4

Inventory of Landslides in Sikkim

Information on landslides in Sikkim has been reviewed from previous published and unpublished work related to field geological survey, geomorphic mapping, landslide zonation studies, and geotechnical investigation of actual landslides. The out come of this critical review has resulted in an inventory of landslides (see Table 4.1).

The scope of different studies reviewed varied in terms of emphasis. However in most of the reports/ publications the following aspects were covered:

1. Name of slide / location	Usually named after a locality or a milestone. However exact location is generally not specified in terms of long. and lat. and thus values shown in the inventory need to be corrected.
2. Physiographic Zone	The slide has been placed in relevant zone by us as per the scheme discussed in this report.
3. Geomorphic Characteristics	Information in respect of geometry, area covered,, affected slope and aspect was sought for each landslide. Every publication / report did not contain information on all the aspects.
4. Geologic province and rock type	In most cases only the regional litho-unit within which the landslide is located has been listed. Specific details of site geology are usually lacking.
5. Type of Material / regolith	Surface characteristics of regolith are usually reported. No information on degree/depth of weathering is available.
6. Nature of Mass Movement	Descriptive nature of the mass movement is generally reported, however, the type of movement has not been classified as per the internationally accepted terminology.
7. Structural attributes	In most cases regional joint/ bedding /foliation patterns have been reported. Specific details in respect of the mass involved in the slide are lacking.
8. Causative factors	Overwhelmingly " heavy precipitation" and " cloud bursts" are cited as the trigger. However in no case any information on rainfall data from a rain gauge in close vicinity is actually reported. In most cases no rain gauge site is close enough to provide representative data.

Based on the information cited in the inventory, landslide incidence in the state is controlled primarily by precipitation pattern, lithology, and tectonic framework of the region. Maximum number of slides have been recorded in Daling formation of Lesser

Himalaya (75 %), this is followed by Crystalline complex of Higher Himalaya in which 21 % of slides are located. Landslide incidence is comparatively less in the Buxa and Gondwana (about 4%). Predominance of landslides in Daling formation is further confirmed by Jain (1966) who reported that in the Lish river catchment in the southern part of West Bengal (bordering with Sikkim), 115 out of total 130 landslides (89%) in 19 square mile area occurred in Dalings. East District of the state has maximum number of landslides (66%)in Sikkim.

Table 4.1

INVENTORY OF LANDSLIDES IN SIKKIM HIMALAYA

(BASED ON PUBLISHED AND UNPUBLISHED INFORMATION NOT INTENTENDED TO BE EXHAUSTIVE)

S. No.	Slide name / Location	Physiographic zone/Tectono stratigraphic domains	Geomorphic characteristics (geometry, area covered, affected slope & aspect)	Lihology	Type of material / regolith	Nature of mass movement	Structural attributes	Causative factors	Activated since & Current Status	Authors
East Sikkim										
1	Rangpo Slide Lat $27^0$10'42.6" Long 88^0 31'29.1" 31.8 km. from Gangtok on NH 31A	Lesser Himalaya		Quartz sericite schist, quartz mica schist, phyllites and quartzite	Disintegrated mica schist saturated with water and quartzite boulders	Debris flow and rock fall	Dip 60°-65° northwesterly, strike NW-SE, (?) tightly folded	Heavy precipitation. Gully and toe erosion, with developed pore pressure		Sinha BN (1975) Sarkar S.and Deb R. 1998
2	Burdang slide/20th mile Slide Lat 27^0 12' 57.0" Long 88^0 29' 38.2" 33.5 km. from Gangtok 2 km. South of Singtam NH-31 A	Lesser Himalaya	Width at road 230 m, length 490 m crown to river bed	Phyllite Quartzite of Daling group intruded by thin white quartz veins	Disintegrated boulders of Quartzite, phyllite quartzite mixed in sandy silt matrix	Slump(Chandra) Rock cum debris slide(Mehrotra)	Foliation NNW-SSE to WNW _ ESE ,dip 30° to 75° NE	Very high weathering strong toe cutting presence of shear zone Heavy precipitation/cloudburst	First active in 1968 reactivated in 1970 and 12 and 13 July 1996	Chandra 1975 Meharotra 1994,1995 Kandpal and Sengupta ((2002) Bhasin et.al. 2002
Rishi – Rongli –Padamchen Kupup Road										
3	10th Mile Slide Ranikhola	Lesser Himalaya				Rotational slide, flash flood			Started in Sept. 1970	Chandra 1975

4	9th Mile Slide Lat 27° 16' 44.9" Long 88° 35' 30.9" 14.4 km. from Gangtok	Lesser Himalaya	Altitude ranges 800m.a.s.l.- 2082 m.a.s.l.m (toe and head of the slide) below activated hill slope	Biotite schist, and highly fractured slates!	Sandy clay with fragment of rock pieces	Rotational slide (Chandra) Circular failure with subsidence (Mehrotra)	NW-SE 24° NE	Debris/ soil slump due to pore pressure increase		Chandra 1975 Mehrotra et.al.1994, 1995
5	Songkhala Slide Lat 27° 14' 50.2" Long 88° 31' 45.4" 22.0 km. from Gangtok	Lesser Himalaya		Schist	Soil debris with weathered rock	Debris slide	N-S 70° NE	Mainly due to road cutting in weathered rock mass	1957	Mehrotra et. al.1994,1995
6.	Kuekhola Slide- 31.7 km. from Rishi	Higher Himalaya	Steep slope 40°	Garnetiferous gneiss,	Garnetiferous gneiss, hill slope covered with talus material Talus formed by of gneissic rock with clayey material	Creep, Debris slide	N40 E- S40° W dip 30° due S 50°E joints N40° E – S 40 W dip 30° due S 50° E N50° W -- S50° E vertical N70° E -- S70° W dip due 60° due S 20° E		1966	Sinha B.N. et. al.(1975)
East Sikkim – Gangtok Pakyong –Rangpo Road										
7.	Padamchen Slide Km.33.7 from Rishi	Higher Himalaya	Slide on single slope face 1100 m.a.s.l to 2300, Zone I average slope angle 40° 140 m 15° to 20°. Slope angle of main body for 200m till toe Zone II 100m long 30m wide back tilt angle 15° to 20° average slope 35° to 40° Zone III average slope 25° to 35°	Garnetiferous augen gneiss	Thick deposit of talus material	Complex type essentially a soil type	Rocks dip 40° due E (into the hill slope)joints 45° SW and 65° NW	Excessive saturation increased in gravity and loss of cohesion and internal friction due removal of lateral support	1968	Sinha BN (1975) Natarajan et. al 1984

