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Geological Survey of India

कर्नाटक राज्य के उत्तर कन्नड़ और सिमोगा जिले, के भूआकृति संख्या 48J/12 और 48J/16 के
कुछ हिस्सों में वृहद पैमाने पर (1:50,000)
भूस्खलन संवेदनशीलता का मानचित्रण ।

**Macro scale (1:50,000) Landslide Susceptibility Mapping in parts of
Toposheets Nos. 48J/12 and 48J/16, Uttara Kannada
and Shimoga Districts, Karnataka**

टोपोशीट सं: 48J/12 & 48J/16/ Toposheets No.: 48J/12 & 48J/16

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Final report for field season 2018-19

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National Landslide Susceptibility Mapping

राष्ट्रीय भूस्खलन संवेदनशीलता मानचित्र

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Macro-scale (1: 50, 000) Landslide Susceptibility Mapping in parts of Toposheets Nos. 48J/12 and 48J/16, Uttara Kannada and Shimoga Districts, Karnataka

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F.S.P 2018-19

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कर्नाटक राज्य के उत्तर कन्नड़ और सिमोगा जिले, के भूआकृति संख्या 48J/12 और 48J/16 के कुछ हिस्सों में वृहद पैमाने पर (1:50,000) भूस्खलन संवेदनशीलता का मानचित्रण ।
कार्य-सत्र कोड सं:(M4LSSM/एनसी/एस आर/SU-KG/2018/20207)

कार्य-सत्र : 2018-19

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सारांश

कर्नाटक राज्य के उत्तर कन्नड़ और सिमोगा जिलों, के भू अकृति संख्या 48J/ 12 और 48J / 16 के कुछ हिस्सों में वृहद पैमाने 1: 50, पर भूस्खलन संवेदनशीलता का मानचित्रण किया गया जिसमें कुल 1399 वर्ग किलोमीटर का क्षेत्र को मैप किया गया । कार्य-सत्र: 2018-19 के दौरान , कार्य-सत्र कोड सं: (M4LSSM/एनसी/एस आर/SU-KG/2018/20207) । अध्ययन का उद्देश्य 1: 50,000 पैमाने पर एक सुस्पष्ट भूस्खलन संवेदनशीलता मानचित्र तैयार करना है, जो उपर्युक्त क्षेत्र / टोपोशीट के लिए जीआईएस प्लेटफॉर्म में मल्टी-क्लास इंडेक्स ओवरले विधि और स्थानिक डेटाबेस का उपयोग करके उपर्युक्त क्षेत्र / टोपोशीट के लिए उच्च रिज़ॉल्यूशन रिमोट सेंसिंग डेटा अन्य फ़ील्ड जानकारी का उपयोग किया गया । अध्ययन क्षेत्र में देखे गए प्रमुख लिथोयूनिट्स सरगुर समूह के एम्फीबोलाइट्स, पी जी सी कॉम्प्लेक्स के ग्रेनाइट नीस, पुराने ग्रेनिटोइड्स, बाबाबुदान समूह, चित्रदुर्ग समूह और आर्कियन आयु के इंडुसिव , अम्ल और क्षार इंडुसिव पेलियोप्रोटेरोज़ोइक उम्र की लेटेराइट से ढका हुआ है ।

अध्ययन तीन चरणों में किया गया है: i) आईआरएस LISS III डेटा और मल्टी-टेम्पोरल गूगल अर्थ इमेजरियों की दृश्य व्याख्या के माध्यम से आर्क-जीआईएस में 1: 50,000 पैमाने पर विभिन्न विषयगत इनपुट मानचित्रों की तैयारी के साथ प्री-फील्ड अध्ययन किया गया । डेम व्युत्पन्न भू-कारकों अर्थात् ढलान कोण, स्लोप एस्पेक्ट स्लोप कर्वेचर मानचित्र पहलू और ड्रेनेज मानचित्र 30 मीटर रिज़ॉल्यूशन एस्टर डेम से बनये गए। ii) सभी विषयगत भू-कारकों के मानचित्रों का फ़ील्ड-चेक और अपडेशन, गूगल अर्थ के नये और पुराने रिकॉर्ड में भूस्खलन की मान्यता, नए भूस्खलन की घटनाओं की रिकॉर्डिंग और भूस्खलन सूची डेटा की तैयारी की गयी अद्यतन करने के लिए फ़ील्ड डेटा का संग्रह और अन्य प्रासंगिक विवरण जैसे कि बारिश के आंकड़ों की गणना ।

iii) पोस्ट-फील्ड अध्ययन में जीआईएस प्लेटफॉर्म में सभी विषयगत और इन्वेंट्री मैप्स का अद्यतन शामिल है, जिसके बाद विश्लेषण और मल्टी-क्लास इंडेक्स ओवरले मॉडलिंग को सहज भूस्खलन संवेदनशीलता मानचित्र तैयार करने के लिए किया गया । लैंड-यूज / लैंड कवर (एल यू एल सी), जियोमॉर्फोलॉजी, ड्रेनेज, स्लोप बनाने वाली सामग्री (एस एफ एम), लैंडस्लाइड घटनाओं और रोड मैप जैसे सभी प्री-फील्ड विषयगत इनपुट मानचित्रों, LISS-III डेटा और मल्टी टेम्परेरी गूगल अर्थ में आर्क-जीआईएस में तैयार किए गए थे।

उसके बाद सभी प्री-फील्ड विषयगत मानचित्रों को क्षेत्र में प्रासंगिक / सुलभ स्थानों पर मान्य, संशोधित और अद्यतन किया गया और क्षेत्र के अध्ययन के बाद फिर से तैयार किया गया। इसी तरह, अन्य गैर-प्री-

फील्ड विषयगत जैसे कि गहराई और ढलान बनाने वाली सामग्री (एसएफएम) मानचित्रों को शुरू में फ़ील्ड में ही टोपोसीट बेस मैप पर तैयार किया गया था और फिर आर्क-जीआईएस में डिजिटल किया गया था। अध्ययन क्षेत्र में भूस्खलन मुख्य रूप से सड़क के कटाई के कारण और सड़क के चौड़ीकरण के कारण निम्न से मध्यम विच्छेदित ढलान में पाया गया है। सामान्य तौर पर, व्यापक ढलान काटने जो कमजोर कट ढलानों को उजागर करते हैं और खड़ी कट ढलान को रिपोज के कोण पर खड़े होने के कारण भूस्खलन को बढ़ावा देते हैं, सबसे महत्वपूर्ण कारक हैं ढलान की विफलता का, विशेष रूप से सड़क खंड एनएच-206 क्षेत्र के कुछ हिस्सों और भटकल से कारगल (एसएच -50) पर सबसे ज्यादा है।

मॉडलिंग के बाद के परिणामों से पता चलता है कि अधिकतम क्षेत्र घनी वनस्पति द्वारा ढका हुआ है, इसके बाद मध्यम वनस्पति, विरल वनस्पति, उच्च ऊंचाई के वृक्षारोपण, कम ऊंचाई के वृक्षारोपण और में खेती की गई भूमि एल्यूएलसी मानचित्र में आती है। □□-□□□□□□, अध्ययन क्षेत्र में मोटे तौर पर निम्न विच्छेदित ढलानों द्वारा कवर किया जाता है, इसके बाद रोलिंग मैदान, मध्यम विच्छेदित ढलान और अत्यधिक विच्छेदित ढलान होते हैं। ढलान बनाने वाली सामग्री (एसएफएम) के संदर्भ में, क्षेत्र में बड़े पैमाने पर इन-सिटू मिट्टी का वर्चस्व पाया जाता है, जिसमें 0.5-5 मी की मोटाई होती है। इसके अलावा, अधिकांश प्रलेखित भूस्खलन की घटनाएं इंसिटू मिट्टी में पाए जाते हैं। निर्धारित 42-बिंदु प्रारूप में कुल 87 भूस्खलन दर्ज किए गए थे। जिसमें से 58 भूस्खलन मृदा स्लाइड थे और 29 भूस्खलन मलबे स्लाइड थे। भूस्खलन का मुख्य कारण मानव हस्तक्षेप मुख्य रूप से सड़क बैंच और बस्तियों के निर्माण के लिए ढलान संशोधन है। हालाँकि, क्षेत्र में कुछ प्राकृतिक स्लाइडों की पहचान भी की जाती है।

अध्ययन क्षेत्र के लिए भूस्खलन की संवेदनशीलता मानचित्र तैयार करने के लिए विश्लेषणात्मक पदानुक्रम प्रक्रिया (□□□□□) विधि को अपनाया गया था, क्योंकि इस क्षेत्र में भूस्खलन की संख्या कम है और भूस्खलन के स्थानिक वितरण समान नहीं हैं। भूस्खलन के साथ विभिन्न विषयगत मानचित्र की तुलना का पता लगाने के लिए एक सांख्यिकीय विश्लेषण किया गया था। इसने विभिन्न विषयगत कक्षाओं को रैंक देने में मदद की और फ़ील्ड इनपुट द्वारा सहायता प्राप्त की। विषयगत मानचित्र को एकीकृत करके बहु-श्रेणी सूची बंध तरीका का उपयोग करके स्लोप कर्वेचर मानचित्र, लैंडयूज / लैंड कवर, भू-आकृति विज्ञान मानचित्र, ढलान बनाने वाली सामग्री और रेजोलिथ मोटाई के बहु-वर्ग ओवरलेइंग भूस्खलन सुग्राहिता मानचित्र तैयार किए गए हैं। इसे प्राकृतिक के अनुसार तीन वर्गों में वर्गीकृत किया गया। वर्तमान अध्ययन में कुल क्षेत्रफल का केवल 4.93% अतिसंवेदनशील के रूप में वर्गीकृत किया गया है। यह □□□□ 48 J / 12 और 48 J / 16 में लगभग 68.97 वर्ग किमी क्षेत्र में है। □□□□□ क्षेत्र में 27.04% (378.34 वर्ग किमी) के लिए अतिसंवेदनशील क्षेत्र हैं, जबकि □□□□□ क्षेत्र में 68.03% (951.73 वर्ग किमी) अतिसंवेदनशील हैं।

अध्ययन के परिणाम स्वरूप यह संकेत मिलता है कि भूस्खलन संवेदनशीलता मानचित्र अध्ययन क्षेत्र को उच्च, मध्यम और निम्न अतिसंवेदनशील क्षेत्रों के तीन वर्गों में वर्गीकृत करता है, भूस्खलन प्रवृत्त क्षेत्रों की पहचान करने में उपयोगी होगा, क्षेत्र के भूस्खलन की संवेदनशीलता क्षेत्रों के आधार पर विकासात्मक गतिविधियाँ योजना के लिए सहायता प्रदान करता है।



Macro scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets Nos. 48J/12 and 48J/16, Uttara Kannada and Shimoga Districts, Karnataka

FSP CODE: M4LSSM/NC/SR/SU-KG/2018/20207

F.S.P. 2018-19

By

K. Senthil Kumar, Geologist and Salu S, Senior Geologist (PT)

Abstract

Macro-scale (1:50,000) landslide susceptibility mapping covering an approx. 1399 Sq. Km. area in the Survey of India Toposheet nos. 48 J/12 & 48 J/16 has been carried out in parts of Uttara Kannada and Shimoga Districts, Karnataka., under FSP item code no. M4LSSM/NC/SR/SU-KG/2018/20207 during FS: 2018-2019. The purpose of the study is to prepare a seamless landslide susceptibility map on 1:50,000 scale using multi-class index overlay method and spatial database on landslide inventory in GIS platform for the above stated area/toposheets using high resolution remote sensing data followed by ground check and other field inputs. The major lithounits observed in the study area are amphibolites of Sargur Group, granite gneiss of Peninsular Gneissic Complex, older granitoids, Bababudan Group, Chitradurga Group and intrusive of Archean age, acid and basic intrusive of Paleoproterozoic age and lateritic capping's.

