3.7 Field Reconnaissance

3.7.1 Damage to Houses

a. Chitrakoot

A survey on damage to houses was conducted in conjunction with MPI, with the aim of understanding the extent of landslide damage in the relevant areas. The results of this survey can be seen in Figure 3.7.1. The houses determined to have suffered damage are shaded in pink, with heavily damaged houses shaded in red. The locations of damaged houses generally correspond to the locations that suffered deformation in the 2005 landslide.

The locations with considerable damage to houses were categorized into 5 areas which were used as a reference when conducting field reconnaissance.

The surface of the Chitrakoot region is comprised of soft colluvial sand, and it is questionable whether the bearing capacity of the ground is great enough to serve as a building foundation. Moreover, as walls are made of stacked concrete blocks without a structurally solid foundation, in addition to damage from landslides, damage caused by lack of ground bearing capacity and uneven settlement was frequently seen.

In Table 3.7.1, damage is classified into that caused mainly by landslides and that caused mainly by problems with foundation ground or building structure, and a chart was created. To determine the type of damage, we referred to the extent of damage and width and direction of cracks.

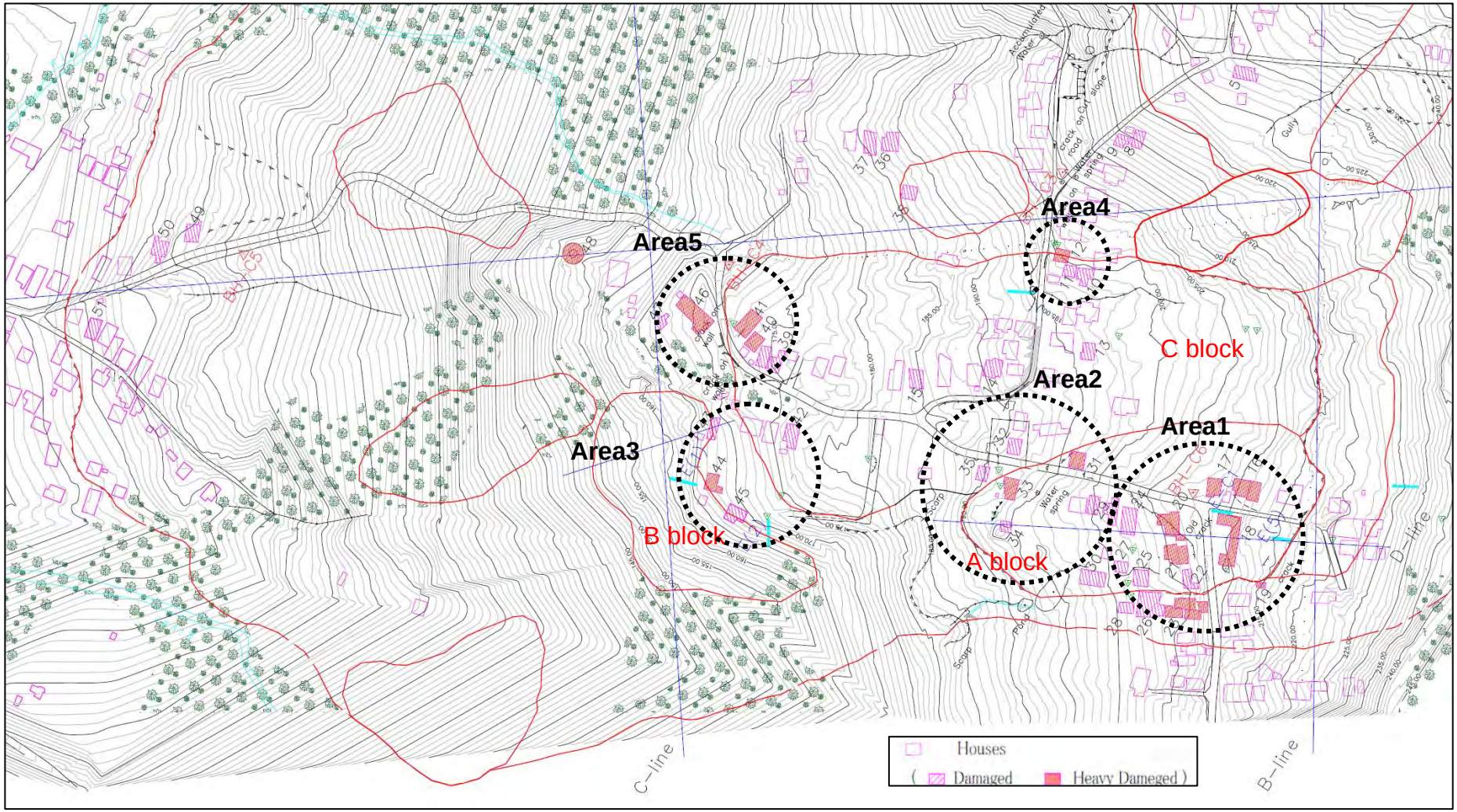


Figure 3.7.1 Results of Survey on Damage to Houses, Chitrakoot (source:JET)

Table 3.7.1 Differentiation of House Deformations and Causes of Damage (source:JET)

House No.	Damage Level	Cause	Photo
16	H	Landslide	
17	H	Landslide	
18	H	Landslide	
20	H	Landslide	
21	H	Landslide	
23	H	Landslide	
31	H	Landslide	
33	H	Landslide	

House No.	Damage Level	Cause	Photo
12	M	Subsidence	
46	H	Subsidence	
48	H	Subsidence	
44	H	Landslide	
41	H	Erosion	
40	H	Subsidence	
19	H	Landslide	

Damage Level
M : Medium – Maximum Crack Width = 1cm – 5cm
H : Heavy – Maximum Crack Width = Over 5cm

Damage Level	Number	Cause	Number
Medium and Heavy Damaged House	15	Landslide	10
		Others	5
Light Damaged House	36		
Damaged House Total	51		

b. Quatre Soeurs

A house deformation survey was carried out in December 2010. In addition, a crack monitoring survey is being conducted on 6 houses with heavy damage.

Table 3.7.2 Monitoring of Damaged Houses (source: JET)

House.No	Owner	Location of control points	House.No	Owner	Location of control points
1	JHURRY JUGNUNUN	C1,C2,C3,C14	4	JHOOMAH RAJEN	C8,C9
2	JHOOMAH ROOPCHAND	C4,C5	5	JHOOMAH DHANANJAY	C10
3	JOOMAH NEERMAL	C6,C7	19	MURACHPERSAD TETREE	C11,C12,C13,C15

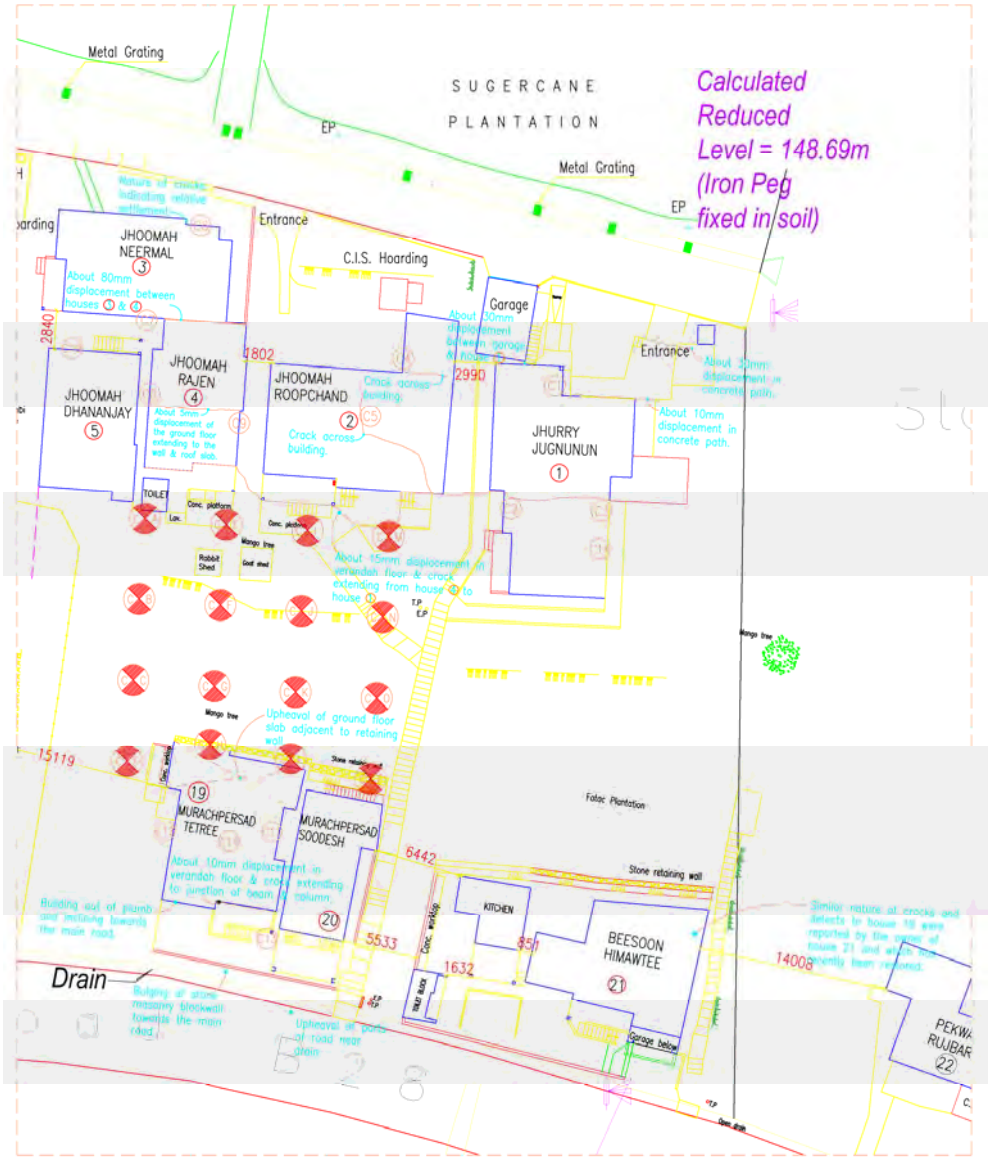


Figure 3.7.2 Monitoring Locations of the Damaged Houses (from Past Material, C1～C15: Monitoring Locations)[18]

Crack monitoring involved a simple method of sticking a plate of glass over the crack and checking the progression of deformation according to whether the glass plate cracks. After examining each of the monitoring locations, none of the glass plates have cracked since commencement of observation (cracks were found in one location, but the cause was not by landslide).

Photographs of the condition of each monitoring location are shown below.

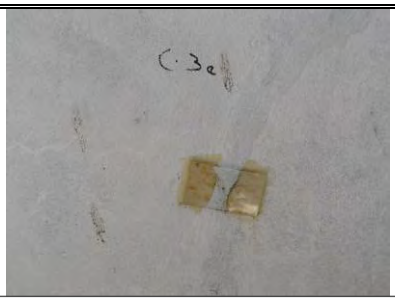
Crack C1	Crack C2	Crack C3
		
Crack C14	Crack in entrance	Crack in wall
		

Photo 3.7.1 Cracks in House 1 (source:JET)

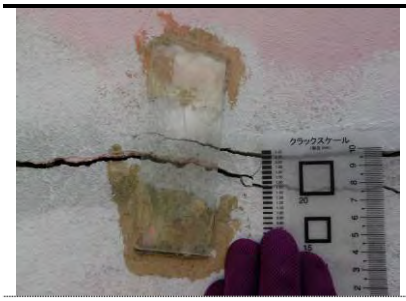
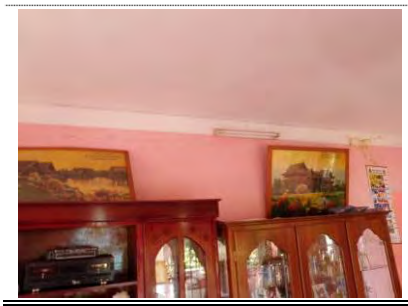
Crack C4	Crack C5	Crack across building
		
Horizontal crack in Wall		
		

Photo 3.7.2 Cracks in House 2 (source:JET)

Crack C6	C7(gap between Houses 3 and 4)	Crack C8
		
Crack C9	Crack C10	Gap between Houses 3 and 4
		

Photo 3.7.3 Cracks in Houses 3,4,5 (source:JET)

Crack C11	Crack C12	Crack C13
		
Exposure of reinforced concrete	Crack in pillar	Upheaval
		

Photo 3.7.4 Cracks in House19 (source:JET)

c. Vallee Pitot

The area in Vallee Pitot has been well known as a landslide hazard area since the landslide disaster occurred in 2007. This area has been recognized one of the 37 landslide zones in Mauritius, as listed in the Cyclone and Other Natural Disasters Scheme 2011. A survey on damage to houses was conducted in conjunction with MPI, with the aim of understanding the extent of landslide damage in the relevant areas, 26th Feb. 2013. Eighteen houses were damaged (refer to the figure below) and a 90 m section of the canal at the toe of the landslide was also damaged.

Le Matinal

Une maison dangereuse pour ses occupants

Abhi Ramsahaye
Port-Louis, 7 mars

Plusieurs parties de la maison, comme cet escalier, sont lézardées.

La maison de Saynaaz Meerun est inhabitable. C'est un réel danger pour les six occupants. Les fêlures et craquelures en témoignent. La plus grosse craquelure traverse sa cuisine et la chambre où elle et sa petite fille dorment. La Police de l'Environnement a été mandée sur les lieux mercredi matin pour voir la situation.

"Les policiers ont examiné la maison et ont pris des photos. Ils m'ont conseillée d'évacuer la maison le plus rapidement possible," a confié Saynaaz dans une déclaration au Matinal.

L'installation électrique constitue un gros danger pour eux. "Les premières fêlures ont apparu le samedi 24 février pendant les grosses pluies du cyclone Gamede. Les fêlures et les craquelures augmentent drastiquement de jour en jour. Parfois, on entend les bruits effrayants des craquelures dans la maison. Nous sommes horrifiés par ces bruits. Surtout la nuit. Nous ressentons ces bruits comme un tremblement de terre," dit Saynaaz. Les six occupants de la maison sont : Saynaaz, sa fille de 11 ans, son frère, sa belle-soeur et ses deux neveux. Saynaaz travaille comme couturière à son propre compte pour se nourrir et envoyer sa fille à l'école. "In [illegible] 15 ans travaille pou capav [illegible] sa la case la. Li pas facile pou moi gagn cash pou range enn [illegible] la case. C'est avec bocou difficulté mone arrange sa la case la. [illegible] la vie en danger ici", se lamente la mère.

Tout récemment, elle a investi une importante somme d'argent pour compléter les travaux de construction. "Je lance un appel au gouvernement pour qu'il m'aider à sortir de cette situation", dit Saynaaz.

Plusieurs maisons du voisinage portent des fêlures et des craquelures.

Croissance de 0,7 % de la population en 2006

Mahesh Bugnath
Port-Louis, 7 mars

La population de Maurice a augmenté de 0,7 % en 2006 pour atteindre 1 256 739 âmes au 31 décembre 2006, composée de 635 429 femmes et 621 310 hommes. C'est ce qui ressort du rapport 'Population and Vital Statistics 2006', publié par le Bureau central des statistiques (BCS).

La population féminine était supérieure de 14 000 par rapport à la gent masculine. Les personnes âgées de 0-14 ans représentaient 23,9 % de la population alors que celles de la tranche d'âge de 15 à 64 ans s'élevaient à 69,5 %. Les personnes de plus de 65 ans représentaient 6,6 %. Les naissances ont accusé une hausse de 6,5 % par rapport à 2005 pour atteindre 17 605.

Le nombre de décès enregistrés en 2006 était de l'ordre de 9 151 indiquant ainsi une croissance de 5,8 % par rapport à l'année précédente. Le taux de mortalité infantile a augmenté de 2,4 % en 2006, passant de 248 en 2005 à 254. Le nombre de mort-nés est passé à 147 en 2006, soit une baisse de 10,5 % par rapport au 185 décès enregistrés en 2005. Le nombre de mariages est passé à 11 471 en 2006, soit une hausse de 1,8 %.

Figure 3.7.3 Past Newspaper Report[19]

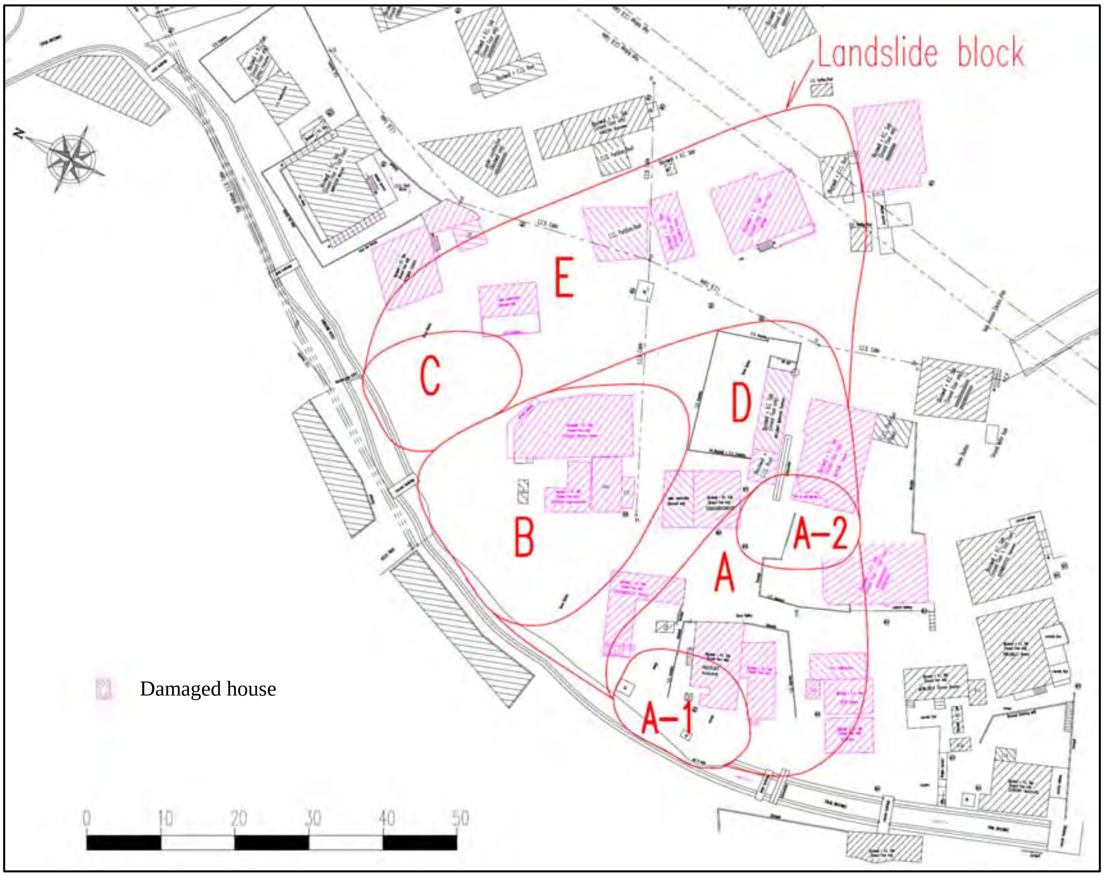


Figure 3.7.4 Results of Survey on Damage to Houses, Vallee Pitot (source:JET)

3.7.2 Results of Field Reconnaissance

a. Chitrakoot

Field reconnaissance was conducted with a focus on crack occurrence in houses with deformation and as indicated in past reports, and the results sorted.

Areas with extensive deformation and their characteristics are summarized in Table 3.7.3.

Table 3.7.3 Areas with Extensive Damage and Its Characteristics (source:JET)

Area	Location	Characteristics	Past investigation
1	Around School	Cracks occurred in the elementary school building and the slope in back, and part of the school building was removed. The damaged school building is currently under restricted use. Major deformation was seen in houses by the side of the school building. This area suffered the most damage in the 2005 landslide.	Extensometer E(5) Drilling BPI(7),BPP(16),BPP(11) BPX(1),BPP(19), BPI(1),BPP(5)
2	Around Upper Main Road	Damage has occurred in the main road near the elementary school and houses close to the main road. Damage to houses is varied, including inclination of houses, subsidence, and cracks in walls and floors, and first became apparent after the 2005 cyclone.	Drilling BPX(3),BPP(9)
3	Downward Slope	Intermittent cracking is occurring in the slope north of Area 2. Damage to houses is also evident, and a crack passing through the wall of a house beside extensometer E(1) has developed.	Extensometer E(1),E(2) Drilling BPX(2),BPI(3)
4	Roadside and Houses	Cracking has occurred in the road and houses located on the east side of the stream (waterway) that cuts across the land, but the scale of damage is comparatively small. Below the road is an expanse of sugarcane fields.	Extensometer E(4) Drilling BPP(6),BPI(6)
5	Around Lower Main Road	There is damage to the houses and concrete-block walls near the main road. Damage to houses includes inclination of houses, subsidence, and cracks in walls, becoming evident after the 2005 cyclone. Whether damage is due to landslide cannot be determined.	Extensometer E(3) Drilling BPX(4),BPI(13)

a.1 Around school (Area1)

a.1.1 Around remains of school building

Part of the elementary school building was removed due to a landslide, but the foundation concrete still remains. Cracks and level differences can be seen in the steps of the foundation concrete, and deformations in the floor such as settling and open cracks are conspicuous. Cracks in the foundation concrete extend intermittently, generally in an east-west direction. The area with the most extensive deformations is around the west-side stairs, and a cave-in of more than several tens of centimeters was confirmed.

Photo 3.7.5 Steps to the School Building Foundation (East Side)

Photo 3.7.6 Floor of the School Building Foundation (West Side)

(source:JET)

Photo 3.7.7 Major Damage to the Steps

Photo 3.7.8 Intermittent Cracks (East-West)

(source:JET)

A surface extensometer E(5) was installed on the east side of the removed school building. This extensometer was installed during the 2007 investigation, but the whereabouts of the observation data are unknown.

Observation data from extensometers remains in only 3 locations: E(2), E(6), and E(7)（18th March 2011～16th March 2012）.

Extensometer E(5) is installed between two obvious vertical displacements and movement of several centimeters is presumed to have occurred after installation as well since cracks can be seen in several places in the foundation concrete of the extensometer safety fence. Unlike drying shrinkage cracks, these are open cracks of several millimeters on both sides of the foundation concrete.

Although there has not been a day when cumulative rainfall has exceeded 100mm since 2008, there is a possibility that slight movement similar to creep occurs whenever it rains.

Photo 3.7.9 Vertical Displacement beside Extensometer(5)

Photo 3.7.10 Direction of Vertical Displacement (East-West)

(source:JET)

The vertical displacement extends in an east-west direction, and the retaining wall portion where it extends is also damaged. However, there is a waterway below the retaining wall, and it is not certain whether the damage was caused by landslide or settling of the foundation. Moreover, traces of partial settling can be seen in the roadside ditch. Currently there are no cracks in the road surface, and it is possible that it has been repaved.

Photo 3.7.11 Damage to the Retaining Wall (Roadside)

Photo 3.7.12 Settling of the Roadside Ditch

(source:JET)

Settling of the concrete was observed in the lavatory on the west side of the school building, but no major deformations were detected in the building itself. There was no mention of cracks in this vicinity in previous investigation reports, inferring either that landslides had no effect or that the effects were extremely minor.

Photo 3.7.13 Lavatory beside School (House No.9) (source:JET)

a.1.2 School building

Use of the elementary school building is restricted in one part. The building facing the main road exhibits the worst deformations. Window frames are distorted and cracks extending diagonally can be seen in the wall.

Photo 3.7.14 An Elementary School in Chitrakoot (House No.18)

Photo 3.7.15 Cracks in the School Wall

(source:JET)

Although no open cracks were seen in near the base of the school wall, cracks several millimeters long running horizontally near the base of the school wall can be seen.

Photo 3.7.16 Cracks in the Base of the Wall

Photo 3.7.17 Cracks in the corner of the School Building

(source:JET)

There are no prominent deformations in the retaining wall facing the main road, but fine cracks have occurred inside the concrete blocks.

Circumstances and detailed locations of deformations when the landslide occurred cannot be confirmed, but vertical movement (subsidence) seems to be predominant with no evidence of horizontal movement.

Photo 3.7.18 The Wall and Sidewalk facing Main Road (source:JET)

Across the main road on the school's west side are a scattering of houses. Two of those houses suffered major damage such as cracks in walls, distortion of window frames, and settling.

Photo 3.7.19 Heavily Damaged House

Photo 3.7.20 Heavily Damaged House

(source:JET)

As the houses are somewhat old, there is a possibility that there were deformations even before the 2005 cyclone. However, given their proximity to the school, it is conceivable that the deformations were caused by the landslide.

a.2 Around upper main road (Area 2)

Deformation of the main road in front of the elementary school was also confirmed. Continuous cracks have occurred around the road and premises of houses. Currently no cracks can be seen in the road, but unevenness and gaps in the curbs as well as cracks in the retaining walls are evident.

Photo 3.7.21 Gaps and Unevenness in the Curb

Photo 3.7.22 Cracks in the Retaining Wall of the House in front of the School (source:JET)

Settling was particularly serious in the house in front of the elementary school. Open cracks can be seen in the retaining wall next to the house, and cracks are developing on the edge of the entrance veranda. Open cracks were seen in this vicinity when the 2005 landslide occurred and damage to buildings and structures resulted from the landslide.

House No.21

Photo 3.7.23 Cracks in the Retaining Wall beside House

Photo 3.7.24 Cracks in the Veranda

(source:JET)

A depression has formed in the slope on the west side of one this house. According to neighboring residents, during the cyclone, surface water from the main road flowed down to the houses at the bottom of the road and flooded them. In addition, major deformations can be seen in the concrete foundation of what looks to be the remains of a house, reflecting the vulnerability of house foundations. This region has slight undulations and in parts exhibits stepped terrain. The cause of the building damage is thought to be not only landslides, but also the effects of the foundation ground bearing capacity and erosion due to running water.

Medium-sized shrubs are scattered within the depression and bare areas can also be seen here and there. A large number of cracks have occurred in the walls and floors of the nearby houses and repair work on the cracks was underway. In addition, there was a diagonal penetrating crack in a concrete structure near one of the houses.

Photo 3.7.25 Deformation of the House in front of the School (source:JET)

Photo 3.7.26 Deformation of the Concrete Foundation of Suspected House Remains

(source:JET)

Photo 3.7.27 Cracks in the Concrete Structure

Photo 3.7.28 Cracks in the Floor

(source:JET)

Several deformations have also appeared in the houses along the main road farther away from the elementary school. Deformation includes inclination of houses, settling, and cracks in walls.

According to the testimony of residents, deformations manifested with the torrential rain associated with the 2005 cyclone, and landslide activity can be considered the cause. As most houses are made of concrete blocks, other structural factors or lack of ground bearing capacity are also believed to have played a role.

Photo 3.7.29 Settling in the Middle of House

Photo 3.7.30 Cracks in the Wall (Window Frame)

(source:JET)

Photo 3.7.31 Inclination of the House (Left: Settling)

Photo 3.7.32 Penetrating Cracks in the Wall

(source:JET)

a.3 Downward Slope (Area 3)

The downward slope is a natural slope on the west side of the main road and is sprinkled with houses. Extensometers E(1) and E(2) were installed here and drilling (BPI(3)、BPX(2)、BPP(10)) was also conducted. According to previous data, there are intermittent cracks on the slope near extensometers E(1) and E(2).

Photo 3.7.33 Road that Leads Down to Houses (Extensometer is Installed up ahead)
(source:JET)

Extensometer E(1) is set up on the slope below the houses, and several spots with vertical displacements can be seen in the slope. No fresh cracks can currently be seen, but partial deformation has been observed in the foundation concrete of the extensometer protection fence.

Photo 3.7.34 Extensometer E(1) (Shot from below) (source:JET)

Many open cracks can be seen in the walls and inside the houses above extensometer E(1), reflecting the large movement associated with the landslide.

Cracks in house walls extended diagonally to horizontally, occurring on the opposite side of the walls as well.

Photo 3.7.35 Deformation of the Protection Fence Foundation Concrete (source:JET)

House No.44

Photo 3.7.36 Cracks in the House Wall

House No.44

Photo 3.7.37 Horizontal Open Cracks

(source:JET)

Extensometer E(2) is set up on a slight slope to the south of the houses. No fresh cracks were seen in this vicinity either, but cracks were found in the foundation concrete of the extensometer protection fence.

Photo 3.7.38 Extensometer E(2) (Shot from below) (source:JET)

The length of this slope is long and it extends to the stream on the west side. There are few herbaceous plants on the surrounding slopes and bare natural slopes can be seen.

Photo 3.7.39 Deformation of the Protection Fence foundation (source:JET)

Photo 3.7.40 Surrounding Slopes of Extensometer E(2) (source:JET)

Photo 3.7.41 Surrounding slopes of Extensometer E(2) (source:JET)

To the north of the downward slope a stream cuts across the landslide area. There are houses and farmland between extensometer E(1) and the stream, and cracking has occurred in the houses. Moreover, bank erosion is advancing on both banks of the stream and large tree

roots are exposed.

