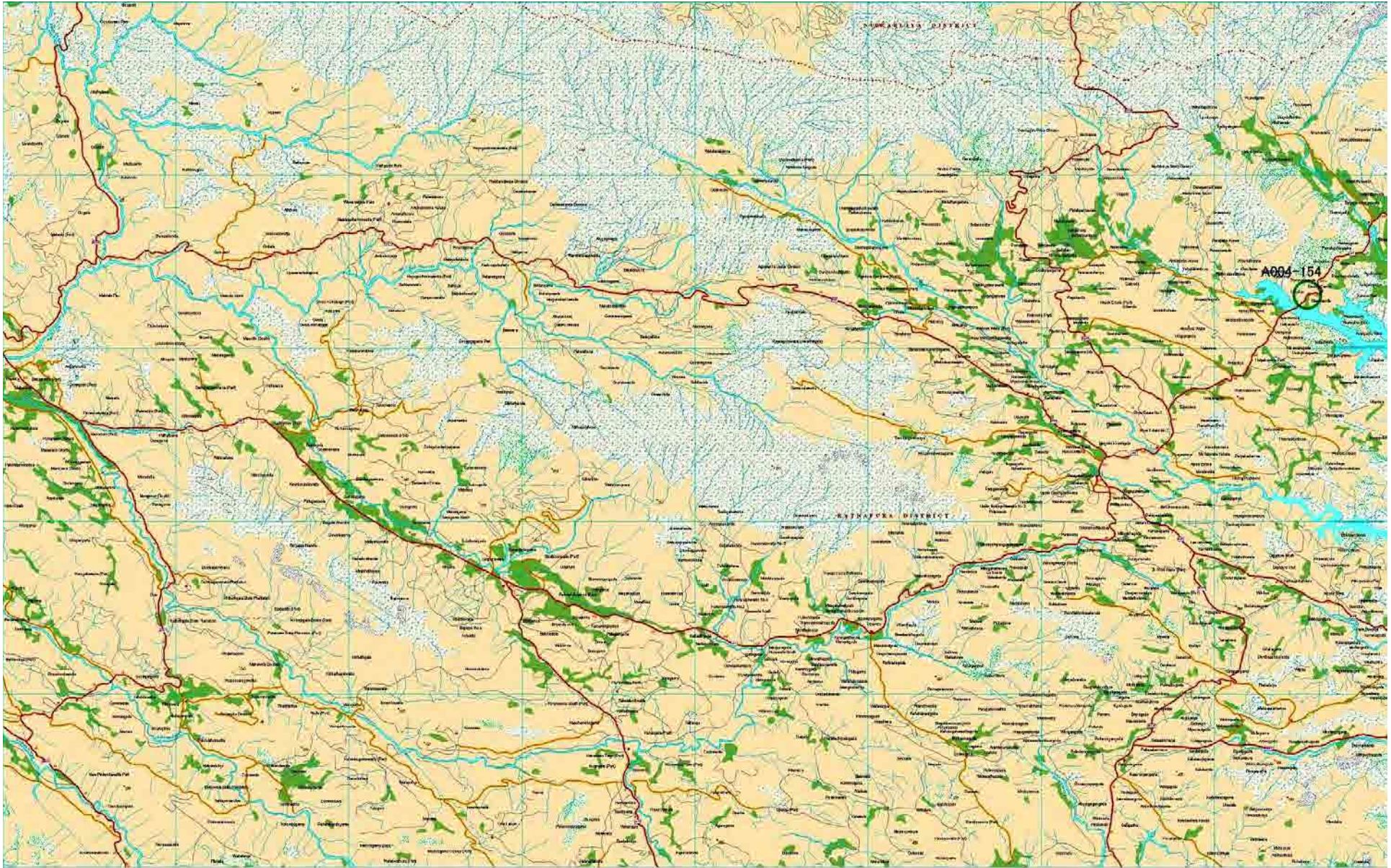
Due to the improvement of A005 road, some locations of the sites are away from the road depicted on this map.