The study has been carried out in three phases: i) Pre-field study with preparation of different thematic input maps on 1:50,000 scale in Arc-GIS through visual interpretation of IRS LISS III data and multi-temporal Google imageries. DEM derived geo-factors viz. slope angle, aspect, curvature and drainage were derived from 30m resolution ASTER DEM. ii) Field-check and updation of all thematic geo-factors maps, validation of landslides identified in the Google Earth imageries and old records, recording of new landslide incidences and collection of field data for preparing/updating landslide inventory data and other relevant details such as rainfall data. iii) Post-field study includes updating of all the thematic and inventory maps in GIS platforms followed by analysis and multi-class index overlay modeling to prepare seamless landslide susceptibility map. All pre-field thematic input maps such as Land Use/Land Cover (LULC), Geomorphology, Drainage, Slope Forming Material (SFM), Landslide incidences and Road map were prepared in Arc-GIS using LISS-III data and multi temporal Google earth images. Subsequently all the pre-field thematic maps were validated, modified and updated at relevant/accessible locations in the field and re-prepared after the field check; similarly, other non-pre-field thematic such as depth and slope forming material (SFM) maps were initially prepared

on the toposheet base map at field itself and then digitized in Arc-GIS. Landslide initiation in the study area is found caused mainly due to road cutting and widening of road in low to moderately dissected hill slope. In general, extensive slope cutting which exposed vulnerable cut slopes and steep cut slope allowed to stand beyond angle of repose have been the most important factors leading to slope failure, particularly along parts of the NH-206 sector and Bhatkal to Kargal (SH-50) road section.

The post modeling results show that maximum area is covered by thick vegetation followed by moderate vegetation, sparse vegetation, High height plantation, low height plantation and cultivated land in the LULC theme. Geomorphologically, the study area is largely covered by lowly dissected slopes, followed by rolling plain, moderately dissected slopes and highly dissected slopes. In terms of the Slope Forming Material (SFM), the area is found largely dominated by in-situ soil having a regolith thickness of 0.5-5m. Further, most of the documented landslide incidences are found occurring in the insitu soil. A total of 87 landslides were recorded in prescribed 42-point format. Out of which 58 landslides were soil slide and 29 landslides were debris slide. The main cause for the landslides are human interference mainly slope modification for construction of road benches and settlements. However, few natural slides are also identified in the field.

Analytical Hierarchy Process (AHP) method was adopted to prepare the landslide susceptibility map for the study area, as the area has few numbers of landslides and spatial distribution of the landslides are not equal. A statistical analysis was done to find out the comparison of different thematic map with landslides. It helped in giving rank to different thematic classes and maps aided by field inputs. Susceptibility map was prepared by multi-class overlaying of slope, curvature, landuse/land cover, geomorphology, slope forming material and regolith thickness. It was classified into three classes using natural break. In the current study only 4.93% of the total area is classed as highly susceptible. This accounts for about 68.97 sq. km area in toposheets 48 J/12 and 48 J/16. Moderately susceptible area accounts for 27.04 % (378.34 sq. km) while low susceptible area accounts for 68.03 % (951.73 sq. km).

The output of the study indicates that the Landslide Susceptibility Map classifying the study area into three classes of High, Moderate and Low susceptible zones will be useful in identifying landslide prone zones, aid in the development of effective stabilization designs to minimize impact

and efficient planning for developmental activities based on the landslide susceptibility zones of the area.



1. INTRODUCTION

1.1 Background Information

Landslides are a ubiquitous phenomenon on Earth which has the potential to affect society detrimentally. It represents the directly gravity-driven component of erosion and they occur in sizes ranging from individual rocks falling to whole mountain sides collapsing.

Geological Survey of India (GSI), being the Nodal Agency for study of landslides in the Country has launched the National Landslide Susceptibility mapping (NLSM) programme, during the 53rd Central Geological Programming Board Meeting held at New Delhi on 5th February 2014 by Shri Dinsha Patel, the then Honorable Minister of Mines, Government of India. The objective of the programme is to (i) prepare landslide inventory database using high resolution remote sensing data and field inputs, (ii) to prepare Toposheet wise 1: 50,000 scale spatial database for geofactors of landslides for use as input maps, (iii) to prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

In continuation of this programme, the Landslide susceptibility mapping on 1: 50,000 scale was taken up by State Unit: Karnataka & Goa, Geological Survey of India, Bangalore for FSP: 2018-19 covering two toposheets 48J/12 & 48J/16 in Uttara Kannada and Shimoga Districts vide FSP ID: M4LSSM/NC/SR/SU-KG/2018/20207.

1.2 Study Area

The study area is bounded by the co-ordinates, latitudes 14°00' 00" -14°15' 00" and longitudes 74°30' 00"- 75°00' 00" comprises of two toposheets, 48J/12 & 16. The nearest Railway Stations are Murudeshwar and Bhatkal falls in TS. No. 48J/12 and Talguppa in TS. No. 48J/16. The area is well connected by metalled and the interior places are connected by unmetalled roads/ foot tracks. It is well connected to Bangalore, the state capital. Bangalore-Honnavar road passes through the area in the North Eastern part of the toposheet 48J/12. Bhatkal-Gudumakki all-weather metalled road passes through the area in the southeastern part. Kumta Bhatkal Highway (NH-17) passes through the western part of the area Shirali and Bhatkal-Kattinkat metalled road passes through the area in the southern part. The location map is represented in Plate-I.

1.3 Present Work

The present work comprises of pre-field map preparation, field work and post-field updating and finalization of maps. In pre-field work, different thematic layers were prepared. In

field, field checks along with collection of land slide data along with updating of all pre-field maps were carried out. An area of 1399 Sq. Km. area was covered by landslide susceptibility mapping on 1: 50,000 scale. Finally, the collected data are updated and post-field maps are prepared along with landslide susceptible maps.

Table 1, The Nature and Quantum of work is appended below.

Nature of Work	Target F.S 2018- 19 (sq.km)	Achievement F.S. 2018-19 Total(sq.km)
1.Pre field map preparation		
i)Thematic maps (in GIS on scale 1:50000)		
a) Slope Forming Material map	1399	1399
b)Geomorphology & Lineament map	1399	1399
c)Slope Morphometry (slope, aspect & curvature) map	1399	1399
d)Landuse / Land cover map	1399	1399
e)Drainage map	1399	1399
f)Regolith depth map	1399	1399
ii)Landslide inventory map	1399	1399
2.Field based studies		
i)Field checking of all thematic maps	1399	1399
ii)Field checking and collection of landslide inventory attributes (41 point geo -parametric sheet)	1399	1399 87 Landslides
3. Post field studies and modelling		
i)Updation of thematic and landslide inventory maps	1399	1399
ii)Landslide susceptibility modelling and finalization of landslide susceptibility map in GIS	1399	1399
4.Collection of rainfall data		Collected last ten year rainfall data

1.4 Physiography and Drainage

Physiographically, the area is an undulated, moderately to highly dissected hilly terrain with dense forests, comprising steep hills and valleys. The highest elevation is 810 m above msl at 500 m northeast of Gubbagadu. Lowest elevation is Δ 59 m above msl at west of Kindikodla in

south western part. Two main rivers draining the area, River Sharavati and River Venkatapur. The River Sharawati drains the northern part of the study area which will ultimately culminates in to Linganamakki Reservoir, adjacent to Jog Falls. The main drainage pattern is dendritic to sub-dendritic pattern in undulated areas and in hilly areas the drainage will slowly migrate to trellis pattern. In the study area, the streams are categorized into six orders (Plate-IV). The prominent hillocks falling in the hill ranges trending in NW-SE direction separated by Sharavathi valley. The prominent hillocks falling in the hill ranges are Koramur (2522), Adugatte (2441) and Kurkunj gudda (2513). The Sharavathi River forms the main drainage of the area and flows in a NNW direction taking a sharp turn at Jog falls.

A Reservoir is constructed across River Sharawati at Linganamakki. The height of the Dam is 60.96 m and the reservoir occupies an area of 80 sq. km at its maximum level of 1819 ft. The Linganamakki reservoir is connected to another small Talakallale reservoir by way of a 2745.4 m. long tunnel. Four power generation stations are situated in toposheet 48J/16. They are The Linganamakki Dam power house, Mahathma Gandhi power house, Sharavathi power generating station and Karnataka Power Corporation Ltd at Gerasoppa.

1.5 Climate and Rainfall

The Uttar Kannada and Shimoga districts experiences tropical monsoon climate. Along the coastal areas, the weather is hot and humid and the temperature varies from 22° C to 38° C. The highest day time temperature may rise up to 38° C. The humidity is lowest during the dry season and highest during the monsoons. The climate is drier to the east of the Ghats except in the south-west monsoon season. Heavy rainfalls are received particularly in the coastal and Western Ghats region. Summer season starts from March extends up to May, monsoons starts from June and extends up to September, winter is from October to December and the weather is bright and clear during January to February.

1.6 Soil Types

In the study area, there are mainly three types of soils are present. Alluvial soil is seen along the coastal areas which are brownish in colour. Lateritic soils are observed in the gently undulating areas by the weathering of thick, hard duricrust. Ash coloured clayey rich soil are noticed by weathering of shale/phyllite at some places. The thickness of soil cover will vary from places to places. Generally, the thickness of the soil cover is 5-10m. In the Forest areas, the thickness of the soil cover is 2-5m, which is reddish to brownish coloured soil.

1.7 General Geology

The main litho units observed in the study area are amphibolites of Sargur Group, granite gneiss of Peninsular Gneissic Complex, Older granitoids, Bababudan group, Chitradurga Group and intrusive of Archean age, acid and basic intrusive of Paleoproterozoic age and laterite cappings (Plate-II).

Rocks of Sargur Group is represented by amphibolites, small lenses are noted at 4km SE of Talguppa. It occurs as irregular lensoidal enclaves within the Hornblende-Actinolite-Chlorite schist, quartzite and granite gneiss. The rock is leucocratic, medium grained, foliated and consists of hornblende, plagioclase feldspars with subordinate amount of quartz.

The Peninsular Gneissic Complex is represented by granite gneiss and is well exposed in the western and south eastern parts of the area and it covers about 10% of the study area. The granitic gneiss is exposed north of Sharavati River, around the Jog Falls, in the west all along the western margin of the area, in the northeastern part, around Hire Gudda, Havaligadde gudda, Gubba Godu. The gneisses are leucocratic, medium-coarse grained, foliated comprises quartz, orthoclase and plagioclase feldspars as major accessories with sub ordinate amount of biotite (minor accessories) and epidote.