Photo 3.7.42 Farmland between Extensometer E(1) and Stream (source:JET)

Photo 3.7.43 Advancement of Bank Erosion (Downstream) (source:JET)

Photo 3.7.44 Advancement of Bank Erosion (Upstream) (source:JET)

a.4 Roadside and House (Area 4)

Deformations have appeared in the road surface of the road that branches off from the main road and extends to the east side, as well as one of the houses there. Houses are scattered along the road, but only one house suffered major damage while adjacent houses show no signs of conspicuous damage. An open crack has developed extending horizontally near the base of the damaged house, and several cracks can be seen in the walls. There is also a conspicuous gap between the concrete block retaining wall and the concrete wall. The cause of the damage to the building is thought to be not only the landslide, but also settling due to lack of adequate foundation ground bearing capacity and serious structural problems.

House No.12

Photo 3.7.45 Heavily Damaged House

House No.12

Photo 3.7.46 Open Cracks in the House and Retaining Wall

(source:JET)

Because there are many cracks in the road in front of this house, drilling (BPP(6)、BPI(6)) was conducted in the vicinity and extensometer E(4) installed.

Currently there are no conspicuous cracks in the road surface, but the road in front of the heavily damaged house is showing signs of settling.

Photo 3.7.47 Cracks in the Road
(Left：Sugarcane Field)

Photo 3.7.48 Road in front of House

(source:JET)

An expanse of sugarcane fields lies across the street from the house and a waterway is located on the west side. There are no records concerning deformation in the sugarcane fields, but it is a relatively wide area and the gradient of the slope below the road is rather steep. Part of the waterway is constructed of concrete with an earthen side ditch on the upstream side. It is possible it serves as a groundwater supply source.

Photo 3.7.49 Sugarcane Field in front of House (source:JET)

Photo 3.7.50 Sugarcane Field (Shot from below) (source:JET)

a.5 Around lower main road (Area 5)

A survey of the land reveals a very uneven terrain and several small-scale streams traversing the landslide area. Furthermore, much of it is farmland such as sugarcane fields, and the paths that lead to the farmland are connected to the main road or area roads. There are houses scattered along the road, but there are also several houses isolated some distance from the road. Most of the houses are of concrete block construction. However, a few wooden buildings and galvanized iron shacks can also be seen. Houses with cracks in the walls and retaining walls are relatively widespread. Cases of cracks due to subsidence caused by lack of ground bearing capacity and erosion of reinforcing bars in concrete can also be seen.

The deformations and topographical features confirmed during field reconnaissance are described below.

a.5.1 Heavily damaged houses

On the east side of the downward slope where cracks have occurred are houses with notable damage. Two adjacent houses across from the main road on the inside of a curve in particular suffered damage. Both houses have diagonal cracks large enough to penetrate the sidewall extending in a vertical direction. Although it isn't certain whether these deformations were caused by landslide, the sidewall of the house located on the side of the main road also has cracks, and many deformations can be seen in this region. There is a stream on the west side of the main road, and the comparable height difference and the advancement of fairly serious bank erosion indicate possible movement toward the stream.

・House No.40

Many cracks have been found in the concrete foundation that leads from the entrance into the house. In addition, cracks that penetrate the concrete sidewall at the top of the stairs extend vertically. The cracks in the concrete foundation may be due to settling of the foundation ground. It is conceivable that the cracks in the sidewall are due to structural defects or settling of the foundation.

House No.40

Photo 3.7.51 House No.40

House No.40

Photo 3.7.52 Penetrating Cracks in the Wall

(source:JET)

・House No.41

In the house adjacent to House No40 there are vertical and horizontal cracks extending from the foundation to the ceiling. A cavity can be seen in the concrete foundation, leaving the foundation in a suspended state. This part may have been scoured by surface water. When the surface of a concrete foundation is scoured, that part becomes its structural weak point and cracks can occur due to uneven settling. Drilling (BPX(4)) is currently being carried out by the side of the house.

Photo 3.7.53 House No.41

Photo 3.7.54 Cavity in the Concrete Foundation

(source:JET)

a.5.2 Sidewall of house located on side of the main road

There are also prominent cracks in the walls of the house (House No.46) across the main road from House No.41. Open cracks running diagonally have developed in several places.

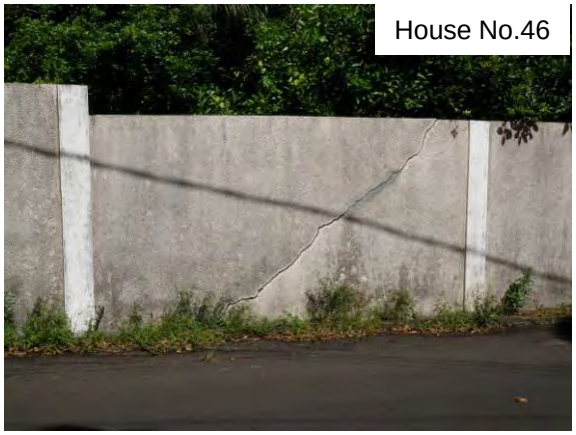


Photo 3.7.55 Cracks in the Wall

Photo 3.7.56 Cracks in the Wall (Entrance)

(source:JET)

b. Quatre Soeurs

The topography of this area can be divided into an upper slope with gradient of 16～20°, a middle slope with gradient of about 5°, and a lower slope with gradient of 15～17° .

Photo 3.7.57 Full View of the Site (source:JET)

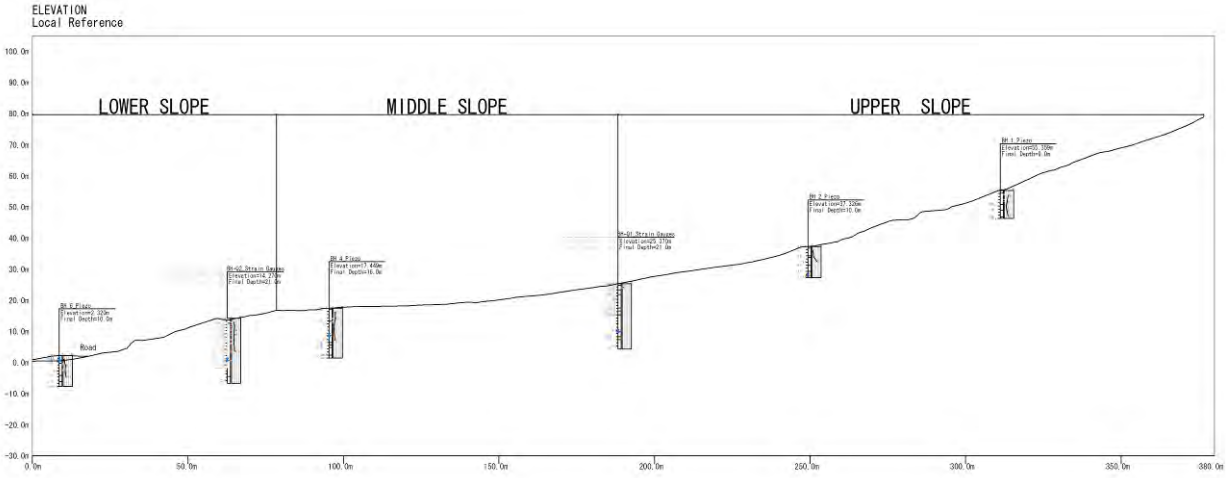


Figure 3.7.5 Slope classification of the area (source:JET)

Table 3.7.4 The Characteristics of Slope Classification (source:JET)

Slope classification	Gradient	Characteristics
Upper Slope	16～20°	The slope above elevation 25m. The slope type is one in which the contour lines correspond to an almost parallel linear slope. Topsoil and cultivated soil are distributed thinly, and many blocks such as basalt and breccia can be seen. One side of the slope, particularly above about elevation 40m, is comprised of unstable blocks.
Middle Slope	5°	A gentle slope from the road above the houses to an elevation of around 25m, it is a flat terrain with a slope gradient of 5°. The ground surface is composed of topsoil and cultivated soil, but unlike the upper slope the distribution of blocks is relatively small. It is a stable slope with few deformations such as cracks.
Lower Slope	15～17°	Spanning from the road above the houses to the main road on the coast, it is a steep slope crowded with houses. Because there are houses and a main road along the coast subject to preservation, whenever a landslide or slope failure occurs the damage is extensive and it is an area with an urgent need for countermeasure works.

Photo 3.7.58 Upper Slope (Shot from below, Gradient:16～20°) (source:JET)

Photo 3.7.59 Middle Slope (Shot from below, Gradient:5°) (source:JET)

Photo 3.7.60 Lower Slope (Shot from below, Gradient:15～17°) (source:JET)

b.1 Upper Slope

The upper slope is the slope above the vicinity of borehole BH-Q1 at elevation 25m. The slope type is one in which the contour lines correspond to an almost parallel linear slope. Taking advantage of the slope type, farm roads have been made along the contour lines and the land is used as farmland. The ground surface is comprised of thinly distributed topsoil and cultivated soil, and blocks with a diameter of 10～30cm, such as basalt and breccia, are plentiful. Particularly at an elevation of around 40m and above, unstable blocks are distributed over one side of the slope.

Photo 3.7.61 Full View of the Upper Slope (source:JET)

Photo 3.7.62 Vicinity of the Slope
(Elevation: about 50m)

Photo 3.7.63 Vicinity of the Slope
(Elevation: about 70m)
(source:JET)

The upper limit of farmland is at around elevation 80m. The slope above this point is a natural slope where shrubs flourish and the slope gradient becomes even steeper. Furthermore, some outcrops can be observed in the upward slope and are thought to be composed of shallow bedrock.

Photo 3.7.64 Outcrop (Elevation: about 80m) (source:JET)

In the area around borehole BH-1 (elevation about 55m) where deformations such as cracks had been observed in the past as well as the slope below (elevation about 45m), the results of the topographical survey show marked disturbances in the contour lines suggesting surface layer movement.

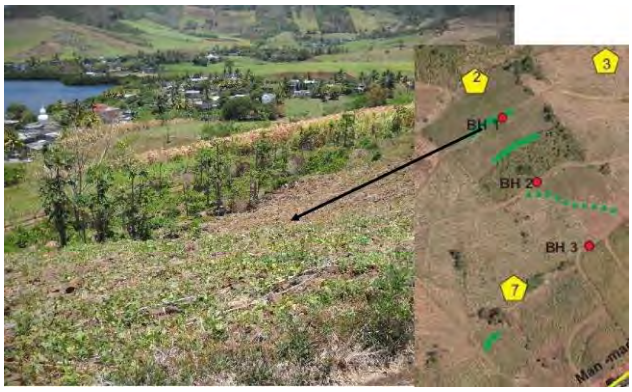


Photo 3.7.65 Past Deformations on Upper Slope (From Past Report) (source:JET)

Topographical unevenness was observed in this area even in the field reconnaissance, and the blocks of the surface layer have become slightly unstable.

Photo 3.7.66 Deformations around Borehole BH-1 (Current Condition)

Photo 3.7.67 Deformations around Elevation 45m (Current Condition)

(source:JET)

Cracks (73m in length) in the center of the farm road leading from borehole BH-2 to borehole BH-3 were confirmed in the past. Currently, herbaceous plants are flourishing here and the depth and continuity of the cracks cannot be confirmed. However, several places where the cracks have developed into cavities can be seen.

Photo 3.7.68 Cracks in the Farm Road (from below)

Photo 3.7.69 Cracks in the Farm Road (from above) (source:JET)

Photo 3.7.70 Cracks along the Farm Road (source:JET)

In previous reports, the side of the farm road where cracks have occurred (the flat portion below the road) has been described as marshy land and topographically water tends to collect in this vicinity

Photo 3.7.71 Marshy Land (source:JET)

b.2 Middle Slope

The middle slope is a gentle slope extending from the road above the houses to an elevation of 25m. It is a flat terrain with a slope gradient of 5°. Taking advantage of the flat terrain, sugarcane is cultivated, with sugarcane fields on all over the slope. Topsoil and cultivated soil are distributed throughout the ground surface, but unlike the upper slope, distribution of blocks is relatively small. In addition, the contour lines are a convex shape facing the sea and indicate contour lines of a semi-ridge type slope.

Photo 3.7.72 Full View from Borehole BH-1 (source:JET)

Deformations on this slope such as cracks cannot be confirmed, but it is relatively stable.

However, both past reports and this survey confirm that soft colluvium gradually thickens as the slope extends toward the sea. Colluvial soil including cultivated soil has the property of turning muddy when it holds any kind of water, which is not an ideal geological condition.

The southwest side of this slope exhibits a reduction in altitude and a valley terrain. In the upstream slope of the valley terrain, distinct cracks were confirmed at the time damage of the houses occurred (from a past report). Currently this area is used as farmland, but the site of a collapse was confirmed. It is a surface collapse of about 1.5m in length and 4m in width, probably the collapse of soft cultivated soil.

Photo 3.7.73 Collapse at the Head of a Stream (source:JET)

b.3 Lower Slope

The lower slope extends from the road above the houses to the main road along the coast. It is a steep slope crowded with houses. Because there are houses and a main road along the coast subject to preservation, whenever a landslide or slope failure occurs the damage is extensive, and there is an urgent need for countermeasure works in this area. Deformations such as cracks and vertical displacements occurred due to the cyclone in 2005, and it has been reported that 11 houses suffered damage.

There are manmade objects on this slope such as houses, stairs, and retaining walls and many of them were subject to deformations such as cracks. Deformations are concentrated in an area around the tip of the convex contour lines and the slope below the tip, where the average slope gradient is about 16°. However, there are also steep slopes with a gradient of more than 20° in places.

Cracks several tens of meters in length can be seen running along the center of the road surface above the houses. The cracks are open in places, and the road dips on the side of the gutter.

Photo 3.7.74 Road above the Houses

Photo 3.7.75 Cracks in the Road

(source:JET)

Similar to the coastal main road, this road extends from southeast to northwest, and the eastern slope at the end of the road is a steep slope exhibiting valley terrain. There are also houses below this steep slope, but no deformations caused by the 2005 cyclone have been confirmed.

Photo 3.7.76 View of the end of the Road (East Side Slope) (source:JET)

The starting point of the road crosses over the coastal main road at almost a right angle, and following the channels gains altitude and turns right. Major deformations of the road surface in this section cannot be confirmed. However, there are alligator cracks and unevenness in part of section, leading to concerns about lack of bearing capacity of the roadbed and road foundation.

There is a retaining wall at the boundary of the road and the houses, and an opening has been confirmed in part of section. The gap is about 2cm wide, and vertical open cracks in the wall of the house next to this opening (House 3) can also be seen.

Photo 3.7.77 View of the Starting Point

Photo 3.7.78 Opening between Road and Boundary Line

(source:JET)

About a dozen or more houses are crowded together on the slope below the road. Six houses have notable deformations（House1～5, House19）, varying from cracks in walls and cracks that traverse houses to cracks and other deformations in verandas and floors. They are all due to the 2005 cyclone, and the cracks run parallel to the contour lines.

Photo 3.7.79 Horizontal Open Cracks in the Wall

Photo 3.7.80 Open Cracks in the Foundation

(source:JET)

No notable cracks or vertical displacements were seen in the slope, but the slope gradient was the steepest in the middle and looked unstable. In addition, the vegetation on the slope included herbaceous species as well as large trees such as palm trees. Bare ground was also evident in some places. Cyclones with wind speeds of over 100 km/h have been known to hit the area, and large trees are disadvantageous for slope stability. There are no drainage facilities on the slope, and rainwater permeates it.

Photo 3.7.81 Middle of the Slope (source:JET)

Photo 3.7.82 Slope above House19 (source:JET)

No major changes can be seen in the masonry retaining wall below the slope behind House 19 compared to previous observation. Though none of the masonry is missing or damaged, surface water from the upper slope is passing through this retaining wall and flowing into the house.

Photo 3.7.83 Masonry Retaining Wall behind House 19 (Left: 2011, Right: Present)

(source:JET)

Furthermore, there are defects and cracks in the concrete of the stairs on the slope. Although the stairs are aging, it cannot be confirmed whether there are major deformations that would indicate fragmentation.

Photo 3.7.84 Steps on the Lower Slope (source:JET)

Below the slope there is prominent swelling of the road surface. Loose masonry and cracks in retaining walls have also been confirmed. The swelling in the road surface was confirmed after the cyclone of 2005, and there is also swelling of the concrete part in front of the stairs of House 19. In addition, vertical cracks in the concrete wall are open cracks that extend from the foundation to the top of the wall due to the effects of foundation settling. There have been no major changes in the condition of the cracks since 2011.

Photo 3.7.85 Swelling on the Road (Left: 2011, Right: Present) (source:JET)

Photo 3.7.86 Cracks in the Concrete Wall (Left: 2011, Right: Present) (source:JET)

Part of the masonry at the base of a utility pole facing the road is damaged and it is unstable. Further deterioration of stability is expected during rainy season with the permeation of rainwater.

The road is separated from the sea area by a distance of about 10m, and the difference in height between the road and the sea area is about 2m.

If a cyclone hits, seawater is expected to reach the road easily.

Photo 3.7.87 Masonry Retaining Wall in front of the Road (source:JET)

Photo 3.7.88 View of the Ocean Side from House 19 (source:JET)

c. Vallee Pitot

Site Reconnaissance in Vallee Pitot has been carried out three times so far (1st: 2012, 2nd: 22nd Feb. 2013, 3rd: 26th Feb. 2013) as follows;

1st Reconnaissance in 2012

The first reconnaissance was carried out by JET (JICA expert team) on the 22nd June 2012. A landslide boundary of 35m x 20m was detected clearly (red lines in figure below). House (1) had been damaged, and main scalp of landslide was observed. The surface soil is comprised of very weak colluvium, dark brown, moderately plastic gravelly silty clay. This landslide is small size, but not stable. JET decided that this landslide required monitoring. Therefore, two extensometers were installed on this landslide several days after the field reconnaissance in 2013.

Figure 3.7.6 Landslide Plan Map, 1st Reconnaissance in 2012

Photo 3.7.89 Damage to House (1) (source: JET)

a) Main Scalp b) A landslide Boundary (Toe)

Photo 3.7.90 Main Scalp and Landslide Toe (source: JET)

Photo 3.7.91 Damage to House(2) (source: JET)

2nd Reconnaissance on 22nd February 2013

A resident of Vallee Pitot informed JET office by telephone that a house had been heavily damaged on the afternoon of 21st February. JET soon after informed MPI, and MPI went to the site on 22nd February with JET and the police to carry out site reconnaissance.

Damage to House (1): The damage to House (1) was much more severe than during the 1st reconnaissance in 2012. House (1) is located on the main scarp of the landslide head area. On the outer wall of House (1), a lot of large open cracks were recognized. And the cracks and steps occurred in the room of the house. According to the resident, this house was damaged on the night of 18th February 2013. It was judged to be too dangerous for residents to continue living in this house. In addition, the extensometer (E-V1) showed displacement of 4mm/day, landslide activity was confirmed. From the result of this site reconnaissance, MPI and JET had recommended the evacuation of the resident in House (1).

Trigger of Landslide: It is thought that there is abundant groundwater because some springs are seen in the landslide toe area. Heavy rain from 12th February to 13th February is thought to be a trigger of this landslide activity. However, it was confirmed that a large quantity of surface water was flowing into this site from the mountain, therefore it is thought that this landslide occurrence was caused by not only the heavy rain but also the surface water.

Photo 3.7.92 Landslide Plan Map, 2nd Reconnaissance at, 22nd February 2013 (source: JET)

Photo 3.7.93 Damage on the Outer Wall of House(1), Large Open Crack Grew (source: JET)

Photo 3.7.94 House (1) was Tilting as Result of Landslide Activity, Causing a Large Gap with the Neighboring House (source: JET)

Photo 3.7.95 Open crack in the room of House (1) (source:JET)

Photo 3.7.96 The cracks and steps in the room of House (1) (source:JET)

3rd Reconnaissance on 26th February 2013

News that a part of House (1) had broken reached MPI on 25th February 2013. MPI and JET went to the site on 26th February, and 3rd reconnaissance was carried out. The outside wall of house (1) was completely broken, and the main scalp had increased in size since the 2nd reconnaissance. In addition, new open cracks were found in the upper part of this house. The 3rd reconnaissance confirmed that the landslide area of Vallee Pitot was much larger than previously thought (indicated by the yellow dotted line in the figure below).

Photo 3.7.97 The Outside Wall of House (1) was Completely Broken (source:JET)

Photo 3.7.98 New Open Cracks in the Upper Part of House (1) (source: JET)

Figure 3.7.7 Landslide Plan Map (3rd Reconnaissance on 26th February 2013) (source: JET)

3.8 Disaster Inspection

As described in the “Landslide Inventory” in Chapter 2, the 32 landslide hazard areas selected in the "Cyclone and Other Natural Disasters Scheme 2011-2012" were redefined as 37 slope disaster hazard areas based on the field reconnaissance and the aerial photograph interpretation. The 37 areas include not only landslides but also slope failures, rock falls, debris flows, stream erosion, damage to embankments, damage to walls, damage to houses, and caves (Table 3.8.1).

Table 3.8.1 The 37 Slope Disaster Hazard Areas in the Disasters Scheme (source: JET)

No.	District Council/ Municipality	Area name	Classification of disaster
1	Pamplemousses/ Riviere du Rempart District Council	Temple Road, Creve Coeur	Wall damage
2		Congomah Village Council (Ramlakhan)	Stream erosion
3		Congomah Village Council (Leekraj)	Wall damage
4		Congomah Village Council (Frederick)	Wall damage
5		Congomah Village Council (Blackburn Lanes)	Embankment damage
6		Les Mariannes Community Centre (Road area)	Slope failure
7		Les Mariannes Community Centre (Resident area)	Stream erosion
8		L'Eau Bouillie	Damage of embankment
9	Municipality of Port Louis	Chitrakoot, Vallee des Pretres	Landslide
10		Vallee Pitot (near Eidgah)	Landslide
11		LePouce Street	Stream erosion
12		Justice Street (near Kalimata Mandir)	Wall damage
13		Mgr. Leen Street and nearby vicinity, La Butte	Landslide
14		Pouce Stream	Stream erosion
15		Old Moka Road, Camp Chapelon	Landslide
16		Boulevard Victria, Montague Coupe	Wall damage
17		Pailles: (i) access road to Les Guibies and along motorway, near flyover bridge	Slope failure
18		Pailles: (ii) access road Morcellement des Aloes from Avenue M.Leal (on hillside)	Stream erosion
19		Pailles: (iii) soreze regin	Slope failure
20	Black River District Council	Plaine Champagne Road, opposite "Musee Touche Dubois"	Slope failure
21		Chamarel: (i) near Reataurant Le Chamarel	Embankment damage
22		Chamarel: (ii) Roadside	Embankment damage
23		Gremde Riviere Noire Village Hall	Damage to houses
24	Savanne District Coundil	Baie du Cap: (i) Near St Francois d'Assise Church	Debris flow
25		Baie du Cap: (ii) Maconde Region	Rock fall
26	Grand Port District Coundil	Riviere des Anguilles, near the bridge	Stream erosion
27		Quatre Soeurs, Marie Jeanne, Jhummah Streert, Old Grand Port	Landslide
28		Bambous Virieux, Rajiv Gandhi Street (near Bhavauy House), Impasse Bholoa	Slope failure
29		Cave in at Union Park, Rose Belle	Cavern
30	Municipality of Curepipe	Trou-AUX-Cerfs	Slope failure
31		River Bank at Cite L'Oiseau	Stream erosion
32		Louis de Rochecouste (Riviere Seche)	Stream erosion
33		Piper Morcellement Piat	Stream erosion
34	Municipality of Quatre Bornes	Candos Hill at LallBahadoor Shastri and Mahatma Gandhi Avenues	Landslide
35		Cavernous Area at Mgr Leen Avenue and Bassin	Cavern
36	Municipality of Beau Bassin/ Rose Hill	Morcellement Hermitage, Coromandel	Slope failure
37		Montee S, GRNW	Stream erosion

Thirty-seven (37) slope disaster hazard areas are defined in the Disaster Scheme, which means that the 37 areas are officially identified by the Mauritius Government as “high hazard areas for slope disasters”. Therefore countermeasures which mitigate the risk of disasters are necessary to protect the citizens and the infrastructures in Mauritius

However it is impossible to immediately conduct countermeasures and to diminish the risk

completely in a short period for the 37 slope disaster hazard areas because of the limited budget and human resources and the lack of technology. It would take several to a dozen years to complete all of the countermeasures for the areas because they will be conducted one by one.

Therefore a regular disaster inspection is a better risk management method to identify ominous signs that may cause a serious disaster before a slope disaster happens, which should last until the completion of countermeasure construction and the confirmation of effectiveness of the countermeasures. The disaster inspection procedures JET has proposed to MPI will be conducted continuously in the Project.

3.8.1 Significance and Objectives of Disaster Inspection

Inspection for slope disaster is a risk management method which reduces the risk of slope disasters through daily road maintenance. It is to inspect slope disasters such as landslides, rock falls, slope failures and debris flows by engineers with inspection sheets. In case a slope disaster happens, there would be a serious impact on citizens and infrastructure.

By using an inspection sheet to conduct an inspection, engineers are able to objectively judge factors and triggers of landslides, rockfalls, slope failures and debris flows and to identify ominous signs that may cause a serious disaster before a slope disaster happens. Furthermore, accumulation of the inspection results and the disaster records are conductive to effective and efficient assessment of the risk of a slope disaster.

The inspection is a “simple”, “brief” and “understandable” method to prevent slope disasters.

Figure 3.8.1 Situation of the Inspection for Slope Disasters (source: JET)

The overall goal of the inspection is to implement the management of slopes disaster effectively and efficiently. The specific objectives are as follows;

- To find out early the anomalies related to potential disasters
- To systematically understand the disaster risk area along roads

- To organize records of disasters along roads and potential disasters
- To decide the mitigation methods/countermeasures

3.8.2 Method of Disaster Inspection

The disaster inspection is conducted with a regular check sheet and photo sheets as shown in the following figure. In the regular check sheet, new failures, cracks, small rock falls/failures, spring water, clogged culverts etc. should be checked and the inspector should describe the current condition and the proposed action. In the photo sheet, the overview, the checkpoints and the abnomaly etc. should be taken and the inspector should take the photos from fixed points to compare the situation with previous photos.

Regular Check Sheet

Management number	0 0 0 0 0 0 0 0 0 1	Disaster	*Landslide, Rockfall*	Area name			
Date		April 20, 2013					
Reporter's nate		Takeshi KUWANO					
Landslide /Slope failure	New failure						
	Swell slope						
	New /enlarged step/cliff						
	New /enlarged crack on slope						
Rockfall	New rockfall						
	Enlarged crack on rock slope						
	Erosion of unstable rock						
Debris flow	Filling up of debris sediment						
	Overflow of debris on road						
	Clogged culvert						
	New failure on river slope						
Spring water	Depleted/decreased spring water						
	Increased spring water						
	New spring water						
	Turbid spring water						
House/ road	New /enlarged step/settlement						
	New /enlarged crack						
Counter-measure	Damage/deformation						
	Clogged drainage						
	Overflowed drainage						
Other problem							
Condition							
Proposed action							
Purpose of action							

Figure 3.8.2 Example of Regular Check Sheet (source: JET)

Inspector should conduct the disaster inspection after the rainy season (April – May), because landslide movement is highly affected by surface/ground water behavior. The inspection can be conducted after torrential rain and earthquake.

3.8.3 Results of Disaster Inspection

The JET and C/P have conducted the disaster inspection for the 37 slope disaster hazard areas after the rainy season from April to May in 2013, and have discussed the stability and the priority.

The 37 slope disaster hazard areas are divided into three (3) ranks as follows based on the

emergency and priority as judged by the disaster inspection.

A: Need for emergency countermeasures

B: Need for continuous inspections

C: Removal from a list

Rank A means the slope disaster hazard is in need of countermeasures as soon as possible and it is a serious threat to residents and/or infrastructures. The inspections should last until the completion of countermeasure construction and the confirmation of effectiveness of the countermeasures

Rank B means a slope disaster hazard is in need of countermeasures and has the potential to affect residents and/or infrastructures. However the priority is not higher than Rank A. Therefore the countermeasures can be implemented after the completion of Rank A countermeasures. The inspections should last until the completion of countermeasure construction and the effectiveness of the countermeasures has been confirmed.

Rank C means a slope disaster hazard is already repaired/stabilized completely or no longer considered a landslide risk, which is confirmed with disaster inspections after the rainy season. The area can be removed from the list after discussions with related organizations.

The summary of the results of disaster inspections is listed as follows and the regular check sheets and the photo sheets are included in the Supporting Report.