8	Padamchen I Slide Lat 27° 12' 27.5" Long 88° 35' 16.4" 51.4 km. from Gangtok	Higher Himalaya	Slide width along road 110 m.	Quartzite and phyllite	Small pieces of rock Clayey material	Rock slide with sinking zone	NE-SW 45° NW	Highly weathered rock mass, seepage zone		Mehrotra G.S. et. al 1994,1995
9	Padamachen II Slide Lat 27° 12' 45.6" Long 88° 34' 40" 54.4 km .from Gangtok	Higher Himalaya	Slide width along road 60 m.	Phyllite and quartzite	Disintegrated rock with silty clay soil	Rock slide (planar failure)	NE-SW 40° NW	Highly weathered and crushed material, unfavorable bedding road cutting		Mehrotra G.S. et.al 1994,1995
10	Padamachen	Higher Himalaya	1500ft. deep wide toe, slope uphill 45-50°, downhill 50-55° the entire slide area is devoid of vegetation, weathered soil and boulders to a depth of 30ft.	Bands of schist and gneiss	Average sized boulders with clays/ shales and fissured lime stones	--	--	--do--		Diddi 1975, Works Engieers, Palam (AF)
11.	Samsing Slide Lat 27° 15' 16.4" Long 88° 36' 12.7" 22.1 km. from Gangtok		Slide width along road 60 m	Weathered schist	Disintegrated rock with clayey soil	Rock slide (planar failure along bedding plane, sinking zone)	NNE - SSW 55° ESE	Highly weathered rock mass, unfavorable foliation plane		Mehrotra G.S. 1994,1995
12	Nam Chung Slide Lat 27° 14' 56.7" Long 88° 36' 21.8" 24.8 km. from Gangtok		Slide width along road 40 m	Weathered phyllite	Disintegrated rock Clayey soil	Rock slide	NW-SE 20° NE	Highly weathered rock Unfavorable bedding plane		Mehrotra G.S. 1994
13	Pache Slide Lat 27° 14' 46.9" Long 88° 37' 20" 31.0 km. from Gangtok		Slide width along road 90 m	Weathered schist	Rock pieces with silt clay soil	Rock slide (planar failure)	NW-SE 38° NE	High weathering, unfavorable bedding plane		Mehrotra G.S. 1994,1995

14	Lusing Slide Lat 27^0 12' 40.6" Long 88^0 36' 21.8 "47.4 km from Gangtok		Slide width along road 80 m	Schist	Small fragments of rock chips with sandy soil	Debris slide	NE- SW 20° NW	Loose rock debris		Mehrotra G.S. 1994,1995
15	Pachak I Slide Lat 27^0 13' 0.3" Long 88^0 34' 18.2" 55.9 km. from Gangtok		Slide width along road 50 m	Quartzite, schist	Highly weathered gauge material,	Rock cum debris slide	N-S 32° Westerly	Highly weathered gauge material, fault / shear zone road cutting		Mehrotra G.S. et al 1994,1995
16.	Pachak II Slide Lat 27^0 12' 58.7" Long 88^0 33' 43.6" 57.4 km. from Gangtok		Slide width along road 50 m	Phyllite	Boulder and rock pieces embedded in sandy soil	Rock slide	E-W 36° N	Steep slope highly crushed and sheared rock mass toe erosion		Mehrotra G.S. et. al 1994,1995
17.	Tsochen -Pheri Slide Lat 27^0 15' 30" Long 88^0 42' 30" 23 km. from Pakyong--Rolep - Rongli road	Higher Himalaya	Affected area 3 sq km. 940m m.a.s.l Rongpo Chu to 2260 m.a.s.l Ridge line	Ferruginous quartzite with intercalation of phylites, Aguen and banded gneiss, quartzite	Highly weathered bed rock material and quaternary deposits colouvial material is formed of angular fragments of rocks in sandy matrix,	Slumping , rock slide, mud flow , slope failure where ever slope exceeds 25	N55° E - S55° W dipping due SE	Unusual rain fall and cloud bursts	June 1995	Sharma A.K. 1998
Rangpo – Rorathang –Lingtham Road										
18	Gangate Slide Lat 27^0 11' 20.3" Long 88^0 33' 30.9" 5.0 km. from Rangpo		Slide width along road 520 m	Schist	Weathered rock mass	Rock cum debris slide	NW- SE 34° SE	Weathered rock mass, fault / shear zone, folded strata unfavorable beds, toe erosion		Mehrotra G.S. et al 1994,1995