Bababudan Group of rocks are represented by Kudremukh Formation which consists of hornblende-actinolite-chlorite schist, greywacke-argillite, orthoquartzite, hornblende-mica schist and acid porphyry, which are well exposed in the area. The predominant lithounit exposed in the area is hornblende-actinolite-chlorite schist. The rock is highly foliated, soft, friable and pale greenish in colour. Most of the places, the rock is altered to chlorite and actinolite. On road cuttings, the rock has the tendency to weather easily giving rise to clayey soil. Greywacke-argillite is exposed as linear bands and small lenses, along with the Banded magnetite quartzite and Chlorite schist. It is also exposed in the southwestern part of the toposheet 48J/12 as a linear band along with quartzite bands. Quartzite occurs as linear bands and small lenses within the hornblende-actinolite-chlorite schist. The quartzites are leucocratic hard, compact and generally massive. It consists of recrystallised quartz with subordinate mica and tourmaline.

Greywacke-argillite of Ranibennur Formation, banded magnetite quartzite of Jholdal Formation and Chlorite-schist of Jhandimatti Formation are observed in the study area which forms part of Chitradurga Group of rocks.

Ultramafic intrusive, Quartz vein, Basic intrusives are seen exposed within hornblende-actinolite-chlorite schist. Basic intrusives represented by dolerite dykes are seen traversing the PGC and Bababudan Group of rocks. They are of small dimension and limited in strike length, trending in NNW-SSE to WNW-ESE direction. Acid intrusives are represented by quartz veins of Paleo-Proterozoic age, traversing the quartzite, hornblende-actinolite-chlorite schist and greywacke-argillite suite of Bababudan Group of rock.

Laterite cappings are extensively occur in the north eastern and south western parts of the area and is found at all topographic levels. They are noticed mainly on the gneisses, Hornblende-actinolite-chorite schist and argillites. At many places, the laterite occurs as thick, hard duricrust forming a plain topography.

1.8 Landuse and Land cover

Land Use & Land Cover map is prepared in Arc GIS through visual interpretation in multi-temporal Google Earth Imageries of the area. It is an outcome of natural and socio-economic factors and their utilization by man in time and space. In many of the places, the anthropogenic activities have played a significant role in the modification of Landuse and Land cover. On rough visual estimation, the area in terms of LU/LC can be divided into following classes: Barren rocky slopes, river terraces, settlements, plantations, sparse, moderate and thick vegetated areas; extensive cut slopes, river, and fallow land. The areas along river banks is covered with alluvial material and along low lying valleys is covered with overburden material and are being used for cultivation. Major part of the area is covered with moderate to thick vegetation. In the study area, the river banks are used for cultivation of low height plantation- areca nut and coconut plantation along with paddy. The low lying hills are used for Cashew plantation and the high height plantation, Acacia, Euclayptus and Nilgiris are noted on hill slopes. The land use land cover map is represented in Plate-VII.

1.9 Geomorphology

Geomorphology map is prepared in Arc GIS through visual interpretation of multi-temporal Google Imageries of the area. NGLM data from CHQ was also taken into account while preparing the geomorphology map of the study area. In terms of Geomorphology, the area can be divided in to ridges, highly/moderately/low dissected slopes, escarpments, alluvial plain, valley

fill, plateau top and pediment-pediplain complex. The geomorphology map is represented in **Plate-VIII**.

1.10 Data and Software used

- ✓ Data used: Topographic sheets and OSM sheets (open series) of SOI Toposheets no. 48J/12& 48J/16
- ✓ Softcopy of Geology map on 1:50,000 scale (in jpg and shape file (.shp) format; Source: GSI, M&C Division).
- ✓ National Geomorphological and Lineament Map (NGLM data) on 1:50,000 scale (Source: GSI and NRSC).
- ✓ Software used: Arc GIS, Google Earth (Open source)
- ✓ Satellite Data used: Aster DEM (30 m resolution), Google Earth Satellite Imagery (multi-temporal data)

1.11 Methodology

The study area relatively stable terrain with very few natural landslide incidences data and non-uniform spatial distribution, most of the documented landslides data indicate causal factor for landslide initiation as anthropogenic interference in modifying natural slope for development activities and quarrying and mining. In such condition, Analytical Hierarchy Process (AHP) based modeling is adopted to determine the landslide susceptibility of the study area. This is one of the methods of predictive mapping to arrive at qualitative landslide susceptibility as shown in Flow chart (**Fig. 1.1**). The susceptibility modeling essentially invokes expert opinion and application of Analytical Hierarchy Process (AHP) for Weighted Multi-class Index Overlay Method (**Bonham-Carter, G.F., 1994; Guzzetti et al., 1999; Ghosh et al., 2011**). For deriving the expert opinions, several levels of discussion (e.g., orientation programme, interactive workshop etc.) were held amongst various domain experts/working geologists of GSI and a mutually-agreed ranking in the scale of 0 to 9 were decided for each of the factor classes in different terrains/States. Accordingly, the Landslide Occurrence Favourability Score (LOFS) for each class of factor maps are generated. The class ratings and integer weights derived from AHP were used to obtain landslide susceptibility score map.

I. Pre-field thematic/geo-factor map preparations (in GIS on 1:50,000 scale)

A total of six geo-factor maps viz., Slope and Curvature (30m ASTER DEM), Geomorphology and Landuse/Landcover (prepared using Google Earth and ArcGIS base map

SPOT imagery), Slope Forming Material and Regolith thickness (field based and GSI Geology map) were prepared for susceptibility analysis. Besides these maps, Landslide Inventory Map was prepared using Google Earth, previous reports of GSI and field documentation of landslides.

II. Field based studies/Ground check

- i) Ground check/ field checks of all geo-factor thematic maps.
- ii) Field validation of landslide inventory and collection of recent and historic landslides.
- iii) Collection of landslide inventory and damage data as per 42-point geo-parametric sheet.
- iv) Validation of landslide incidences at important locations.

III. Post field studies and modelling

- i) Updating of thematic and landslide inventory maps in GIS platform.
- ii) Pair wise correlation matrix calculation, determination of LOFS and Rank as per weightage/rating assigned to different thematic (causative factors) variables.
- iii) AHP based modelling and overlay analysis of different thematic maps for the preparation of Landslide susceptibility map on 1:50,000 scale on GIS platform.

All the Pre-field thematic layers were updated and compiled after field validation to prepare the seamless susceptibility map, edge matching done with the adjacent toposheet no 48J/8, J/11 and J/15. During FS 2015-16 the landslide susceptibility mapping carried in parts of toposheet no 48J/08 and J/11. To match the boundary between toposheet no 48J/08, J/11 and 48J/12 the portion of the boundary of the toposheet no 48J/12 deliberately modified according to the boundary of the toposheet no 48J/08 and J/11. The thematic maps are rasterized for data modelling and analysis. To perform the GIS analysis all the layers were projected in UTM (Zone 43N) taking WGS84 as spheroid and datum.

- a) The LSM map was prepared in raster format, using pixel of 50mx50m grid as a mapping unit and by calculating the Landslide Occurrence Favorability Score (LOFS) for all factor classes of each geo-factor theme in GIS.
- b) A susceptibility score map is calculated after adding LOFS values of all six geo-factor maps and normalizing it by its weight.
- c) The natural breaks or the cut-off boundaries between the low, moderate and high susceptibility is assessed based on the mutual comparison expert-driven ranking (Fig1.1).

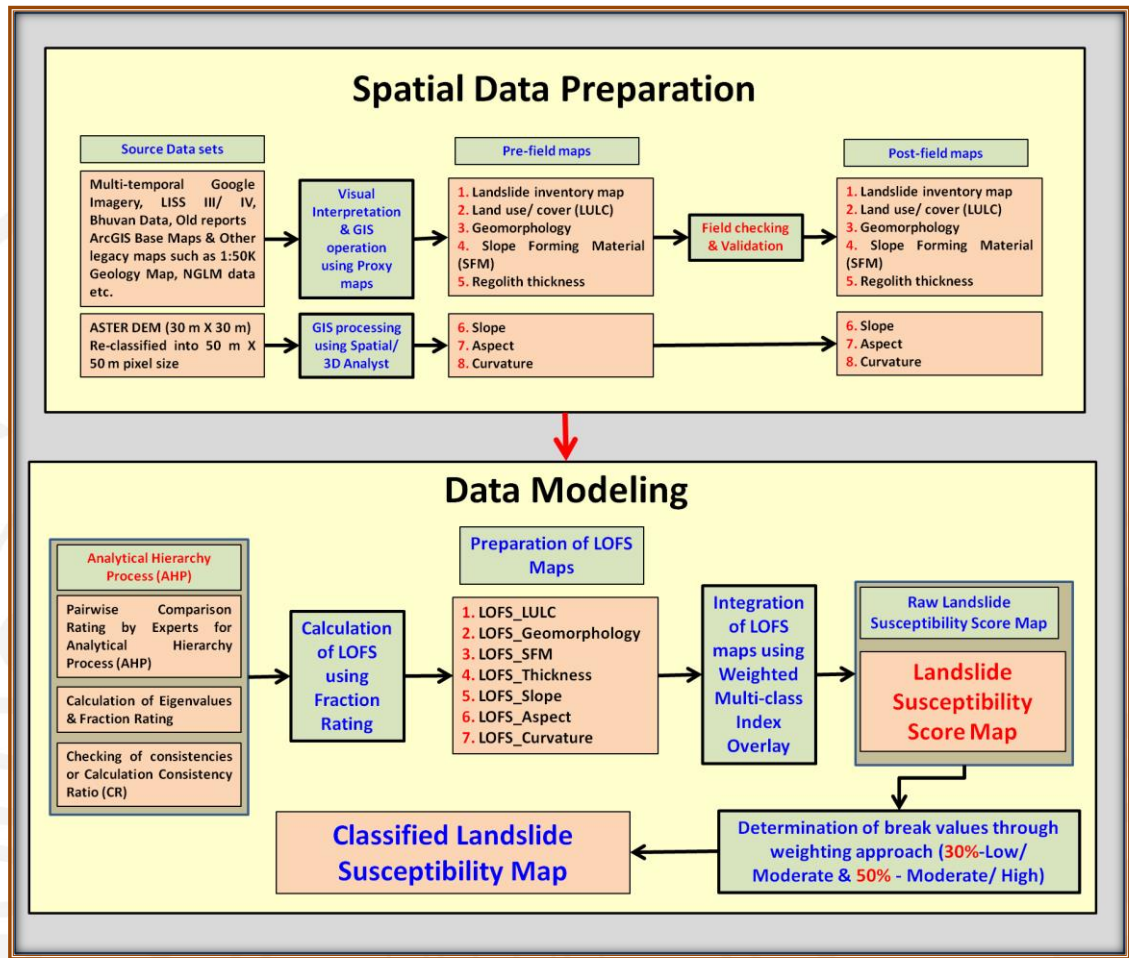


Fig. 1.1 Flow chart showing the steps for Landslide Susceptibility Mapping

1.12 Rainfall data

Although the assessment of the rainfall thresholds is very important in order to establish efficient correlation of rainfall and slope failures, in the current study, no empirical relationships or hydrological modelling have been attempted with regard to rainfall and landslide. Such possible correlation between rainfall parameters and the occurrence of landslides can help identify the local rainfall threshold for triggering landslides. Given the fact that the few existing natural landslides in the study area and extensive slope cut failures in the study area are largely triggered by rainfall during monsoon season (June-September), monthly rainfall data for the years 2009 through 2017 (**Fig.1.2**) have been obtained from DC office, in order to get perspective understanding of the temporal distribution of rainfall in the study area. Details of last ten-years rainfall data of Uttara Kannada and Shimoga districts are given in Annexure-I.