Table 3.8.2 The Results of Disaster Inspection for 37 Slope Disaster Areas (source: JET)

No.	Area name	Classification of disaster	Striking condition	Evaluation	Proposed action
1	Temple Road, Creve Coeur	Damage of wall		B	
2	Congomah Village Council (Ramlakhan)	Stream erosion		B	
3	Congomah Village Council (Leekraj)	Damage of wall		B	
4	Congomah Village Council (Frederick)	Damage of wall		B	
5	Congomah Village Council (Blackburn Lanes)	Damage of Embankment		B	
6	Les Mariannes Community Centre (Road area)	Slope failure		B	
7	Les Mariannes Community Centre (Resident area)	Stream erosion		B	
8	L'Eau Bouillie	Damage of embankment	The road was paved and repaired. There are no ditches in the area. But new cracks and deformation happened by erosion of the roadside because of the heavy rainfall in the middle February and the end of March.	A	Concrete ditched should be constructed along the road to prevent further erosion of the road foundation.
9	Chitrakoot, Vallee des Pretres	Landslide	As a pilot project site, monitoring is being conducted.	A	Until the completion of countermeasures, monitoring and early warning system should be continuously implemented.
10	Vallee Pitot (near Eidgah)	Landslide	As a pilot project site, monitoring is being conducted.	A	Until the completion of countermeasures, monitoring and early warning system should be continuously implemented.
11	LePouce Street	Stream erosion	No significant progress.	B	It is necessary to construct the ditch of an appropriate scale.
12	Justice Street (near Kalimata Mandir)	Damage of wall	No significant progress. However, the mud flow is generated	B	Artificial structures (drainage, culvert, etc.) should be constructed in the future. The fill

			after the heavy rain, and the drain system is not enough.		removal in the back of the ditch is also effective. It is preferable to construct the channel on the slope.
13	Mgr. Leen Street and nearby vicinity, La Butte	Landslide		B	
14	Pouce Stream	Stream erosion	Damage is confirmed to the gabion. However, the function of the erosion prevention is secured.	B	
15	Old Moka Road, Camp Chapelon	Landslide	No significant progress. However, the groundwater level is high in this area. Pushing the ditch out and cracks of house are confirmed. A detail investigation shall be carried out.	B	Artificial structures (drainage, horizontal drainage etc.) should be constructed on the house side along the road to decrease the water level.
16	Boulevard Victria, Montague Coupe	Damage of wall	No significant progress. However, the gabion has become unstable recently.	A	It will be necessary to reinforce the gabion in the future. The fill removal in the back of the gabion is also effective.
17	Pailles: (i) access road to Les Guibies and along motorway, near flyover bridge	Slope failure	The slope around the bridge has small collapsed and sediment discharge was confirmed in the ditch.	A	Artificial structures (drainage, ditch etc.) should be constructed on the slope. It is necessary to green the slope to prevent further erosion of the slope.
18	Pailles: (ii) access road Morcellement des Aloes from Avenue M.Leal (on hillside)	Stream erosion	No significant progress.	B	
19	Pailles: (iii) soreze regin	Slope failure	A lot of damages of the ditch are confirmed. The rockfall and the small collapse are confirmed.	A	It is necessary to repair the ditch. In the future rockfall countermeasures should be constructed along the road.
20	Plaine Champagne Road, opposite "Musee Touche Dubois"	Slope failure		B	
21	Chamarel: (i) near Reataurant Le Chamarel	Damage of embankment		B	
22	Chamarel: (ii) Roadside	Damage of embankment		B	
23	Gremde Riviere Noire Village Hall	Damage of house	No significant progress. The cracks are caused by not landslide but lack of bearing capacity of the ground.	C	This area can be removed from the inspection sites after the discussion with related organization.
24	Baie du Cap: (i) Near St Francois d'Assise Church	Debris flow	No significant progress. Small debris and garbage are stacked at the inlet of culvert	B	Regular maintenance (excavation of debris and garbage) should be conducted after rainy season to prevent the clog of culvert and overflow.
25	Baie du Cap: (ii) Maconde Region	Rock fall		B	
26	Riviere des Anguilles, near the bridge	Stream erosion	No significant progress. However, over the past several years, the erosion is slightly progressing so that the edge of the cliff has been approaching the houses.	A	Artificial structures (gabion, concrete walls etc.) should be constructed on the house side along the river to prevent further erosion of the cliff.
27	Quatre Soeurs, Marie Jeanne, Jhummah Streert, Old Grand Port	Landslide	As a pilot project site, monitoring is being conducted.	A	Until the completion of countermeasures, monitoring and early warning system should be continuously implemented.
28	Bambous Virieux, Rajiv Gandhi Street (near Bhavauy House), Impasse Bholoa	Slope failure		B	
29	Cave in at Union Park, Rose Belle	Cavern	No significant progress. The cave was already filled. There is no movement or erosion.	C	This area can be removed from the inspection sites after the discussion by related organization.
30	Trou-AUX-Cerfs	Slope failure	Vegetation is getting recovery	B	
31	River Bank at Cite L'Oiseau	Stream erosion		B	
32	Louis de Rochecouste (Riviere Seche)	Stream erosion		B	
33	Piper Morcellement Piat	Stream erosion	Stone masonry wall was collapsed due to the heavy rain in Middle February. The collapse cause further erosion on house side.	A	The retaining wall should be repaired to avoid further collapse.
34	Candos Hill at LallBahadoor Shastri and Mahatma Gandhi Avenues	Landslide	The cracks are in the retaining wall, and spring water is observed though there is no damage in the house. No significant progress.	B	It is preferable to observe the crack of the retaining wall continuously.
35	Cavernous Area at Mgr Leen Avenue and Bassin	Cavern	No significant progress. The cave was already filled.	C	This area can be removed from the inspection sites after the discussion by related

			There is no movement or erosion.		organization.
36	Morcellement Hermitage, Coromandel	Slope failure		B	
37	Montee S, GRNW	Stream erosion	No significant progress. However, the erosion is slightly in progress.	B	It will be necessary to construct a bank protection in the future.

3.8.4 Recommendation on Disaster Inspection

a. Rank A Area

Prompt implementation for countermeasures is necessary for the selected nine (9) Rank A areas. The countermeasures should be discussed by MPI with cooperation of each district office. After the completion of countermeasure construction and the confirmation of effectiveness of the countermeasures, the area can be removed from the list of the Disaster Scheme after discussions with related organizations.

Chitrakoot and Vallee Pitot in the Municipality of Port Louis and Quatre Soeurs in the Grand Port District Council are Rank A areas, but three (3) other areas, where detailed investigations/monitoring has been conducted and countermeasures are already being considered as pilot sites in the Project, are omitted in this chapter. The following actions are recommended for the following six (6) sites that are Rank A.

a.1 L'Eau Bouillie, Pamplemousses/Riviere du Rempart District Council

The road has been paved and repaired. There are no ditches in the area. But new cracks and deformations have been caused by erosion of the roadside because of the heavy rainfall in the middle of February and the end of March. A concrete ditch should be constructed along the road to prevent further erosion of the road foundations.

a.2 Boulevard Victoria, Montague Coupe, Municipality of Port Louis

No significant progress has been made. However, the gabion has become unstable recently. It will be necessary to reinforce the gabion in the future. The removal of fill material from behind the gabion is also considered an effective countermeasure.

a.3 Pailles: (i) access road to Les Guibies and along motorway, near Flyover Bridge, Municipality of Port Louis

The slope around the bridge has small collapses and sediment discharge was confirmed in the ditch. Artificial structures (drainage, ditches etc.) should be constructed on the slope. It is necessary to green the slope to prevent further erosion of the slope.

a.4 Pailles: (iii) soreze regin, , Municipality of Port Louis

A lot of damage to the ditch has been confirmed. The rockfall and the small collapses are confirmed. It is necessary to repair the ditch. In the future rockfall countermeasures should be constructed along the road.

a.5 Riviere des Anguilles, near the bridge, Grand Port District Council

No significant progress has been made. However, over the past several years, the erosion is

slightly progressing so that the edge of the cliff has been approaching the houses. Artificial structures (gabion, concrete walls, etc.) should be constructed on the house side along the river to prevent further erosion of the cliff.

a.6 Piper Morcellement Piat, Municipality of Curepipe

Stone masonry wall has collapsed due to the heavy rain in the middle of February. The collapse has caused further erosion on the house side. The retaining wall should be repaired to avoid further collapses.

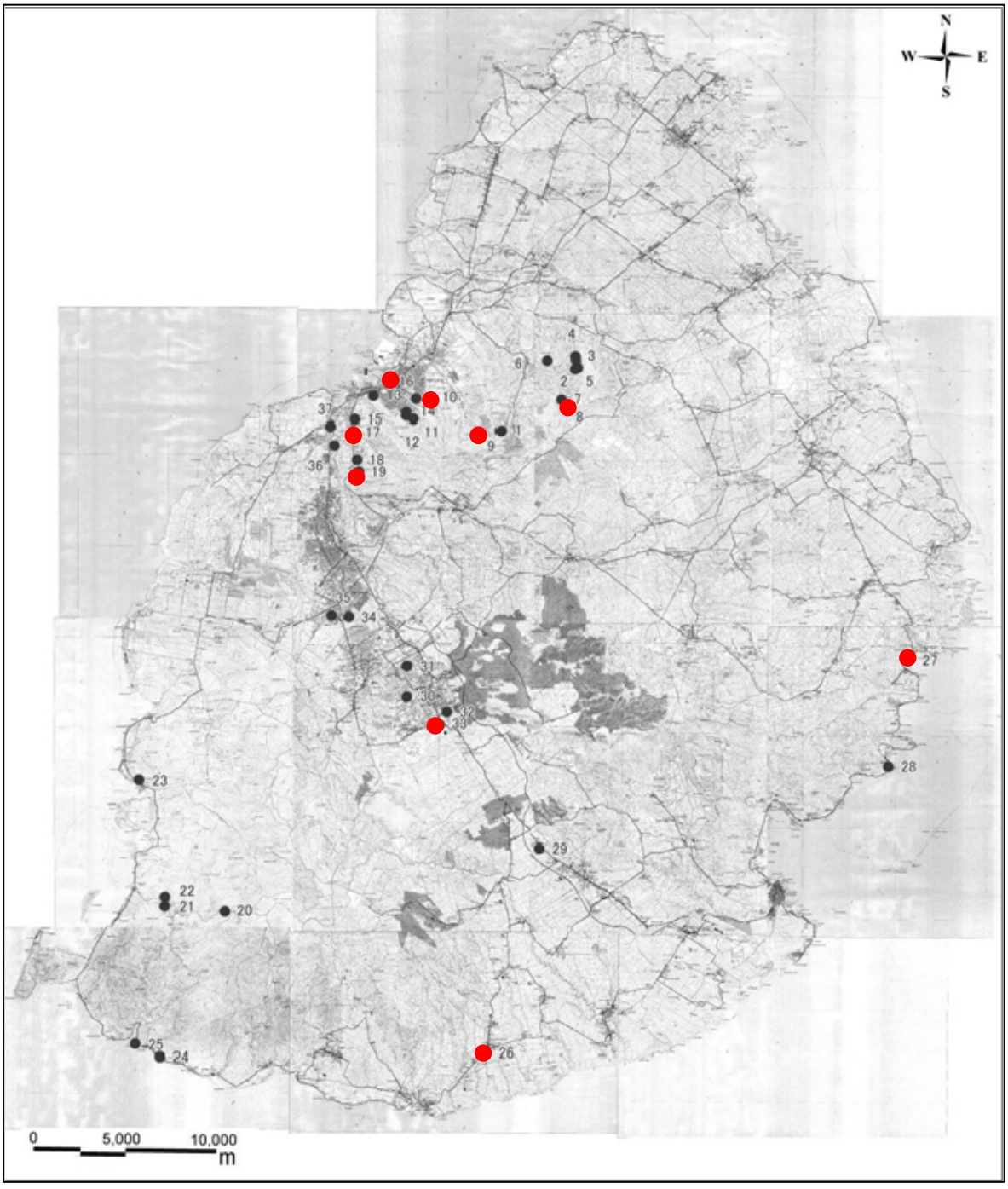


Figure 3.8.3 Location Map of Rank As (●) including Chitrakoot, Vallee Pitot and Quatre Soeurs (source: JET)

b. Rank B Area

For the selected 25 Rank B areas, the regular inspection should be continuously implemented after every rainy season until the countermeasures have would be been completed. After the completion of countermeasure construction and the confirmation of effectiveness of the countermeasures, the area can be removed from the list of the Disaster Scheme after the discussions with related organization.

c. Rank C Area

The following three (3) areas on Rank C areas can be removed from the list of the Disaster Scheme after the discussions with related organization.

c.1 Gremde Riviere Noire Village Hall, Black River District Council

The cracks are caused not by a landslide but by a lack of bearing capacity of the ground.

c.2 Cave in at Union Park, Rose Belle, Grand Port District Council

The cave in has already been filled in. There are no movements or erosion.

c.3 Cavernous Area at Mgr Leen Avenue and Bassin, Municipality of Quatre Bornes

The cave in has already been filled in. There are no movements or erosion.

3.9 Review and Recommendations for the Disaster Scheme

In this section, recommendations for the Disaster Scheme are examined through consideration of solutions for the issues based on the review of the existing disaster schemes. The process used in making the recommendation is shown below.

(1) Review of the existing disaster scheme.
(2) Making the draft basic policy for the recommendation based on the results of the review of the existing disaster scheme.
(3) Meeting with stakeholders to share/exchange opinions regarding the draft basic policy for the recommendation. Making the draft recommendation based on the meeting result.
(4) Meeting with the stakeholders to explain the draft recommendation and to collect their opinions. Revision of the draft recommendation based on the meeting result.
(5) Meeting with the stakeholders to explain the revised draft recommendation and to collect their opinions. Making the recommendation based on the meeting result.
(6) Meeting with LMU regarding the recommendation. Revision of the recommendation based on the meeting result.
(7) Meeting with the stakeholders to explain the revised recommendation and to collect their opinions.
(8) Making the final recommendation based on the above meeting result.

3.9.1 Review of the Existing Warning System of Landslides in Mauritius

The schemes of emergency response for cyclones, torrential rain, tsunamis, high waves and landslides are indicated in Cyclone and Other Natural Disasters Scheme (CONDS) in Mauritius.

The chapter on landslides in the scheme contains monitoring, actions by Local Authorities, responsibility of the Central Cyclone and Other Natural Disasters Committee, warning/evacuation system, and distribution of landslide bulletins.

The section on warning/evacuation systems has five stages based on monitoring data of rainfall and displacement. The following table shows the responsibility of ministries/agencies, communication method and necessary responses in each stage.

Table 3.9.1 The Warning Stages, Standards for Issuing Warnings and Responses[20]

Stage	Standards for issuing warnings and responses
Stage 1 (Preparatory Stage)	・ Rainfall will be measured by the representatives of Local Authorities/ inhabitants. As soon as 30mm rainfall per 12 hours is recorded, the information will be communicated to the Director, Meteorological Services. ・ The Meteorological Services (MS) will confirm the recording and transmit it to the National Disaster and Operations Coordination Centre (NDOCC) which in turn will communicate it to the Prime Minister's Office (PMO) and to the Ministry of Public Infrastructure and Land Transport (MPI). ・ On being informed that 30mm of rainfall in 12 hours has been recorded, the MPI will start taking daily readings of extensometers to measure ground displacement. ・ Upon 2mm a day or more displacement being recorded, the MPI will communicate the reading to the MS, NDOCC and the appropriate Local Authorities. (At sites where no extensometers are available, the MPI will arrange for a site inspection on being informed that there has been some land movement.) ・ Stage I warning is communicated by the Chairperson of the Coordinating Committee (PMO), to MPI. The latter will communicate same to the NDOCC and the MS.

	・ The NDOCC will then inform the residents of the affected areas. The warning will also be communicated by the NDOCC to related ministries and organizations which make up the Coordinating Committee of NDOCC. ・ The Police will advise the inhabitants of landslide-prone areas through their representatives, to start preparing themselves to move out of their houses in accordance with instructions already issued to them.
Stage 2 (Warning Stage)	・ The MPI will constantly monitor ground movement and will inform the MS and the NDOCC as soon as displacement of 1cm per day is recorded or if visual displacement of ground is noted. ・ The NDOCC will inform the PMO and the Chairperson of the Coordinating Committee who will convene a meeting to issue the Stage 2 Warning. ・ The warning will be broadcast by the Mauritius Broadcasting Corporation (MBC) and private radio stations. ・ Communication to the affected residents will be done by the Police Department by loudspeakers or other means. ・ The Police Department shall, when issuing a Stage 2 Warning, advise the residents to complete all preparations for eventual evacuation and stand by ready to vacate their houses once the order is issued. Arrangements should be made by the Ministry of Health and Quality of Life (MHQL) and the Police Department for the transfer to hospitals of disabled people who elect to do so. First Aid Service (FAS) providers may be invited to extend their assistance. ・ The Crisis Committee (CC) will review the situation in the light of all available information pertaining to rainfall recording and ground displacement. ・ The Stage 2 Warning will also be communicated by the NDOCC to the following Ministries/Departments/Organizations which will be responsible for the following: ➢ MHQL: (i) to prepare special ward for any casualty that may arise out of an eventual evacuation; (ii) to provide an adequate number of medical and para-medical personnel intended to receive casualties; and (iii) to be ready to dispatch ambulances adequately staffed and equipped. ➢ The Ministry of Social Security, National Solidarity and Reform Institutions (MSS) and the Ministry of Gender Equality, Child Development and Family Welfare (MGCW) will ensure that all Refugee Centres under their respective control are opened and made ready for use. ➢ The Central Water Authority (CWA) will stand by ready to close the shut-off valves on the pipes going through the region as soon as the evacuation order is issued. ➢ The Central Electricity Board (CEB) will be ready to switch off electricity supply in the affected area as and when instructed by the Crisis Committee or the most senior gazetted Police Officer. CEB will ensure as far as possible that power cuts are restricted to the affected areas only so as to avoid unnecessary deprivation of electricity to unaffected areas. ➢ MPI will take readings of extensometers as frequently as may be appropriate to determine whether the ground displacement progresses beyond 1cm a day and ensure that the information is communicated to the NDOCC and the MS. ➢ The Fire Services and the Non-Governmental Organizations (Red Cross Society, St. John Ambulance, etc.) will be informed by the NDOCC of the possibility of an evacuation order being issued and to enlist their assistance.
Stage 3 (Evacuation Stage)	・ Stage 3 is reached when ground displacement is equal to or is greater than 2mm in an hour. ・ As in the case of the two previous stages, the recording will be continually monitored by the MPI and the data communicated to the NDOCC and the MS. The NDOCC will then pass on the information to the CC which will meet to approve the evacuation order. The evacuation order will be broadcast and/or communicated to the appropriate residents in the same manner as in Stage 2. ・ If, on information being obtained from the MPI and the MS, the NDOCC considers that an urgent and immediate evacuation is required and that there might not be enough time to convene the CC, then the most senior gazetted officer present in Line Barracks will give the order for evacuation after consultation with the Chairperson of the CC, if possible. ・ As Stage 3 is reached and evacuation is in progress, the various Ministries/Departments/Organizations involved should actively set in motion arrangements for which they are responsible. In particular, the following measures should be implemented: ➢ Ministry of Education and Human Resources (MEHR) and Ministry of Tertiary Education, Science, Research and Technology (MTSRT):

	Educational Institutions in affected areas should be closed. ➢ MSS and MGCW will ensure that all Refugee Centres under their respective control are opened and made ready for use. ➢ MHQL: Ambulances should be dispatched on site for the conveyance of handicapped, old and sick people, and any casualty cases to hospital. Arrangements will also be made for Health Inspectors to visit regularly the refugee centres to ensure acceptable sanitary conditions there. ➢ CWA will close the valves on the pipelines within the affected area and will arrange for water to be supplied regularly to the refugee centres. ➢ CEB will proceed with the interruption of the power supply in the affected areas. ➢ Police Department will cordon off the affected area and ensure the protection of property of the residents. An Incident Officer will be responsible and will have full authority for the control and coordination of the operation on site. Access to the cordoned off area will only be permitted by the Incident Officer.
Stage 4 (Emergency Stage)	・ When there is sudden landslide and the CC cannot for practical reasons be convened, the Emergency Warning is issued by the NDOCC after consultation with the Chairperson of the CC, if possible. ・ Action will be triggered off as provided for under Stage 3. ・ The prevalence of cyclonic conditions over and around Mauritius will entail the adoption of special arrangements with regard to the inhabitants of landslide-prone areas. ・ The issue of a Cyclone Warning Class II or a Torrential Rain Warning may constitute for the inhabitants a Landslide Stage 2 Warning. Being given that the issue of a Cyclone Warning Class III entails the cessation of all normal activities, the inhabitants of the landslide prone areas may be evacuated if there exists a strong likelihood of a Cyclone Warning Class III being issued and the possibility of landslide to occur. ・ As soon as a Cyclone Warning II or a Torrential Rain Warning is issued by the MS, the CC will, in consultation with the Chairperson of the Coordinating Committee, convene a meeting to consider the advisability of issuing an evacuation order. Action as provided for in Stage 3 will be triggered off.
Stage 5 (Termination)	・ A close monitoring and stocktaking exercise will be undertaken by relevant authorities after stabilization of ground movement has been noted. ・ The all-clear signal will be given after a meeting of the CC.

3.9.2 Recommendation for the Disaster Scheme

Figure 3.9.1 shows the outline image of the draft recommendation for the Disaster Scheme.

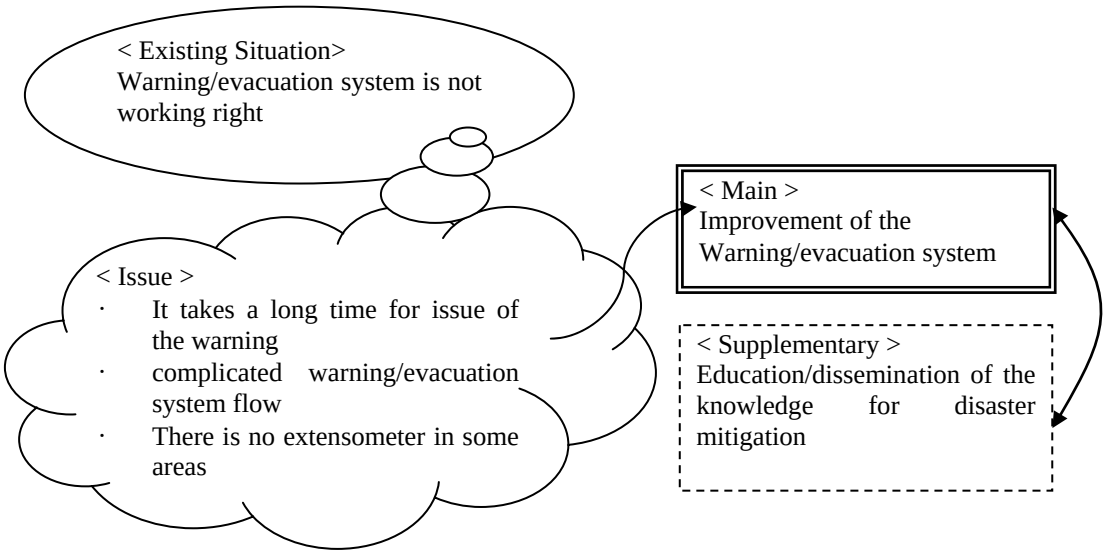


Figure 3.9.1 Outline Image of the Draft Recommendation for Disaster Scheme (source: JET)

- The Disaster Scheme is basically the manual for the warning/evacuation system in a time of disaster/emergency. Therefore, it is required that the response by the related ministries/agencies should be simply described at each stage for prompt action.
- Regular activities for education/dissemination/drill will be required in order for the warning/evacuation system to work properly.
- The education/dissemination has no immediate relationship to the Disaster Scheme as a manual of the warning/evacuation system. Therefore, it is difficult to incorporate the education/dissemination into the Disaster Scheme. But education/dissemination is a matter related to the Disaster Scheme. The incorporation of the contents to the guideline/manual by this project is proposed as a supplemental recommendation.

Table 3.9.2 shows the existing situation, issues and basic policy for countermeasure regarding the warning/evacuation system in the Disaster Scheme.

Table 3.9.2 Existing Situation, Issues and Basic Policy for Countermeasure regarding the Warning/Evacuation System in the Disaster Scheme (source: JET)

Existing situation	Issues	Basic policy for countermeasure
MPI is responsible for the monitoring of landslides all over the Island.	It is difficult to take responsibility for landslide monitoring all over the island due to limited human resources/systems and budget of MPI	Change concentration of the responsible area from all of Mauritius to high risk area.[1]
Warning/evacuation order will be issued by decision of the Crisis Committee based on the information from the site through NDOCC[2]	The landslide disaster might occur before the decision of evacuation notice when an emergency situation occurs (cyclone, torrential rain, etc.)	Introduction of the voluntary evacuation of the site in response to the emergency (torrential rain, cyclone, etc). Separating the warning/evacuation system flow between site and government response. And introduction of issue of the evacuation notice by decision on the site. (The information sharing between site and government will be required through the Police, Special Mobile Force and NDOCC)
The warning/evacuation system flow has too many processes and is complicated.	The response might be delayed.	Change the warning/evacuation stages from five to three and simplify the warning/evacuation system flow.
The warning/evacuation notice is issued using data from rain gauges and extensometers.	There is no rain gauge/extensometer in some areas.	Multiple triggers which include not only the rain gauge/extensometer data, but also residents' information (deformation, signs of movement) should be utilized to avoid the situation of non-functional warning/evacuation system not turning the triggers into action.
The monitoring data of the extensometer is the trigger for the warning/evacuation in the existing disaster scheme. The recording will be continually monitored by the MPI.	MPI may not be able to access the site during an emergency (cyclone, torrential rain, etc.) because of flooded roads, traffic restriction by government, etc.	The trigger for evacuation notice should not rely only on the MPI's monitoring data. (The multiple trigger is required.) Separating the warning/evacuation system flow between site and government response, and introduction of issue of the evacuation notice by decision on the site.
The communication between NDOCC and MMS[3]/MPI is required for issue of evacuation notice and sharing the information (data of rain gauge/extensometer).	It might not be possible to communicate with each other because of electrical power outage/ disconnection during an emergency.	Introduction of the voluntary evacuation of the site to respond to the emergency (torrential rain, cyclone, etc). Separating the warning/evacuation system flow between site and government response, and introduction of issue of the evacuation notice by decision on the site.

Based on the above, Table 3.9.3 shows the existing disaster scheme article, draft proposal of addition/modification, reason of addition/modification and necessity as a recommendation for the disaster scheme. Part of the draft proposal of addition/modification is attached to the Supporting Report.

[1] The technical transfer about the designation of the warning zone will be implemented by this project. The designation, warning/evacuation system development and education/dissemination by MPI with related ministries/agencies will be required in the future. The survey and designation will be required not only in the warning zone, but also in the landslide-prone areas in Mauritius of the Disaster Scheme in the future on an as needed basis.

[2] NDOCC: National Disaster and Operations Coordination Centre: Police Information and Operations Room will be changed to the core of the NDOCC. The NDOCC has experience of the implementation of the disaster drill and education on a nationwide basis.