19	Bhasme I Slide Lat 27° 11' 26.9" Long 88° 35' 7.3" 9.4 km. from Rangpo		Slide width along road 30 m	Phyllite	Weathered phyllite	Rock slide (planar failure)	NE - SW 34° SE	Weathered foliated phyllites unfavorable beds road excavation, toe erosion		Mehrotra G.S. et. al 1994,1995
20	Bhasme II Slide Lat 27° 11' 36.7" Long 88° 35' 40" 13.1 km from Rangpo		Slide width along road 60 m	Phyllite	Weathered rock mass	Rock cum debris slide	NE - SW 23° SE	Weathered rock mass nala erosion		Mehrotra G.S. et. al 1994,1995
21	Pachekhani Slide Lat 27° 11' 46.6" Long 88° 36' 23.6" 13.4 km. from Rangpo		Slide width along road 50 m	Schist	Weathered schist	Rock slide (planar failure)	E-W 58° S	Weathered schist folded strata, unfavorable discontinuity planes		Mehrotra G.S. et. al 1994,1995
22	Tarkin Slide Lat 27° 11' 13.8" Long 88° 38' 0" 17.6 km. from Rangpo		Slide width along road 45 m	Schist	Weathered rock mass	Debris slide (slump type)	NE-SW 20° SE	Weathered rock mass, shear zone toe erosion		Mehrotra G.S. et. al 1994,1995
23.	Suntalitar I Slide Lat 27° 12' 3" Long 88° 38' 34.5" 17.9 km. from Rangpo		Slide width along road 50 m	Weathered phyllite	Highly weathered and pulverized material	Rock slide	E-W 50° S	Highly weathered and pulverized material, road excavation		Mehrotra G.S. et.al 1994,1995
24	Suntalitar II Slide Lat 27° 12' 19.3" Long 88° 39' 45.5" 20.4 km. From Rangpo		Slide width along road 55 m	Highly weathered geniss	Boulder and rock fragment	Rock cum debris slide	NW- SE 20° NE	Highly weathered gneiss, fault zone		Mehrotra G.S. et. al 1994,1995
25	Suntalitar III Slide Lat 27° 12' 19.3" Long 88° 40' 14.5" 21.4 km. from Rangpo		Slide width along road 60 m	Thinly bedded schist and faulted breccia	Friable and highly weathered rock	Rock slide (planar failure)		Highly weathered and pulverized rock, fault/zone		Mehrotra G.S. et. al.1994,1995

26	Aritar Slide Lat 27^0 11' 59.7" Long 88^0 40' 9.1" 31.7 km from Rangpo		Slide width along road 30 m.	Gneiss	Boulders and small rock fragments with sandy soil	Rock cum debris slide	N- S 30° E	Highly weathered and crushed gneiss, fault zone		Mehrotra G.S. et. al 1994,1995
27	Rongli Slide Lat 27^0 12' 11.1" Long 88^0 42' 1.8" 26.4 km. from Rangpo		Slide width along road 80 m.	Garnetiferrous schist	Rocky pieces with sandy soil and fault breccia	Rock slide	NW-SE 27° NE	Highly weathered schist fault zone		Mehrotra G.S. et.al 1994, 1995
28	Lingtham Slide Lat 27^0 13' 21.6" Long 88^0 44' 12.7" 38.8 km. from Rangpo		Slide with along road 15 m	Gneiss	Boulders with loose sandy soil	Debris flow	NW-SE 75° SW	Loose boulders, steep slope		Mehrotra G.S. et.al 1994
Gangtok										
29	Tathangchen	Lesser Himalaya	1300 – 1700 masl 50,000 sq m	Schists		Composite, schistosity controlled in the upper part; slumping in the lower part.			1960	Gergan et.al.1987 Tashi T. 1994 Tashi T. et.al 1996 Krishna 1997 Bhasin et.al. 2002
30	Chandmari	Higher Himalaya	1900 – 2000 m.a.s.l 8000 to 10000 sq m	Gneiss		Debris flow				Gergan et.al.1987 Tashi T. 1994 Tashi T. et.al 1996 Krishna 1997 Bhasin et.al. 2002
East Sikkim Gangtok Nathula Road										
31	Panchmil I Slide Lat 27^0 21' 35.1" Long 88^0 38' 43.6" 8.5 km. from Gangtok		Slide width along road 100m	Hornblend gneiss with mica flakes	Boulders and weathered rock fragments embedded In clayey soil	Rock- cum debris slide	NE-SW 45° SE	Weathering of micaceous material , steep slope		Mehrotra. et.al.1994,1995

32	Panchmil II Slide Lat 27^0 21' 43.3" Long 88^0 38' 41.8" 9.5 km. from Gangtok		Slide width along road 30 m	Fine grained hornblend gneiss	Boulders and weathered rock fragments	Rock slide (planar failure)	NW-SE 36^o NE	Weathering of gneiss Toe erosion, unfavorable discontinuities		Mehrotra et. al. 1994,1995
33	Panchmil III Slide Lat 27^0 21' 49.8" Long 88^0 38' 52.7" 10.0 km. from Gangtok		Slide width along road 50m	Quartizite and geisses	Debris consisting of rock pieces and sandy soil	Rock cum Debris slide	NNE- SSW 34^o ESE	Gully erosion debris slide due to high pore pressure		Mehrotra et.al.1994,1995
34	Km 13 Slide Lat 27^0 22' 17.7" Long 88^0 40' 45.4" 13.0 km. from Gangtok		Slide width along road 240 m	Gneiss	Rock pieces with Clayey soil	Rock cum debris slide	NW - SE 20^o NE	Toe erosion highly weathered pulverized material		Mehrotra et.al.19941995
35	Dosmil Slide Lat 27^0 22' 50.5" Long 88^0 42' 45.4" 20.0 km. from Gangtok		Slide width along road 150 m	Augen gneiss	Weathered gneiss, Rock pieces and boulders of varying sizes	Rock slide (topple failure)	N-S 35^o easterly dip folded strata	Weathered gneiss, failure along fissures, heavy rain fall		Mehrothra. et.al. 1994,1995
36	Kyangnosa Slide Lat 27^0 22' 25.9" Long 88^0 42' 43.6" 60.0 km. from Gangtok		Slide width along road 60 m	Garnetiferous agune gneiss	Rock debris with sandy soil	Rock cum debris flow	N-S 45^o easterly dip	Cloud burst unfavorable discontinuities nala erosion		Mehrothra et..al 1994,1995
Gangtok – Dikchu – Singtam Road										
37.	Majadhari Slide Lat 27^0 21' 44.9" Long 88^0 37' 18.2" 8 km. from Gangtok		Slide width along road 40 m	Gneissis boulders no orientation	Large boulders with sandy soil	Debris slide		Perennial water flow Steep slope, road cutting		Mehrothra et.al.1994,1995
38	Lingdong Slide Lat 27^0 16' 43.3" Long 88^0 27' 1.8" 42.4 km. from Gangtok		Slide width along road 30 m	Quartzite schist	Disintegrated rocks with boulders and sandy soil	Rock cum debris slide	N-S 50^o easterly	Highly weathered rock With nala erosion		Mehrothra. et. al. 1994,1995