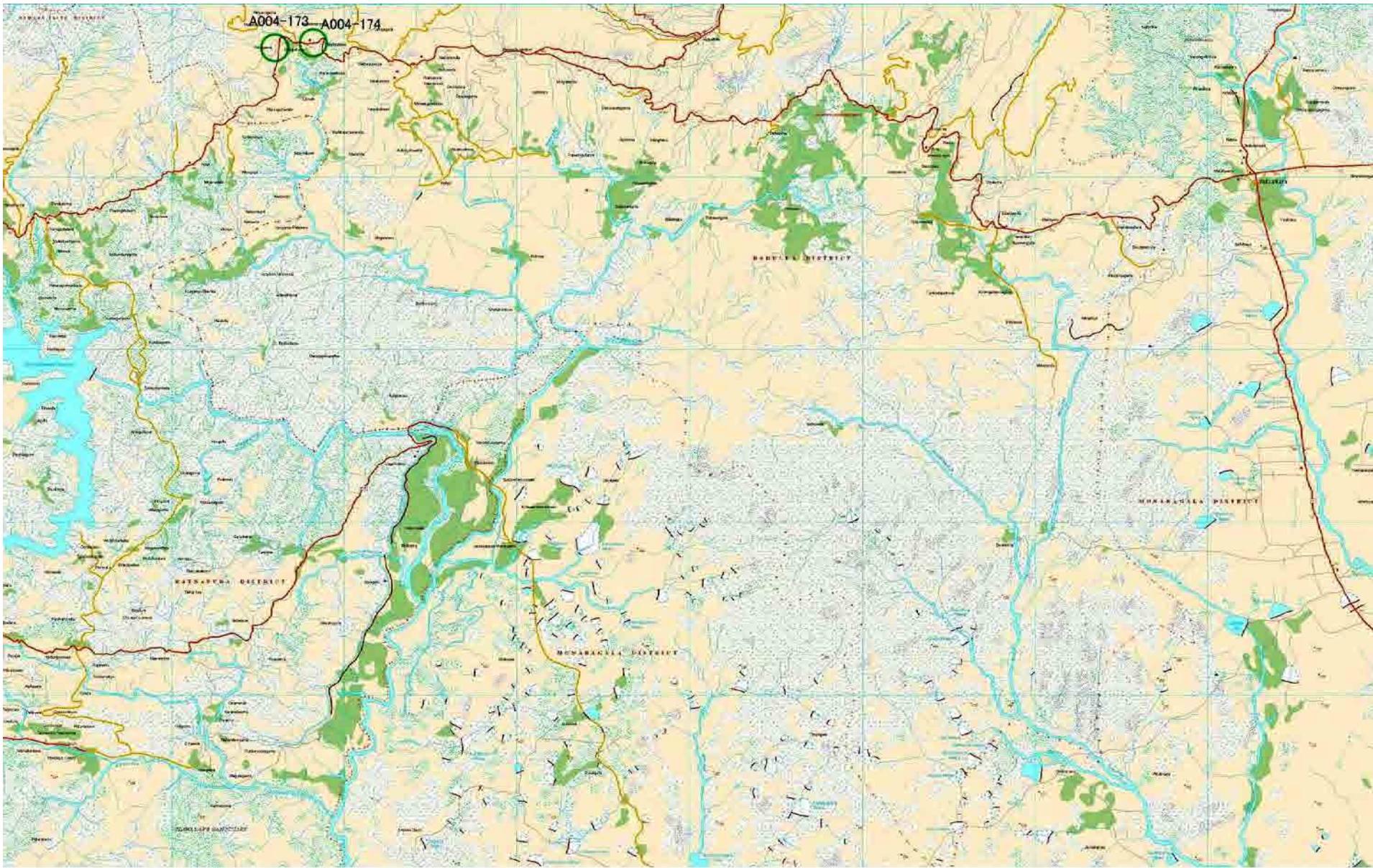












Appendix 3-4 Photo reading and geological map information (Rank A, B, C)

Photo Reading and Geological Map Information (Rank A, B, C)

No	Route No	Disaster Type	Rank	Featuring Points	District	Aerial Photos		Photo Reading	Number	Geological Map	
						Course	Number			Geological Condition	
A004-134	A004	Rock Fall	B		Rainapura	2001-05	162,163	Blocked by clouds. Some photo lineaments were read.	17	Pmgk ³ : Undifferentiated charnockitic biotite gneiss	
A004-154	A004	Landslide?	A	Slope Failure in Embankment? Needs to be investigated.	Rainapura	99-21	62,63	Shape of the landslide is unclear. But several small landslides were read along the valleys around the site. Convergence of photo lineaments was seen around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmq: Quartzites. Beside a shear zone and a fault inferred by aerial photos.	