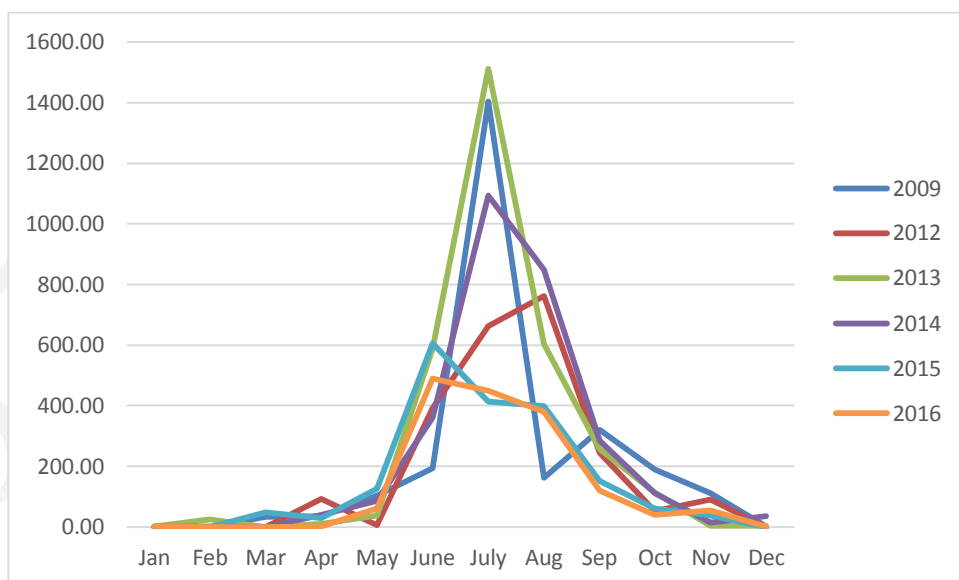


Fig. 1.2. Monthly rainfall data for the year 2009 – 2017, as collected from the DC Office, Shimoga district.

1.13 Acknowledgements

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2. PREVIOUS WORK ON LANDSLIDE STUDIES

Previous work on landslide studies in parts of the study area is mainly of landslide inventory study and has indicated that anthropogenic interference has been the causal factor for land sliding in the area.

In 2009, K. V. Maruthi, Sr. Geologist et.al. Prepared a landslide inventory along NH & SH of ghats in Chikmagalur, Coorg and Shimoga Districts. The area comprising parts of the toposheet nos.48 O/8 &12; P/6 ,9,11,13 &15; J/7,9,11,12 &16. In this report, seven numbers of landslides were reported from toposheet 48J/12 &16.

A brief detail of the historic landslide incidences documented in the study area are given in **Table: 2**. Available historic landslide incidences were entirely documented along the NH-206 (NH-40) road corridor.

Table 2, Historic landslide data of the study area.

Sr.No	Latitude			Longitude			Length (m)	Width (m)	Height (m)	Road section
1	14	14	16.3	74	35	49.1	16.00	10.00	1.50	JOG - HONNAVAR ROAD SECTION SH 50 & NH 206 /FS: 2008-09
2	14	14	24.5	74	35	39.3	18.00	42.00	1.00	
3	14	14	41.7	74	34	39	8.00	50.00	0.50	
4	14	13	43	74	48	53	70.71	22.20	2.00	
5	14	13	45.8	74	48	59.5	12.60	15.00	2.00	
6	14	13	57.9	74	48	47.2	8.00	24.60	0.50	
7	14	13	59	74	48	46.6	8.00	14.50	0.50	

3. LANDSLIDE INVENTORY

Landslide inventory maps are prepared on the motto of generating a landslide database. As a part of the action plan 2006 of National Disaster Management Authority (NDMA), the landslide inventory database has been prepared at various stretches covering in parts of Western Ghats of Karnataka. To execute the programme, GSI had taken up Field Season Programme since 2007-08. Given the fact that the landslides are deficient and non-uniform in spatial distribution in the study area heuristic or knowledge driven approach is adopted for which the landslide incidences map is not directly employed in the modeling. However, landslide inventory map has varied scopes and is prepared to understand the extent of landslide phenomena in an area and is a precursor of any landslide susceptibility mapping. Landslide inventory maps contain a combined graphic and attribute database of a particular landslide and therefore landslide inventory is required to investigate the distribution, types, and patterns of landslides and their evolution in space and time. Comprehensive landslide inventory is the prerequisite for subsequent studies and can be prepared through various methods such as mapping from remote sensing data and topographic maps, detailed fieldwork and historical archival studies.

3.1 Data source

Landslide inventories contain basic information about landslides such as location, classification, morphology, volume, run-out distance, activity and date of occurrence / activity (*Wieczorek, 1984; Fell et al., 2008*). Landslides occur individually in time and space and have to be identified, mapped and inventoried one by one as and when it occurs (*van Westen et al., 2006*). There is no single ideal method for the preparation of a landslide geospatial database. Therefore, combinations of several methods are made to generate the inventory which includes both the collection of historic records along with the use of remote sensing tool for accurate mapping of landslides.

Course of this study, pre-field landslide inventory map has been prepared by augmenting the presently available past source information such as archival data, old maps/ reports etc. Archival data sources and old reports of GSI are of paramount importance in compiling of the landslide data. Inventory data of all available landslide incidences documented from the previous available Field Seasons were consulted the same were converted to GIS database and validated during field work.

Landslide is a dynamic phenomenon and therefore its study and identification requires a source that will cater not only by providing spatial data but multi-temporal data. In the current study high resolution open source Google Earth imagery and ArcGIS base map SPOT imagery has been used to obtain multi-temporal and spatial landslide inventory.

3.2 Inventory mapping methodology

Steps followed for mapping a landslide polygon in ArcGIS and building its inventory attribute are detailed below.

- I. The boundary file of the study area is converted to. kml file and opened in Google Earth after which every segment of the study area is viewed in all available time frames. The apparent landslides are identified and marked as a point, since the landslide dimension are very small.
- II. The mapped point is then saved as. kml file and later imported to ArcGIS using conversion function. In ArcGIS the. kml to layer conversion is first done and then the layer data is exported as a polygon shape file or directly to the geodatabase.
- III. The attributes for each landslide polygon such as name, state, district, taluka, toposheet number, initiation and reactivation year based on dates of Google Earth images are entered.
- IV. Extensive field check is then carried out to validate the pre-field map at all the accessible locations. The morphological signatures left by landslides on slopes were used to identify the shape of landslides.
- V. The morphological parameters such as landslide scar length, width and depth, type, run-out distance, present landuse, regolith thickness, probable cause, and damage details are added to the inventory following the 42-point geo-parametric sheet.
- VI. A number of minor landslides particularly slope cut failures which are not discernible in Google imagery are identified in the field and plotted in the base maps and their attributes are noted.

The landslide inventory map contains a graphical part illustrating locations of landslides as a point and an attribute-bearing textural database for each of them in a table. Preparation of this type of combined graphic and attribute database of a particular landslide, which can easily be formalized in a Geographic Information System (GIS) for future retrieval and subsequent updating. During the course of this study, the pre-field landslide inventory map has been field verified at all

possible locations and landslide inventory details of additional incidents have been collected in a 42-point geo-parametric data sheet.

3.3 Spatial distribution of Landslides

The landslides in the study area of Toposheet Nos. 48J/12 and 48 J/16 are few and are non-uniform in distribution. The spatial distribution of landslides suggests landuse pattern as a dominant influence. In the process of preparing landslide inventory for the study area, both by remote sensing and field based, 87 landslides in total were identified. The documented landslides were classified following the classification proposed by (*Varnes, 1978*) and documented following the 42-point geo-parametric attributes. The natural slope settings of the study area away from anthropogenic interference such as communication corridors, settlement, cultivation, etc. show a matured topography and are devoid of landslide. Landslides caused under natural conditions are few and are mainly confined to the slopes near stream or river, which are mainly caused due to toe erosion by stream channels.

Majority of the slides are soil slides which were initiated due to slope modification for construction or extension of road, settlement construction. Intense weathering, local increase of pore fluid pressure and toe cut by small streams caused due to incessant rainfall in the hilly terrains also aggravate the slope failure. In Magod village near to Ferry (N14° 13' 31.2" E 74° 31' 54.3"), a landslide (Photo.3.1) has been reported 5 years back and is now stabilized by vegetation. Loose soil along with debris is noticed on the toe portion. The slide is having a length of about 20m, width of 40m, height of 8m and depth of 5m. The slide may reactivate in the future in case of incessant rainfall. One soil slide (Photo no:3.2a, 3.2b, 3.2c) has reported in Kodani Panchayat (N 14° 13' 48.0" E 74° 33.2' 23.1") where the soil along with debris lying over the slope below the road bench. On the road bench cracks developed, this cracks may reactivate during the next monsoon. Below the road bench, towards valley side the slope having an angle approximately 25-35 degree followed by few settlements situated at the toe of the hill by disturbing the toe without any proper support. The slide has happened due to slope modification for the construction of village link road. On Upslope portion, low height plantation is noticed, mainly cashew. Rill erosion is noted on the slide material.

In southern and eastern part of toposheet no 48J/16 around 30-35 nos. of landslide were recorded. Majority of the landslides are located vicinity to the cultivation or High Height Plantation (HHP). Geomorphologically the area is low dissected slope to rolling plain where the slope angle

between the 0-35°. Most of the slides (photo no: 3.3a, 3.3b, 3.3c, 3.3d) are soil slide and larger in dimension when compared to the road cut failure and it exhibits maximum regolith thickness in the scarp faces and both flank of the slide.

Few landslides (photo no: 3.4a, 3.4b) were documented along the NH-206 (Honnavar-Jog road section) and Bhatkal to Jog road section which is passing nearly undulating terrain. The documented landslides are initiated due to modification of the slope for road extension. Weak slope forming material and thickness of regolith which is more than 5m coupled with absence of proper drainage facilities are main causes of slides in this stretch. The construction of gabion wall is to be provided or else slope grading. A road leading to SRVP power station which is moderate to high susceptible zone because of high slope angle, vertical cutting of the toe for road construction and weak slope forming material. It is recommended to construct retaining wall, proper maintenance of toe drain and construction of adequate culvert in the valley side. Vicinity to the power station (left hand side) debris slide noticed. In this area chances of sliding are there if prolonged rainfall happens during monsoon. To prevent the slope from the future slide it may recommend that channelizing all stream around this area and divert the surface runoff by constructing contour drain. Just above the power station right side of the penstock area small soil slide observed due to weak slope forming material, indecorous maintenance of the surface runoff and impulsive slope modification. For this area it may be recommended that easing of the slope by multiple benching, divert the surface runoff and maintenance of earlier hill side drain. It is also recommended that the detailed study to be carried in and around the power station to avoid future slope failure. Road leading to Mahatma Gandhi power station, the road protected by constructing iron crib walls (Photo no: 3.5) along the road section to prevent the slide material do not come across the road.

The triggering factor in these slope failures is mainly monsoon rain. The heavy monsoonal rain starting from the month of June through September affects surface and sub-surface water movement. Generic remedial measures suggested during the time of landslide inventory documentation are based on the site condition, material involved, hydrological condition, anthropogenic interferences, nature of failure, etc. Short term generic remedial suggested are easing or moderation of steep engineered slopes, construction of well-founded retaining structure and proper surface run-off drainage and plantation of lateral root-spreading grass or vegetation. Detailed landslide inventory attributes of all the documented landslides in 42-point proforma is given in **Annexure-III** along with suggested remedial measures.