[3] MMS: Mauritius Meteorological Services

Table 3.9.3 Existing Disaster Scheme Article, Draft Proposal of Addition/Modification, Reason of Addition/Modification and Necessity (source: JET)[4]

Existing disaster scheme article	Draft proposal of addition/modification	Reason of addition/modification and necessity
C LANDSLIDE EMERGENCY SCHEME	No need to change	
C.1 Monitoring of Landslides	No need to change	
C1.1 The Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) is responsible for the monitoring of landslides all over the Island.	The Ministry of Public Infrastructure and Land Transport (MPI) is responsible for the monitoring of landslides ~~all over the Island~~ *in the Landslide-Prone Regions*. · *The LANDSLIDE EMERGENCY SCHEME applies to the List of Landslide-Prone Regions provided in Annex A and any other area where landslide may occur in the future.*	· MPI is responsible for the monitoring of landslides all over the Island in the existing Disaster Scheme. · But, it is difficult to take a responsibility for landslide monitoring all over the island due to limited human resources/systems and budget of MPI. · To solve the problem, the concentration of the responsible area from all of Mauritius to the high risk area (the Warning Zone) is proposed. · The technical transfer about the designation of the warning zone will be implemented by this project. The designation, warning/evacuation system development and education/dissemination by MPI with related ministries/agencies will be required in the future. · The survey and designation will be required not only for the warning zone, but also for other Landslide-Prone Areas in Mauritius of the Disaster Scheme in the future on an as needed basis
	(The definition of the monitoring in the bottom note) Landslide monitoring includes regular measurement of ground displacement and on-site visual check. These will be conducted under the instruction of a Landslide Expert Team.	· The definition of the monitoring was required by stakeholders. It was added.
C1.1.1 General ~~Preparedness~~		It was modified for appropriate expression of the caption (consistency with the contents)
C.1.1.2 With the increase in development and the pressure on land requirements, new and existing constructions have considerably changed the configuration and physical properties of some areas which, as a result, have become prone to landslide.	No need to change	
C.1.1.3 There is a need to warn the public and more particularly the inhabitants of these sensitive areas of the need for precautionary measures in case of likelihood of landslides.	No need to change	
C.1.1.4 It is recommended that extensometers be installed in all areas prone to landslide. In the absence of objective (measured) data, the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) will coordinate with Local Authorities for collection of on-site visual data.	Removed	· It has a similar content to C.1.1. It is better to remove to avoid the confusion, to simplify this scheme
C.2 Action by Local Authorities	No need to change	
C.2.1 Local Authorities shall, ahead of the convening of the Cyclone and Other Natural Disasters Committee, undertake a fresh survey and update the list of landslide-prone regions in Mauritius.	Local Authorities shall, ahead of the convening of the Cyclone and Other Natural Disasters Committee, *undertake a fresh survey and provide such information to MPI and any other ministry/agency and* update the list of landslide-prone regions in Mauritius.	· The contribution of Local Authorities of information regarding the landslide will be required. It was added for collaboration between MPI and Local Authorities.
C.2.2 Government Information Service In collaboration with Local Authorities, the Government Information Service and the MBC will prepare illustrated posters and film strips to remind the public of the dangers of landslide.	No need to change	
C.2.3 Police The Police, in collaboration with the Meteorological Services and the MBC shall arrange to give talks on TV and Radio on dangers to transportation in landslide conditions.	No need to change	
C.3 Responsibility of the Central Cyclone and Other Natural Disasters Committee	No need to change	
C.3.1 The Central Cyclone and Other Natural Disasters Committee will become operational in case of natural disasters such as landslide conditions.	No need to change	
C.3.2 Role of NDOCC/DOCR A National Disaster and Operations Coordination Centre (NDOCC) has been set up at the Police Headquarters Line Barracks and is operational for the purpose of taking charge of the management of disasters in Mauritius. In cases of national emergency/crisis such as cyclones, torrential rains, landslides, tsunamis, high waves, oil spills on large scale inland or at sea, aircraft crashes, major road accidents, and so on, the NDOCC is activated and initiates all necessary actions to deal with the situation. Where such incidents have occurred on a national scale, Police Divisional Operations Rooms and Branch Operations Rooms (where applicable) will likewise be converted into Local Disaster and Operations Coordination Rooms (DOCR) to coordinate efforts of concerned Government services and Parastatal Bodies at ground level. However, in case of a local incident/occurrence, the Police Divisional/Branch Operations Rooms are automatically transformed into a local DOCR and the Divisional Commander/Branch Officer concerned immediately takes charge of his respective DOCR.	No need to change	

[4] In this document, “C.x” level is expressed as a “Chapter” and “C.x.x” is expressed as a “Section”. The addition :italic text, deletion: strike-through, existing: existing article of the disaster scheme, new: draft proposal of addition/modification

C.4 Landslide Conditions The following criteria for the issue of warnings to the inhabitants of landslide areas will henceforth apply: (i) geomorphology; (ii) identification of landslide areas; (iii) rainfall recording; and (iv) ground displacement.	No need to change	
C.5 The warning/evacuation system shall consist of five stages as follows: (i) Stage 1 - Preparatory Stage (ii) Stage 2 - Warning Stage (iii) Stage 3 - Evacuation Stage (iv) Stage 4 - Emergency Stage (v) Stage 5 - Termination	The warning/evacuation system shall consist of ~~five~~ *three* stages as follows: ~~(i) Stage 1 - Preparatory Stage~~ ~~(ii)~~(i) Stage ~~2~~ 1 - Warning Stage ~~(iii)~~(ii) Stage ~~3~~ 2 - Evacuation Stage ~~(iv) Stage 4 - Emergency Stage~~ ~~(v)~~(iii) Stage ~~5~~ 3 - Termination *The warning/evacuation system flow chart is shown in the Annex B for landslide areas which are identified as subject to high risk of landslide. When the warning system is activated, the relative ministries/agencies will follow procedures.*	It is confirmed that there is some problem shown below · Warning/evacuation order will be issued by decision of the Crisis Committee based on the information from the site through NDRRMC. But, the landslide disaster might occur before the decision of evacuation notice when the emergency situation (cyclone, torrential rain, etc.) occurs · The response might be delayed because the warning/evacuation system flow has too much process and is complicated. · The warning/evacuation notice is issued by data of rain gauge and extensometer but there is no rain gauge/extensometer in some areas. · The monitoring data of the extensometer is the trigger for the warning/evacuation in the existing disaster scheme. The recording will be continually monitored by the MPI. But, MPI may not be able to access the site during an emergency (cyclone, torrential rain, etc.) because of flooded roads, traffic restriction by government, etc · The communication between NDRRMC and MMS[5]/MPI is required for issue of evacuation notice and sharing the information (data of rain gauge/extensometer). But, they might not be able to communicate with each other because of electrical power outage/disconnection during an emergency. Based on the above Issues, the following amendments are proposed. · Change the warning/evacuation stages from five to three and simplify the warning/evacuation system flow. · Separate the warning/evacuation system flow between site and government response and introduce issue of the evacuation notice by decision on the site. (The information sharing between site and government will be required through the Police, Special Mobile Force and NDRRMC). · Introduce the voluntary evacuation of the site to respond to the torrential rain, cyclone, etc. · Multiple triggers which contain not only the rain gauge/extensometer data, but also residents' information (deformation, sign of movement) should be utilized to avoid the situation of non-functional warning/evacuation system by not putting the trigger into action. The points to keep in mind are shown below: · In this project, the model flow is proposed, because it is difficult to develop the warning/evacuation out of nothing. · As a material for further discussion, the examination of the warning/evacuation system will be required based on the consideration of landslide character, damage situation, social circumstances, monograming and the others to develop the appropriate system/flow for the warning zone. · And, the checking by residents and related ministries/agencies/local authorities is required to work properly in the system/flow through the drill and education/dissemination for disaster mitigation.
C.5.1 Stage 1 – Preparatory Stage Stage 1 is reached when rainfall of 30mm or more in 12 hours is recorded and ground displacement is equal to or more than 2mm a day.	Removed	· The flow of the existing Disaster Scheme is shown below. Stage 1 (Preparatory Stage) Stage 2 (Warning Stage) Stage 3 (Evacuation Stage) Stage 4 (Emergency Stage) Stage 5 (Termination) · The flow of the draft proposal is shown below Stage1 (Warning Stage) Stage2 (Evacuation Stage) Stage3 (Termination) · The existing Stages 1 and 2 are merged to the proposed Stage 2. · Some contents are moved to the appropriate chapter/section because of the modification such as the above consolidation.
C.5.1.1 Rainfall will be measured by the representatives of Local Authorities/	Removed	· This content is modified and moved to new C.5.1.1 - 5.1.4

[5] MMS: Mauritius Meteorological Services

	inhabitants. As soon as a 30mm rainfall per 12 hours is recorded, the information will be communicated to the Director, Meteorological Services. The Meteorological Services will confirm the recording and transmit it to the NDOCC which in turn will communicate it to the Prime Minister's Office and to the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division).		because of the change of the MMS/MPI's response and monitoring threshold.
C.5.1.2	On being informed that the 30mm rainfall in 12 hours has been recorded, the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) will start taking daily readings of extensometers to measure ground displacement. On 2mm a day or more displacement being recorded, the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) will communicate the reading to the Meteorological Services, NDOCC and the appropriate Local Authorities. Upon being informed by the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) of ground displacement of 2mm per day or more, the Chairperson of the Coordinating Committee as in C.5.1.3 will confirm that Stage I has been reached. At sites where no extensometers are available, the Ministry will arrange for a site inspection on being informed that there has been some land movement.	Removed	Same as above
C.5.1.3	Once Stage I warning is communicated by the Chairperson of the Coordinating Committee (PMO), to Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division), the latter will communicate same to the NDOCC and the Meteorological Services. The NDOCC will then inform the residents of the affected areas. The warning will also be communicated by the NDOCC to the following Ministries and Organizations which make up the Coordinating Committee: ◆ Prime Minister's Office (Chairperson) ◆ Ministry of Energy and Public Utilities ◆ Ministry of Social Integration and Economic Empowerment ◆ Ministry of Local Government and Outer Islands ◆ Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) ◆ Ministry of Public Infrastructure and Land Transport (Land Transport & Shipping Division) ◆ Ministry of Public Infrastructure and Land Transport (NDU Division) ◆ Ministry of Social Ministry of Social Security, National Solidarity and Reform Institutions ◆ Ministry of Education and Human Resources ◆ Ministry of Environment and Sustainable Development ◆ Ministry of Tertiary Education, Science, Research and Technology ◆ Ministry of Health and Quality of Life ◆ Ministry of Gender Equality, Child Development and Family Welfare ◆ Meteorological Services ◆ Government Fire Services ◆ Central Water Authority ◆ Central Electricity Board ◆ Local Authorities ◆ University of Mauritius	Moved to new C5.1.5	· This content is moved to new C.5.1.5 because of the proposal of the voluntary evacuation, simplification of the flow, the multiple triggers.
C.5.1.4	Upon issuance of the Stage 1 warning, the Police will advise the inhabitants of landslide-prone areas through their representatives, to start preparing themselves to move out of their houses in accordance with instructions already issued to them.	Removed	· • Same as above
C.5.2	*Stage 2 – Warning Stage*	C.5.1 Stage 1 ~~2~~ – Warning Stage	· The number of the stage is changed because of the simplification of the flow
C.5.2.1	The Stage 2 Warning will be triggered on a further ground displacement of 1cm in 24 hours being recorded**.**	Changed the contents to new C.5.1.1	· It is changed because of the proposal of the warning/evacuation flow which have multiple trigger.
C.5.2.2	The Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) will monitor constantly ground movement and will inform the Meteorological Services and the NDOCC as soon as a displacement of 1cm per day is recorded or if visual displacement of ground is noted. The NDOCC will inform the Chairperson of the Coordinating Committee who will convene a meeting for the issue of the Stage 2 Warning. The warning will be broadcast by the MBC and Private Radios. Communication to the affected residents will be done by the Police Department by loudspeakers or other means.	The contents have been modified and moved to new C.5.1.2/5.1.3/5.1.6.	· The contents have been changed and moved to C.5.1.2/5.1.3/5.1.6 because the response of MMS/MPI/ NDRRMC is changed by the multiple triggers and voluntary evacuation.
C.5.2.3	The Police Department shall, when issuing Stage 2 Warning advise the residents to complete all preparations for an eventual evacuation and stand ready to vacate their houses once the order is issued. Arrangements should be made by the Ministry of Health and Quality of Life and the Police Department for the transfer to hospitals of disabled people who elect to do so. First Aid Service providers may be invited to extend their assistance.	The contents have been changed and moved to new C.5.1.7	· The response of the Police will be modified due to the introduction of self-evacuation and setting of triggers (several). Therefore, the contents will be moved from the existing C.5.1.7 and modified.
C.5.2.4	The NDOCC will also contact the Secretary to Cabinet and Head of the Civil Service or, in his absence, the Senior Chief Executive, Home Affairs, with a view to convening, at the earliest, a meeting of the Crisis Committee consisting of representatives of:	Moved to new C.5.2.5	· Moved from the existing C.5.2.5 due to the simplification of self-evacuation flow.

(i) Prime Minister's Office (ii) Ministry of Energy and Public Utilities (iii) Ministry of Social Integration and Economic Empowerment (iv) Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) (v) Ministry of Local Government and Outer Islands (vi) Police Department (vii) Meteorological Services (viii) Local Authorities The Crisis Committee will review the situation in the light of all available information pertaining to rainfall recording and ground displacement.		
C.5.2.5 The NDOCC will take appropriate measures to muster all available resources and equipment in order to assist in an eventual evacuation exercise and any salvage operation.	Moved to new C.5.1.8	· Moved from the existing C.5.1.8 due to the simplification of self-evacuation flow.
C.5.2.6 The Stage 2 Warning will also be communicated by the NDOCC to the following Ministries/Departments/Organizations and which will be responsible for the following: (a) Ministry of Health and Quality of Life: (i) to prepare special ward for any casualty that may arise out of an eventual evacuation; (ii) to provide an adequate number of medical and para-medical personnel intended to receive casualties; and (iii) to be ready to despatch Ambulances adequately staffed and equipped. (b) Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare (i) The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use. (c) *The Central Water Authority* will stand ready to close the shut-off valves on the pipes going through the region as soon as the evacuation order is issued. (d) *The Central Electricity Board* will be ready to switch off electricity supply in the affected area as and when instructed by the Crisis Committee or the most senior gazetted Police Officer. (i) The Central Electricity Board will ensure as far as possible that power cuts are restricted to the affected areas only so as to avoid unnecessary deprivation of electricity to unaffected areas. (e) *Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division)* will take readings of extensometers as frequently as may be appropriate to determine whether the ground displacement progresses beyond 1cm a day and ensure that the information is communicated to the NDOCC and the Meteorological Services. However, the Special Mobile Force will take readings of extensometers on hills and will communicate the information to the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) and the Meteorological Services.	Moved to new C.5.1.9	· Moved from the existing C.5.1.9 due to the simplification of self-evacuation flow.
C.5.2.7 The Fire Services and the Non-Governmental Organizations (Red Cross Society, St. John Ambulance etc.) will be informed by the NDOCC of the possibility of an evacuation order being issued and to enlist their assistance.		· Moved from the existing C.5.1.9 due to the simplification of self-evacuation flow.
	C.5.1.1 The Stage 1~~2~~ Warning will be triggered ~~on a further ground displacement of 1cm in 24 hours being recorded~~ *by one of the following conditions*: (i) The MMS observed rainfall R_{m1} mm/hour, or (ii) the MPI confirmed measurement of displacement E_1 mm/day, or (iii) Inhabitants confirmed the anomalies (cracks, subsidence, etc.), R_{i1} mm/hour rainfall	· The content has been modified and moved from the existing C.5.2.1 due to the recommendation of warning/evacuation flow with several triggers.
	C.5.1.2 The MMS will constantly monitor the amount of rainfall and will inform the NDRRMC as soon as the R_{m1} mm/hour rainfall is recorded. The LP/SMF will give warning to all inhabitants based on the information from NDRRMC.	· The response of MMS will be modified due to the introduction of self-evacuation and setting of trigger (several). Therefore the contents will be moved from the existing C.5.2.2 and modified.
	C.5.1.3 The MPI will monitor constantly ground movement and will inform it to the *NDRRMC* as soon as a displacement of E_1 *mm/day* is recorded or if visual displacement of ground is noted. *The LP/SMF will react according to C.5.1.7.* However, *under the situation of Cyclone/Torrential Rain which is described in the disaster scheme,* the Special Mobile Force will take readings of extensometers on hills and will communicate the information to the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) and the Meteorological Services.	· The response of MPI will be modified due to the introduction of self-evacuation and setting of trigger (several). Therefore the contents will be moved from the existing C.5.2.2 and modified. · The same content as on the left is stated in the existing C.5.2.6(e). Integrate response of MPI to simplify the content. Also, the content regarding support on reading/acquisition of extensometer data by SMF is moved.
	C.5.1.4 The inhabitants will inform the LP/SMF about anomalies/rainfall. The LP/SMF will check the situation and inform the NDRRMC. The LP/SMF, in collaboration with Local Authorities, will give warning to the inhabitants.	· Addition due to the introduction of self-evacuation and setting of trigger (several).
	C.5.1.5 Once ~~Stage I warning~~ *the above warning* is communicated by the Chairperson of the Coordinating Committee (PMO), to the MPI, the latter will communicate same to the NDRRMC and MMS. The NDRRMC will then inform the residents of the affected areas. The warning will also be communicated by the NDRRMC to the following Ministries and	· Moved from the existing C.5.1.3 due to the simplification of self-evacuation flow.

	Organizations which make up the Coordinating Committee:- ◆ Prime Minister's Office (Chairperson) ◆ Ministry of Energy and Public Utilities ◆ Ministry of Social Integration and Economic Empowerment ◆ Ministry of Local Government and Outer Islands ◆ Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) ◆ Ministry of Public Infrastructure and Land Transport (Land Transport & Shipping Division) ◆ Ministry of Public Infrastructure and Land Transport (NDU Division) ◆ Ministry of Social Ministry of Social Security, National Solidarity and Reform Institutions ◆ Ministry of Education and Human Resources ◆ Ministry of Environment and Sustainable Development ◆ Ministry of Tertiary Education, Science, Research and Technology ◆ Ministry of Health and Quality of Life ◆ Ministry of Gender Equality, Child Development and Family Welfare ◆ Meteorological Services ◆ Government Fire Services ◆ Central Water Authority ◆ Central Electricity Board ◆ Local Authorities ◆ University of Mauritius	
	C.5.1.6 The NDRRMC will inform the Chairperson of the Coordinating Committee who will convene a meeting for the issue of the Stage 1 Warning. The warning will be broadcast by the MBC and Private Radios. Communication to the affected residents will be done by the ~~Police Department~~ *LP/SMF* by loudspeakers or other means.	· Moved from existing C.5.2.2 due to the simplification of self-evacuation flow. Addition of warning order to the residents by the local police and SMF.
	C.5.1.7 The ~~Police Department~~ *LP/SMF* shall, when issuing Stage ~~2~~ 1 Warning advise the residents to complete all preparations for an eventual evacuation and stand ready to vacate their houses once the order is issued. Arrangements should be made by the Ministry of Health and Quality of Life and the ~~Police Department~~ *LP/SMF* for the transfer to hospitals of disabled people who elect to do so. First Aid Service providers may be invited to extend their assistance.	· Moved from the existing C.5.2.3 due to the simplification of self-evacuation flow.
	C.5.1.8 The NDRRMC will take appropriate measures to muster all available resources and equipment in order to assist in an eventual evacuation exercise and any salvage operation.	· Moved from the existing C.5.2.5 due to the simplification of self-evacuation flow.
	C.5.1.9 The Stage ~~2~~ 1 Warning will also be communicated by the NDRRMC to the following Ministries/Departments/Organizations and which will be responsible for the following: (a) Ministry of Health and Quality of Life: (i) to prepare special ward for any casualty that may arise out of an eventual evacuation; (ii) to provide an adequate number of medical and para-medical personnel intended to receive casualties; and (iii) to be ready to despatch Ambulances adequately staffed and equipped. (b) Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare (i) The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use. (c) *The Central Water Authority* will stand ready to close the shut-off valves on the pipes going through the region as soon as the evacuation order is issued. (d) *The Central Electricity Board* will be ready to switch off electricity supply in the affected area as and when instructed by the Crisis Committee or the most senior gazetted Police Officer. The Central (i) Electricity Board will ensure as far as possible that power cuts are restricted to the affected areas only so as to avoid unnecessary deprivation of electricity to unaffected areas. (e) *Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division)* will take readings of extensometers as frequently as may be appropriate to determine whether the ground displacement progresses beyond 1cm a day and ensure that the information is communicated to the NDRRMC and the Meteorological Services. However, the Special Mobile Force will take readings of extensometers on hills and will communicate the information to the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) and the Meteorological Services. (f) *The Fire Services and the Non-Governmental Organizations (Red Cross Society, St. John Ambulance etc.)* will be informed by the NDRRMC of the possibility of an evacuation order being issued and to enlist their assistance.	· Moved from the existing C.5.2.6 due to the simplification of self-evacuation flow. · To simplify the content, organize the content in (e) response of the MPI and integrate/transfer to new C.5.1.4.
C.5.3 Stage 3 – Evacuation Stage	C.5.2 Stage ~~3~~ 2– Evacuation Stage	· Modification due to the simplification of the flow (Stage 1 and 2 of the Disaster Scheme have been integrated, therefore Stage 3 is carried up to Stage 2)。
C.5.3.1 Stage 3 is reached when ground displacement is equal to or is greater than 2mm in an hour.		· The content has been modified and moved to new C.5.2.1 due to the simplification of the flow, setting of trigger (several) and introduction of self-evacuation by judgement of the site.
C. 5.3.2 As in the case of the two previous stages, the recording will be continually monitored by the Ministry of Public Infrastructure and Land Transport (Public		· The response of MPI, MMS, NDRRMC and other organizations will be modified due to the introduction of

	Infrastructure Division) and the data communicated to the NDOCC and the Meteorological Services. The NDOCC will then pass on the information to the Crisis Committee which will meet to approve the evacuation order. The evacuation order will be broadcast and/or communicated to the appropriate residents in the same manner as in Stage 2.		self-evacuation and setting of trigger (several). Therefore the contents have been modified and moved to new C.5.2.2, 5.2.3, 5.2.6.
C.5.3.3	If, on information being obtained from the Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) and the Meteorological Services, the NDOCC considers that an urgent and immediate evacuation is required and that there might not be enough time to convene the Crisis Committee, then the most senior gazetted officer present in Line Barracks will give the order for evacuation after consultation with the Chairperson of the Crisis Committee, if possible.		· The content has been modified and moved to new C.5.2.7 due to the setting of trigger (several) and introduction of self-evacuation.
C.5.3.4	As Stage 3 is reached and evacuation is in progress, the various Ministries/Departments/Organizations involved should actively set in motion arrangements for which they are responsible. In particular, the following measures should be implemented: (i) Ministry of Education and Human Resources and Ministry of Tertiary Education, Science, Research and Technology: Educational Institutions in affected areas should be closed. (ii) Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare: The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use. (iii) *Ministry of Health and Quality of Life*: Ambulances should be despatched on site for the conveyance of handicapped, old and sick people, and any casualty cases to hospital. Arrangements will also be made for Health Inspectors to visit regularly the refugee centres to ensure acceptable sanitary conditions there. (iv) *Central Water Authority*: The Central Water Authority will close the valves on the pipelines within the affected area and will arrange for water to be supplied regularly to the refugee centres. (v) *Central Electricity Board*: The Central Electricity Board will proceed with the interruption of the power supply in the affected areas. (vi) *Police Department* will cordon off the affected area and ensure the protection of property of the residents. An Incident Officer will be responsible and will have full authority for the control and coordination of the operation on site. Access to the cordoned off area will only be permitted by the Incident Officer.		· The content has been modified and moved to new C.5.2.8 due to the setting of trigger (several) and introduction of self-evacuation.
			•
		C.5.2.1 Stage ~~3~~ 2 is reached when ~~ground displacement is equal to or is greater than 2mm in an hour~~ *one of the following conditions prevails*. (i) the MMS has observed continuous rainfall Rm2 mm/hour or (ii) the MPI has confirmed measurement of displacement E2d mm/day or E2h,mm/hour or (iii) Inhabitants have confirmed heavy damage to their buildings, Ri2 mm/hour rainfall.	· Modification of the content moved from the existing C.5.3.1 due to the recommendation of the warning/evacuation system which may have several triggers.
		C.5.2.2 The MMS will monitor constantly amount of rainfall and will inform the NDRRMC as soon as continuous rainfall of R_{m2} mm/hour is recorded. The LP/SMF will give warning to all inhabitants based on the information from NDRRMC.	· The response of MMS will be modified due to the introduction of self-evacuation and setting of trigger (several). Therefore the contents will be moved from the existing C.5.3.2 and modified.
		C.5.2.3 The MPI will monitor constantly ground movement and will inform the NDRRMC as soon as a displacement E_{2d} mm/day or E_{2h} mm/hour is recorded or if visual displacement of ground is noted. This task will be performed by the LP/SMF in the situation of Cyclone/Torrential Rain which is described in the disaster scheme. The LP/SMF will give warning to the inhabitants based on the information from NDRRMC.	· The response of MMS will be modified due to the introduction of self-evacuation and setting of trigger (several). Therefore the contents will be moved from the existing C.5.3.2 and modified.
		C.5.2.4 The inhabitants will evacuate by themselves (voluntary evacuation) and will inform the LP/SMF when they notice heavy damage to their buildings or R_{i2} mm/hour rainfall. The LP/SMF will check the situation and inform the NDRRMC. The LP/SMF will give warning to all inhabitants.	· Addition of introduction on self-evacuation and trigger (several) set up.
		C.5.2.5 The NDRRMC will also contact the Secretary to Cabinet and Head of the Civil Service or, in his absence, the Senior Chief Executive, Home Affairs, with a view to convening, at the earliest, a meeting of the Crisis Committee consisting of representatives of: (i) Prime Minister's Office (ii) Ministry of Energy and Public Utilities (iii) Ministry of Social Integration and Economic Empowerment (iv) Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) (v) Ministry of Local Government and Outer Islands (vi) Police Department (i) Meteorological Services (ii) Local Authorities. The Crisis Committee will review the situation in the light of all available information pertaining to rainfall recording and ground displacement.	· Moved from existing C.5.2.4 due to the change and simplification of warning/evacuation flow.
		C.5.2.6 As in the case of the ~~two~~ previous stage~~s~~, the recording will be continually monitored by the *MMS and* the MPI and the data communicated to the NDRRMC*, the LP/SMF* and the MMS.	· Moved from existing C.5.3.2. Addition of warning order to the residents by the local police and SMF.

	The NDRRMC will then pass on the information to the Crisis Committee which will meet to approve the evacuation order. The evacuation order will be broadcast and/or communicated to the appropriate residents in the same manner as in Stage ~~2~~1.	
	C.5.2.7 If, on information being obtained from the MPI and the MMS, the NDRRMC considers that an urgent and immediate evacuation is required and that there might not be enough time to convene the Crisis Committee, then the most senior gazetted officer present in Line Barracks will give the order for evacuation after consultation with the Chairperson of the Crisis Committee, if possible.	· Moved from existing C.5.3.3 for simplification and overall review.
	C.5.2.8 As Stage ~~3~~2 is reached and evacuation is in progress, the various Ministries/Departments/Organizations involved should actively set in motion arrangements for which they are responsible. In particular, the following measures should be implemented: (i) Ministry of Education and Human Resources and Ministry of Tertiary Education, Science, Research and Technology: Educational Institutions in affected areas should be closed. (ii) Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare: The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use. (iii) *Ministry of Health and Quality of Life*: Ambulances should be despatched on site for the conveyance of handicapped, old and sick people, and any casualty cases to hospital. Arrangements will also be made for Health Inspectors to visit regularly the refugee centres to ensure acceptable sanitary conditions there. (iv) *Central Water Authority*: The Central Water Authority will close the valves on the pipelines within the affected area and will arrange for water to be supplied regularly to the refugee centres. (v) *Central Electricity Board*: The Central Electricity Board will proceed with the interruption of the power supply in the affected areas. (vi) *Police Department* will cordon off the affected area and ensure the protection of property of the residents. An Incident Officer will be responsible and will have full authority for the control and coordination of the operation on site. Access to the cordoned off area will only be permitted by the Incident Officer.	· Moved from existing C.5.3.4 for simplification and overall review.
C.5.4 Stage 4 – Emergency Stage	Moved to new C.5.4.	· The flow of the existing Disaster Scheme is shown below. Stage 1 (Preparatory Stage) Stage 2 (Warning Stage) Stage 3 (Evacuation Stage) Stage 4 (Emergency Stage) Stage 5 (Termination) · • The flow of the draft proposal is shown below. Stage 1 (Warning Stage) Stage 2 (Evacuation Stage) Stage 3 (Termination) · In the existing Disaster Scheme, Stage 4 is prescribed to issue the evacuation order, skipping Stages 1 and 2 during sudden torrential rain/cyclone. · From the point of understanding, the flow mentioned above is recommended in this project to ensure measures are taken promptly. · Considering simplicity following a disaster, Stage 4 (emergency measure during cyclone/torrential rain) of C.5.4 shall be separated from the base flow (1–3) as a special case. Therefore, transfer to the new C.5.4 will be recommended.
C.5.4.1 When there is sudden landslide and the Crisis Committee cannot for practical reasons be convened, the Emergency Warning is issued by the NDOCC after consultation with the Chairperson of the Crisis Committee, if possible. Action will be triggered off as provided for under Stage 3.		· Moved to new C.5.4.1 for the same reason as above.
C 5.4.2 Special Arrangements during Cyclone Warning/Torrential Rains Warning The prevalence of cyclonic conditions over and around Mauritius will entail the adoption of special arrangements with regard to the inhabitants of landslide-prone areas. The issue of a Cyclone Warning Class II or a Torrential Rain Warning may constitute for the inhabitants a Landslide Stage 2 Warning. Being given that the issue of a Cyclone Warning Class III entails the cessation of all normal activities, the inhabitants of the landslide-prone areas may be evacuated if there exist a strong likelihood of a Cyclone Warning Class III being issued and the possibility of landslide to occur. As soon as a Cyclone Warning II or a Torrential Rain Warning is issued by the Meteorological Services, the Crisis Committee will, in consultation with the Chairperson of the Coordinating Committee, convene a meeting to consider the advisability of issuing an evacuation order. Action as provided for in Stage 3 will be triggered off.		· Moved to new C.5.4.2 for the same reason as above.
C.5.5 Stage 5 – Termination	C.5.3 Stage ~~5~~ 3– Termination	· Simplification of the flow (modification of Stages 1 and 2 of the existing Disaster Scheme into Stage 1) and change in the stage number due to the transfer of Stage 4 in the existing Disaster Scheme.