A004-162	A004	Debris Flow	A	Debris Flow (L=8km)	Rainapura	99-21	81,82,83	Sources of the debris flow were read in the mountain slopes located in the north of the site. The site is located at around the apex of the fan where the debris was accumulated.	17	Pmgga: Garnet - sillimanite - biotite gneiss. Close to a shear zone and an axis of a overturned synform.	
A004-173	A004	Slope Failure	B	Adjacent to a high-tension pylon	Badulla	99-21	208,209,210	Convergence of photo lineaments was seen around the site. In the upper mountain slope, a trace of collapse was read.	17	Pmgk: Charnockitic gneiss, Pmq: Quartzites, Pmgk ³ : Undifferentiated charnockitic biotite gneiss.	
A004-174	A004	Slope Failure	B	2 major slope failures	Badulla	99-21	208,209,210	The site is surrounded by photo lineaments.	17	Pmgk: Charnockitic gneiss, Pmq: Quartzites, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmgga: Garnet - sillimanite - biotite gneiss. Close to a probable thrust.	
A004-185	A004	Landslide	A	Less Traffic	Badulla	99-21	215,216	Location shall be verified by geographical coordinate. Shape of the landslide is unclear.	17	Pmgk: Charnockitic gneiss, Pmq: Quartzites, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmgga: Garnet - sillimanite - biotite gneiss. Close to a probable thrust.	
A004-193	A004	Landslide	A	Less Traffic	Badulla	99-21	183,184	Location shall be verified by geographical coordinate. Shape of the landslide is unclear.	17	Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmgga: Garnet - sillimanite - biotite gneiss. Convergence of 4 shear zones and faults inferred by aerial photos.	
A004-196	A004	Landslide	A	Less Traffic (Not confirmed)	Badulla	99-21	219,220	Location shall be verified by geographical coordinate. Shape of the landslide is unclear.	17	Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmgga: Garnet - sillimanite - biotite gneiss. Convergence of 4 shear zones and faults inferred by aerial photos.	
A005-042	A005	Landslide	A	Landslide (L=1km)	Nuwara Eliya	99-34	148, 149, 150, 151, 152	Shapes of landslides were unclear. Instead, traces of collapse and deeply eroded gullies were confirmed by photo reading.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A005-043	A005	Rock Fall, Rock Slide	B	Unstable rocks with open cracks	Nuwara Eliya	99-34	148, 149, 150, 151, 152	Photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A005-044	A005	Rock Fall, Rock Slide	B	Unstable rocks with open cracks	Nuwara Eliya	99-34	148, 149, 150, 151, 152	Photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A005-046	A005	Rock Fall, Rock Slide	C	Unstable rocks with open cracks	Nuwara Eliya	99-34	148, 149, 150, 151, 152	Very steep slope. Photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A005-063	A005	Slope Failure	B		Nuwara Eliya	99-35	32,33,34	Small landslides were read as aligned terrace fields around the sites. Much larger landslides were read in the opposite side of the stream flown along the lower slope.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss. Close to a shear zone and a fault inferred by aerial photos.	
A005-082	A005	Slope Failure	C	Former 2 sections were merged in to 1 section.	Nuwara Eliya	99-35	153,154,155	The site is surrounded by photo lineaments. The axis of the valley which the site is facing corresponds to one of the photo lineaments.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmc: Marble. Close to shear zones inferred by aerial photos.	