39	Khamdong I Slide Lat 27^0 15' 27.9" Long 88^0 27' 32.7" 36. 2 km from Gangtok		Slide width along road 170m	Quartzite schist	Boulders of varying sizes coarse sandy soil	Debris slide with subsidence (rotational failure)	NNW-SSE 40° ENE	Highly weathered formation fault zone, toe erosion		Mehrothra. et.al. 1994,1995
40	Khamdong II Slide Lat 27^0 14' 53.4" Long 88^0 28' 45.5" 33.2 km. from Gangtok		Slide width along road 40 m	Highly weathered schist	Weathered rock with Coarse textured soil	Debris slide	NW-SE 45° easterly dip	Fault, high degree of weathering, road excavation, toe erosion		Mehrothra. et.al.1994,1995
41	Sirwani Slide Lat 27^0 14' 32.1" Long 88^0 29' 14.6" 32.0 km. from Gangtok		Slide width along road 400 m	Quartzite, schist	Boulders and rock With clayey soil	Rock - cum debris Slide(rotational failure)	N-S 30° easterly dip	Highly weathered, fault zone, sheared rock mass, steep slope, toe erosion		Mehrothra. et. ai. 1994,1995
42	7th Mile Slide 11-12 km. from Gangtok on G.N. road	Higher Himalaya	Slopes: uphill 30°, down hill 40°, length 2800ft, width 1300ft	Biotite gneiss covered with thick slope wash material	Slope wash with disintegrated rock pieces	Debris slide (slump type)	Rocks dip 40°E, two sets of joints fault in basement rock	Thick talus deposit failed under heavy saturation by rain Annual rainfall 200inches	Activated since 1966	Sinha (1975) Raghuraman, 1975
North Sikkim –Gangtok – Chungthang Road										
43	B 2 Slide 20 km. from Gangtok	Higher Himalaya	Length of slide 600m approximately width 440 m. slope in the vicinity of road 10° to 15° down hill slope 40°	Gneiss, pegmatite	Boulders of varying sizes in matrix of fine sandy silt	Toe erosion, movement planar over wedged shaped rock	Bed rock not exposed	Toe erosion ,	1965	Natarajan. et al 1984
44	Old Mangan bazar Slide	Higher Himalaya		Bed rock not exposed	Fragments of gneissic rock material thick cover of clouvial material	Toe erosion, slumping		Intense erosion by Rafong river		Jan Otto Larsen 2000

45	Vong Slide Named as Richu I by Natarajan T.K.et.al. 1984 82.3 km from Gangtok	Higher Himalaya	Slope from road to Teesta 45°	Biotite-tourmaline granite and gneiss with aplite and pegmatites	Fragments of gneissic rock mixed with sandy and silty material	Debris flow and debris avalanche Toe erosion		Heavy precipitation causing valley widening activities along Teesta and gully erosion by the adjoining tributary,	First active in 1961	Sinha (1975) Natarajan T.K. et.al.1984
46	New Vong Slide Richu II by 83.6km from Gangtok Natarajan T.K. et al. 1984	--do--	Crown of the slide is 800ft.vertical height from road level, uphill slope vary between 40 to almost vertical, down hill slopes 30-40. river Teesta at the toe at a distance of 250ft.	---- do ----		Combination of debris flow cum debris avalanche, (Shooting and falling boulders)	None	Debris flow due to springs generated by very heavy rain fall, gully erosion by nala on the main face, toe erosion by river Teesta and higher percolation of water on disturbed surface-activating deeper movements	Started in 1961 monsoon, became the major one in 1965.	Raghuraman,S. 1975 Diddi 1975 Natarajan T.K. et al.1984
47	Namnsa Slide Stretches between 120.50 km. and 125 km.	Higher Himalaya	Valley slope $50^0$to 60^0	Gneiss, highly jointed	Moraine deposits			Yakchu nalla got blocked due to avalanche, bursting of blocked lake caused erosion of moraines	4^{th} June 1982	Natarajan et.al 1974
48	Myang Slide Near Myang nala 79.5 km. from Gangtok	Higher Himalaya		Left bank cherty quartzite, right bank granite gneiss	Quartzite blocks on left bank and gneissic rock fragments in clay material on right bank	Rock fall on left bank and debris slide on right bank	Dip of quartzite beds 50°NE, Granite gneiss dip 40°-50°NE	Rock fall along parallel joint plane due to vibration after saturation due to heavy rainfall. Debris slide due to pore pressure and reduced shear strength.		Sinha (1975) Natarajan et al. 1984
49	Lanta Khola Near Myang nala 73 km from Gangtok North Sikkim	Higher Himalaya		Gneisses and schist	Boulder of varying sizes in loose sandy silt of schistose origin	Debris flow, very high erosion due to torrential rains		Heavy erosion and debris flow caused by torrential rains, Course changing tendency of Lanta Khola, Cloud burst	1983	Natarajan. 1983 Gosh et.al.(2002)