C.5.5.1 A close monitoring and stocktaking exercise will be undertaken by relevant authorities after stabilization of ground movement has been noted. The all-clear signal will be given after a meeting of the Crisis Committee.	C.5.3.1 A close monitoring and stocktaking exercise will be undertaken by relevant authorities after stabilization of ground movement has been noted. *As in the case of the previous stages, the recording will be continually monitored by the MMS and the MPI and the data communicated to the NDRRMC. The NDRRMC will then pass on the information to the Crisis Committee*. The all-clear signal will be given after a meeting of the Crisis Committee when the following conditions have been reached. (i) Inhabitants have confirmed no new anomalies, or (ii) the MMS has observed no rainfall for three days or (iii) the MPI has confirmed measurement of displacement 0 mm a day The Local Authority/Police will inform the inhabitants of the termination of the evacuation stage.	· Transferring from the existing C.5.5.1, modification of the content to NDRRMC shall be in contact with the Crisis Committee on the consideration of evacuation order based on the information from residents, MMS and MPI
	C.5.4 ~~Stage 4 – Emergency Stage~~ *In Case of Sudden Landslide*	· Considering simplicity following a disaster, Stage 4 (emergency measure during cyclone/torrential rain) of the C.5.4 shall be separated from the base flow (1–3) as a special case. Therefore, transfer to the new C.5.4 will be recommended.
	C.5.4.1 When there is sudden landslide and the Crisis Committee cannot for practical reasons be convened, the Emergency Warning is issued by the NDRRMC after consultation with the Chairperson of the Crisis Committee, if possible. Action will be triggered off as provided for under Stage ~~3~~2.	· Moved/merged from existing C.5.4.1/ C.5.4.2 for the same reason as above.
	C.5.4.2 Special Arrangements during Cyclone Warning/Torrential Rains Warning The prevalence of cyclonic conditions over and around Mauritius will entail the adoption of special arrangements with regard to the inhabitants of landslide-prone areas. The issue of a Cyclone Warning Class II or a Torrential Rain Warning may constitute for the inhabitants a Landslide Stage 1 Warning. Given that the issue of a Cyclone Warning Class III entails the cessation of all normal activities, the inhabitants of the landslide-prone areas may be evacuated if there exists a strong likelihood of a Cyclone Warning Class III being issued and the possibility of landslide occurring. As soon as a Cyclone Warning II or a Torrential Rain Warning is issued by the MMS, the Crisis Committee will, in consultation with the Chairperson of the Coordinating Committee, convene a meeting to consider the advisability of issuing an evacuation order. Action as provided for in Stage 2 will be triggered off. It will be followed by the warning/evacuation system flow chart of the Landslide Stage 1/2 when the trigger reaches the designated threshold even though the Cyclone Warning I.	· Moved from existing C.5.4.2 for the same reason as above · There is no concrete instruction/procedure of evacuation in the Cyclone Emergency Scheme of the existing Disaster Scheme. · If inhabitants stay in their house during the cyclone to protect themselves from damage by strong wind, after that, if the cyclone brings not only strong wind but also heavy rain, the inhabitants will have lost the chance to evacuate. Therefore, evacuation in advance is needed.
C.6 Landslide Bulletins	No need to change	
C.6.1 Bulletins giving the intensity and estimated duration of the rain event will be issued at regular intervals by the Meteorological Services.	No need to change	
C.7 Distribution of Landslide Bulletins	No need to change	
C.7.1 Landslide information and warning stages are distributed through the MBC, the Press, the Private Radios, the telephone system including Mauritius Telecom Call Centre and the NDOCC.	No need to change	
C.7.2. The Meteorological Services is responsible for distribution of bulletins to: The Secretary to Cabinet and Head of the Civil Service, the Senior Chief Executive, Home Affairs The Ministry of Energy and Public Utilities The Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) The Ministry of Education and Human Resources The Ministry of Tertiary Education, Science, Research and Technology, the Ministry of Local Government and Outer Islands The NDOCC The Government Information Service, the Department of Civil Aviation The Government Fire Services, the Water Resources Unit, the MBC The Mauritius Telecom Call Centre (Telmet), the Mauritius Ports Authority The Airports of Mauritius Ltd, the Central Electricity Board, the Central Water Authority The Waste Water Management Authority, Airport of Rodrigues Ltd Private Radios	No need to change	
C7.3 MBC The MBC will, on receipt of the warning, arrange for immediate broadcast and for its rebroadcast at half hourly intervals.	No need to change	
C.7.4 Ministry of Information and Communication Technology and Mauritius Telecom The Ministry of Information and Communication Technology will explore the possibility with Mauritius Telecom and other Mobile Operators of informing the public in general through an SMS-based system of cyclone warnings/emergency measures to be taken in case of natural disasters or to target specifically parents of students through the e-Register system, in case of natural calamities.	No need to change	
C. 7.4.1 The Mauritius Telecom will arrange for the operation of the Telmet Service by which any telephone enquirer may listen to the recorded version of latest bulletin. The Mauritius Telecom will arrange with the Government Information Service to give wide publicity to the above facilities through the Radio, TV and Press.	No need to change	
C.7.5 Police The NDOCC is responsible for informing the following that a warning is in	No need to change	

force: (a) The President (b) The Prime Minister (c) The Deputy Prime Minister, Minister of Energy and Public Utilities (d) The Vice-Prime Minister, Minister of Finance and Economic Development (e) The Vice-Prime Minister of Public Infrastructure, National Development Unit, Land Transport and Shipping (f) The Minister of Social Integration and Economic Empowerment (g) The Permanent Secretary and the Director (Civil Engineering), Ministry of Public Infrastructure and Land Transport (Public Infrastructure Division) (h) The Permanent Secretary, Ministry of Public Infrastructure and Land Transport (Land Transport & Shipping Division) (i) The Permanent Secretary, Ministry of Public Infrastructure and Land Transport (NDU Division) (j) The Senior Chief Executive, Ministry of Education and Human Resources (k) The Permanent Secretary, Ministry of Tertiary Education, Science, Research and Technology (l) The Permanent Secretary, Ministry of Local Government and Outer Islands (m) The Commanding Officer, Special Mobile Force (n) The Divisional Police Headquarters which will inform Local Cyclone Commissioners, Chief Executive Officers of Municipalities and District Councils (o) The General Manager, Road Development Authority		
C.7.6 Ministry of Housing and Lands and Ministry of Social Integration and Economic Empowerment The Ministry of Housing and Lands will intervene immediately to identify sites in the affected areas for putting up temporary shelters for victims. The Ministry of Social Integration and Economic Empowerment will assist in the provision of temporary shelters to accommodate victims who have lost their houses during the landslides.	No need to change	

C.7.7 Mauritius Revenue Authority, Customs Department The MRA, Customs Department, will take necessary measures for the rapid release of relief consignments and any goods needed during a disaster.	No need to change	

Annex

LIST OF LANDSLIDE-PRONE REGIONS IN MAURITIUS

1.	PAMPLEMOUSSES/RIVIERE DU REMPART DISTRICT COUNCIL
	Temple Road, Crève Coeur
	Congomah Village Council (Ramlakhan, Leekraj, Frederick and Blackburn Lanes
	Les Mariannes Community Centre
	L'Eau Bouillie
2.	MUNCIPALITY OF PORT LOUIS
	Chitrakoot, Vallée des Prêtres
	Vallée Pitot (near Eidgah)
	Le Pouce Street
	Justice Street (near Kalimata Mandir)
	Morcellement Hermitage, Coromandel
	Mgr. Leen Street and nearby vicinity, La Butte
	Pouce Stream
	Old Moka Road, Camp Chapelon
	Montée S, GRNW
	Boulevard Victoria, Montagne Coupé
3.	BLACK RIVER DISTRICT COUNCIL
	Pailles : (i) access road to Les Guibies and along motorway, near flyover bridge; (ii) access road to Morcellement des Aloes from Avenue M. Leal (on hillside); and (iii) Soreze region Morcellement Hermitage, Coromandel. Plaine Champagne Road, opposite "Musée Touche Dubois" Chamarel, near Restaurant Le Chamarel Grande Rivière Noire Village Hall
4.	GRAND PORT/SAVANNE DISTRICT COUNCIL
	Baie du Cap : (i) Near St Francois d'Assise Church (ii) Macondé Region
	Rivière des Anguilles, near the bridge
	Quatre Sœurs, Marie Jeanne, Jhummah Street, Old Grand Port
	Bambous Virieux, Rajiv Gandhi Street (near Bhavany House), Impasse Bholoa
	L'Escalier – La Sourdine, near the bridge
5.	MUNICIPALITY OF CUREPIPE
	Trou-aux-Cerfs River Bank at Cité L'Oiseau (Rivière Sèche) Louis de Rochecouste (Rivière Eau Bleu) Pope Hennessy Avenue, Curepipe (River Morcellement Piat)
6.	MUNICIPALITY OF QUATRE BORNES
	Candos Hill at Lall Bahadoor Shastri and Mahatma Gandhi Avenues Cavernous Area at Mgr Leen Avenue and Bassin.

Annex A

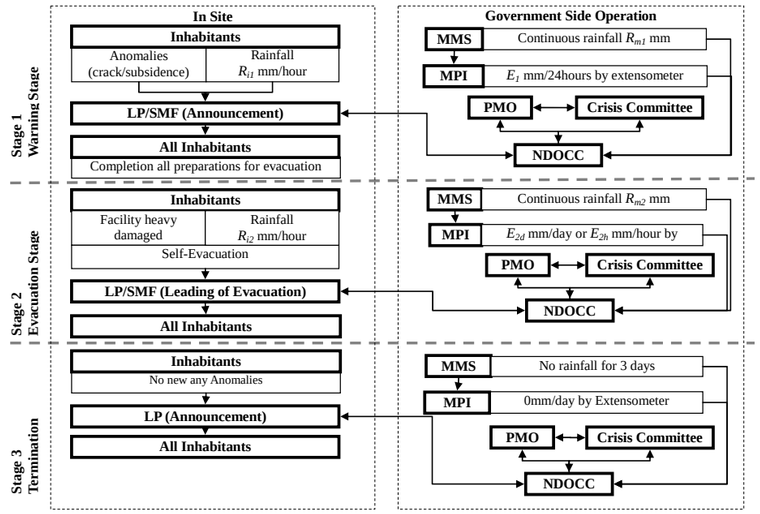
LIST OF LANDSLIDE-PRONE REGIONS IN MAURITIUS

No.	Area Name
Pamplemousses District Council	
1	Temple Road, Creve Coeur
2	Congomah Village Council (Ramlakhan)
3	Congomah Village Council (Leekraj)
4	Congomah Village Council (Frederick)
5	Congomah Village Council (Blackburn Lane)
6	Les Mariannes Community Centre (Road area)
7	Les Mariannes Community Centre (Resident area)
8	L'Eau Bouillie
Municipality of Port Louis	
9	Chitrakoot, Vallée des Prêtres
10	Vallée Pitot (near Eidgah)
11	Le Pouce Street
12	Justice Street (near Kalimata Mandir)
13	Mgr. Leen Street and nearby vicinity, La Butte
14	Pouce Stream
15	Old Moka Road, Camp Chapelon
16	Boulevard Victoria, Montagne Coupe
17	Pailles: (i) access road to Les Guibies and along motorway, near flyover bridge
18	Pailles: (ii) access road Morcellement des Aloes from Avenue M. Leal (on hillside)
19	Pailles: (iii) Soreze region
20	Montée S, GRNW
Black River District Council	
21	Plaine Champagne Road, opposie « Musee Touche Dubois »
22	Chamarel: (i) near Restaurant Le Chamarel
23	Chamarel: (ii) Roadside
24	Grande Rivière Noire Village Hall
Savanne District Council	
25	*Baie du Cap: (i) Near St Francois d'Assise Church*
26	*Baie du Cap: (ii) Maconde Region*
27	*Riviere des Anguilles, near the bridge*
Grand Port District Council	
28	Quatre Soeurs, Marie Jeanne, Jhummah Street, Old Grand Port
29	Bambous Virieux, Rajiv Gandhi Street (near *Bhowany* House), Impasse Bholoa
30	Cave in at Union Park, Rose Belle
Municipality of Curepipe	
31	Trou-aux-Cerfs
32	River Bank at Cite l'Oiseau
33	Louis de Rochecouste (Riviere Seche)
34	Piper Morcellement Piat
Municipality of Quatre Bornes	
35	Candos Hill at Lall Bahadoor Shastri and Mahatma Gandhi Avenues
36	Cavernous Area at Mgr. Leen Avenue and Bassin
Municipality of Beau Bassin/Rose Hill	
37	Morcellement Hermitage, Coromandel

- Some Local Authorities were separated by new Local Government Act 2011. They should be categorized based on the Act.
  - "Baie du Cap: (i) Near St Francois d'Assise Church" and "Baie du Cap: (ii) Maconde Region" should be categorized to "Savanne District Council"
  - "Riviere des Anguilles, near the bridge" should be categorized to "Savanne District Council"
- Modification of item No.29 (error in spelling).

Annex B

(Draft) Flow Chart of the warning/evacuation system



Area Name	Stage 1: Warning Stage			Stage 2: Evacuation Stage			
	R_{i1} (Rainfall [mm/hour] observed by inhabitants)	R_{m1} (Rainfall [mm/hour] observed by MMS)	E_1 (Displacement of ground [mm/day] observed by MPI)	R_{i2} (Rainfall [mm/hour] observed by inhabitants)	R_{m2} (Rainfall [mm/hour] observed by MMS)	E_{2d} (Displacement of ground [mm/day] observed by MPI)	E_{2h} (Displacement of ground [mm/hour] observed by MPI)
Chitrakoot	75			100			
Quatre Soeurs							
Vallée Pitot	75			100			
…							

MMS: Mauritius Meteorological Services
MPI: Ministry of Public Infrastructure and Land Transport
NDRRMC: National Disaster Risk Reduction and Management Centre
PMO: Prime Minister's Office
LP: Local Police
SMF: Special Mobile Force

- Addition of the flow chart of the proposed draft warning/evacuation system.

Education/dissemination of knowledge for disaster mitigation is proposed as a supplementary recommendation of the above main recommendation.

Even if the warning/evacuation system is developed, without the proper evacuation, it will possibly bring harm to the residents. A regular education/dissemination activity (training and education) will be required for the warning/evacuation system to be functional. For a proper warning/evacuation system to work, introduction of education/dissemination of disaster knowledge and disaster drills by local authorities will be required.

<Knowledge dissemination/education for disaster mitigation>

Dissemination of disaster mitigation knowledge, and publicity activities to promote knowledge during a disaster, relating to a warning/evacuation system, should be implemented.

- Medium/method: Consider which dissemination/education mediums/methods are easiest for residents to utilize such as distribution of a poster, leaflet, Disaster Map; publication on television, radio, newspaper, internet, bulletin board; or through a community gathering.
- Contents: Once the communication methods/routes to disseminate information related to the disaster have been decided, provide information on evacuation place and route; information on warning and evacuation (preparation/warning/steps); and other information such as anomalies of the landslide disaster, emergency contact address, disaster records, points to remember upon evacuation, etc.

Early implementation of disaster prevention education is required, not only for general residents, but also for school students who will take up the role of community disaster preparedness for the next generation. Also, incorporation of the disaster prevention/mitigation into the school curriculum and disaster drill will be required.

- If there is education on disaster prevention in school, dissemination of that knowledge from the children to adults through family communication can be expected. As a result, education on disaster prevention for children will lead to improvement of the whole region.
- Also, education on disaster prevention in school will contribute to sustainable regional development in the future. This can be assumed because the children will take the role of the development for the next generation.

<Disaster drill>

MPI will conduct periodical disaster drills with community participation/involvement (including enhancement of awareness, confirmation of the warning/evacuation system) along with the cooperation of local authorities, Police, NDRRMC and related organizations in the Warning Zone.

- Using residents' participation as the base, MPI will cooperate with NDRRMC /Police Department who have disaster drill experience, and coordinate with the Special Mobile Force, local authorities and related organizations to implement the drills.
- Periodical disaster drill implementation will take place with community participation/involvement (including enhancement of awareness, confirmation of the warning/evacuation system)
- Disaster drills will be implemented based on previous disaster experience and the

situation in a particular region, and incorporate a drilling menu confirming the warning/evacuation procedure and system. Also, issues brought up during drilling training will be promptly considered.

- Regular drills will be held every year before rainy season.
- Drills will be conducted effectively (including during holidays/night-time).
- Assistance for people in need during the disaster will be required.
- Drills will include provision of information on the disaster, issue of evacuation notice, opening of shelter, evacuation of residents, and assistance for people in need during the disaster. A drill assuming an actual slope disaster will be included.

The following table shows the record of the meeting, discussion and workshop for the above recommendation. The recommendation was compiled based on the result of the meeting.

Table 3.9.4 Record of the Meeting/Workshop regarding the Recommendation (source: JET)

No.	Date	Meeting partner	Content
1	18 Jul 2012	Natural Disaster Operation Coordination Center (chief police inspector, police sergeant)	Explanation of aim, Information collection regarding the landslide disaster risk management by the Disaster Scheme
2	8 Mar 2013	Natural Disaster Operation Coordination Center (chief police inspector, police sergeant)	Explanation of aim, Information collection about the existing situation regarding the Disaster Scheme
3	7 Jun 2013	MPI (acting director of civil engineering section, engineer x 2)	Explanation about the draft recommendation for the Disaster Scheme, and its discussion
4	11,12,13 Jun 2013	MPI (acting director of civil engineering section, engineer x 2)	Discussion about the draft recommendation for the Disaster Scheme
5	18 Jun 2013	MPI (acting director of civil engineering section, engineer x 5)	Discussion about the draft recommendation for the Disaster Scheme
6	21 Jun 2013	MPI (acting director of civil engineering section, engineer x 5)	Discussion about the draft recommendation for the Disaster Scheme
7	24 Jun 2013	Special Mobile Force (chief inspector, inspector)	Explanation of aim, Information collection about the existing situation regarding the Disaster Scheme, Explanation/discussion about the draft recommendation for the Disaster Scheme
8	24 Jun 2013	Natural Disaster Operation Coordination Center (chief police inspector, police sergeant)	Sharing the existing situation and issues regarding the Disaster Scheme, Explanation/discussion about the draft recommendation for the Disaster Scheme
9	26 Jun 2013	Mauritius Meteorological Services (director)	Explanation of aim, Explanation/discussion about the draft recommendation for the Disaster Scheme
10	28 Jun 2013	The City Council of Port Louis (head of infrastructure department, assistant chief executive officer, chief building inspector)	Explanation/discussion about the draft recommendation for the Disaster Scheme
11	28 June 2013	Prime Minister's Office (adviser for disaster management)	Explanation of aim, Information collection about the organizational structure of disaster risk management in Mauritius, Explanation/ discussion about the draft recommendation for the Disaster Scheme
12	1 Jul 2013	District Council of Grand Port (chief executive officer, assistant chief executive officer, head of infrastructure department, assistant building inspector)	Explanation/discussion about the draft recommendation for the Disaster Scheme
13	1 Jul 2013	MPI (director of civil engineering section , acting director of civil engineering section, engineer)	Explanation/discussion about the draft recommendation for the Disaster Scheme
14	2 Jul 2013	District Council of Grand Port (head planning department, planning inspector, acting .senior building inspector, assistant building inspector, planning assistant)	Explanation/discussion about the draft recommendation for the Disaster Scheme
15	5 Jul 2013	District Council of Grand Port (head of infrastructure department, head planning department)	Explanation/discussion about the draft recommendation for the Disaster Scheme
16	5 Jul 2013	The City Council of Port Louis (head of infrastructure department, head planning department)	Explanation/discussion about the draft recommendation for the Disaster Scheme
17	5 Jul 2013	Police Department (commissioner of police, commanding officer of special mobile force, deputy commissioner of police operation, superintendent, chief police inspector of NDOCC)	Explanation/discussion about the draft recommendation for the Disaster Scheme
18	10 Jul 2013	MPI (acting director of civil engineering section, senior engineer x5)	Explanation/discussion about the draft recommendation (final version) for the Disaster Scheme

*The other meetings were implemented to respond to questions and answers from stakeholders

A recommendation for the disaster scheme was compiled based on the above meeting/workshop results and coordination with stakeholders. The points to remember for the recommendations obtained from the coordination are shown in the following table.

Table 3.9.5 Points to Remember for the Recommendations (source: JET)

No.	Points to remember for the recommendations	Contents
1	The basic stance of the Disaster Scheme	· The Disaster Scheme shows the general/basic policy and concept. · The system flow of the Disaster Scheme shows a model (example). · The appropriate system flow for each specific site will be developed by utilizing the system flow in the Disaster Scheme. · The system/flow should be examined based on consideration of topographical features, geology, timing of the disaster occurrence, social circumstances, etc. · Residents and related ministries/agencies/local authorities need to check the system/flow works properly for disaster mitigation through drills and education/dissemination.
2	Education/consensus building with inhabitants	· Education/consensus building with inhabitants will be required in order to develop appropriate warning/evacuation systems, and to avoid conflict. · The limitation/pros-cons of the system should be shared with inhabitants.
3	Organizational and institutional formation	· The consideration of role/scope of work by LMU will be required. How can the LMU manage the 37 landslide prone areas with limited human resources and budget? · LMU needs capacity such as human resources, full time technical officers, budget, etc. · Or, a new structure/establishment of landslide risk management organization is needed. · The involvement of the administration side of MPI will be needed. · The capacity development of the LMU will be required. And the dispatch of the landslide experts will also be needed.
4	Difficulty of the response due to limited human resources/systems and budget	· Concentration of the responsible areas “all over the island” into a “List of Landslide-Prone Regions” · LMU will consider all over the island, but LMU will concentrate the List of Landslide-Prone Regions to develop warning/evacuation systems for specific sites.
5	MPI’s scope of work in the Disaster Scheme	· The existing Disaster Scheme is an instruction manual for landslide emergency response. · The manual shows especially the procedure/flow for warning/evacuation. · The trigger is necessary for activation of the warning/evacuation procedure and flow. · It is considered that LMU/MPI would focus on the activation of the trigger in the current situation. · The human resources, budget and capacity will be needed for “Management”. · It is better to focus on “Monitoring” in the current situation. · Involvement of the administration side of MPI. · LMU will provide the monitoring data to the Crisis Committee as one part of the information for decision making prior to the issue of a warning/evacuation order.
6	The definition of monitoring in the Disaster Scheme	· Landslide monitoring includes regular measurement of ground displacement and on-site visual checks. These will be conducted under the instruction of a Landslide Expert Team.
7	The name of subject area for the warning/evacuation system	· It’s better to use the expression “Landslide Prone Regions” from the viewpoint of this being easy for the general public to understand as in the past, and to avoid confusion.

8	Role of Local Authorities	· Local Authorities are willing to contribute to landslide disaster mitigation by providing information to the relevant ministries/agencies and updating the list of landslide-prone regions in the Disaster Scheme.
9	The involvement of the MMS	· MMS can send rainfall data to the relevant ministries/agencies during the emergency situation. However, for data provision, equipment (such as automatic rain gauges) will be required. · If MMS has the equipment, MMS will be able to add this to its observation network, and will be able to provide real-time data. · The installation location of the equipment will be considered from viewpoint of appropriate meteorological observation (not only for landslide, but also cyclone, flood, etc.)
10	The involvement of ocal Police and Special Mobile Force	· Local Police and SMF can give warning to all inhabitants based on the information from NDOCC. · Under the situation of a Cyclone/Torrential rain, the SMF takes readings of extensometers and will communicate the information to the MPI and the Meteorological Services. · The Police Department will be able to receive training to take extensometer data.
11	Actual handling of the monitoring	· There are various methods to measure the ground displacement such as extensometer (manual/automatic), simple crack gauge by pegboard, etc. · The monitoring plan will be made following consultation with related ministries/agencies/local authorities and experts based on the consideration of landslide features, social circumstances and other concerns.
12	Warning/evacuation system during the cyclone emergency situation	· There is no concrete instruction/procedure for evacuation in the Cyclone Emergency Scheme of the existing Disaster Scheme. · If inhabitants stay in their house during the cyclone to protect themselves from damage by strong wind, and after that the cyclone brings not only strong winds but also heavy rain, the inhabitants will lose the chance to evacuate. · Therefore, evacuation in advance will be needed.
13	Response in the normal situation and during the emergency situation	· The point of the warning/evacuation system is to trigger activation of the system flow. · The trigger is based on monitoring information provided, for example, by the extensometer. · The warning/evacuation flow will be utilized, whether or not the situation is normal/emergency. · (Once, the trigger is activated, the inhabitants, Police and relevant ministries/agencies will take the prescribed response. They will just wait for the information about the trigger.)
14	The list of the Landslide-Prone Regions	· The list covered the current condition of all sites. Further response/measures will be required. · The necessity to screen/update the list should be considered. (In the case of updating/screening, proof of non-landslide, prioritization and other considerations will be required.)
15	Further work	· The continuous review of the Disaster Scheme through meeting/discussion with stakeholders (such as regular meetings/committee-style) will be required.

3.10 Review and Recommendations for the Planning Policy Guidance

In this section, recommendations for Planning Policy Guidance (PPG) are examined through the clarification of legal system issues for landslide disaster risk management (LDRM: Landslide Disaster Risk Management) and consideration of the solution for the issues based on the review of the existing Mauritian legal systems/schemes about LDRM, analysis of the present situation concerning the landslide prone area and review of Japanese legal systems. The process of making the recommendation is shown in the following figure.

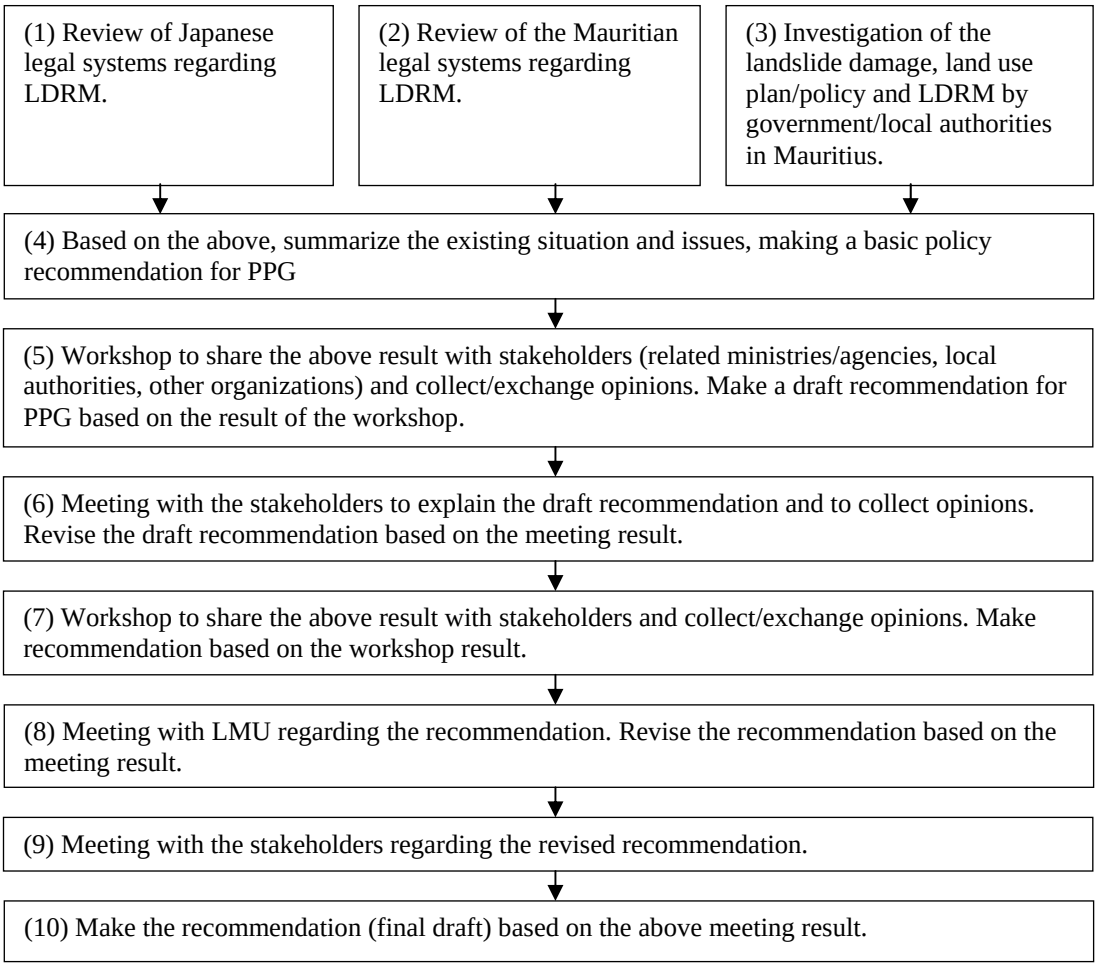


Figure 3.10.1 Process for Making Recommendation for PPG (source: JET)

3.10.1 Review of Japanese Legal Systems for Landslide Countermeasures

There are four main Acts for countermeasure of landslide damage in Japan:

(a) Sabo Act; Erosion Control Act (legislation 1887)
(b) Landslide Prevention Act (legislation 1958)
(c) Act for Prevention of Disasters Due to Collapse of Steep Slopes (legislation 1969)
(d) Landslide Disasters Prevention Act (legislation 2000)

The Disaster Measures Basic Law, Building Standards Act and City Planning Act etc. are also related Acts.