4. LANDSLIDE SUSCEPTIBILITY ANALYSIS

4.1 Background Informations

The stability of a slope is influenced by a variety of time-independent and time-dependent factors can lead to landslide. The major triggering factors of landslides are-

- i) Unfavorable geology
- ii) Removal of support by quarrying at the toe of the slope
- iii) A long- term rise in groundwater
- iv) Rainfall during the last few days of movement
- v) Anthropogenic activities
- vi) Clearance of native vegetation

Landslides are expected to occur in the most susceptible areas. The only limitation of the landslide susceptibility analysis is that it does not take time frame and magnitude into consideration. A susceptibility map gives only the qualitative or quantitative estimation that the mapping unit will be affected by a future landslide source.

4.2 Selection of Preparatory factors

A prior knowledge of the main causes of landslides in the area of interest is essential in selecting the most relevant factors out of the many known preparatory factors that can “theoretically” cause landslides (Ghosh et al., 2010). The preparatory cause of landslides depends on the scale of analysis, characteristics of the study area, geology and mechanisms of failure. The factors those we are dealing are of two types: definite (geomorphology, aspect) and continuous (Landuse land cover, slope morphometry, elevation). These spatial geo-factor maps are prepared using various source data and employing different mapping techniques.

Debris slides are noticed mostly in our study area and are affecting natural slopes and caused mainly due to anthropogenic activity. In view of the landslide characteristics, seven factor maps were prepared that are considered to be the main spatial causal factors for landslides in the area. Out of the eight maps, three are related to terrain morphometry derived from DEM and four are field based maps prepared from remote sensing data. These spatial geo-factor maps are prepared using various source data and applying different mapping methods.

4.3 Geo-factor Themes

The geo-factor maps prepared for the landslide susceptibility analysis are geomorphology maps, land use/land cover maps, slope morphometry maps, slope forming material maps, regolith thickness maps, and road and water bodies. Brief description of the maps is detailed below:

- (i) **Geomorphology Map:** The geomorphology map is prepared from NGLM data (National Geological and Lineament Mapping) and from Google Earth Imagery on a scale of 1: 50,000. The prepared pre-field map is then validated using field checks and final updating is done in the finalized/post-field maps.
- (ii) **Landuse/ Land cover Maps:** This map is prepared basically by digitizing the features from Google Earth Imagery along with the support of toposheet (1: 50,000). The prepared pre-field map is then validated using field checks and final updating is done in the finalized/post-field maps.
- (iii) **Slope Morphometry Maps:** In the Slope morphometry, three derivative maps are prepared from Aster DEM data of 30m resolution on 1: 50,000 scale. The three derivative maps are slope angle, slope aspect and slope curvature maps.
- (iv) **Slope Forming Material Map:** The pre-field map is prepared taking into account geomorphology, geology, and landuse/land cover maps. The prepared map is updated based on field observations, geology map of the area on 1: 50,000 scale.
- (v) **Regolith Thickness Map:** The map is prepared with help of overburden thickness data collected on the field, slope forming material map and NGLM data.
- (vi) **Road and water bodies:** Based on the toposheet and Google Earth imagery, both the road and water bodies layers are prepared.

4.3.1 Slope Morphometry

The outward or downward movement of material takes place necessarily through certain angle of slope and hence, the slope gradient factor is invariably associated with any type of landslides. This inherent causal relationship of slope in inducing slope instability makes it the most important and effective parameter to consider. The slope gradient map defines slope categories on the basis of frequency of occurrence of particular angle of slope.

Slope gradient map was extracted from ASTER DEM of 30 m to derive slope angle for the study area using ArcGIS (**Plate-VI**). The slope gradient map so derived is reclassified for analysis into 5 classes with 10 percentile distribution (**Table 3**). In the study area slope angle

varies between 0° and 68° with steeper slopes concentrated in central eastern, central southern quadrant of Toposheet 48 J/12 and NNW quadrant of toposheet 48 J/16. Slope gradient with <15 largely represent (72.7%) the area (**Fig.4.1**), similarly 21.8% of the area is having 15°-25, 4.5% of the area is 25° - 35°, 0.8% of the area is 35°-45°, 0.2% is >45.

In general, landslide frequency increases with the slope gradient until the maximum frequency is reached in the 35 - 40° categories, followed by a decrease (Lee and Min, 2001; Dai and Lee, 2002). About 50.57% of documented landslides have been observed in slopes class of 0°-15°. Similarly, 32.18% of documented landslides have been observed in slopes class of 15°-25° and 14.94% in 25-35°. 2.29% of landslide documented in 35°-45° slope class. (Fig. 4.2).

Table 3, Slope morphometry, rank and LOFS values.

CLASS	Rank	LOFS
<15	2	0.1631
15-25	4	0.4597
25-35	8	1.0000
35-45	6	0.2817
>45	2	0.1631

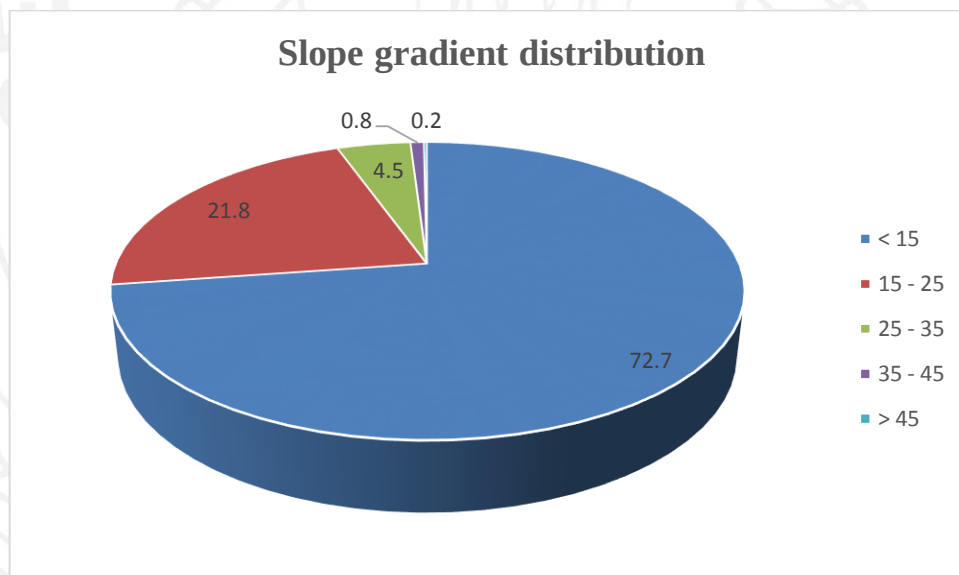


Fig. 4.1. Slope percentage distribution of the study area.

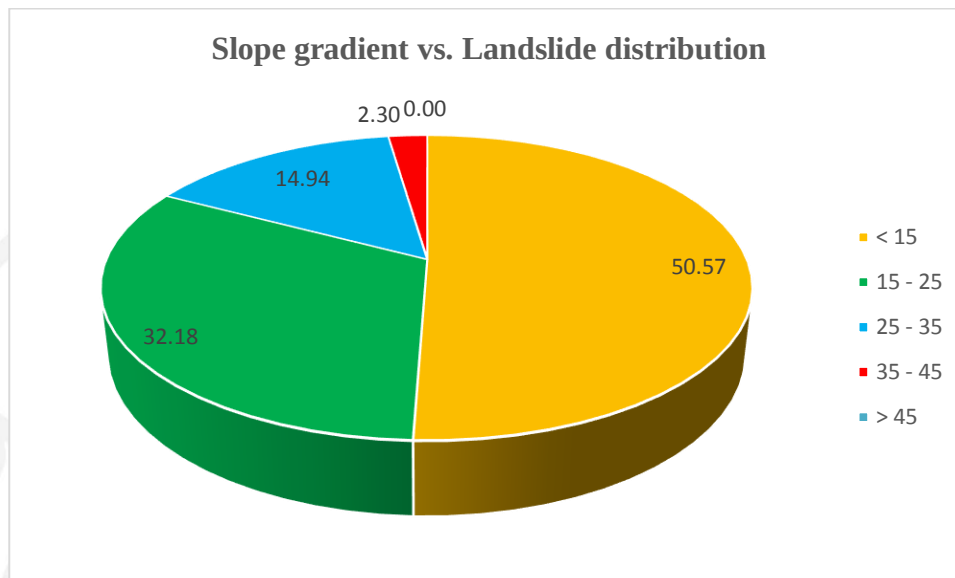


Fig.4.2. Slope gradient vs. Landslide distribution.

4.3.2 Slope Curvature

Another derivative map used in the analysis is a curvature map of slope. This is basically the slope shape or profile curvature and is derived from 30m ASTER DEM using ArcGIS10.2. The term curvature is theoretically defined as the rate of change of slope gradient or aspect, usually in a particular direction. The curvature map of the study area (**Plate-V**) has been reclassified into three categories viz. concave, flat and convex. A positive curvature represents upwardly convex surface while a negative curvature indicates that the surface is upwardly concave at a given pixel.

Failures can be expected to occur in both convex and concave areas. The curvature maps were reclassified into three classes viz., concave, flat and convex. Taking knowledge of relatively less spatial relation with landslides and after due discussion a factor weight of **1** is assigned for the curvature.

The area percentage wise distribution of three curvature classes Concave having 46%, Convex having 48% and flat having 6% is given in pie diagram (**Fig.4.3**).

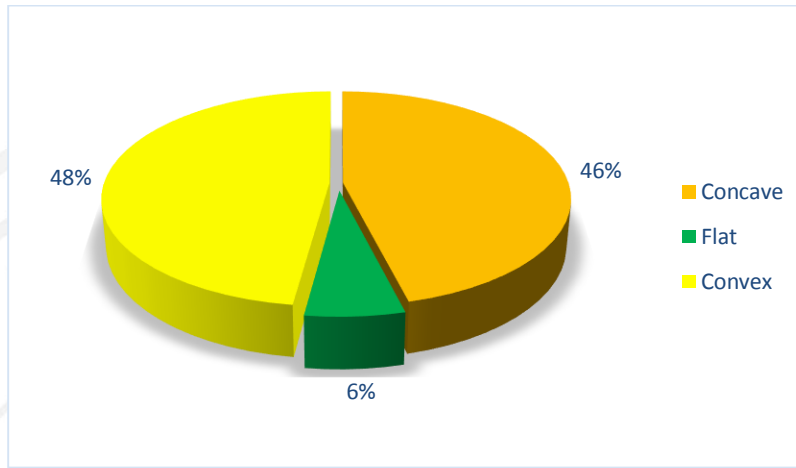


Fig. 4.3. Slope curvature percentage distribution of the study area.

4.3.3 Landuse and Land cover

The natural vegetation cover/or absence of it over a slope (Landcover) and anthropogenic activities like agriculture / plantation / major excavation for road and other civil structures (Landuse) has a direct bearing on the stability aspects of hill slope. During present study the delineation of all available categories of landuse and landcover has been prepared mainly using with the latest available Google imagery data, LISS-III data and all other available satellite data sets. Landuse-Landcover map (**Plate-VII**) thus prepared during the pre-field stage has been modified, corrected and finalized after thorough field check at all accessible locations.