A005-091	A005	Slope Failure	C		Badulla	99-27	206,207	The site is surrounded by photo lineaments. Lateral displacement over a linament was confirmed.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss, Pmq: Quartzites. Close to shear zones inferred by aerial photos.	
A005-135	A005	Landslide	C	Landslide (L=0.2 - 0.3km)	Badulla	99-28	53,54,55	Multiple Landslide, less clearly read. Other landslides were read in the upper slope but unclearly. This leads some possibilities of much larger landslides than currently expected. Divided landslides were seen in the lower slope.	17	Pmgk: Charnockitic gneiss, Pmq: Quartzites. Beside shear zones inferred by aerial photos.	
A005-167	A005	Landslide	C	Landslide (L=0.1 - 0.2km) Detour by a bridge can be an option.	Badulla	99-17	35,36	Clearly read landslide. Another landslide was read on the west side but may not affect the road.	15	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmgk: Charnockitic gneiss, Pmq: Quartzites. A shear zone inferred by aerial photos.	
A007-031	A007	Slope Failure	B	Eroded by Kelani River.	Kegalle	No Photo			16	Pmgga: Garnet - sillimanite - biotite gneiss. Faults inferred by aerial photos.	
A007-042	A007	Landslide?	A	Landslide or Slope Failure	Nuwara Eliya	99-35	04,05,06,07	Shape of a landslide was not read at the site. Several photo lineaments were read around the site. A trace of collapse was confirmed at the upper slope upstream.	17	Pmgga: Garnet - sillimanite - biotite gneiss. Convergence of shear zones and faults inferred by aerial photos.	
A007-045	A007	Rock Fall, Rock Slide	B	Along with Slope Failure	Nuwara Eliya	99-35	04,05,06,07	Several lineaments were read around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss. Close to shear zones and faults inferred by aerial photos.	
A007-047	A007	Landslide	A		Nuwara Eliya	99-35	04,05,06,07	Shape of the landslide is unclear. Photo lineaments were seen around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmq: Quartzites. Close to a fault inferred by aerial photos.	
A007-054	A007	Slope Failure	B		Nuwara Eliya	99-35	09,10	Convergence of photo lineaments was seen around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss. Close to a shear zone and a fault inferred by aerial photos.	
A007-057	A007	Slope Failure	B		Nuwara Eliya	99-35	95,96	Blocked by clouds. Steep planner slope. Several photo lineaments were read around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss. Close to shear zones and a fault inferred by aerial photos.	
A007-069	A007	Landslide	A	Old road was moved away by the landslide.	Nuwara Eliya	99-35	195,196	Shape of the landslide is unclear, unable to read. Photo lineaments were seen around the site.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss. Close to shear zones inferred by aerial photos.	
A016-010	A016	Landslide	C	Head scarp approaching to the road shoulder	Badulla	99-22	17,18	Clearly read landslide, located in a rolling slope of colluvium provided by a huge collapse of mountain slope. In the lower slope, several small sized divided landslides were read. Several landslides were read in the upper slope. This leads some possibilities of far much larger landslides than currently expected.	17	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss. Convergence of shear zones and faults inferred by aerial photos.	
A021-020	A021	Landslide	A	Land owner didn't allow RDA to investigate the site.	Kegalle	07-07	236,237,238	Shape of the landslide is unclear, unable to read. Convergence of photo lineaments was seen around the site.	13	Pmg: Granite gneiss, Pmgk ³ : Hornblend - biotite gneiss. Surrounded by shear zones inferred by aerial photos and probable thrusts.	
A026-027	A026	Rock Fall, Rock Slide	A		Kandy	No Photo			14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmc: Marble, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A026-029	A026	Rock Fall, Rock Slide	A		Kandy	No Photo			14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss, Pmc: Marble, Pmq: Quartzites. Faults and a shear zone inferred by aerial photos.	
A026-036	A026	Slope Failure	A	Damage occurred during construction. Retaining wall was constructed.	Kandy	99-29	53,54	Trace of small collapse of mountain slope was read in the upper slope. Photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk: Charnockitic gneiss.	