The following figure shows the relationship and positioning of the above main four Acts. These Acts can be divided into two parts covering physical and non-physical countermeasures.

Countermeasures such as erosion control works, landslide prevention works and steep slope collapse prevention work are implemented under the Sabo Act, Landslide Prevention Act and Act for Prevention of Disasters Due to Collapse of Steep Slopes.

On the other hand, disaster prevention and evacuation (landslide disaster hazard map, capacity development/improvement of evacuation system/structure and information system for landslide disaster etc.) and the development/building control (restrictions of work such as cutting/filling/banking land, building structure control/restriction, restriction of specific development activity) are covered by the Landslide Disasters Prevention Act.

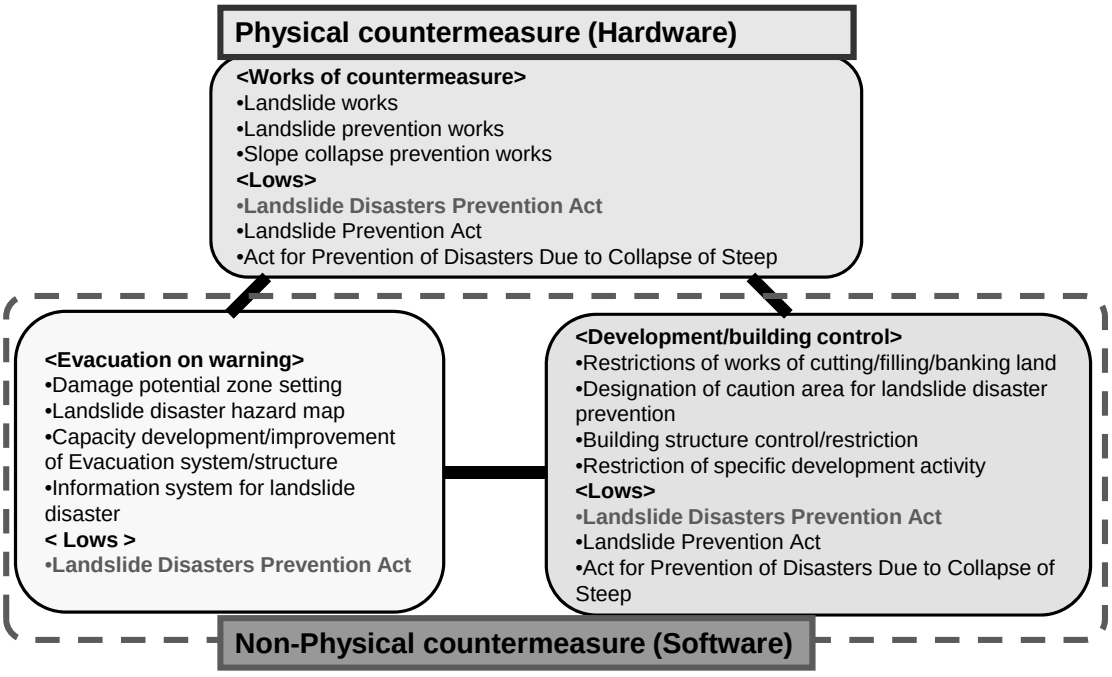


Figure 3.10.2 Japanese Legal Systems for Landslide Countermeasures[21]

A Summary of each Act is shown below.

a. Sabo Act; Erosion Control Act (legislation 1887)

This Act aims to conserve national land by prevention of sediment discharge and mountainous land deterioration. An Erosion Control Area of this Act is land for construction of dams and facilities which can prevent debris flow, slope failure and landslide and it is a restriction zone covering specific actions designated by the Minister of Land, Infrastructure, Transport and Tourism. The permission of the prefectural governor is needed for the following actions in an Erosion Control Area.

- Construction, reconstruction, relocation or removal of facilities/structures.
- Cutting of trees/bamboo or carrying by dragging.
- Excavation of land, reclamation, embankment and other change of land form.
- Removing/piling up/dumping of sand or gravel.
- Removing/piling up/dumping of mineral substances.
- Digging/removing of turf grass.
- Incinerating.

b. Landslide Prevention Act (legislation 1958)

This Act aims to prevent landslides and spoil bank collapse (dumping site of waste soil through mining of coal and brown coal). The Landslide Prevention Area of this Act is a restriction zone for specific actions designated by the Minister of Land, Infrastructure, Transport and Tourism to prevent the inducement/triggering of landslides in landslide risk zones and surrounds. The permission of the prefectural governor is needed for the following actions in a Landslide Prevention Area:

- Inducing/obstructing outflow or causing stagnation of groundwater and such acts that cause increased levels, inhibiting the function of groundwater drainage facilities and other inhibition of groundwater drainage.
- Discharging (from a dam etc.)/causing to stagnate and forced infiltration into ground of surface water.
- cutting a slope of three meters or more and cut earth height of two meters or more, and
- Constructing new or reconstructing facilities/structures except for landslide prevention facilities (drainage facilities, retaining walls, dams and other landslide prevention facilities) in the Landslide Prevention Area.

c. Act for Prevention of Disasters Due to Collapse of Steep Slopes (legislation 1969)

This Act aims to prevent acts that trigger/aid in the collapse of steep slopes. A Danger Area of Steep Slope Collapse is restriction area for specific actions designated by the prefectural governor because there is a risk to a steep slope site (the slope angle is over 30%). And, there are standards for the designation: 1) height of the steep slope is five meters or more, 2) there are five or more buildings which have a risk of damage by steep slope collapse, and 3) public agencies, facilities, schools, hospitals, accommodation facilities etc. are present, even though less than five buildings. The permission of the prefectural governor is needed for the following actions in the Danger Area of Steep Slope Collapse.

- Water discharge, stagnation of surface water and other induction of surface water percolation.
- Installation/reconstruction of facilities/structures except for a small reservoir, canal or other facilities for steep slope collapse prevention.

- Cutting of slope and earth, digging or embankment.
- Cutting of trees/bamboo.
- Carrying trees/bamboo by dragging.
- Removing/piling up soil and stones.
- Besides the above, triggering/inducing steep slope collapse designated by government decree.

d. Landslide Disasters Prevention Act (legislation 2000)

The Sabo Act (Erosion Control Act) aims to restrict/prohibit the specific actions in the Erosion Control Area and to establish/install the erosion control facilities/structures. The Landslide Prevention Act aims to implement the erosion control works and to restrict/prohibit the specific actions in the Landslide Prevention Area. Act for Prevention of Disasters Due to Collapse of Steep Slopes aims to implement works to prevent the collapse of steep slopes and to restrict/prohibit specific actions in steep slope collapse danger areas. These three Acts focus on “physical” countermeasures aimed at the “original source” of a disaster. On the other hand, the Landslide Disasters Prevention Act focuses on “non-physical” countermeasures for “risk areas (preserving such things as residences, roads etc.)” as listed below:

- Publicity of landslide disaster potential area
- Development of warning/evacuation system
- Restriction of specific development activity
- Building structure control/restriction
- Relocation order by government

The following figure shows the concepts for non-physical countermeasure implementation covered by the Landslide Disasters Prevention Act.

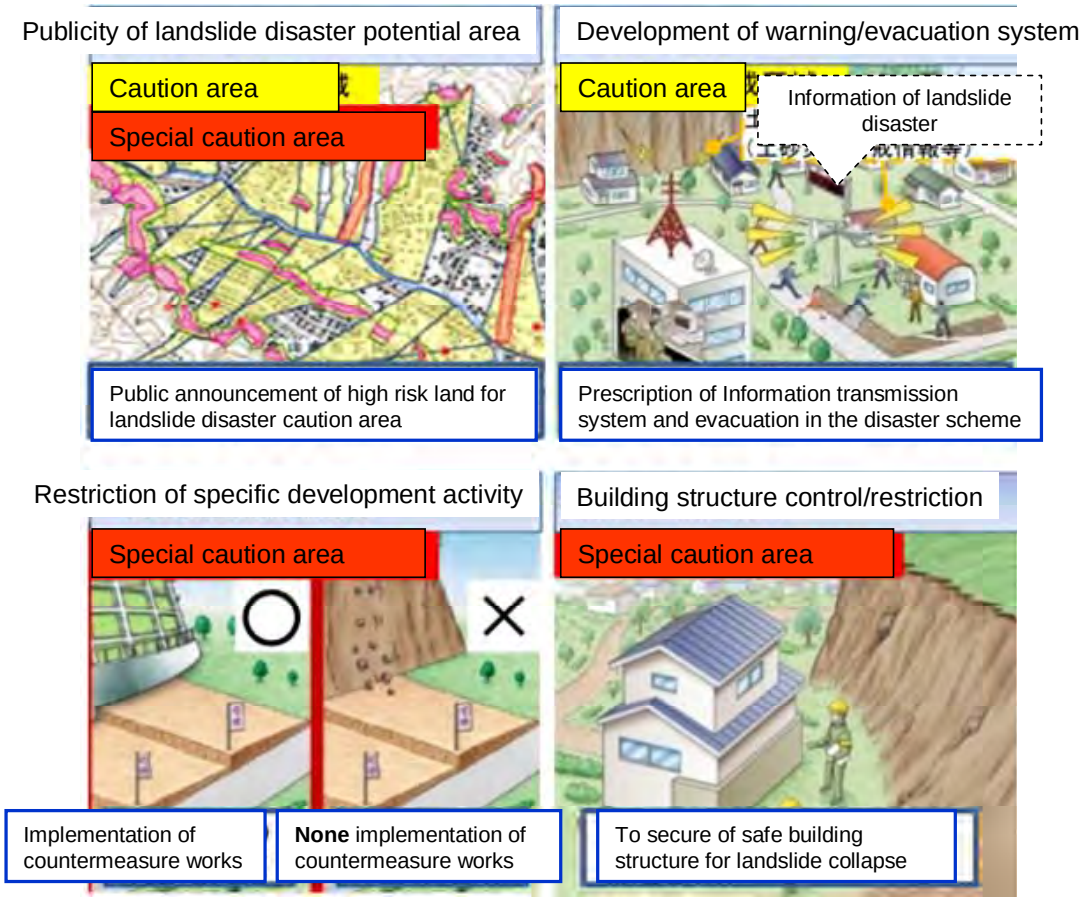


Figure 3.10.3 Conceptual Image of Non-Physical Countermeasure Implementation by the Landslide Disasters Prevention Act[21]

The following figure and table show the summary of the Landslide Disasters Prevention Act.

Table 3.10.1 Summary of the Landslide Disasters Prevention Act[21]

Item	Summary
Basic survey	A basic survey is conducted to confirm the topography, geology, precipitation and land use etc. of the landslide risk area.
Designation of caution zone for landslide disaster	<Caution Zone> The zone which poses a danger to the lives/bodies of the residents when a landslide disaster occurs. <Special Caution Zone> The zone which poses a danger to the lives/bodies of the residents and building damage when a landslide disaster occurs in the Caution Zone.
Development of warning/evacuation system	• If there is the designated caution zone, the contents of a warning/evacuation system are developed to fit within the regional disaster of prevention plan of the municipality. • If there is a welfare/health/medical care facility in the designated caution zone, a communication system/structure is planned. • The mayor of a municipality in the designated caution zone makes and disseminates a hazard map.
Restriction of specific development activity	Development of residential or welfare/health/medical care facilities in the Special Caution Zone shall require permission from the prefectural governor in advance.
Building structure control/restriction	A building which has a living room in the Special Caution Zone shall receive confirmation to secure the safety of the building structure from the shock/impact of soil and stones, etc. under the Building Standards Act.
Support of residence relocation	The government and prefectures shall endeavor to secure financial arrangements for building relocation.

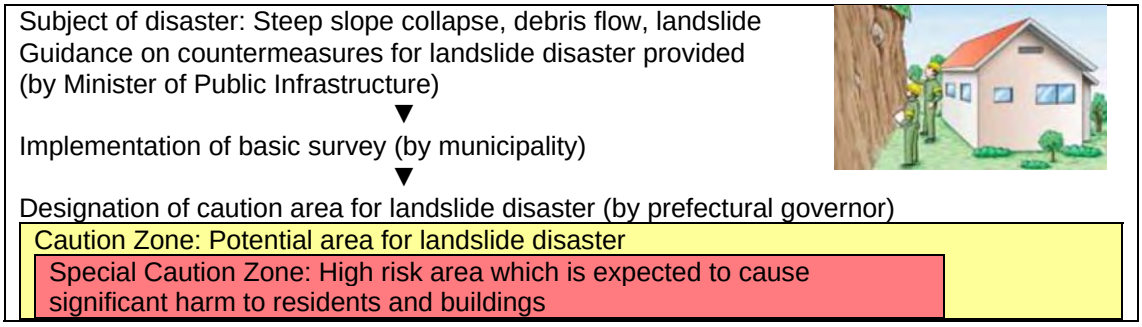


Figure 3.10.4 Summary of the Landslide Disasters Prevention Act[21]

e. Related Acts regarding Landslide Disaster Prevention

The following table shows the names of other Acts and contents relating to landslide disaster prevention. It doesn't include the above four Acts (Sabo Act; Erosion control Act, Landslide Prevention Act, Act for Prevention of Disasters Due to Collapse of Steep Slopes and Landslide Disasters Prevention Act).

Table 3.10.2 Related Acts regarding Landslide Disaster Prevention (source:JET)

Name	Contents related with landslide disaster prevention
Disaster Countermeasure Basic Act	・ Responsibilities of municipalities ・ Disaster prevention council of municipality ・ Regional disaster prevention plan of municipality ・ Precaution/alert system by municipality mayor ・ Proactive steps by municipality mayor ・ Evacuation instructions by municipality mayor ・ Rights for designation of caution zone by municipality mayor
Building Standards Act	・ Building certification ・ Health and safety: Appropriate countermeasures such as construction of retaining walls should be taken to avoid landslide disaster damage ・ Standards of structural strength ・ Disaster dangerous zone ・ Addition of restriction by municipal ordinance
Act on Regulation of Residential Land Development	・ Restriction zone for housing land development ・ Permission for housing land development ・ Disaster prevention obligations for housing land development ・ Order for improvement
Housing Loan Corporation Act	・ Provision of loans to persons who relocate their own buildings
City Planning Act	・ Permission for development ・ Standards for development permission
Building Lots and Buildings Transaction Business Act	・ Explanation of important matters in the agreement
National Government Defrayment Act for Reconstruction of Disaster Stricken Public Facilities	・ Regulation of cost burden to government, including what can be taken on by national government dependant on the financial capability of local authorities to cover costs for disaster recovery of public infrastructure ・ Public infrastructure facilities include: rivers, coast, erosion control, restoration of degraded forest land, landslide prevention, steep slope collapse prevention, roads, ports, fishery ports, sewerage, parks.

3.10.2 The existing Legal Systems/schemes for LDRM in Mauritius

The following table shows the existing legal systems/schemes for LDRM in Mauritius that relate to land use policy and urban/regional planning.

Table 3.10.3 The Existing Mauritian Legal Systems/Schemes for LDRM (source:JET)

Legal system/scheme	Content
Town and Country Planning Act (TCPA), 1954	・ Town and Country Planning Act (TCPA) make provisions for social appeals about development restrictions/regulations to Local Authorities. ・ Local Authorities make Outline Planning Schemes (OPS) which contain the actual development area/boundary and its contents. The developer has to submit an application to the Local Authority about the development including information such as building/construction works, changes of the land/building use, subdivision of a land lot. ・ Local Authorities have the right to stop a development which does not follow the OPS and other related legal systems/schemes.
Planning and Development Act (PDA), 2004	・ The Planning and Development Act (PDA) is a new and modern piece of legislation enacted to bring the planning exercise more in line with the requirements of today's changes and challenges (globalization, structural changes in the economy, the need to provide for new sectors of activities). ・ It gives legal status to the National Development Strategy which had remained as a vision document only. ・ However, only a few sections of the PDA 2004 have been proclaimed to date. ・ The objectives of PDA: Sustainable development considering ecological systems; to provide for the appropriate sharing of responsibility for planning and development between the different levels of government; to establish appropriate institutions, structures and processes to achieve effective planning and development; to encourage appropriate private sector participation in planning and development, etc. ・ The Minister of the Ministry of Housing and Lands (MHL) is able to issue Planning Policy Guidance (PPG) regarding development and land use planning to the Local Authorities based on this Act (Article 13 of PDA).
Building Act (BA)	・ Application for a building permits (including new construction, extension or reconstruction); responsibilities around dangerous building and legal proceedings are defined by this Act.
Local Government Act (LGA), 2003	・ The Local Government Act (LGA) is very closely related to the Local Authorities' jurisdiction over development plans. In particular, it covers decentralization, appropriate financial and administrative operation, procedures for development permission, property taxation etc. ・ The LGA also contains the powers and functions of the Permits and Licences Committee, applications for permits, examination of applications for permits and licences by the committee, application to Judge in Chambers, etc.
National Development Strategy (NDS), 2005	・ National Development Strategy (NDS) aims to adopt strategic guidance for the economic infrastructure development of government and local authorities with the goal of achieving development in a planned manner. ・ NDS is made up of two volumes: Volume 1, National Development Strategy & Policies, and Volume 2, Institutional and Legislative Aspects. ・ Volume 1 contains the introduction, context, vision and key development principles, core strategy for conurbation, countryside and coast, housing, social and community facilities, industry and commerce, tourism, agriculture, forestry, natural resources, environment and fisheries, transport, physical infrastructure. In the contents of the core strategy for conurbation, countryside and coast, the PPG is defined as a translated national strategy, namely, made easier to understand, for Local Authorities to actually achieve NDS implementation. ➢ Guidance notes are intended for use by officers involved in development control activities at central and local levels. ➢ It is expected that PPG will be an important element in preparing Local Councils' revised Local Plans and Action Area Plans by translating the NDS policies and principles for application at the local level. ➢ To provide this bridge between policy and implementation, a series of

	PPG notes has been prepared consistent with the NDS and policies and relevant Local Development Plans (Outline Planning Schemes) as revised.
Planning Policy Guidance (PPG), 2004	・ PPG is a scheme which has legal binding force for land use policy/planning and can contribute to LDRM in Mauritius. ・ The objective is to create a set of performance criteria and design standards that are applicable to most forms and scales of development for use by individual site owners, developers of large schemes, and assist Government and Local Authorities when considering permit applications. ・ This guidance should be considered with the NDS, Outline Planning Schemes/Local Plans, Action Area Plans and Subject Plans. ・ PPG was established in 2004 and it is revised for commercial development, cultural landscape, place of worship, industrial commercial development and small firms, urban heritage areas, radio telecommunication equipment, hotel/resort development and petrol filling stations, etc. ・ PPG has a total of six hundred pages composed of A) introduction and design principles, B) design sheets and C) technical sheets. The design sheets contain commercial development, hotels and resort development, industrial development and residential development. The section on residential development covers design for sloping sites. The design for sloping sites has the following design standards: ➢ Development will not normally be permitted on slopes steeper than 1:5 (20%). ➢ Above slopes of 1:10 (10%), and in areas of poor load-bearing capacity, the ground conditions should be checked and proposed structures certified by a qualified engineer. A Site Constraint Analysis and written statement detailing all proposed mitigation measures should be submitted to and approved by the Permit Authority prior to the commencement of any on-site works. ➢ As a general guide, development should not be any higher than 45 meters above the mountain base or, in the case of slopes facing the sea, 45 meters above Mean Sea Level.
Outline Planning Schemes (OPS)	Outline Planning Schemes (OPS) were legally established based on the TCPA. They are planned for each Local Authority. OPS have three functions: ・ To provide guidance to scheme promoters, developers and individuals contemplating a development project and the subsequent submission of a building and land use permit application; ・ To assist Government officers at Ministry and Local Authority levels when offering advice to developers and when subsequently assessing permit applications; and ・ To provide the physical development focus for programmes and projects for the variety of Ministries and agencies, as well as the private and non-governmental sectors which have an interest in land development. The Outline Planning Schemes are in two parts: ➢ The Text section which includes: ✧ the Development Context for the Scheme which outlines key development trends, constraints, issues and objectives, and ✧ the Policies and Proposals, which are written in bold, followed by their reasoned justification. The policies are grouped together according to particular subject matter or by land use type. ➢ The Map section which includes: ✧ the Development Strategy Map, covering major proposals for the whole of the District, and ✧ the Development Management Map, which shows settlements and zones where development is likely to be permitted and other areas where there are various constraints to development.
The Building and Land Use Permit Guide (BLUPG)	・ The Building and Land Use Permit Guide (BLUPG) explains how to prepare, submit and process an application. ・ BLUPG provides a simple, step by step guide for applicants, persons involved in preparation of plans, officers of Local Authorities, and for the public at large. ・ BLUPG can be used as a checklist for completing plans and other supporting documentation. ・ BLUPG includes the simplified contents of TCPA, PDA, BA, LGA, PPG and OPS.

The following figure shows the relationship between the above Acts and schemes. PPG is made based on NDS. Based on the PPG, OPS are made as a development plan which contains the specific contents of development for each Local Authority. PPG and OPS contain the development/building restrictions and regulations based on TCPA, PDA, BA and LGA.

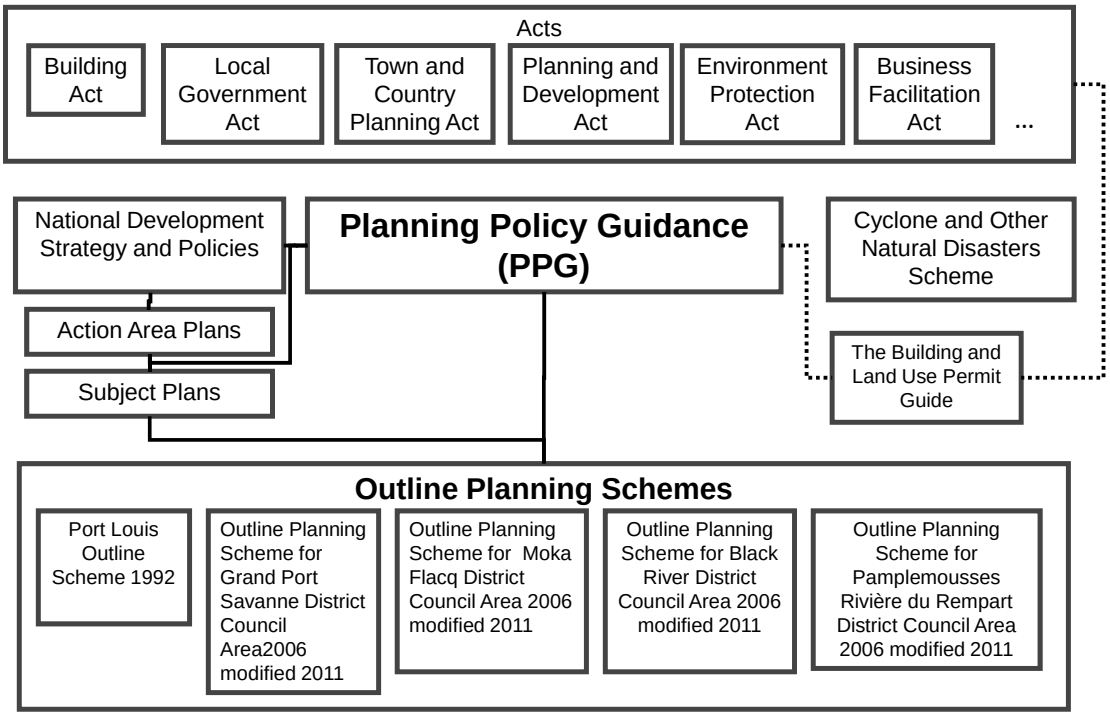


Figure 3.10.5 Acts and Schemes related with PPG (source:JET)

3.10.3 Existing Situation of Landslide Prone Areas in Mauritius

There is a list of landslide prone areas in the Cyclone and Other Natural Disasters Scheme[22]. The list includes La Butte which has already had landslide countermeasure works implemented, Chitrakoot which has had a landslide disaster risk from a long time before development, Quatre Soeurs which has landslide damage due to inadequate construction works in a slope area, and Vallée Pitot which is suffering from suburban sprawl due to high development pressure.

The landslide disaster issues from the viewpoint of land use/urban planning are categorized as follows:

(a) Emerging landslide risk in an existing developed area (example: Chitrakoot).
(b) Disaster damage due to inadequate construction works in a slope area (example: Quatre Soeurs).
(c) Sprawl in the slope area of a suburb which is under the pressure of development (example: Vallée Pitot).

The following reports the existing situation and analysis results from the viewpoint of land use/urban planning for each categorized issue.

a. Emerging Landslide Risk in the Existing Developed Area (example: Chitrakoot)

A clear landslide landform is confirmed in Chitrakoot. It was formed in prehistoric times. The activity of the landslide is not high, but the landslide was activated in torrential rain of March 2005 and damaged 54 houses. The government tried to relocate the residents, prohibited new construction and closed the school in the area in 2007 but development has continued there despite the countermeasures of the government[23].

Chitrakoot is located in the Port Louis Municipal Council area. According to the OPS of Port Louis, Chitrakoot is designated as a residential area (see figure below).

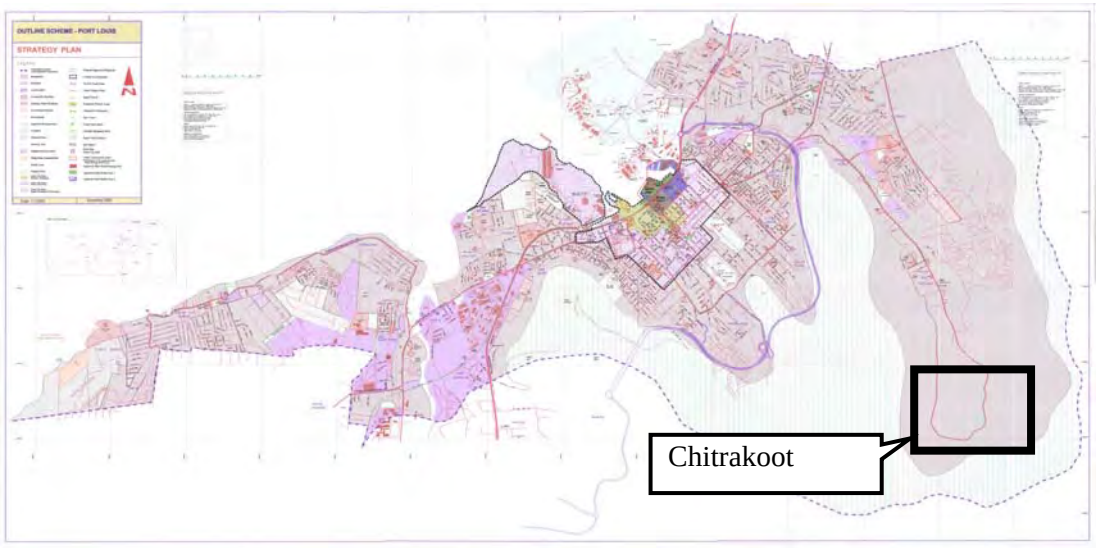


Figure 3.10.6 Strategy Plan of Port Louis[24] (Chitrakoot is shown in Black Frame)

The following table shows the interview survey results relating to development restrictions in the area.

Table 3.10.4 Interview Survey Results relating to Development Restrictions in Chitrakoot (source: JET)

Subject	Interview survey result
Ministry of Housing and Lands (MHL)	・ Relocation was implemented by government order. MHL was not directly involved in the relocation. Some residents are living in the landslide risk area despite the order. Port Louis Municipal Council, MHL and Ministry of Local Government and Outer Lands (MLG) are aware of the problem. Based on the above situation, MHL fully comprehends the necessity for the legal system to restrict/regulate in the landslide risk area. ・ MLG issued a letter to the Port Louis Municipal Council regarding the development restriction in the landslide risk area. MPI and MHL are also considering this problem. ・ The zoning of the development restriction in the landslide risk areas (Chitrakoot and Vallée Pitot) is examined in the OPS, which is in the process of being made. ・ MHL would like to implement countermeasures with related organizations (MPI, MLG, Port Louis Municipal Council etc.) through discussions.
Port Louis Municipal Council	・ Port Louis Municipal Council considers that development in the landslide disaster risk area should not be approved. However, the Local Authorities cannot reject an application because they are just operating within the legal system. The situation is recognized as a problem by Port Louis Municipal Council. ・ Port Louis Municipal Council considers that amendment to the PPG is necessary to restrict development in the landslide risk area. They have been

	asking related ministries such as MHL, MPI, Ministry of Environment and Sustainable Development (MoESD) and MLG for the amendment. The ministries have indicated that development in the risk area should not be allowed. Based on the above, Port Louis Municipal Council has rejected development applications in the risk area, which is an original approach to the problem without legal basis.
Explanatory meeting for local residents	・ A development restriction in the landslide risk area of Chitrakoot have been adopted since 2005 ・ Some residents could not obtain permission for construction/reconstruction of buildings from Port Louis Municipal Council, and are in trouble.