The LULC map prepared during pre-field map requires field validation of the features identified through the Google Earth imagery. Field validation of the map in all accessible locations is done and all necessary modifications and value addition in the boundary and name of the LULC classes are incorporated. It is observed that pre-field map for LULC is largely accurate excepting a few patches of barren, sparse vegetation, LHP, HHP and cultivated areas which are updated in the map. The pre-field map is then validated in field through ground checks and updated map is prepared. The study area consists of fourteen features, namely barren, cultivation, extensive cut slope, fallow land, sparse vegetation, moderate vegetation, thick vegetation, high height plantation, low height plantation, quarry, river, and settlement, settlement on modified slope and water body (**Photo no 4a, 4b,4c,4d**).

The present study area mainly occupied by the thick vegetation because of presence of Kargal reserve forest, Jog reserve forest, Chennagonda reserve forest in toposheet no 48J/16 and Govardhanagiri reserve forest in toposheet no 48J/12. Valley portion extensively used for

cultivation and High height plantation. High height plantation mainly observed in the northern and southern part of toposheet no 48J/12 in and around Dabbod, Honnebar, Belemakki, Magod, Samsi and Hadavalli. The same also observed in toposheet no 48J/16 in and around Talguppa, Muruttur, Srivate, Kargal, Arlagodu, Marlagodu villages etc. Short height plantation observed in and around Midal, Devikan and Handakani, Jalavalli villages. The high height plantation includes Areacanut, coconut, Acacia, Rubber and Nilgiri whereas low height plantation includes cashew, pepper and a very few coffee plantations. Around Balkur, Heggur, Beranki, Kodani, Magod, Hinnur and Masabag villages the settlement is situated after modifying the slope without any proper slope prevention and around these areas village like road constructed by extensively modifying the slope. Barren area largely occupied in Southern and northern part of toposheet no 48J/12 in and around Bilavalakhand, Kindikodla, Kembre, and Jalavalli villages. Patches of extensive cut slope observed along the NH-206, Bhatkal-Kargal and some village link roads.

Table 4, Land use and Land cover classes with rating and LOFS values.

Landuse/Landcover	Rating	LOFS
Barren	1	0.0626
Cultivation	2	0.0937
Extensive Slope Cut	9	1
Fallow ground	1	0.0626
Moderate Vegetation	5	0.2912
Plantation (HHP)	4	0.1988
Plantation (LHP)	3	0.1366
Quarry	5	0.2912
Settlement	1	0.0683
Settlement on modified slope	7	0.5631
Thick Vegetation	4	0.1988
Sparse Vegetation	7	0.5631
Water body	0	0
River	0	0

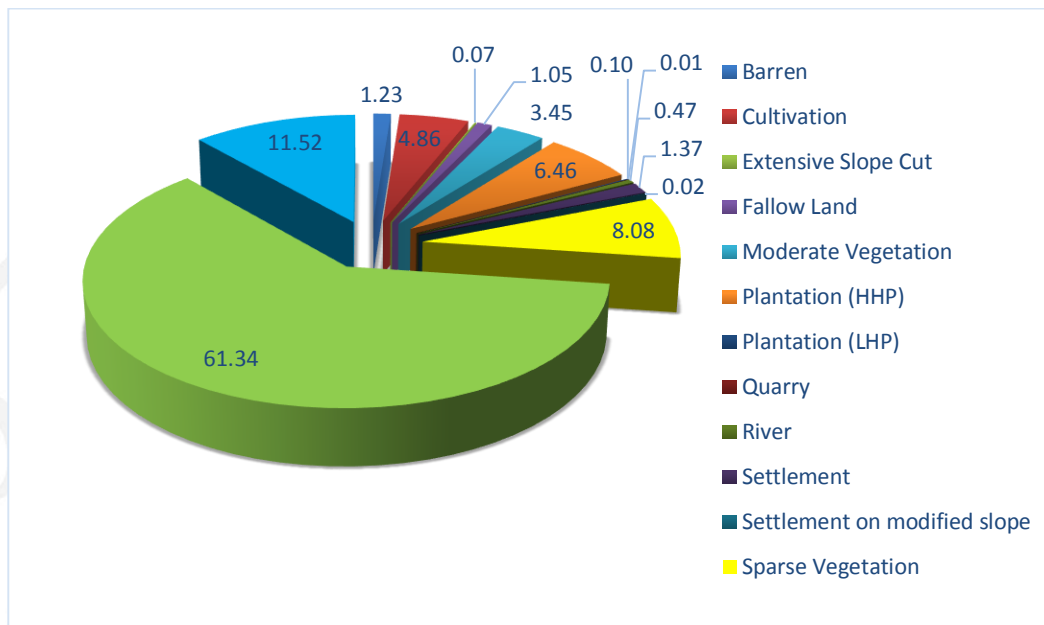


Fig.4.4 LULC classes percentage distribution of the study area.

4.3.4 Geomorphology

Geomorphology is the study of surface landforms, processes and landscape evolution of the earth. Geomorphology plays an important predictor role or governing factor in landslide susceptibility mapping and the map is prepared using high resolution Google Earth data. Pre-field Geomorphology map was prepared by visual interpretation of latest available Google Earth imagery as base map. Initial attempt was made to use National Geomorphological and Lineament Map (NGLM) data but the map required significant modification to suit to the current study by incorporating more classes as well as discarding certain irrelevant ones. The different classes of Geomorphology theme are identified and marked or digitized using polylines on Google Earth imageries.

The pre-field geomorphology map was validated at all accessible locations during field work and necessary modifications were incorporated in the final input geomorphology map (**Plate-VIII**). There are fifteen different geomorphic units identified in the study area. The area percentage wise distribution of various geomorphologic units in the study area (**Fig. 4.5**) indicate that around 5.81% of the area covers under highly dissected hills followed by lowly dissected (**Photo. no 4e**), moderately dissected slopes and rolling plain with 37.76%, 14.70% and 16.36% respectively of the hillslopes and ratings of 8, 6, 4 and 0 are assigned to these classes respectively.

Highly dissected slopes (**Photo.no 4g**) and moderately dissected sloped are observed in and around Geripal, Surimane, Battalmuli, Chikkanhalli, Mundar and Hadil villages. Escarpment

(**Photo.no 4f**) noticed in and around Jog, Koppa and Surimane villages. Pediment pediplain complex (**Photo.no 4f**) are spread in and around NNE part of the study area and the PPC portion extensively used for cultivation purpose. The analysis of various geomorphic units with respect to landslide incidences data shows that the lowly dissected slope is more significant in the study area with a proportionally more number of landslide incidences. Around 37.76% of the study area being a lowly dissected and relatively stable, landslide incidences documented along road corridors, settlement, etc. which are mainly causal factor of anthropogenic induced landslide and landslide occurrences in the study area is relatively independent of geomorphic classes.

Table 5, Geomorphology classes with rating and LOFS values.

Geomorphology	Rating	LOFS
Escarpment	2	0.0819
Mound	2	0.0819
Lowly Dissected Slope	4	0.1947
Moderately Dissected Slope	6	0.402
Highly Dissected Slope	8	0.7279
Ridge - top	0	0
River	0	0
Water body	0	0
Plateau Top (Flat)	0	0
Rolling Plain	0	0
Valley Fill	0	0
Pediment pediplain complex	0	0
Hilltop	0	0
Alluvial plain	0	0

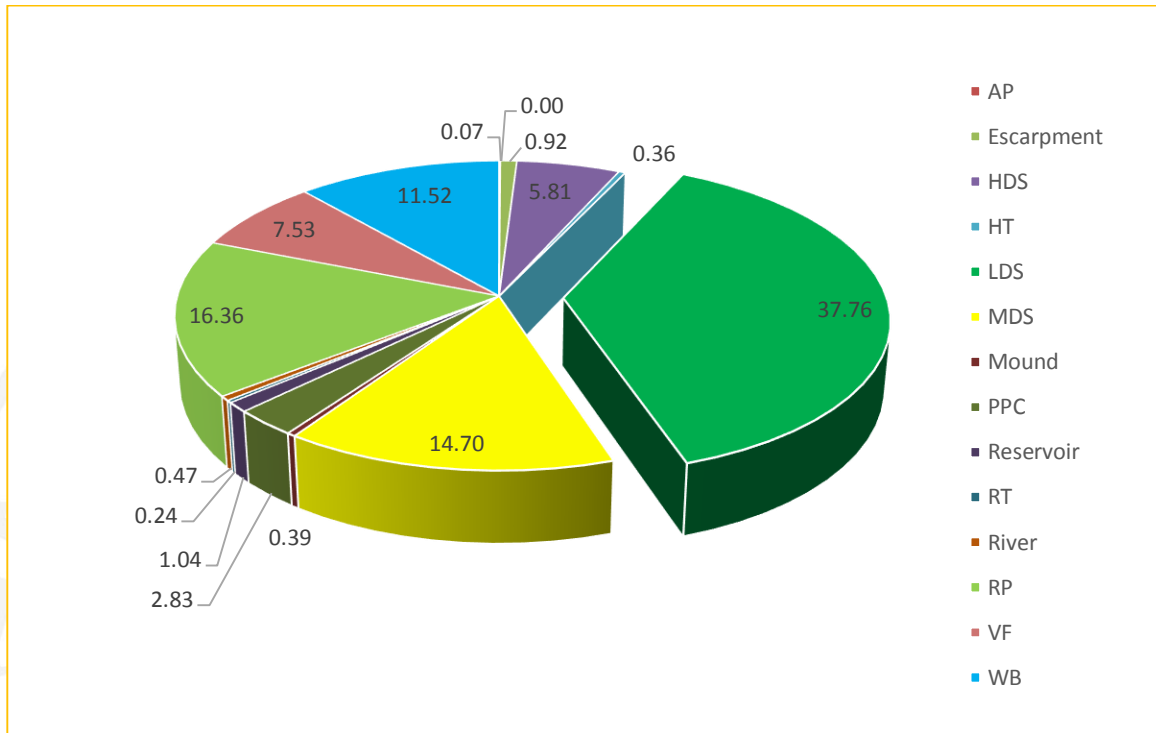


Fig. 4.5. Geomorphology classes percentage distribution of the study area.

4.3.5 Slope Forming Material (SFM)

Landslide initiation largely depends on the nature of the material resting on the slope i.e. the composition and consolidation and therefore slope forming material (SFM) (**Plate-IX**) an important categorical geo-factor theme. SFM and its spatial distribution and depth play a crucial role in causing different types of landslides. The spatial distribution of soil/overburden and its thickness is controlled by erosion processes and slope morphometry (**Dietrich et al., 1986; De Rose et al., 1991**). The pre-field Slope Forming Material (SFM) map is prepared by using proxies of the existing geological legacy map of 1:50k available with GSI and the already prepared geomorphology and LULC maps. With the help of geomorphology map, attempts have been made to categorize the overburden polygons into different types, for example all Escarpment will have rock exposers. Based on the slope and inferences drawn from the Google Earth images, different SFM such as in-situ soils (if the covers lie at the ridge top or few meters below), transported soil (if the covers are located on valley portion and evidences of surface transportation is evident) have been mapped.

The pre-field SFM map prepared is validated in the field at all accessible locations and all necessary modifications are incorporated. During the field work an attempt to made to identify the different classes of SFM in the road cut, quarry section and nala cut section and other

excavation. The slope forming material is broadly divided into bedrock part and overburden part. Around 65.61% of the area comes under the insitu soil (**Photo no: 4g, j**) followed by water body and Hornblende actinolite chlorite schist with 11.5% and 10.49% respectively (**Fig 4.6**). Transported soils (**photo no: 4l**) are those that are usually found over gentle slope of wide valleys. Transported material is considered to be a mixture of alluvial and colluvial origin lying over gentle slopes and are relatively assessed to be less susceptible to landslides. Loose slide material (**Photo no: 4k**) observed in large slide areas and maximum weightage given to the loose slide material.