50	Manul Slide I Km 74 km from Gangtok	Higher Himalaya	Toe at 1190masl crown at 1900 m.a.s.l slope angle 38^0 to 58^0	Highly weathered and fractured Granite gneiss and cherty quartzite	Pulverized slope wash material consisting sand and silt with granite boulders 10 to 15 m in size	Debris flow	Dip 30°-40° NE, rocks are jointed and fragmentary. Two faults make a graben block	Fault, toe erosion and sudden overflow due to heavy rainfall by Manul Chu I (stream)	1966	Sinha et.al.(1975) Natarajan. et. al. 1984
51	Manul Slide II Km 76 km From Gangtok	Higher Himalaya	1300m above the road 300 m wide 400 m in length slide Paleo land slide		Silty sand with boulders of 8to 10m	Debris flow		Intense erosion during rains	Sept 1983	Natarajan. et. al. 1984
52	Rang Rang Slide Between km 59-65 on North Sikkim highway	Lesser Himalaya	Slopes ranges between 20^0- 40^0 width of lowest tier 500 feet	On Mangan side garnet ,muscovite/ biotite schist (highly weathered) are exposed on Gangtok side they are less weathered	Slope wash material	Debris slump with soil cum boulder mass		Debris slump due to pore pressure and reduced shear strength. High discharge of nallas and springs lack of free drainage	Active since 1962 maximum damage Oct.1968	Raghuraman, 1975 Sinha et.al.1975 Sharma. 1995
53	Melli bazar Slide WB?	Higher Himalaya	South-East facing slope, Covered area 600 ha.		Slope wash material	Debris flow		Debris slump due excessive wetting/ pore pressure increase		Chandra 1975
54	Sangse Slide 1km South of Rangpo1km. South of Rangpo	Higher Himalaya				Very large rotational slide				Chandra 1975
55	Tar Khola 2 km. further towards Rangpo	Higher Himalaya	Catchment 1400 ha.							Chandra 1975
56	Tumthang Khola 4km South of Rangpo	Higher Himalaya	Catchment 1800 ha.						Oct. 1968	Chandra 1975

East Sikkim – Gangtok Singtam Rangpo Road										
57	Burdang slide/20th mile Slide Lat 27° 12' 57.0" Long 88° 29' 38.2" 33.5 km. from Gangtok	Lesser Himalaya		Phyllite and quartz	Boulders and disintegrated rock pieces, sandy soil	Slump(Chandra) Rock cum debris slide(Mehrotra)	NW-SE 55° NE	Very high weathering strong toe cutting presence of shear zone	Started in 1970	Chandra 1975 Meharotra 1994,1995
58	10th Mile Slide Ranikhola	Lesser Himalaya				Rotational slide, flash flood			Started in Sept 1970	Chandra 1975
59	9th Mile Slide Lat 27° 16' 44.9" Long 88° 35' 30.9" 14.4 km from Gangtok	Lesser Himalaya	Altitude ranges 800m-2082m (head and toe of the slide) below activated hill slope	Biotite schist, and highly fractured slates!	Sandy clay with fragment of rock pieces	Rotational slide (Chandra) Circular failure with subsidence (Mehrotra)	NW-SE 24° NE	Debris/ soil slump due to pore pressure increase		Chandra 1975 Mehrotra et.al.1994, 1995
60	Songkhala Slide Lat 27° 14' 50.2" Long 88° 31' 45.4 22.0 km. from Gangtok			Schist	Debris of weathered rock	Debris slide	N-S 70° NE	Mainly due to road cutting in weathered rock mass	1957	Mehrotra et. al.1994,1995
Melli –Jorthang Road, South Sikkim										
61	Melli Slide Lat 27° 5' 2.93" Long 88° 26' 39.45"1. 4 km. from Melli	Lesser Himalaya		Phyllite, weathered, crushed and pulverised	Big boulders embedded in clayey soil mass	Rock cum debris slide	N80° E- S 80° W dip 40° to N 10° W	Highly weathered and pulverized material, heavy water flow, toe erosion		Mehrotra et.al. 1995
62	Ratmatey compound - Salingay landslides and Bagwa sinking area Lat 27° 07' N Long 88° 20' E 80 km. from Gangtok	Lesser Himalaya	Slide affected area 300 to 900 m.a.s.l steep slope	Phyllite of Daling group						
63	Sumbuk Slide Lat 27° 5' 33.26" Long 88° 22' 21.82" 10.5 km. from Melli	Lesser Himalaya		Phyllite and quartzite	Loose rock with soil mass	Rock cum debris slide	N20° E-S 20° W dip 20° to N70° W	Weathered and folded rocks toe cutting		Mehrotra et. al. 1995

64	Gam Slide Lat 27^0 6' 25.63" Long 88^0 20' 21.82" 19.0 km. from Melli	Lesser Himalaya		Thinly bedded folded phyllites	Huge blocks of rocks with loose soil mass	Rock cum debris slide	N65° E-S65° W dip 41° to N25° W	Mainly due toe cutting by river, weathered and jointed rocks		Mehrotra et.al 1995
65	Manjhitar Slide Lat 27^0 6' 32.97" Long 88^0 19' 22.91" 20.4 km from Melli	Lesser Himalaya		Thinly bedded fractured interbedded phyllites and quartzite	Loose rock pieces with red clayey soil	Debris slide	N75°W-S75° E dip 50° to N15° E	Fractured and Weathered phyllitic rocks		Mehrotra et. al. 1995.
66	Baisalu Slide Lat 27^0 7' 3.33" Long 88^0 18' 9.82" 24.0 km. from Melli	Lesser Himalaya		Thickly to thinly bedded, fractured and jointed quartzite	Small blocks of rocks with little amount of soil	Rock slide	N55° W - S55° E dip 33° to N35° E	Highly crushed fractured and jointed quartzite, unfavorable bedding plane		Mehrotra et. al. 1995
67	Jorethang Slide Lat 27^0 6' 35.41" Long 88^0 17' 27.27" 26.0 km. from Melli	Lesser Himalaya		Jointed and fractured phyllites and quartzite	Highly weathered rocks with huge amount of loose soil mass	Rock cum debris slide	N40° E- S40° W dip 40° S50° E joints N55° / N 215° N350° / 45°/N260°	Highly weathered formation major sliding along the fold axis, soil and toe erosion by Rangit river		Mehrotra et.al. 1995
Jorthang – Namchi – Namthang Road										
68	Nandu Slide Lat 27^0 9' 21.33" Long 88^0 18' 12" 4.6 km. from Jorethang	Lesser Himalaya		Quartzite	Weathered jointed and fractured quartzite with loose soil	Debris slide	N5° E - S5° W dip 25° to S85° E	Weathered jointed and fractured quartzite, unfavorable joint plane and road cutting		Mehratora et. al. 1995
71	Dhaphgaon Slide Lat 27^0 9' 31.11" Long 88^0 19' 24" 10.5 km from Jorethang	Lesser Himalaya		Quartzite	Clayey wet soil with little loose rock pieces	Debris slide	N85° E - S 85°W dip 25° to S85° E	Clayey material with heavy water flow on slope road cutting		Mehratora et. al .1995
72	Denchong Slide Lat 27^0 9' 29.15" Long 88^0 19' 29.45" 10.9 km. from Jorethang	Lesser Himalaya		Quartzite	Huge boulders and loose rock pieces with clayey soil	Rock cum Debris	N85° E - S85° W dip 26° N5° W	Crushed and pulverized, highly weathered rock		Mehratora. et.al. 1995