The risk of large scale landslide has existed for a long time in Chitrakoot. The housing land was developed because the risk had not been identified. The following figure shows the topographic map of Chitrakoot around 1989. The settlement of about one hundred households is confirmed by the map (buildings are the gray shaded areas in the map).

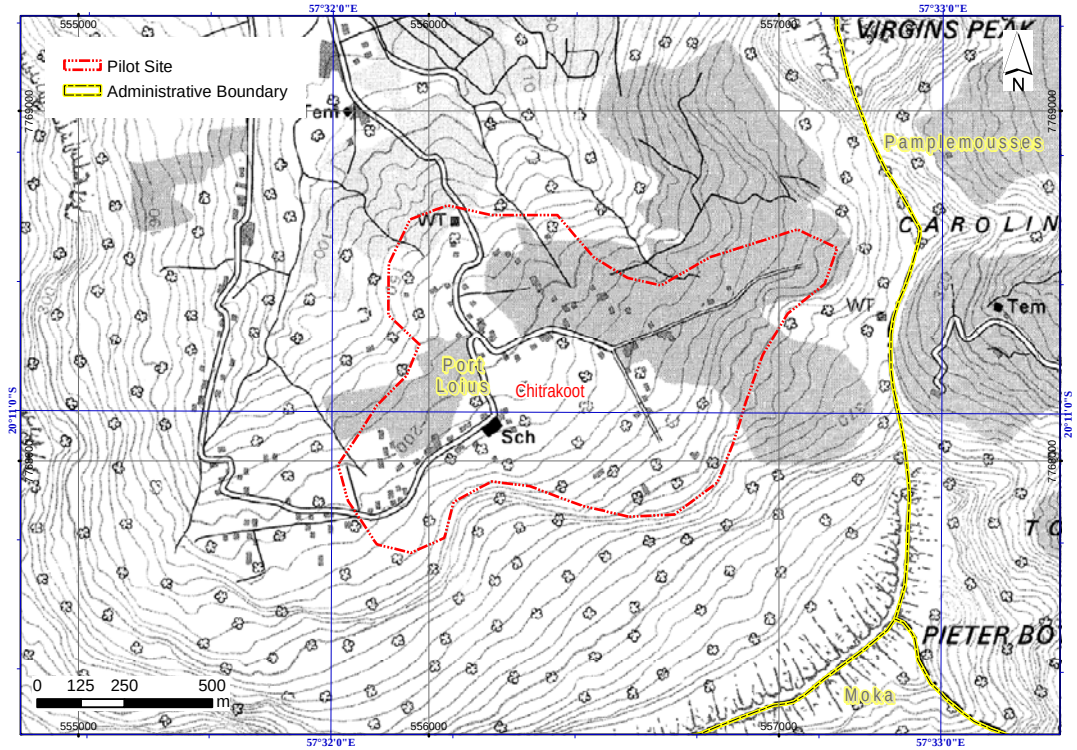


Figure 3.10.7 Building Distribution in Landslide Risk Area of Chitrakoot[25]

The risk has emerged in the settlement due to recent climate change and development activities. Development has been continuing because Chitrakoot is not a development restriction area in the OPS of Port Louis. Moreover, PPG and related Acts (TCPA, PDA, BA and LGA etc.) cannot control development in this area. To solve the problem, Port Louis Municipal Council has been rejecting development applications in this area since around 2006 based on the result of consultation, which is an original approach to the problem without legal basis.

b. Disaster Damage due to Inadequate Construction Works in a Slope Area (example: Quatre Soeurs)

The areas which are fronted by the sea or roads and are backed by slopes are suffering from landslide damage in Quatre Soeurs. The end part or toe of the landslide has been eroded into

a steep slope by coastal erosion. The landslide was activated by the effect of housing development and road construction in the end part. The groundwater level at the lower part of the landslide is high. It is considered that the above situation causes instability in the landslide.

According to the interview survey of residents of damaged houses, they cut land and set retaining walls for house building in 2003 and then they had landslide damage due to torrential rain in 2005. Based on the above, it is considered that the cut land to the slope of soft cohesive geology caused the destabilization, the groundwater level rose rapidly, and then the landslide occurred (source: JET).

Quatre Soeurs is located in the Grand Port/Savanne District Council area. According to the OPS of Grand Port/Savanne, the landslide prone area of Quatre Soeurs is designated as a developable area which can be approved development through application to the Local Authority (see figure below. Orange colored boundary shows the developable area and black frame shows the landslide prone area).

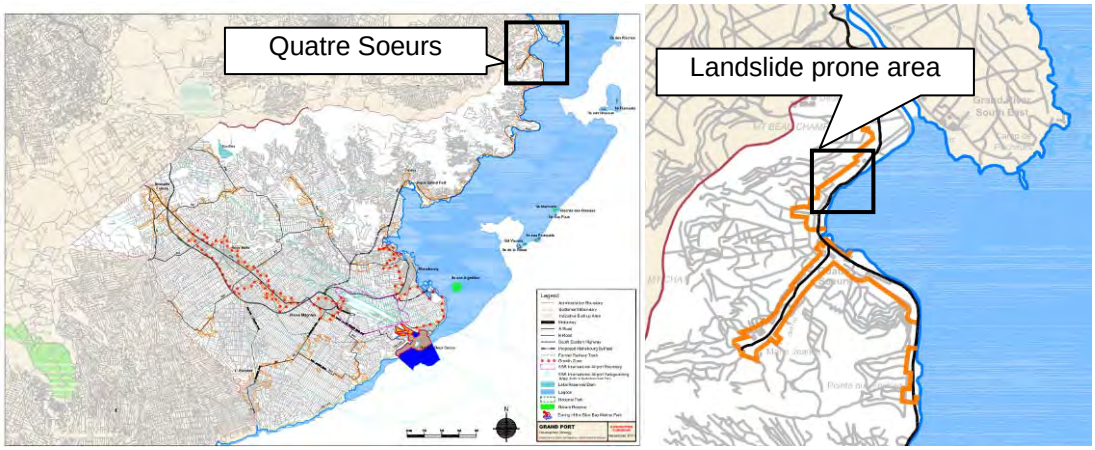


Figure 3.10.8 Development Restriction in Quatre Soeurs[26] (Left: Whole of Grand Port、Right: Magnified Map of Quatre Soeurs)

The following table shows the interview survey results on the development restrictions in the area.

Table 3.10.5 Interview Survey Result about the Development Restrictions in Quatre Soeurs (source: JET)

Subject	Interview survey result
Grand Port/Savanne District Council	・ Grand Port/Savanne District Council considers that development should not be approved in landslide prone areas. However, the District Council cannot reject an application for development in the area based on the existing legal system. The District Council is aware of the problem. ・ Alternative land is required when the District Council considers the residents' relocation and zoning for development restriction. New development in other places will require alternative land. Incentives to promote development should be considered for new development.
Explanatory meeting for local residents	・ About 11 houses have been seriously damaged by landslides. ・ New development such as house construction is not to be implemented in the landslide prone area of Quatre Soeurs ・ The residents place emphasis on financial assistance when considering relocation.

The end part or toe of the landslide was removed during the shore road construction in the landslide prone area of Quatre Soeurs. The end part also suffered coastal erosion. Additionally, houses were built on the end part. Based on the above situation, the land had been destabilized. In other words, inappropriate development on the slope induced the landslide disaster.

The landslide prone area of Quatre Soeurs is designated as a developable area by the OPS of Grand Port/Savanne. Therefore the District Council has no choice other than to issue permission because the District Council does not have a legal basis to refuse permission.

c. Sprawl in the Slope Area of Suburb under the Pressure of Development (example: Vallée Pitot)

The scale of the landslide in Vallée Pitot is small, L=35, W=20m. The end part of the landslide was lightened and destabilized because a drainage channel was constructed on the end part of the landslide. The landslide was activated by torrential rain in 2007 and the landslide caused damage to houses. The damage received press coverage, and therefore the residents of Vallée Pitot know about the landslide.

Vallée Pitot is located in the Port Louis Municipal Council. According to the OPS of Port Louis, Vallée Pitot is designated as a residential area (see figure below).

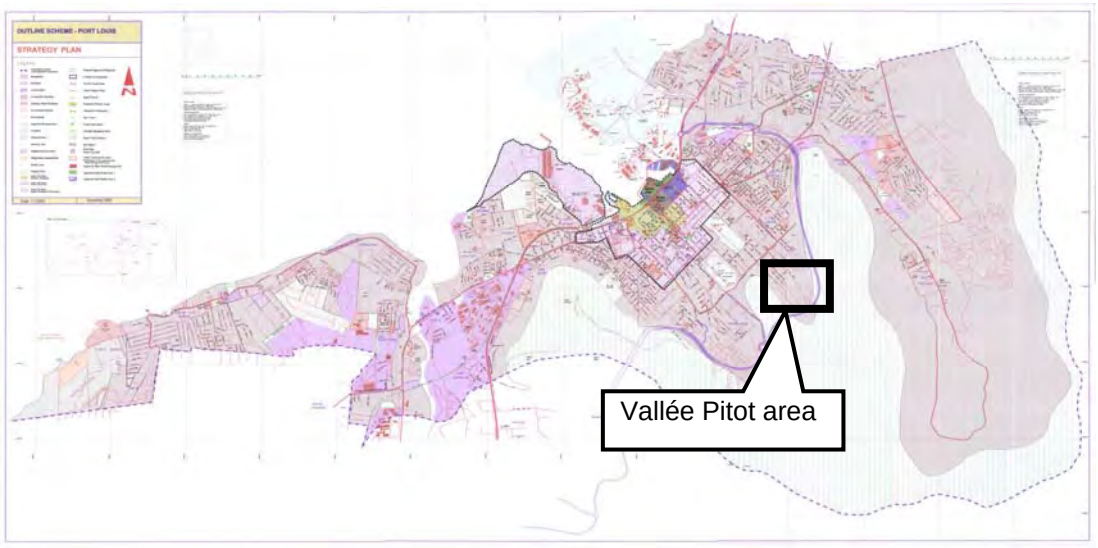


Figure 3.10.9 Strategy Plan of Port Louis (Vallée Pitot is shown in Black Frame)[24]

The following figure shows the damaged area (within the red dotted line) and building (shaded grey) distribution in Vallée Pitot. The roads and blocks are organized in an intelligent way in the city center which is located on the north-west side of the map. This map was made in 1989, and does not show any buildings within the area damaged by the landslide.

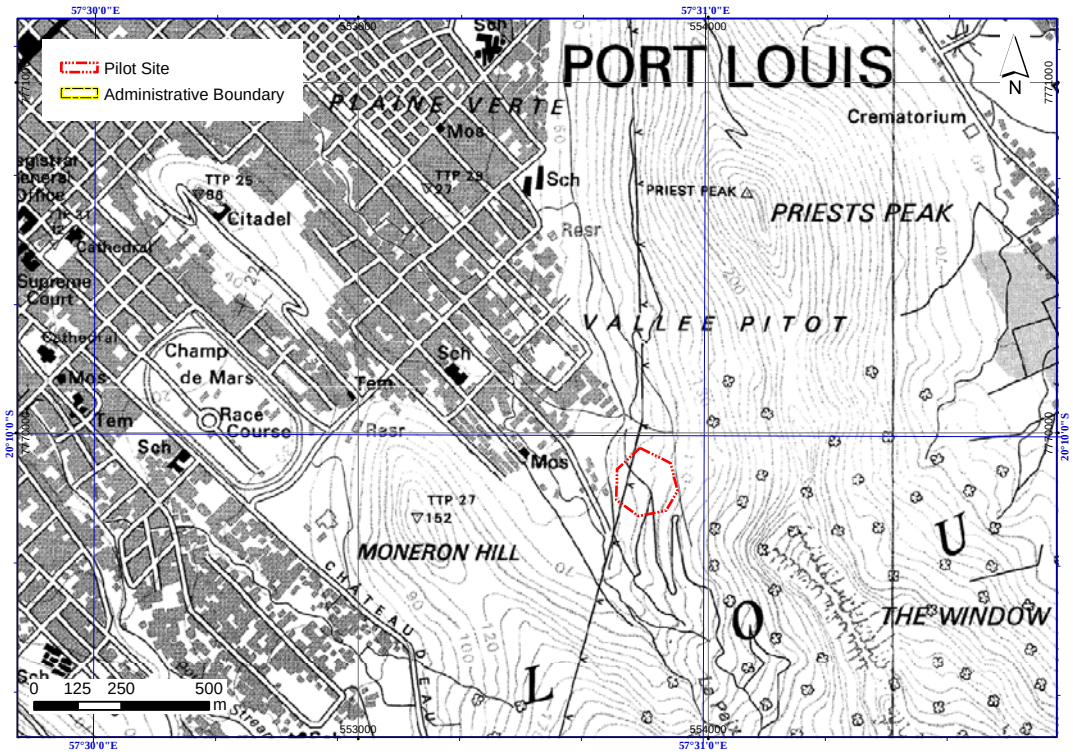


Figure 3.10.10 The Damaged Area and Building Distribution in Vallée Pitot[25]

The following photo was shot with the damaged area in Vallée Pitot in the foreground looking at the south-west (right side) and south-east (left side) slopes. The sprawl is

confirmed from Port Louis city center to the slope of Vallée Pitot. It is considered that the landslide occurred because of haphazard development expansion that did not have drainage planning. According to the information from MPI, the population of this area is about 45,000, and 80% of the population occupies the land illegally[23].

The city center of Port Louis was formed on limited flat land on the seafront with the slope behind. When the city center could no longer sustain development pressure, the built-up area expanded from seafront to the slope behind. This is an inevitable corollary of the area's geographical conditions. In other words, the sprawl and haphazard development expansion into the slope area due to the high pressure on development in suburban areas caused the landslide damage.

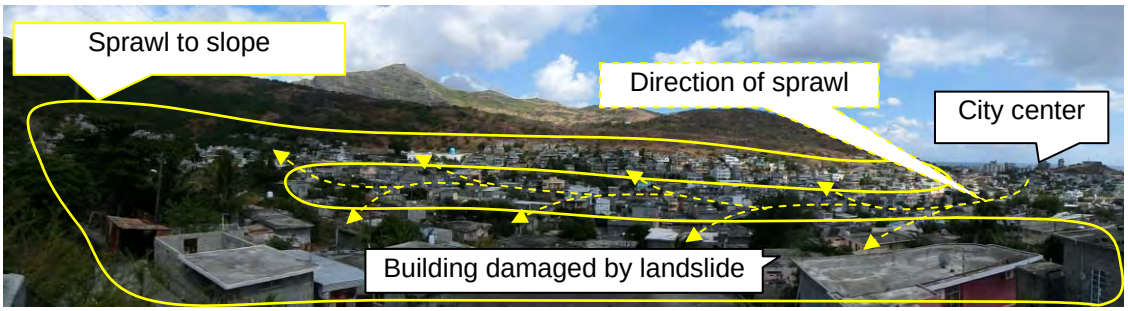


Photo 3.10.1 Sprawl to Slope Area in Vallée Pitot (source: JET)

3.10.4 Recommendation of PPG

Figure 3.10.11 shows the outline image of the draft recommendation for PPG.

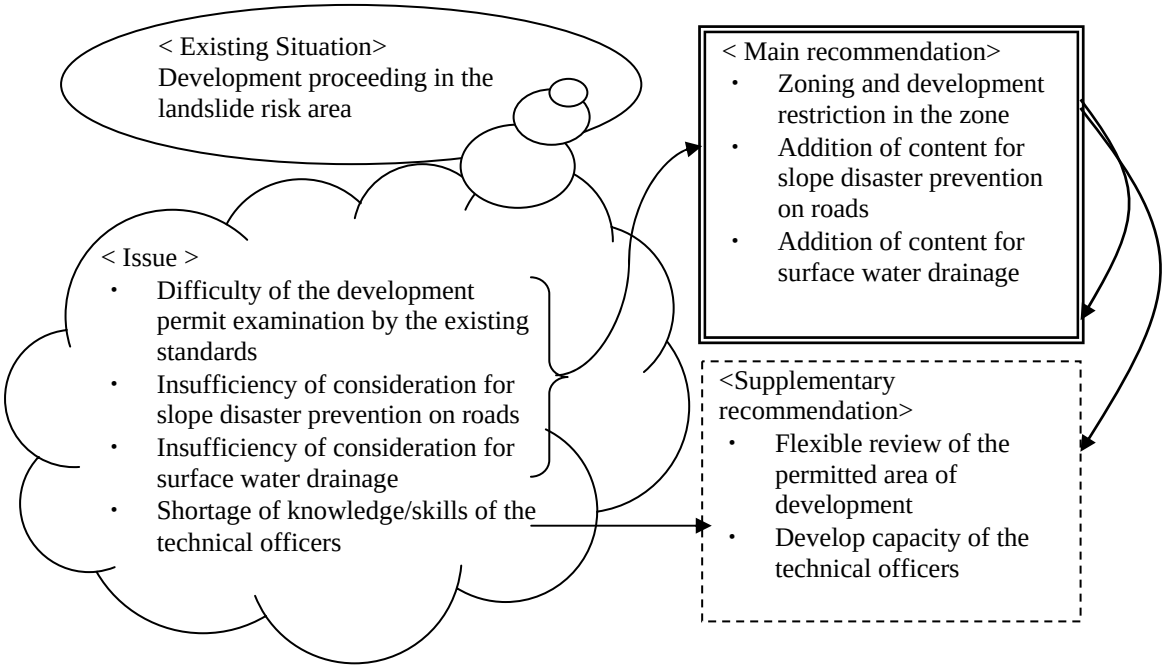


Figure 3.10.11 Outline Image of the Draft Recommendation for PPG (source: JET)

< Existing situation >

PPG has the following criteria regarding development restrictions on sloping sites.

- Development will not normally be permitted on slopes steeper than 1:5 (20%).
- Development above slopes of 1:10 (10%) will be approved conditional on survey completion and implementation of slope stability works.
- Buildings and structures should be set back far enough from ridges and cliff edges so that the structure does not appear to be perched on the edge.

PPG has little content on development restriction in landslide risk areas, but development is proceeding in the risk area.

< Issue >

According to the interview survey result of the local authorities/related ministries, the following issues are confirmed.

- There is no clear zoning of the restriction on a map. It is therefore difficult to identify the restricted area. As a result, a development/building permit application for the landslide risk area can pass the review process by the building/planning/works inspector.
- There is a shortage of an administrative officer/engineer who has knowledge/skills regarding the development restriction at sloping sites.

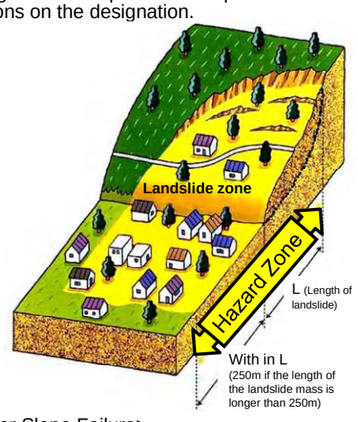
<Main recommendation>

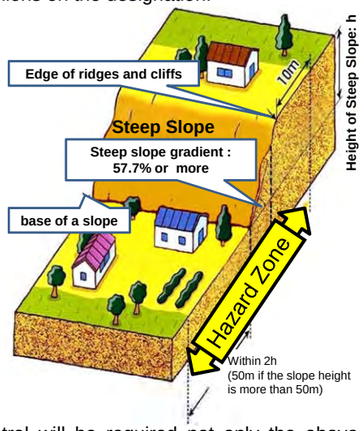
The following solutions are proposed as a main recommendation to the above issues:

- Designate the hazard zone for a slope disaster
- Restrict development in the hazard zone.

Based on the above, Table 3.10.6 shows the existing PPG Article, Draft proposal of addition/modification, Reason of addition/modification and necessity as a recommendation for PPG. Also, the part of the draft proposal on addition/modification is attached in the Supporting Report.

Table 3.10.6 Existing PPG Article, Draft Proposal of Addition/Modification, Reason of Addition/Modification and Necessity (source: JET)

Existing PPG Article	Draft proposal of addition/revision	Reason of addition/revision and necessity
Addition	Residential land development is expanding onto slopes that are at risk of slope disasters. To safely rectify this situation, it is important to clarify the potential danger areas and restrict development in such areas to protect citizens' lives and property. The following contents are criteria for development control in the designated areas of the Landslide Hazard Zone and Slope Failure Hazard Zone. ＜Risk Management for Landslide Disaster＞ · Landslide Hazard Zones will be designated by a committee which will consist of landslide experts in collaborative coordination with the Ministry of Public Infrastructure, Local Authorities and related ministries/agencies, and the Ministry of Housing and Lands will earmark the designated zones on the plan of the Outline Planning Scheme, as areas prone to damage to buildings and life-threatening injuries to residents in case of landslides. A Hazard Zone is designated by the following criteria: ➢ Landslide area (area which is currently prone to landslides or possibly vulnerable to landslides in future) ➢ Area within a distance equivalent to the length of the landslide mass from the bottom end of the landslide area (250m if the length of the landslide mass is longer than 250m) ➢ Authorized research/study achievements by ministries and agencies (Example: Areas evaluated as more than a Medium rank of Landslide Hazard in the "Disaster Risk Reduction Strategic Framework and Action Plan, Ministry of Environment and Sustainable Development, 2012") · Development will not normally be permitted in a Hazard Zone. · When designating a Hazard Zone, it should be publicized in advance, as well as finding out the opinions of ministries/agencies/local authorities. · When it is recognized that there is no longer any reason for the Hazard Zone designation because countermeasures for landslides have been undertaken, the Hazard Zone shall be rescinded in whole or partially through the same procedure of public notification and enquiry of opinions on the designation.  ＜Risk Management for Slope Failure>　 · Slope Failure Hazard Zones will be designated by a committee which will consist of landslide experts in collaborative coordination with Ministry of Public Infrastructure, Local Authorities and related ministries/agencies, and Ministry of Housing and Lands will earmark the designated zones on the plan of the Outline Planning Scheme, as areas prone to damage to buildings and life-threatening injuries to residents in case of slope failure. The Hazard Zone is designated by the following criteria. ➢ Area having a slope gradient of 30 degrees (57.7% or 1 in 1.7) or more and slope height of 5m or more ➢ Area within a 10m horizontal distance from the edge of ridges and cliffs ➢ Area within a distance twice the slope height from the base of a slope (50m if the slope height is more than 50m) ➢ A slope failure hazard area identified by authorized research/study achievements of ministries and agencies · Development will not normally be permitted in the Hazard Zone. · When designating a Hazard Zone, it should be publicized in advance,	· PPG has the following criteria regarding the development restriction on sloping sites. ➢ Development will not normally be permitted on slopes steeper than 1:5 (20%). ➢ Development above slopes of 1:10 (10%) will be approved with conditions of survey and implementation of the slope stability works. ➢ Buildings and structures should be set back far enough from ridges and cliff edges so that the structure does not appear to be perched on the edge. · It is confirmed that the development/building permission system is functioning, and the above criteria are shown in the PPG, but the development is proceeding in the risk area. According to the interview survey result of the local authorities/related ministries, there is no clear zoning of the restriction on a map. It is therefore difficult to identify the restriction subject. As a result, the development/building permit application in landslide risk area can pass the review process by the building/planning/works inspector. It is considered that the adoption of development restriction zoning for landslide disaster risk management will be one of the countermeasures for the above issue.

	as well as finding out the opinions of ministries/agencies/local authorities. · When it is recognized that there is no longer any reason for the Hazard Zone designation because countermeasures for the slope failure have been undertaken, the Hazard Zone shall be rescinded in whole or partially through the same procedure of public notification and enquiry of opinions on the designation.  The development control will be required not only the above landslide/slope failure criteria, but also the following slope stability criteria	
Pressure to develop mountain slopes in Mauritius has recently intensified. The pressure is particularly intense on those slopes that offer a view out to sea. The following criteria apply to plot layouts on sloping sites:	Pressure to develop mountain slopes in Mauritius has recently intensified. The pressure is particularly intense on those slopes that offer a view out to sea. The development of criteria for the sloping sites is required, which can consider not only safety/security but also comfort, aspect/landscape, etc. The following criteria apply to plot layouts on sloping sites:	· Addition of its positioning (The recommendation is to ensure security. The consideration of landscape and amenities of the residential environment are included in the existing PPG. Add these purposes to connect those data.)
Slope Stability		
· Development will not normally be permitted on slopes steeper than 1:5 (20%).	No need to change	· No change is required even though it is not applicable in Hazard Zones for landslide and slope failure mentioned above. It can be the measure for a sloping disaster risk area.
· Above slopes of 1:10 (10%), and in areas of poor bearing capacity, the ground conditions should be checked and proposed structures certified by a qualified engineer. A Site Constraint Analysis and written statement detailing all proposed mitigation measures should be submitted to and approved by the Permit Authority prior to the commencement of any on-site works. **SITE CONSTRAINT ANALYSIS Typical Information** · Topography, with emphasis on slopes over 10% · Vegetation such as individual trees, groupings of trees and shrubs, habitat types · Drainage courses and riparian corridors · Sewage disposal systems · Geologic constraints including landslides and active fault lines · Visibility from off-site · Areas of fire danger · Solar orientation and prevailing wind patterns · Significant ridgelines	No need to change	Same as above
Site Location and Visual Impact	No need to change	
· As a general guide, development should not be any higher than 45 metres above the mountain base, or in the case of slopes facing the sea, 45 metres above Mean Sea Level.	No need to change	· This attempts to set a guideline which restricts the development exceeding a certain altitude in the area of seafront in order to consider the landscape. · Basically, most of slope disaster risk area can be covered by zoning/restrictions. But, this part shall be kept in case of slope disaster at Table mountain. It also has the aim of consideration for landscape which is the purpose of this term.
· Building profiles should not visually break the ridgeline of the slope, especially when seen from important vantage points and buildings should not be built on the crest of slopes. The hillside should act as a	No need to change	· This content relates to consideration of landscape. There is no need to change because it does not have a relationship with slope disaster directly.