Table 6, Slope Forming Material classes with rating and LOFS values.

CLASS	Rank	LOFS
In-situ soil	4	0.2409
Transported Soil	3	0.1506
Laterite	4	0.2409
Granite gneiss	1	0.0682
Hornblende-actinolite-chlorite schist	3	0.2409
Amphibolite	4	0.2409
Quartzite	1	0.0682
Colluvium	4	0.3727
Chlorite schist	4	0.2409
Grewacke-argillite	4	0.2409
Banded magnetite quartzite	1	0.0682
Loose slide debris	8	1
Compacted slide debris	3	0.1506
Water body	0	0
Dolerite	1	0.0682
River	0	0
Ultramafic rock	1	0.0682
Alluvium	0	0

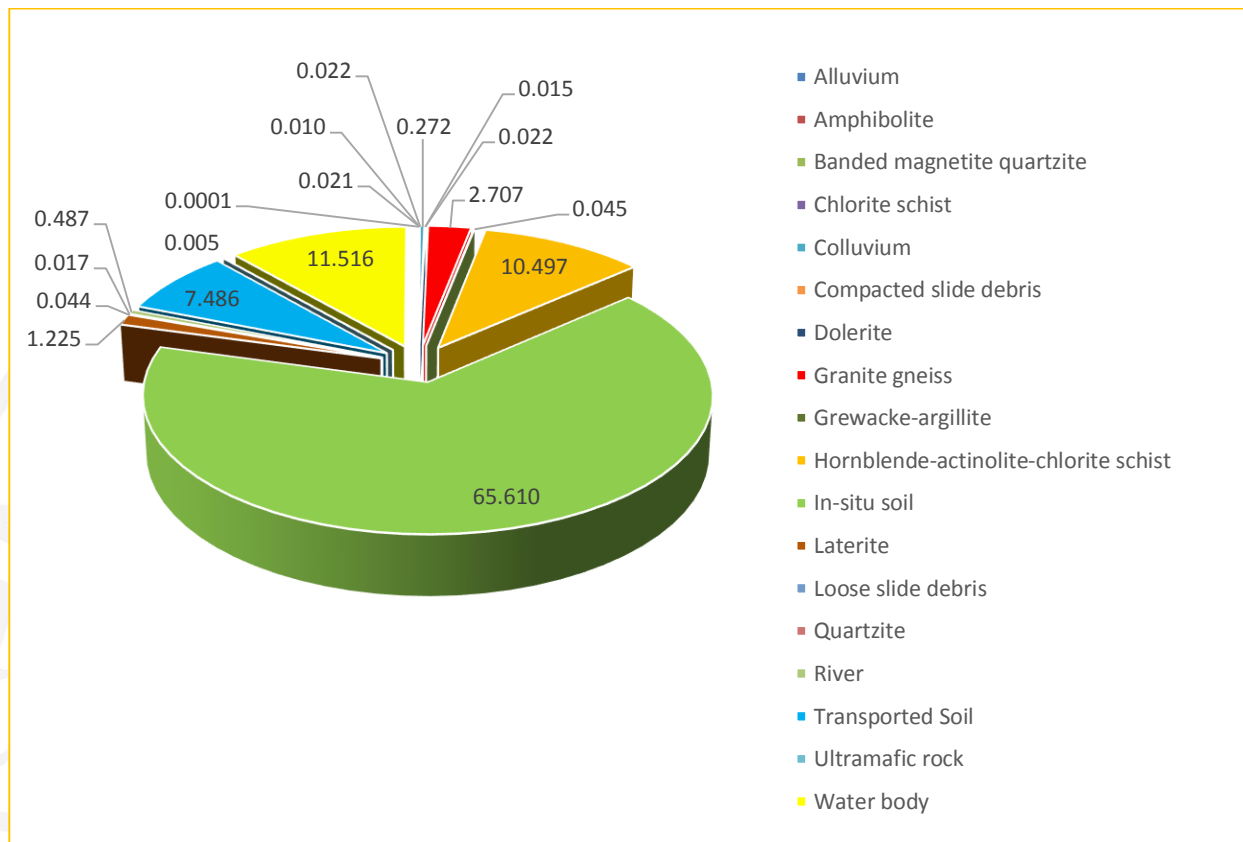


Fig. 4.6. SFM classes percentage distribution of the study area.

Granitic gneiss and Hornblende actinolite- chlorite schist present in and around Hadil, Koppa, Surimane, Jog and laterite present in and around Chikkankod, Hulladevankodlu and Jalavalli..

4.3.6 Regolith Thickness

Regolith thickness map also play a vital role to initiate the landslide. Regolith means the materials (transported soil, insitu soil, colluvium and weathered rock) which is lying over the bed rock. In the study area regolith thickness various from <0.5m thickness to >10m. Regolith thickness depends upon many factors, such as slope forming material, slope, rate of weathering etc. Since the target area is large, the prediction or delineation of the regolith thickness is difficult in the field and for ideal thickness modelling, a large number of observations such as drill holes, outcrops, or geophysical measurements are required. However, for the present study, this approach is difficult to implement due to scale and target area constrains. So assessment of regolith thickness was made at the field by studying the road cut, stream cut sections and slide scar faces and mapping was carried out in toposheet base.

The prepared regolith thickness map (**Plate-X**) is classified into four major classes such as <0.5m, 0.5-5m, 5-10m, >10m. In SFM map where ever rock exposed and similarly in LULC map barren portion assigned as <0.5m in the regolith thickness map. The landslides which are documented in the 48J/16, exhibits maximum thickness ranges from 5-10 and >10m (**Photo no: 4n, 4o**). Thickness of <0.5m (**Photo no: 4p**) assigned as rock with thin insitu soil covers about 14.57%. Similarly, 0.5-5 m thickness has area cover of 24.20%, 5-10 m thickness cover 37.89% and >10 thickness covers 11.30% in the study area (Fig.4.6). 5-10 m regolith thickness observed mostly in the toposheet no 48J/16 in and around Ambargodlu, Kalasavalli, Kerematte and Talguppa villages. Invariably 0.5-5m (**Photo no: 4m**) thickness mostly observed in the SE and SW part toposheet no 48J/12. The maximum weightage is given to the 0.5-5m thickness and less weightage is given to <0.5m. But in the field majority of the landslide incidents falls in the regolith thickness ranges from 5-10 or >10m. From the field observation granitic dominant terrain having thicker regolith thickness which is evident from gradual increase in thickness of insitu soil noticed from west to East in the study area.

Table 7, Regolith thickness classes with rating and LOFS values.

CLASS	Rank	LOFS
< 0.5 m	0	0
0.5 - 5 m	7	1
5 - 10 m	4	0.32296
River	0	0
Water body	0	0
>10m	2	0.13627

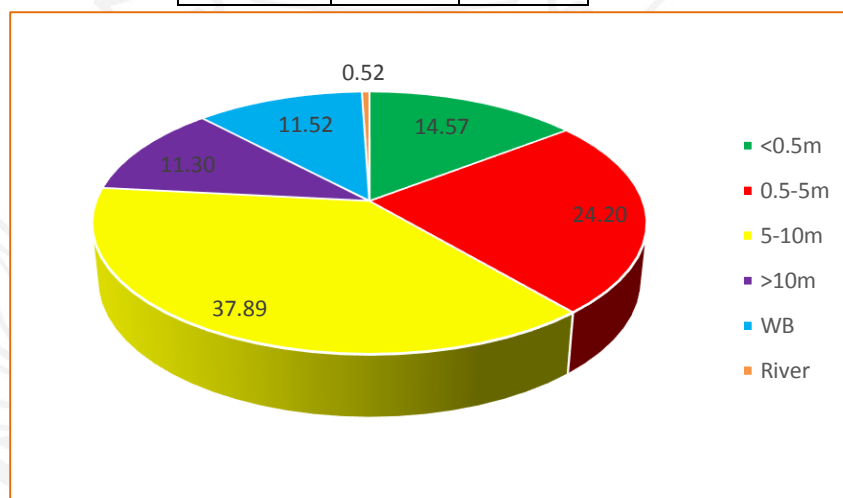


Fig.4.7. Regolith Thickness percentage distribution of the study area.

4.4 Landslide Susceptibility Analysis (AHP)

Landslides or rather slope failures in the study area are concentrated mainly along roads and other transportation corridors. Landslides are a result of anthropogenic activities and considering them for susceptibility zonation of the study area would be highly biased. Normal method of modeling cannot be used in negligible amount of slides. In this situation, ratings and inter-predictor weights can only be determined using expert or knowledge driven techniques by implementing one of the following alternatives or by combining knowledge derived from attempting all the alternatives.

Alternative 1: Finalization of ratings and weights in a smaller neighboring area-

If landslide inventory data is available in a smaller catchment or road-corridor within or adjacent to the proposed study area (or Toposheet), attempts should be made to determine terrain-specific ratings and weights of geo-factors through a pilot study in the study area. This can be executed by employing different spatial association analysis such as determination of Yule's Co-efficient, Distance Distribution Analysis etc. The ratings and weights determined so far through that pilot study can then be utilised for the entire study area where landslide data is not available. Since NLSM aims to develop and utilize terrain specific ratings and weights, this seems to be the best approximation of terrain-specific importance of geo-factors.

Alternative 2: Finalization of ratings and weights using expert opinion and Analytical Hierarchy Process (AHP)-

In a situation of complete non-availability of landslide inventory data, there is absolutely no remedy other than utilizing complete expert or knowledge driven ratings and weights into susceptibility modeling despite its subjectivity. However, this knowledge-driven ratings/ weights in quantitative matrices can easily be determined mathematically using AHP (Saaty, 1977; Ghosh et al., 2010), after preparing/ deciding on the qualitative pair wise importance matrix for different geo-factor classes and amongst different geo-factors for inter predictor weights, obtained so far through discussion and comments received from local experts and landslide scientists engaged in landslide investigation of the area. The procedures of application of AHP through some examples are demonstrated through some illustration below. In line of the above proposition, for determining the terrain-specific knowledge driven ratings and weights through application of AHP, a mandate form/ questionnaire is prepared, where all the concerned landslide scientists, other geologists working in similar terrain and all experts of the concerned Region may submit their mandate/ answer in a semi quantitative term by rating each geo-factor theme separately. While giving the

semi quantitative rating in a scale of 1-9 for each geo-factor theme, the relative importance for influencing/ causing a single proposition that is land sliding in this case should be taken into account. A particular geo-factor class having higher rating would be considered as more instrumental in influencing land sliding. For example, if we classify our slopes into 5 classes say 0-15, 15-25, 25-35, 35-45 and >45 and give semi-quantitative rating as 2, 4, 8, 6, 1 then it will be presumed that for land sliding, slope class 25-35 is the most important among all other classes.

4.4.1 Methodology:

The Analytic Hierarchy Process (AHP), developed by Saaty (1980) is a method of structuring decision problems. The AHP consists of three levels of hierarchy. The first hierarchy level is the goal of the decision making, the second level involves how each of the existing criteria contributes to achievement of goal, and the third level is to find out how each of the alternatives contributes to each of the criteria.