73	Asangthang Slide Lat 27^0 9' 24.26" Long 88^0 19' 26" 13.4 km from Jorethang	Lesser Himalaya		Quartzite	Loose boulders and rock pieces with clayey soil	Rock cum debris slide	N40° W - S40° E dip 41° to N50° E	Highly weathered and fractured rocks heavy water seepage at center of slide and road cutting		Mehratora G.S. et. al. 1995
74	Phalidonda Slide I Lat 27^0 10' 6.85" Long 88^0 23' 12" 16.9 km. from Jorethang	Lesser Himalaya		Quartzite	Highly weathered and fractured rock with clayey soil	Rock cum debris slide	N40° W - S40° E dip 41° to N50° E	Highly weathered and fractured rocks heavy water seepage at the center of the slide area and road cutting		Mehrotra et. al. 1995
75	Phalidonda Slide II Lat 27^0 10' 2.93" Long 88^0 23' 14.18" 17.6 km. from Jorethang	Lesser Himalaya		Quartzite	Weathered rock with loose soil mass	Debris slide	N65° W - S65° E dip 24° to S25° E	Weathered and crushed rocks unfavorable bedding and road cutting		Mehrotra et.al 1995
76	Phalidonda Slide III Lat 27^0 10' 15.36" Long 88^0 23' 14.73" 17.8 km from Jorethang	Lesser Himalaya		Phlyllite with thinly bedded quartzite	Loose weathered soil debris with rock pieces	Debris slide	N55° W - S55° E dip 22° to S345° W	Weathered and fractured rocks , accumulation of debris on the slope road cutting		Mehrothra et.al.1995
Damthang – Namchi Sumbuk Road										
77	Jaubari Slide Lat 27^0 11' 32.48" Long 88^0 23' 33.82" 5.9 km from Damthang	Lesser Himalaya		Interbedded quartzite and phyllite with quartz veins	Blocks of rocks with little rock pieces and loose soil	Rock cum debris slide		Erosion of rock due to continuos flow of water, weathered rock		Mehrothra et.al. 1995
Legship – Rabong Road										
78	Legship Slide I Lat 27^0 17' 33.65" Long 88^0 16' 31.64" 0.5 km from Ligship	Lesser Himalaya		Quartzite and phyllite	Few boulders and loose rock pieces with weathered loose debris	Debris slide		Heavy water infiltration highly weathered rocks, road cutting		Mehrothra et. al. 1995
79	Legship Slide II Lat 27^0 18' 2.54" Long 88^0 17' 1.09" 0.8 km from Ligship	Lesser Himalaya		Phyllites and quartzite	Big boulders and small rock pieces with clayey soil	Rock cum debris slide	N10° E - S10° W dip 49° to N80° W	Highly weathered rocks road cutting		Mehrothra et.al. 1995
80	Legship Slide III Lat 27^0 18' 5.48" Long 88^0 17' 6.55" 1.5 km from lLigship	Lesser Himalaya		Quartzite and phyllite	Highly weathered rock pieces with clayey soil and few boulders	Rock cum debris slide (planer failure along bedding)	N5 E - S5 W dip 50 to N85 W	Heavy infiltration, weathered rock unfavorable bedding , road cutting		Mehrothra et. al. 1995

81	Lungchok SlideLat 27° 18' 2.54" Long 88° 18' 20.73" 10.3 km from Ligship	Lesser Himalaya		Phyllites and quartzite	Big boulders with huge amount of rock pieces and clayey soil	Rock cum debris slide	N65° E S 65° W dip 32° to N25° W	Fractured rocks folded strata and road cutting		Mehrotra et al. 1995
82	Rabong Slide Lat 27° 18' 12.33" Long 88° 22' 21.82"	Lesser Himalaya		Quartzite and phyllite jointed and fractured	Huge boulders with loose rock pieces and clayey soil	Rock cum debris slide	N80 E S80 W, dip 12 to N10 W	Weathered and jointed rocks, high infiltration of water		Mehroatra et. al. 1995
83	Pathing Slide Lat 27° 17' 27.78" Long 88° 23' 22.91"	Lesser Himalaya		Phyllite well jointed and fractured	Huge boulders with loose rock pieces which are highly crushed and pulverized	Rock cum debris slide (planer failure)	N10° E S10° W, dip 35° to S80° E	Heavy rainfall, unfavorable joint plane		Mehrotra. et. al 1995
84	Satam Slide Lat 27° 17' 6.26" Long 88° 24' 13.09"	Lesser Himalaya		Micaceous quartzitic phyllites, jointed and fractured	Blocks of rocks with weathered loose rock pieces and little amount of soil	Rock cum debris slide	N10 E° - S10° W dip 37° to S80° E	High infiltration of water, jointed and sheared, road cutting, open joints with gauge material		Mehrotra et. al 1995
85	Yongang SlideLat 27° 17' 3.32" Long 88° 24' 26.18"	Lesser Himalaya		Quarzitic phyllites, fractured and jointed	Loose rock pieces with clayey wet soil few boulders	Debris slide	N80 E - S80 W, dip 25 to N10 W	Weathered rocks, high infiltration, toe cutting		Mehrotra. et al 1995
86	Mangzing Slide Lat 27° 19' 9.59" Long 88° 20' 22.91"	Lesser Himalaya		Quartzitic phyllites, jointed fractured and crushed	Rock boulders with Loose rocks and clayey soil mass	Rock cum debris slide (sinking zone)	N65° E _ S65° W dip 41° to S25° E	Highly weathered and jointed rocks, poor vegetation, toe cutting by nalla, road cutting, sinking zone		Mehrotra et al 1995
87	Dethang Slide Lat 27° 19' 15.46" Long 88° 22' 6.55"	Lesser Himalaya		Quartzititic pyllites	Weathered and fractured	Rock cum debris slide	N35° W - S35° E dip10° to N55° E	Weathered and jointed rock mass road cutting		Mehrotra et. al 1995.
88	Lingdam Slide Lat 27° 15' 21.28" Long 88° 21' 15.06"	Lesser Himalaya		Quartzitic phyllite	Loose rock with clayey soil mass	Rock cum debris slide (partly planar failure)	N75° E - S75° W, dip 21° to S 15° E	Unfavorable bedding, erosion of soil and road cutting		Mehrothra et al 1995