backdrop to the buildings		
· Care should be taken to protect the view of dwellings both above and below any new development, and unit spacing should be such that views of the natural landscape are retained	No need to change	Same as above
· Buildings and structures should be set back far enough from ridges and cliff edges so that the structure does not appear to be perched on the edge	It can be removed	· This can be removed because it has already been recommended in designation of Hazard Zones and development restriction before (to avoid duplication).
· The mountain or slope should act as the backdrop to the building. This is far more preferable to having the building project into a blue sky background. If the building or structure does break the plane of the natural backdrop, it should be designed to mimic the natural lines of the mountains and hillsides	No need to change	· This content considers landscape. There is no need to change because it does not have a direct relationship with slope disaster.
· Existing and new vegetation should be placed to soften the mass of building as viewed from off site	No need to change	
· Buildings should be placed far enough apart to reveal views of the mountain and the natural landscaped backdrop from other buildings and downslope	No need to change	Same as above
· Buildings sited to maximize views at the expense of natural vegetation should be resisted	No need to change	Same as above
· Buildings should not appear overly prominent or obtrusive	No need to change	Same as above
· Buildings should be planned to enhance a site's natural features. The form, mass, profile and architectural features should be designed to blend with the natural terrain and preserve the undulating profile of the slopes. Multi story buildings on or close to ridge lines should be avoided and on all sites lower profile buildings should be encouraged	No need to change	Same as above
· In areas of varying topography, buildings higher than their surroundings are particularly prominent and due consideration must be given to distant views and important skylines. The same dwelling sited at different heights and locations can have very different impacts on the hillside and skyline. Permit applications for development on slopes must include sufficient information for judgments to be made regarding the acceptability of the development; for instance photo montages, elevations over a wide area showing the setting of the building as well as sections and contours.	No need to change	Same as above
· Existing vegetation should be used to soften structural mass and blend buildings into natural settings	No need to change	· This content considers placement of vegetation. It does not relate directly to slope disaster. Therefore, there is no need to change it. · This is similar to previous item (6 items before). In previous item, "placement" of vegetation was used to soften the mass of buildings viewed from off site. But in this text the existing vegetation should be "utilized" to soften structural mass and blend buildings into natural settings where stated. The difference is between "placement" of new vegetation or "utilizing" the existing vegetation. (Example: The former is when the development is made by clearing the existing tree and replacing it with a new tree by planting it in its original setting. Whereas the latter is when the development is made by avoiding removal and utilizing the existing tree).
· Careful consideration should be given to the potential cumulative impacts of development within the hillside setting and upon existing ridgelines. Ensure sufficient space is retained between buildings to reveal appropriate views of ridges and the natural landscaped backdrop.	No need to change	Same as above
Architectural Form	No need to change	
· The form, massing and architectural features of buildings should be designed to blend with the natural terrain and preserve the undulations of the slopes. Roofs should be orientated in the direction of the slope and large gable ends should be avoided	No need to change	· This item considers scenery and shape of buildings which does not relate directly to slope disaster. Therefore, there is no need to change. · The content is similar to the previous item (4 items before). In the previous item, "location" of building shall be considered to soften the surrounding environment. But in this, the "shape of building itself" should blend to the surrounding environment. Therefore, both contents can be kept.
· Contrasting and varied horizontal and vertical building planes should be used to create various light, shade, and shadow patterns to reduce perceived bulk.	No need to change	Same as above
· Large expanses of wall in a single plane on downhill elevations should be avoided	No need to change	Same as above
· The maximum height of buildings should not normally exceed 7.5m. The maximum height of a building's combined elevation should not normally exceed 10.5m measured from the lowest part of the building to the highest	No need to change	· Regarding the height limit for the building, the item specifies that every land use should consider the sunshine hour, fire prevention, building structure and favorable residential environment in Urban Planning Act/Building Standards Act of Japan. The height for residential area is 10~12m (Not intended to aim at sloping disaster prevention). The

		building restriction also has not been mentioned in Acts that have a relationship with slope disaster. · The risk would be reduced if there is less weight on the slope. But, strict restriction would the guidance difficult to manage practically. · Based on the above, it is considered that this is appropriate, and there is no need to change.
· The height of the lowest finished floor(s) of a structure, excluding basements, should not be more than 1.2m above existing grade to ensure buildings follow slopes	No need to change	· This is regarding the height between lowest finished floor(s) and slope · To secure this height, base, bank fill and retaining wall can be considered. · Regarding embankment and retaining wall height limit, it is specified approximately 1m in Building Standard Act/Residential Land Development Act of Japan · Based on the above, it is considered that this is appropriate, and there is no need to change.
· Retaining walls and structures should be planned in a curvilinear manner that reflects the natural contours of the landscape, and materials and finishes should harmonize both with the terrain and the buildings on the site	No need to change	· This is for the retaining wall, but the purpose is regarding the harmonization of existing natural contour of the landscape (consideration of landscape). · In the slope disaster risk area, the restriction of landslide/slope failure zoning will be applied. These attempts to avoid the modification of existing landscape in gentle slope area which is not applicable for the zoning mentioned above. It does not oppose the slope disaster risk management, therefore no change is needed.
· Long unbroken rooflines should be avoided. Instead, roofs should be broken into smaller components to reflect the irregular natural hillside patterns. The roof should be orientated in the same direction of the slope contour and large gable ends on downhill elevations should be avoided	No need to change	· This is consideration for the shape and landscape of each building. It is not related directly with slope disaster, therefore, there is no need to change
· Dark or earth tone colors should be used to make the building less conspicuous as seen from off site. White or light colors should be avoided. The colors used for buildings should harmonize with the natural colors of the hillside.	No need to change	Same as above
Infrastructure Highways and utility infrastructure services should be of a high standard for developments on steep slopes:	No need to change	
· Roads should be laid out to avoid steep grades and should normally not exceed 1:8 (12.5%))	Add the following. The consideration of the following is required for road design. · Enough stability against external effects such as traffic load and rain · Design for easy/simple maintenance · In a part of cut slope, groundwater drainage and gradient should be considered to avoid landslide, rock fall and slope disaster · In a part of embankment, design and pavement to support the traffic load is required. The material strength, height, shape of the embankment should be considered to avoid deformation/subsidence by traffic load or the embankment. Also, enough stability against destructive cause such rain and percolating water is required. · Road planning should be avoided in high risk areas such as landslides/slopes · Drainage facilities will be required to keep the stability for the slope and avoid erosion. · The gradient of slope should be designed by the geology/bedrock/height of the embankment/cut slope.	· In the existing PPG, the only criteria for preventing slope disaster of a road was its gradient. From the viewpoint of slope disaster management, the addition of consideration points for the design is recommended (mentioned in left column).
· Stormwater should be disposed of within the plot boundary or to a centralised stormwater soakaway system and should not be allowed to flow to adjacent plots or into road reserves	· Groundwater drainage (open ditch, underground drain, or other facility) is required to drain off the surface water which can be the cause of landslides from the landslide/slope failure risk area to another area.	· Recommendation for the addition of supplementary groundwater drainage due to the inappropriateness of existing surface water drainage.
· Special care is needed to control surface water drainage and engineering studies should be provided to show the effect that drainage might have on other properties. Inadequate drainage may trigger land slips	No need to change	
· On-site sewage and waste water disposal systems must take account of soil characteristics. The use of septic tanks may not be possible, or special designs might be required, because of the risk of effluent appearing at the surface in land/properties below the site being developed	No need to change	· This is content regarding the sewage and water waste disposal system. It does not relate directly to slope disaster. Therefore, there is no need to change
· Underground utility services and poles should not be placed in made-up ground	No need to change	· This is content regarding placement of underground utility service. It does not relate directly to slope disaster. Therefore, no change is

			needed.
·	Water pressure from Central Water Authority facilities should be adequate to reach the upper limits of development on a high slope. A minimum residual pressure of 10 metres at property boundary is recommended	No need to change	· Content regarding water pressure from Central Water Authority facilities and not related directly to slope disaster. Therefore, no change is needed.
·	The provision of water to properties above the level of existing water storage reservoirs, or remote from the existing supply network may be difficult and/or costly to achieve. Early discussion should be held with the Central Water Authority.	No need to change	· Content regarding provisions (distance/cost) of water storage reservoir and not related directly to slope disaster. Therefore, no change is needed.

<Supplementary recommendation>

Based on the above, the following is proposed as a supplementary recommendation of the above main recommendation.

- Flexible review of permitted area of development
- Education/dissemination and capacity development of administrative officers regarding the legal systems/schemes for landslide disaster risk management

<Flexible review of permitted area of development>

There is a possibility of development pressure increase at other disaster risk areas or area beyond the restriction zone for the alternative land due to decreased land available within the permitted area of development. It is considered that a flexible review of the permitted area of development or inducement to move to the low disaster risk areas is required.

Table 3.10.7 Supplementary Recommendation for Flexible Review of Permitted Area of Development (source: JET)

Existing situation	In case of adoption of development restriction zoning for landslide disaster prevention within a settlement boundary, the area available for development will be reduced
Issue	There is the possibility of demand for alternative land, increasing development pressure on unexpected areas (development in disaster risk area, urban sprawl, etc.)[6]
Basic policy for countermeasure	The consideration of setting new areas designated for urbanization/development in the development control areas (outside of the settlement boundary) will be required.
Contents of recommendation	It is considered that a flexible review of the settlement boundary in the OPS (Outline Planning Scheme) based on the consultation/coordination of related ministries/agencies can be utilized. Points to remember/consider and examples are shown below. · Object: Areas that are located adjacent to or close to urbanization promotion areas (within the settlement boundary), that are deemed to form integrated daily living areas with those urbanization promotion areas because of their natural and social conditions. An area that is far from the settlement boundary and does not have existing settlement/road network /public facilities will not be subject. (Example: the area should be within x km from the settlement boundary.) · A flexible review of the settlement boundary will be considered for an area that already has road network and public facilities to a respectable degree, and does not need new public investment. (Refrain from excessive public investment in the reviewed urbanization promotion areas/within the settlement boundary.) · Criteria for a consecutive site (Example: the area has x or more consecutive sites which are within x m from each other.) · Criteria for roads (Example: the road width in the reviewed area is normally x m or more. The road connects to the area's boundary road within x m and the road width is x m or more). · Facilities for water supply and sewerage (Example: roadside ditch, drainage ditch and channel are laid out and sewage is able to drain properly.) · It doesn't contain disaster risk areas. · It doesn't contain prime agricultural land. · There is target/objective and policy for management of development in the area.

[6] If the development proceeds to an unexpected area (beyond restriction zone), the development of infrastructure such as roads, water sewage services and public services such as welfare and education would be difficult. Also it might lead to a problem such as traffic jams, environmental problems, and residential congestion in the low disaster preventing capacity area.

<Education/dissemination and capacity development of the administrative officers regarding the legal systems/schemes for landslide disaster risk management>

It is required that administrative officers (inspectors involved in the application) recognize and understand the zoning and the contents of the development restriction. Also, the officers should make the appropriate decision on the application of development at sloping sites.

Looking at education/dissemination of capacity development among administrative officers and a flexible review of permitted area of development mentioned above, are not a direct recommendation for PPG. But it is a relevant subject and includes important points for the zoning/development restriction. Therefore, it will be recommended to incorporate this into the guideline/manual made by this project as a supplementary recommendation.

Table 3.10.8 Supplementary Recommendation for the Education/Dissemination and Capacity Development (source: JET)

Existing situation	An application for development in a landslide risk area passes the permission process.
Issue	Understanding of the PPG's development restrictions relating to landslide risk areas by the inspectors is not enough. And, there are some administrative officers/engineers who do not have enough capacity for appropriate review of a development application which contains survey results, countermeasure work plan, etc
Basic policy for countermeasure	Implementation of seminars/workshops on the legal systems/schemes about the landslide disaster risk management for administrative officers (local authority, MHL, MLG, MPI and the other related ministries/agencies).

Contents of recommendation	MHL has regularly been holding the training/seminar regarding the PPG. The opportunity to utilize training/seminar for education/dissemination and capacity development should be considered. The contents of the landslide disaster risk management could be included in the regular training/seminar. An example of the contents of the training/seminar is shown below:
	· Frequency: Training/seminar of regular training by MHL on demand from the local authority.
	· Host organization: MHL/MPI (Lecturer: Experts from MPI and other organizations)
	· Main target: Inspectors of development planning, architecture, civil engineering in local authority and staff of MHL, MPI, MoESD, MLG
	· Content : Legal systems/schemes for the landslide disaster slope management
	  · Actual situation of a recent disaster
	  · Legal systems/schemes for slope disaster prevention (Outline, meaning, points, recent measure, etc)
	  · Method to judge the slope disaster risk area outline
	  · Case study (Countermeasures at La Butte, Chitrakoot, Quatre Soeurs, Vallée Pitot)
	  · Legal systems regarding development/urban planning/land use and construction. Also slope disaster risk management (Land use, zone classification, permit application, etc)
	  · Group discussion/ exchange of opinions.

The following table shows the record of the meeting, discussion and workshop for the above recommendation. The recommendation was compiled based on the results of the meeting.

Table 3.10.9 Record of the Meeting/Workshop regarding the Recommendation (source: JET)

No.	Date	Meeting partner	Content
1	18 Jul 2012	MHL (chief town and country planning officer, acting chief town and country planning officer, town and country planning officer 2)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the PPG · Information collection regarding current situation of disaster risk management
2	25 Jul 2012	MLG (principal assistant secretary)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
3	26 Jul 2012	Port Louis Municipality Council (lord mayor, chief executive, assistant chief executive, chief inspector, supervisor)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
4	26 Jul 2012	MHL (acting chief town and country planning officer)	· Information collection regarding the building/land-use restriction · Request of the data provision of the Outline Planning Schemes
5	27 Jul 2012	Grand Port/Savanne Municipality Council (chairman, chief executive, head of works, engineer, assistant chief executive, head planner)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
6	30 Jul 2012	MHL (deputy chief town and country planner, acting country planer), MPI (civil engineer, senior engineer x 6), Grand Port/ Savanne District Council (civil engineer),	· Workshop · Explanation of aim · Sharing the result of the information collection regarding the landslide disaster risk management by the land-use planning/policy · Explanation/opinion exchange of the basic policy of the draft recommendation for PPG
7	31 Jul 2012	Moka/Flacq District Council（head of works, chief inspector、chief executive officer、acting head planner, senior welfare officer）	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
8	1 Aug 2012	Pamplemousses/Rivere du Rempart District Council (acting chief executive officer, head of planning department, chief health inspector, principal health inspector, civil engineer, head of works department, assistant chief executive)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
9	1 Aug 2012	Curepipe Municipality Council (senior health inspector, head public inspector, acting chief executive officer, chief welfare officer, senior welfare officer)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
10	30 Aug 2012	Black River District Council (works inspector, planning inspector, building inspector, head of works department, assistant chief executive officer, principal health inspector, health inspector, chief inspector of works, inspector of works, engineer, head of planning department, acting chief executive officer)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
11	31 Aug 2012	Quatre Bornes Municipality Council (head of works department, chief executive officer)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy
12	31 Aug 2012	Vacoa/Phoenix Municipality Council (head of works department, chief executive officer)	· Explanation of aim · Information collection regarding the landslide disaster risk management by the land-use planning/policy

13	1 Oct 2012	Port Louis Municipality Council (head of works department, head of planning department)	· Information collection regarding the development restriction in Chitrakoot · Confirmation of the current situation on the Outline Planning Schemes
14	1 Oct 2012	MPI (senior engineer)	· Information collection regarding the relocation in Quatre Soeurs
15	28 Jan 2013	MPI (principal engineer senior engineer, engineer)	· Sharing the basic policy of recommendation for PPG
16	29 Jan 2013	MPI (engineer)	· Sharing the basic policy of recommendation for PPG
17	31 Jan 2013	MHL(chief town and country planning officer, acting chief town and country planning officer, town and country planning officer, principal planner, acting principal planner)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions · Information collection regarding the actual procedure of PPG review in the government
18	4 Feb 2013	District Council of Grand Port (head of works, head of planning, building inspector, planning department)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
19	5 Feb 2013	Port Louis Municipality Council (head of planning department)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
20	7 Feb 2013	MLG (principal assistant secretary, higher executive officer)	· Explanation of the draft basic policy of recommendation for PPG and exchange the opinion
21	7 Feb 2013	Adaptation Fund Board Project Climate Change Adaptation Program in the Coastal Zone of Mauritius (project manager)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
22	7 Feb 2013	Department of Civil Engineering, Faculty of Engineering, University of Mauritius (lecturer, head of civil engineering department)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
23	11 Feb 2013	Climate Change Division, Department of Environment, Ministry of Environment and Sustainable Development (divisional environment officer, environment officer)	· Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
24	19 Feb 2013	MPI (senior engineer)	· Information collection about the relocation in Quatre Soeurs
25	26 Feb 2013	MoESD (environment officer), MHL (principal planner, planner, acting chief town and country planning officer), Grand Port District Council (head of land-use and planning, planning inspector, building inspector, head of planning department), City Council of Port Louis (head of works department, head of planning department), District Council of Savanne (engineer, acting head planner), University of Mauritius (lecturer) MPI (senior engineer x 6, acting director of civil engineering section)	· Workshop · Explanation of aim · Sharing the existing situation regarding the landslide disaster risk management by land-use policy/planning and PPG · Explanation of the draft basic policy of recommendation for PPG and exchange of opinions
26	5 Mar 2013	MHL(government land surveyor)	· Information collection about the relocation in Quatre Soeurs
27	5 Mar 2013	MHL (acting chief town and country planning officer, principal planner)	· Explanation of the revised draft basic policy of recommendation for PPG and exchange of opinions
28	7 Jun 2013	MPI (acting director of civil engineering section, engineer x 2)	· Explanation of the draft recommendation for PPG and exchange of opinions
29	11,12,13 Jun 2013	MPI (acting director of civil engineering section, engineer x 2)	· Discussion about the draft recommendation for PPG
30	13, 21 Jun 2013	MPI (acting director of civil engineering section, engineer x 2)	· Information collection about the relocation in Quatre Soeurs
31	14 Jun 2013	MHL (acting chief town and country planning officer, principal planner)	· Explanation of the draft recommendation for PPG and exchange of opinions
32	27 Jun 2013	MHL (acting chief town and country planning officer, principal	· Discussion about the draft recommendation for PPG

		planner)	
33	28 Jun 2013	The City Council of Port Louis (head of infrastructure department, assistant chief executive officer, chief building inspector)	· Explanation of the draft recommendation for PPG and exchange of opinions
34	1 Jul 2013	District Council of Grand Port (chief executive officer, assistant chief executive officer, head of infrastructure department, assistant building inspector)	· Explanation of the draft recommendation for PPG and exchange of opinions
35	2 Jul 2013	District Council of Grand Port (head planning department, planning inspector, acting senior building inspector, assistant building inspector, planning assistant)	· Explanation of the draft recommendation for PPG and exchange of opinions
36	5 Jul 2013	District Council of Grand Port (head of infrastructure department, head planning department)	· Explanation of the draft recommendation for PPG and exchange of opinions
37	5 Jul 2013	The City Council of Port Louis (head of infrastructure department, head planning department)	· Explanation of the draft recommendation for PPG and exchange of opinions
38	10 Jul 2013	MPI (acting director of civil engineering section, senior engineer x 5)	· Discussion about the recommendation for PPG (final draft)

*The other meetings were implemented to respond to questions and answers from stakeholders

A recommendation for the PPG (final draft) was compiled based on the above meeting/workshop results and coordination with stakeholders. The points to remember for the recommendations which were obtained from the coordination are shown in the following table.

Table 3.10.10 Points to Remember for the Recommendations (source: JET)

No.	Points to remember for the recommendations	Contents
1	Difference between the Hazard Zone and Landslide-Prone Area	· Landslide Hazard Zone: Areas prone to damage to buildings and life-threatening injuries to residents in case of landslides · Landslide-Prone Area: there is concern around the possibility of landslide occurrence. (The active/risk level of the landslide is less than the Landslide Hazard Zone)
2	The subject of the development restriction	The recommendation focuses on the existing PPG which is the "Design for Sloping Sites" in the part "Residential Development". Consideration of landslide destabilization by infrastructure development will be also required. (reference: table of contents of PPG) 1. Introduction, Approach and Design Principles 1.1 Introduction 1.2 Approach 1.3 Urban Design Principles 2. Specific Design Guidance 2.1 Commercial Development 2.2. Hotels and Resorts 2.3. Industrial Development 2.4. Residential Development 3. Technical Sheets
3	Agriculture in the landslide area	The possibility of agricultural use is considered with advice by ministries/agencies/local authorities to avoid destabilization of the landslide. But, it shall avoid; · Groundwater: bringing in, stagnating and increasing of groundwater or prevention of groundwater drainage. · Surface water: discharge, stagnating, percolating of the surface water. (exception: discharging for normal agricultural activities, daily life) · Embankment and cutting slope · Construction of new facilities such as canals/drainage,

		reservoirs, ponds, etc. Water supply from outside of the landslide area (irrigation channel, reservoir etc.).
4	Living in the Landslide Hazard Zone	Basically, relocation will be needed.
5	Living in the Landslide-Prone Area	Basically, relocation will be required from the viewpoint of security. A possibility exists to continue living in the area, but destabilization of the landslide, by large-scale extension/reconstruction of buildings, changes to land (embankment, cutting slope), etc will not normally be permitted.
6	Living in an area of countermeasure works by the Project	Basically, relocation will be required. The concern is the possibility of destabilization of the landslide because of daily life activities, climate change, etc. It is possible to live here, but destabilization of the landslide such as large-scale extension/reconstruction of buildings, changes to land (embankment, cutting slope), etc will not normally be permitted.
7	Application of the development restriction for the existing land without construction	The restriction will be applied to the land. Support will be required for site acquisition.
8	Application with countermeasure works	When the applicant cannot guarantee to maintain the land properly/permanently, there is a possibility of a landslide disaster occurrence even with the implementation of countermeasure works. Therefore, development will not normally be permitted.
10	Outline Planning Scheme of Port Louis	MPI will not be able to send the view/comment to MHL regarding the Hazard Zone. The draft Hazard Zone map was made for a part of the administrative territory of Port Louis. It is considered that the map will be required not only for part of the territory but the whole of the territory. When MPI finishes the mapping, MPI will be able to send to MHL to view/comment regarding the Hazard Zone.
11	Handling of the zoning for the development restriction	The zoning of the development restriction will be examined by the committee which has landslide experts. (The committee will be coordinated/collaborated by MPI, MHL, Local Authorities and related ministries/agencies)
12	Prompt review of the PPG from viewpoint of landslide risk management	The review of PPG for landslide risk management based on the recommendation of the JICA's project is required as soon as possible because it is difficult to deal with the development permits in the steep slope area until the issue of the revised PPG.
13	Further work	The continuous activities for review of the PPG from the viewpoint of landslide disaster risk management through meeting/discussion with stakeholders (such as regular meeting/committee style) will be required.

3.11 Technical Guideline for Initial Survey

In the Project, "Technical Guideline for initial survey (hereinafter the Guideline)" is prepared as a procedure guideline for landslide survey/countermeasure on emergency landslide disasters. The Guideline has been specifically developed targeting landslide disasters in Mauritius.

The Guideline covers what and how landslide disasters should be dealt with, and includes the procedures MPI should implement on landslide disasters. The procedures are composed of literature survey, initial site survey, emergency response, detailed survey plan, etc. The detailed survey/analysis/monitoring and the design/construction after the discussion of the survey plan are described in "Procedure Manual for Landslide" which is elaborated in the next section.

The scope of application of the Guideline is indicated in the following figure and the detailed contents of it are in the table on the following page.

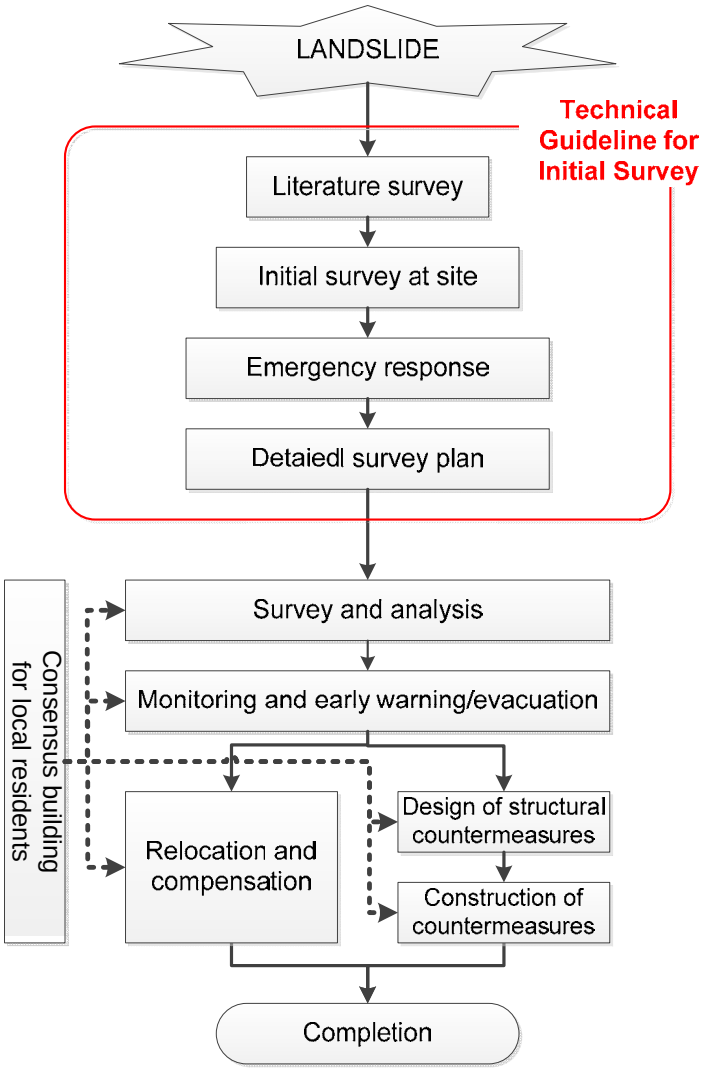


Figure 3.11.1 The Scope of Application of the Technical Guideline for Initial Survey (source: JET)

Table 3.11.1 The Contents of the Technical Guideline for Initial Survey (source: JET)

Cp.	Title	Contents
1	Introduction	- Contents, purpose, flow of the guideline - Outline of landslides in Mauritius - Workflow of initial survey
2	Literature survey	- Data to be collected ant their utilization - Regulation of law and land-use
3	Initial site survey	- Setting of target areas - Site survey and analysis - Monitoring for initial survey
4	Emergency response	- Structure measure - Evacuation and relocation - Early warning system
5	Detailed survey plan	- Outline of detailed survey - Outline of countermeasure policy

Although the Guideline is prepared by mainly JET in the Project, LMU should renew appropriately the contents of the Guideline after the Project so that it becomes more usable and rational based on the case examples and issues in Mauritius.

3.12 Procedure Manual for Landslide

In the Project, "Procedure Manual for landslide (hereinafter the Manual)" is prepared for the implementation of landslide countermeasures from both viewpoints "hard" and "soft", namely, both physical and non-physical countermeasures.

The Manual covers what and how to undertake countermeasures to mitigate the disaster risk of landslides, and how to support MPI in conducting surveys/analysis and planning/design/construction of countermeasures for landslides by themselves. It is also formulated based on the review of the early warning/evacuation procedures and PPG. The manual includes strategic methods to induce development and important points to remember, as well as problems found in the F/S and the pilot project and solutions, and how the solutions were reached.

The scope of application of the Manual is indicated in the following figure and the detailed contents of it are in the table in the following page.

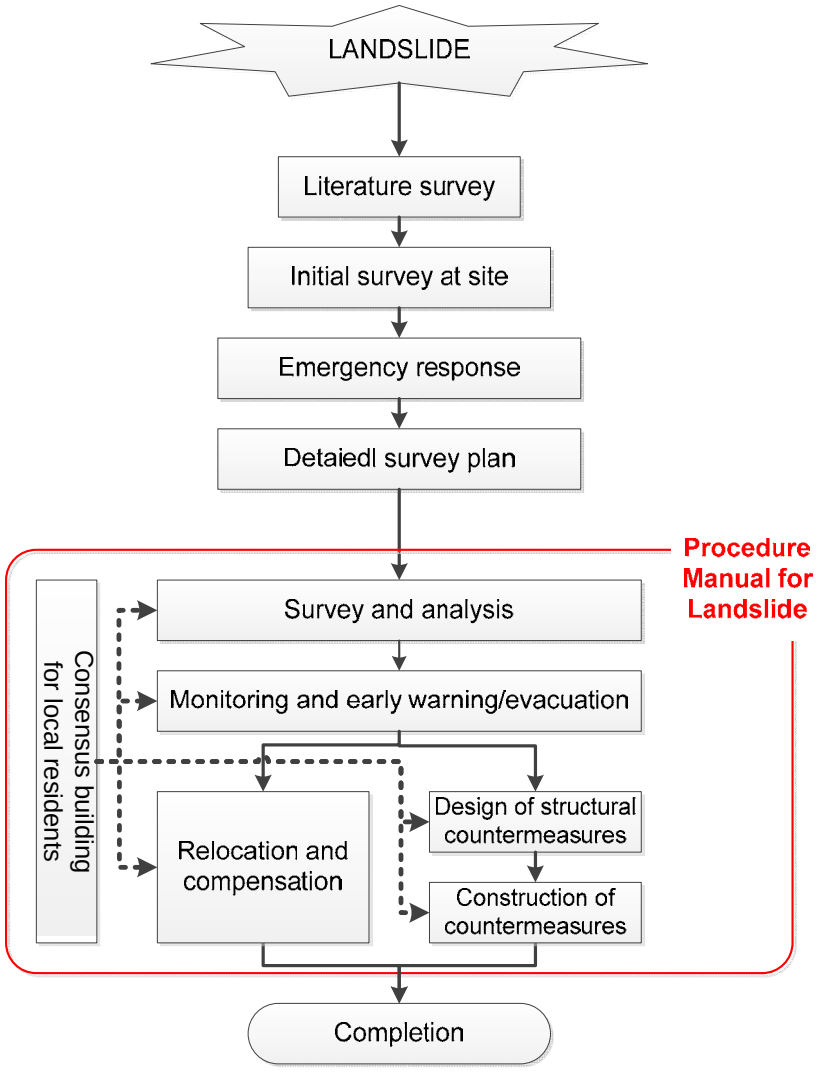


Figure 3.12.1 The Scope of Application of the Procedure Manual for Landslides (source: JET)

Table 3.12.1 The Contents of the Procedure Manual for Landslides (source: JET)

Cp.	Title	Contents
1	Introduction	- Outline of landslides in Mauritius - Contents, purpose, flow of the Manual - Application, composition of the Manual
2	Survey and analysis	- Topographic survey, aerial photo identification, field reconnaissance, drilling, geophysical exploration, laboratory test, water analysis - Installation of monitoring devices - Cross section, active areas/blocks, direction of movement, volume, discussion of slip surface - Basic factor and trigger - Stability analysis and safety factor
3	Monitoring and early warning/evacuation	- Monitoring system and information transmission - Setting of threshold for warning and evacuation - Responsibility and role of related organizations - Evacuation procedure
4	Relocation and compensation	- Existing law (PPG etc.) and planning scheme - Caution area and special caution area - Area setting for relocation/compensation - Implementation of relocation - Implementation of compensation
5	Consensus building for local residents	- Significance of consensus building - Flow of consensus building - When and what to be built for local residents - How to deal opinions and comments from residents
6	Design of structural countermeasures	- Basics of design of landslide countermeasures - Design of restraint works and control works - Environmental and social considerations
7	Construction of structural countermeasures	- Construction plan - Checkpoints for construction - Construction and supervision
8	Initial survey and emergency response	[Excerpt of “Technical Guideline for Initial Survey”]

Although the Manual is prepared by mainly JET in the Project, LMU should renew appropriately the contents of the Manual after the Project so that it becomes more usable and rational based on the case examples and issues in Mauritius.

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