A026-045	A026	Slope Failure	A		Kandy	99-32	65,66,67	Photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmgk ³ : Undifferentiated charnockitic biotite gneiss. Faults inferred by aerial photos.	
A026-048	A026	Slope Failure	A		Kandy	99-32	65,66,67	Terraced rice fields are on the upper slope where colluvium is supposed. Photo lineaments were seen around the site.	14	Pmgk ³ : Undifferentiated charnockitic biotite gneiss. Faults inferred by aerial photos.	
A026-049	A026	Slope Failure	A		Kandy	99-32	65,66,67	Trace of collapse of mountain slope was read in the upper slope. Photo lineaments were seen around the site.	14	Pmgk ³ : Undifferentiated charnockitic biotite gneiss. Faults inferred by aerial photos.	
A026-051	A026	Slope Failure	A	Damage occurred during construction. Retaining wall was constructed.	Kandy	99-32	65,66,67	Trace of collapse of mountain slope was read in the upper slope. Photo lineaments were seen around the site.	14	Pmgk ³ : Undifferentiated charnockitic biotite gneiss. Faults inferred by aerial photos.	
A026-055	A026	Rock Fall, Rock Slide	A		Kandy	99-32	47,48,49	Very steep planner slope. A couple of photo lineaments were seen around the site.	14	Pmgk: Charnockitic gneiss. Shear zones inferred by aerial photos.	
A026-056	A026	Slope Failure	A		Kandy	99-32	47,48,49	Very steep planner slope. A couple of photo lineaments were seen around the site.	14	Pmgk: Charnockitic gneiss, Pmgga: Garnet - sillimanite - biotite gneiss, Pmq: Quartzites. Shear zones inferred by aerial photos.	
A026-058	A026	Slope Failure	A		Kandy	99-32	47,48,49	Very steep planner slope. Trace of small collapse was read less clearly in the upper slope. A couple of photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmq: Quartzites, Pmgk: Hornblend - biotite gneiss. Shear zones inferred by aerial photos.	
A026-060	A026	Rock Fall, Rock Slide	A	Damage occurred during construction. Retaining wall was constructed.	Kandy	99-32	47,48,49	Very steep planner slope. A couple of photo lineaments were seen around the site.	14	Pmgga: Garnet - sillimanite - biotite gneiss, Pmq: Quartzites, Pmgk: Hornblend - biotite gneiss. Shear zones inferred by aerial photos.	
A113-010	A113	Landslide	A		Kandy	99-10	161,162	Shape of a landslide was not read at the site. Trace of collapse of mountain slope was read in the upper slope.	14	Pmq: Quartzites. Close to a probable thrust and an axis of antiform	
A113-015	A113	Landslide	C	Involving road and residence.	Kandy	99-34	135,136	Less clearly read landslide, located in a colluvium slope formed by a collapse of upper mountain slope. In the axis of the ridge of upper mountain, 2 cols were clearly read.	14	Pmgk ³ + Pmgk: Hornblend - biotite gneiss + Biotite hornblende gneiss. Beside a shear zone inferred by aerial photos.	