Singtham – Damthang Rabong Road										
89	Daring SlideLat 27^0 14' 20.35" Long 88^0 27' 27.27" 5.5 Km from Singtham	Lesser Himalaya		Phyllite	Accumulated soil debris with highly weathered rock pieces,	Rock cum debris slide		Highly weathered rock mass with nala cutting on the slope		Mehrothra et. al 1995
90	Amlai Slide Lat 27^0 14' 17.41" Long 88^0 27' 16.36" 6.0km from Singtham	Lesser Himalaya		Phyllite	Loose debris with rock pieces	Rock cum debris slide		Weathered rock mass, heavy water seepage and leakage through drains		Mehrotra et. al 1995
91	Tanak Slide Lat 27^0 14' 20.35" Long 88^0 27' 2.18" 9.0 km from . Singtham	Lesser Himalaya		Phyllitic quartzite	Loose rock pieces with little soil mass	Rock slide (wedge failure)		Weathered rock unfavorable bedding and joint planes forming wedge, road cutting		Mehrothra et al 1995
92	Nambhing Slide Lat 27^0 13' 32.87" Long 88^0 28' 17.45" 9.5 km from Singtham	Lesser Himalaya		Weathered phllitic quartzite	Loose soil mass with little rock pieces	Debris Slide		Highly weathered rock mass highly saturated		Mehrothra et al 1995
93	Tokal Slide Lat 27^0 13' 28.96" Long 88^0 28' 24" 9.9 km from Singtham	Lesser Himalaya		Phyllitic quartzite	Boulders and loose rock fragments embedded in clayey soil	Rock cum debris slide		Weathered rock mass, road cutting		Mehrotra et al 1995
94	Tarku Slide Lat 27^0 15' 0.98" Long 88^0 26' 15.82" 12.5 km from Singtham	Lesser Himalaya		Weathered phyllite	Clayey soil mass with rock fragments	Rock cum debris slide (sinking zone)	N20° E - S20° W, dip 20° to S70° W	Weathered rock, zone of subsidence		Mehrotra. et al 1995
95	Ranking Slide Lat 27^0 14' 33.06" Long 88^0 22' 13.09" 39.5 km from Singtham	Lesser Himalaya		Thinly bedded phyllite	Weathered and fractured rock mass with little soil	Rock slide (planar failure)	N10° W - S10° E dip 30° S80° E	Unfavorable bedding plane, dipping out outwardly, road cutting highly weathered and fractured rock mass		Mehrothra et. al 1995
96	Ningang Slide Lat 27^0 16' 17.08" Long 88^0 22' 19.64" 2.8 km from Robong	Lesser Himalaya		Thickly beddedand fractured quartzite and phyllite	Huge quantity of crushed rock pieces embedded in soil mass	Debris slide	N 75° E - S75° W dip 15° to N15° W	Unfavorable discontinuity, highly weathered and crushed rock mass		Mehrothra et al 1995

97	Chirak SlideLat 27° 15' 27.39" Long 88° 23' 9.82" 8.3 km from Robong	Lesser Himalaya		Well foliated phyllite	Loose soil with little rock pieces	Debris slide	E - W dip 15° N	Road cutting, weathered rock		Mehrothra et al 1995
98	Phyaku Slide Lat 27° 15' 19.56" Long 88° 24' 2.18" 9.4 km from Robong	Lesser himalaya		Phyllitic quartzite	Boulders with loose debris	Rock cum debris slide	N65° W S65° E dip 20° to N25° E	Weathered and saturated rock mass		Mehrothra et al 1995
99	Sinkharka Slide Lat 27° 14' 18.39" Long 88° 24' 28.91" 12.0 km from Robong	Lesser Himalaya		Thickly beded phyllitic quartzite	Huge boulders with rock pieces and loose soil mass	Rock cum debris slide	N60° W - S6° E dip 30° to N30° to N30° E	Highly crushed zone, steep slope		Mehrothra et al 1995
Jorethang – Gyalzing Road, West Sikkim										
100	Naya Bazar Slide Lat 27° 8' 17.22" Long 88° 16' 30.55" 1.0 Km from Jorethang	Lesser Himalaya		Quartzite	Highly weathered rock pieces with loose soil mass	Debris slide	N45° E - S45° W, dip 54° to N45° W	Highly weathered rocks , debris accumulation on slope		Mehrothra. et al 1995
101	Jhum Slide Lat 27° 8' 33.85" Long 88° 16' 32.73" 20.4 km from Jorethang	Lesser Himalaya		Quartzite	Loose clayey soil mass with little rock pieces, gaugy material	Debris cum rock slide	N50 - S50 W , dip 50 to n50 W	Highly weathered jointed and fractured rock mass, toe erosion road cutting and subsidence zone		Mehrothera. et al 1995
102	Samsingh Slide Lat 27° 9' 7.63" Long 88° 17' 12" 5.3 km from Jorethang	Lesser Himalaya		Phyllite thinly bedded, jointed and fractured	Clayey wet soil with loose powdery rocks	Debris slide	N80° W - S80° E, dip 30°, N10° E Joints N340° /40° / N70° N60°/ N150°	Debris accumulation on the slope, weathered rock inter bedded nature of quartzite and phyllite		Mehrothra el al 1995
103	Mabong Slide Lat 27° 10' 24.95" Long 88° 18' 21.82" 7.8 km from Jorethang	Lesser Himalaya		Interbedded quartzite and phyllite and jointed, fractured and folded	Loose soil mass with small fragments of rocks.	Rock cum debris slide	N70 W - S70 E dip 65 to N20 E	Highly weathered and fractured rocks, folded and inter bedded strata, Failure along joints plane N355/45/N85		Mehrothra et al 1995

104	Kamling Slide Lat 27^0 11' 20.74" Long 88^0 19' 28.36" 11.1 km from Jorethang	Lesser Himalaya		Shales and sand stone interbedded jointed and fractured	Huge boulders of rock with loose clayey soil	Rock cum debris slide	N50° W - S50° E, dip 35° to N40° E	Weathered jointed rocks toe erosion		Mehrothra et al 1995
104	Rahu Slide - I Lat 27^0 12' 7.24" Long 88^0 19' 17.45" 13.4 km from Jorethang	Lesser Himalaya		Thinly bedded phyllite, higly weathred and crushed	Mud flow consisting of clayey soil with small pieces of rock	Mud flow	N85° E -S85° W, dip 43° to N5° W	Weathered rocks heavy flow of water at many places on the slide		Mehrothra . et al 1995
106	Rahu Slide -IILat 27^0 12' 27.78" Long 88^0 19' 9.82" 14.5 km from Jorethang	Lesser Himalaya		Dolomite and slate, interbeded, folded and jointed,sheared and crushed	Loose rock pieces with black colour soil mass	Rock cum debris slide	N80° E- S80° W, dip 43° to N5° W	Highly weathered, fractured sheared and folded, toe erosion and road cutting		Mehrothra et al 1995
107	Rishi SlideLat 27^0 13' 21.13" Long 88^0 16' 22.91" 5.9 km from Jorethan1g	Lesser Himalaya		Thickly bedded, jointed and fractured quartzite	Blocks of rock pieces with loose clayey soil mass	Rock cum debris slide	N85° - S85° E, dip 69° to N5° E	Unfavorable bedding plane, jointed and fractured rock , toe erosion		Meherothra et al 1995
108	Namgaon Slide Lat 27^0 14' 16.43" Long 88^0 17' 2.18" 19.6 km from Jorethang	Lesser Himalaya		Thinly bedded and fractured dolomite and slate	Huge rock pieces with little soil mass	Rock cum debris slide	N55° E - S55° W, dip 34° to N35° W	Highly weathered , fractured and well foilated rocks road cutting toe erosion		Mehrothra et al 1995
109	Mayong Slide Lat 27^0 15' 3.91" Long 88^0 16' 29.45" 21.0 km from Jorethang	Lesser Himalaya		Weathered Dolomite and Slates	Loose rock pieces with huge quantity of clayey soil mass	Debris slide	N85° W - S85° E, dip 49° to N5° E	Highly weathered dolomite road cutting		Meharothra et al 1995
110	Bungdam Slide Lat 27^0 15' 20.54" Long 88^0 17' 3.27" 21.5 km from Jorethang	Lesser Himalaya		Thinly bedded dolomite and slates jointed and fractured	Rock boulders and loose rock fragments	Rock fall	N60° E _ S60°W, dip 42° to N30° W	Highly jointed and fractured rocks		Mehrothra. et al 1995
111	Gompa Slide Lat 27^0 17' 8.22" Long 88^0 15' 9.82" 34.5 km. From Jorethang	Lesser Himalaya		Thinly Bedded foliated and folded phyllite	Huge weathered rock pieces with wet clayey soil mass	Debris slide	N10° W-S10° E, dip 44° to S80° W	Highly weathered rocks unfavorable bedding, toe erosion by nalla		Meharothra et.al.1995

West Bengal										
112	Beric Slide WB Km 12 on NH 31A	Higher Himalaya		Orthoquartzites with bands of dark grey phyllites	Fragments of quartzite, phyllite and slope wash	Rock fall and debris slide	Dip 40°-50° northwesterly, strike NE-SW isoclinal folds, three sets of prominent joint planes	Heavy precipitation. Toe erosion, failure under water saturation and increase in weight		Sinha (1975)
111	Beric Slide WB	Higher Himalaya	Fairly steep hill face, crest of the hill at the site 40-200m above the road	Highly deformed limestone, quartzite, phyllite and schists						Chandra 1975
112	Likubir slide ? Km 26 on NH 31A	Higher Himalaya	Hill slopes gentle, span nearly 6 km	Grey schist and green salty phyllites	Fragments of quartzite, phyllite and slope wash	Rock cum debris slide	Foliation dip inside the hill. Four sets of joint planes	Heavy precipitation. Toe erosion, failure under water saturation and increase in weight		Sinha (1975) Chandra 1975
113	Lapchajhora slide WB ? 1km north of Teesta bazar on NH 31A	Higher Himalaya	Covered area 200ha	Mica schists with mineralogical variation	Pulverized schistose material	Slump type, retrogressive in propagation	Minor down dip puckers. Fault zone cutting across	Heavy rain, toe erosion and fault zone		Sinha (1975) Chandra 1975
114	Slide II WB? Near km34 from Sevoke on NH 31A	Higher Himalaya		Phyllites	Pieces of phyllite and clayey material	Debris slide (slump type)	Highly jointed and cleaved rocks	Heavy precipitation. Surface and toe erosion. Development of pore pressure and reduction in shear strength		Sinha BN (1975)
115	Km 40 Slide WB? Km 40 on NH 31A	Higher Himalaya		Phyllites	Pieces of phyllite with slope wash material	Debris slide (slump type)	Highly jointed and cleaved rocks	Induced by toe erosion and slope failure by increased pore pressure due to heavy precipitation.		Sinha BN (1975)