A	Category A
B	Category B
C	Category C

Appendix 4 List of collected materials

No.	date	Material name	Collected from	Format
1	20120618	Statistical Pocket Book - 2010	Department of Census & Statistics	Printed book
2	20120618	Sri Lanka Labour Force Survey AnnualReport -2010	Department of Census & Statistics	Printed book
3	20120618	Statistics on Vital Events2000-2010	Department of Census & Statistics	Printed book
4	20120618	Household Income and Expenditure Survey -2009/10	Department of Census & Statistics	Printed book
5	20120618	Road Atlas of Sri Lanka	Vijithayapa Bookshop	Printed book
6	20120618	Vijithayapa School Atlas	Vijithayapa Publications	Printed book
7	20120618	Sarasavi School Atlas	Sarasavi Publishers	Printed book
8	20120620	ADT Central,Sabragamuwa Provinces.pdf	Planning Division, RDA	DVD
9		MCC Cen Sab Uva Wst		
10		Map: ADT Locations.jpg		
11		Maps: Landslides in Badulla, Kandy, Matalre, Nuwara Eliya and Ratnapura		
12		Road Sections Affected by Landslides		
13	20120620	Hard copy of the maps of No.1 and No.8	Planning Division , RDA	Paper document
14	20120629	Guidelinses for Construction in Landslide Prone Areas, March 2003	NBRO	Paper document
15	20120629	Guidelinses for Construction in Landslide Prone Areas, 2009	NBRO	Paper document
16	20120702	VOC Data 2010	Planning Division, RDA	DVD
17	20120702	Wave of traffic volume(montly and by day of the week)	Planning Division, RDA	Electronic file
18	20120704	20120704Traffic Growth Rate Calculation - 20071130	Planning Division, RDA	Electronic file
19	20120702	Hazard Map S=1:50,000	NBRO	JPG
20	20120614	Topographic Map S=1:50,000	Survey Department	Paper document
21	20120711	Topographic Map S=1:50,000	Survey Department	CD/JPG
22	20120711	Topographic Maps, S=1:10,000	Survey Department	CD (GIS)
23	20120614	Geological Map, Soil Map, Watershed Map	Survey Department	Paper document
24	20120712	Topographic Map S=1:250,000	Survey Department	Paper document
25	20120717	Geological Map of Sri Lanka	Geological Survey & Mines Bureau	Paper document
26	20120717	Metamorphic Map of Sri Lanka	GSMB	Paper document
27	20120717	Structual Map of Sri Lanka	GSMB	Paper document
28	20120717	Geological Map S=1:10,000	GSMB	Paper document
29	20120717	Geological Map of Central and Western Sri Lanka	GSMB	Paper document
30	20120720	Aerial Photo (62Pics)	Survey Department	Contact print
31	20120720	Aerial Photo (62Pics)	Survey Department	CD/TIFF
32	20120720	Index Map of Aerial Photos	Survey Department	Paper document
33	20120720	Geological Map S=1:10,000	GSMB	CD/TIFF
34	20120808	Project Proposal for Integrated Landslide Mitigation Project Phase 1 (Badulla, Kandy, Matale and Nuwara Eliya)	NBRO	PDF

No.	date	Material name	Collected from	Format
35	20120809	Structural Map of Sri Lanka	GSMB	CD/TIFF
36	20120809	Geological Map of Central and Western Sri Lanka	GSMB	CD/TIFF
37	20120815	Aerial Photo (12Pics)	Survey Department	Contact print
38	20120815	Aerial Photo (12Pics)	Survey Department	CD/TIFF
39	20120802	Met Data for 12 Met Stations	Department of Meteorology	Excel file
40	20120816	Earthquake Records	GSMB and other authorities	Excel file
41	20120816	National Atral of Sri Lanka	Survey Department	Paper document
42	20120914	Projects Summary, Emanating from National Physical Plan 2011-2030	National Physical Planning Department, Ministry of Construction, Engineering Services, Housing and Common Amenities	Printed book
43	20120914	National Physical Plannning Policy & Plan	National Physical Planning Department, Ministry of Construction, Engineering Services, Housing and	Printed book
44	20120918	National Road Master Plan Summary	RDA	Printed book
45	20120918	National Road Master Plan 2008-2012 Executive Summary	RDA	Printed book
46	20120918	National Road Master Plan 2008-2017 Investment Plan	RDA	Printed book
47	20120918	20120918 RDC SocioEconomic Data	Various sources	CD
48	20120926	20120926 RDC SE Data	Various sources	Electronic file
49	20120927	20120927 RDC SE Data	Various sources	Electronic file
50	20120928	Boundary maps of Sri Lanka - District and Division	Various sources	CD
51	20120928	Tourist Guide Map of Matale District	Various sources	Printed book
52	20120928	Tourist Guide Map of Nuwara Eliya District	Various sources	Printed book
53	20120928	Annual Report-2011	NBRO	Printed book
54	20120928	Road Maintenance Manual-1989	RDA	Printed book
55	20121005	Annual Report 2010	RDA	Printed book