The AHP method is appropriate and to be used where decisions are to be assessed quantitatively. It is assumed that human beings' natural reaction when facing a complex decision making process, is by grouping the decision elements according to common characteristics. This involves ranking the decision elements, and then comparing between each pair in each group in a form of matrix. Then inconsistency ratio and weight for each element can be measured. This provides ease in testing the data consistency. The higher consistency ratio, the assessment result becomes more inconsistent. The acceptable consistency ratio is less than or equal to 10%.

According to Taylor, Consistency Index (CI) can be calculated by using the following formula:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad \text{Eq-1}$$

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n w_i \cdot c_i \quad \text{Eq-2}$$

The consistency ratio is then calculated as,

$$CR = \frac{CI}{RI} \quad \text{Eq-3}$$

Where, n is the amount of items compared, w_i is the weight, c_i is the sum of column, CR is the Consistency Ratio, CI is the Consistency Index and RI is the Random Consistency Index.

If $CR \geq 10\%$, the data acquired is inconsistent and If $CR < 10\%$, the data acquired is consistent. The ratio-scale form is used as an input. The values in the ratio are organized in a matrix, which is called the pairwise comparison matrix. In the AHP method, the scale range 1–9 is assumed. It is limited to a ratio-scale 1–9 because according to the research conducted by Miller,

human beings cannot simultaneously compare more than seven objects. The Standard Preference Scale used is given in

Table 8, Standard preference scale.

Preference Level	Numerical Value
Equally Preferred	1
Equally to Moderately Preferred	2
Moderately Preferred	3
Moderately to Strong Preferred	4
Strongly Preferred	5
Strongly to Very Strongly Preferred	6
Very Strongly Preferred	7
Very Strongly to Extremely Preferred	8
Extremely Preferred	9

Using the above Standard Preference Scale, GSI, being the Nodal Agency for landslide studies in India assigned for the preparation of a seamless landslide susceptibility map of India by giving weightage to the factor classes and the factor maps in Arc GIS. The obtained score for individual factor class was used for determining the ratings for each factor class. The average score for the factor maps were ranked between 0 and 9. Matrix of pairwise ratings; estimated eigenvectors of pairwise rating matrix; and estimation of consistency vector (CV), consistency index (CI) and consistency ratio (CR) for judgment of consistency of pairwise ratings of factors, respectively for all maps was calculated.

For determination of Predictor Weight for the geo-factor, one comparison matrix is calculated in microsoft excel software for the pair wise qualitative comparison of all the geo-factors. In the comparison matrix, fraction weight is calculated for all the geo-factors.

Once the LOFS values for geo-factor sub classes are determined, all the LOFS values against the sub classes are compiled in an excel sheet. Then the LOFS attributes are joined in the raster map attribute table using “join and relates” option. Finally, LOFS map of the geo-factor is prepared with the help of “Lookup” command in Arc GIS, using raster map of the geo-factor as “input raster” and “geo-factor_LOFS\$LOFS” as lookup field.

Once all the fraction weights are determined, minimum value within the fraction ratings is identified using the “MIN” command in excel software. Then all the fraction weight values are divided with the minimum fraction weight value to determine the Predictor Weight or weight of geo-factors. In this way, as the fraction weights are divided with the minimum fraction weight value, the Predictor Weight or weight values will be one or more than one. For each geo-factor, consider the nearest whole number as its Predictor Weight or weight. For generation of “Raw Landslide Susceptibility Score Map” in Arc GIS, “raster calculation” command under map algebra is used. For “Raw Landslide Susceptibility Score Map” the following formula is used.

Susc Score = (LOFS_Factor1*weight of Factor1 + LOFS_Factor2*weight of Factor2 + LOFS_Factor3*weight of Factor3 + LOFS_Factorn*weight of Factorn) / Sum of inter – predictor weight

In this type of knowledge-driven models, classification break values can be determined on the basis of the logic applied while giving mutual comparison expert driven ranking. It is always thought by any expert that rank value for any factor class is ≥ 5 , and it is considered that the particular factor class has higher likelihood in influencing the landslides. This rank value of “5” in a scale of “0” to “9” comes after 50% of the absolute difference values ($9-0 = 9$; 50% of 9 is 4.5). That is why this 50% cut-off margin or weightage can be used to determine the break raster value between “Moderate” and “High” susceptibility classes (BrMH). Similarly, when rank value for any factor class is ≤ 3 (lower than 30% of the absolute difference value of 9), and it is considered that the particular geofactor class has lesser likelihood in influencing any landslides. Accordingly, 30% cut-off margin or weightage can be used to determine the break values between “Low” and “Moderate” susceptibility classes (BrLM). Using the above logic the required break values can be determined by solving the following formula:

BrMH = [(Abs Diff LOFS Factor1*50)*weight of Fcator1 + (Abs Diff LOFS Factor2*50)*weight of Fcator2 + (Abs Diff LOFS Factor3*50)*weight of Fcator3 + (Abs Diff LOFS Factorn*50)*weight of Fcatorn] / Sum of inter – predictor weight.

BrLM = [(Abs Diff LOFS Factor1*30)*weight of Fcator1 + (Abs Diff LOFS Factor2*30)*weight of Fcator2 + (Abs Diff LOFS Factor3*30)*weight of Fcator3 + (Abs Diff LOFS Factorn*30)*weight of Fcatorn] / Sum of inter – predictor weight

Once break values (BrMH and BrLM) are calculated, Classified Landslide Susceptibility Map is prepared by reclassifying the Raw Landslide Susceptibility Score Map using reclassify

command in Arc – GIS. In reclassification window, three classes is chosen and in break values, 2nd topmost value given as the first value (Class 1), 1st topmost value is given as the second value (Class 2) and third value (Class 3) is given as one. Now the Raw Landslide Susceptibility Score Map is classified into the following categories: Class 1 stands for “Low Susceptibility”, Class 2 stands for “Moderate Susceptibility” and Class 3 stands for “High Susceptibility”.



5. LANDSLIDE SUSCEPTIBILITY MAP

5.1 Discussion and Susceptibility Map

The landslide susceptibility map (**Plate no-XI**) of toposheet nos. 48J/12 and 48J/16 was prepared using weighted multiclass index overlay method. The susceptibility is expressed in terms of the relative proneness to initiation of a landslide in a pixel (the mapping unit) under the given geo - environmental conditions. Table 5.1. Shows the area coverage and percentage with respect to different susceptibility classes for the present study area.

Table 9, Landslide Susceptibility classes with area coverage.

Sl. No	Landslide Susceptibility Class	No. of Pixels	% Coverage
1.	Low	380456	68.03
2.	Moderate	151224	27.04
3.	High	27571	4.93

In the present study area, 68.03 % of the area falls under low susceptibility class, 27.04 % of the area falls under moderate susceptibility class whereas only 4.93 % area falls under high susceptibility class.

The majority of the areas situated in the Eastern, North Eastern, Southeastern and Central part of the study area falls under low susceptibility class with small patches of areas with moderate class within it. On the other hand, areas situated in Western, South Western and South Eastern part of the study area falls under moderate susceptibility class with considerable patches of areas with high susceptibility class within it. Almost all the major localities of the study area like Kogaru, Gudumakki, Chittar, Dabbod, Samsi, Nagabastikere, Jog, Talaguppe, Totakoppa, Besur, Karur, Eratti and Muchavalli etc, comes under low susceptibility class. Localities like Koppa, Muugolli, Mundki, talagadde, Hudil, Kurandur, Makodu, Gubbagodu and surrounding of Hessagi and Surimane etc comes under moderate susceptibility class. Very few localities like West of Govardhangiri fort, NE of Koppa, EW of Surimane and NW of Jog the areas comes under high susceptibility class. One important road corridor i.e. Bhatkal to Jog road (SH-50), certain patches of road section falls under moderate to high susceptibility class.

The distribution of the susceptibility classes shows a very clear indication. In the landslide susceptibility modelling, the slope angle, land use – land cover and geomorphology map played a major role in generation of the final landslide susceptibility map. The North-Eastern and South

Eastern part of the study area is having relatively gentle topography falls under dominantly low susceptibility class with very slight patches of moderate susceptibility class within it. Slope angle wise the majority of the area (72%) falls under $<15^\circ$ slope angle class. Geomorphologically most of these areas come under dominantly lowly dissected slope followed by rolling plain class. Land use – land cover wise the Eastern part of the study area shows classes like HHP and cultivation, settlement etc. All these geofactor classes have relatively lower ratings within the individual geofactor map, thus the LOFS values of these geofactor classes are towards lower side. So, in the landslide susceptibility modelling, while carrying out data integration, these lower LOFS values contributes for the overall low susceptibility class of the area. On the contrary, the Northern, Western and Central part of the study area, shows rugged topography and slope angle of these areas have higher slope classes (slope range varies from approx. 0° to 68°). In land use – land cover map the dominant classes are thick vegetation, water body, sparse vegetation, plantation (HHP) cultivation, along with extensive slope cut. In landuse/ land cover map second largest class is water body which cover the 11.52% of the study area which accounts for 161.26 Sq. km. Plantation (LHP) & thick vegetation have moderate rating and barren has low rating in land use – land cover geofactor. On the other hand the extensive slope cut and settlement on modified slope is having the highest rating within land use – land cover geofactor. Moderately dissected slope has relatively higher rating in geomorphology geofactor and dominant slope angle classes (15° to 25° , 25° to 35° and 35° to 45°) of these area has relatively higher ratings within slope angle geofactor. Moreover, within the geofactor classes, slope angle and land use – land cover has highest and 2nd highest weightage. So, these higher ratings of the geofactor classes contribute to the higher LOFS values for these geofactor classes within the individual geofactor. Similarly, the higher weightage of the geofactors contribute to the higher predictor weight or weight of the particular geofactor within the all the geofactors. So, in the landslide susceptibility modelling, while carrying out data integration, these higher LOFS and predictor weight of geofactor classes and geofactors respectively, contribute to the overall high to moderate susceptibility class of the area.

Although there is no provision of direct validation of the pre-field map in the field, an attempt was made to determine the success rate of the landslide susceptibility map by overlapping the landslide points on the landslide susceptibility map in GIS software. In this exercise, it was observed that out of total 87 landslides, 17 landslides (19.54%) falls within the high susceptibility class followed by 46 landslides (52.88%) under moderate susceptibility class and 24 landslides

(27.58%) under low susceptibility class. In low susceptible area out of 20 landslides, around eight to ten landslides falling fringe of the moderate to low susceptible area.

So, overall 72.42% of the landslides fall under high and moderate susceptibility class which clearly indicates that the landslide susceptibility model fits reasonably well in the present study area.



6. CONCLUSIONS AND RECOMMENDATIONS

Macro scale (1:50,000) landslide susceptibility mapping carried in parts of toposheet no. 48J/12 and 48J/16, covering parts of Uttar Kannada and Shimoga districts, Karnataka for an area covering of 1399 sq. km, was carried out during field season 2018 – 19. In this study, a qualitative landslide susceptibility map was prepared by using the weighted multi class index overlay method, as recommended in the SOP of NLSM. The mapping unit used is a pixel of 50 m x 50 m grid. The outcome of the study is enumerated below:

- A multi – temporal landslide inventory map of the study area is prepared using old reports data, multi temporal Google imagery from 2002 to 2018, LISS III / LISS IV data and field inputs. Most of the landslides are smaller in dimension and are due to slope modification by cutting of the slope (extensive slope cut) for road construction, settlement construction and are found in the vicinity of roads. Although few landslides documented vicinity to the cultivation or plantation (HHP). Those landslides are mainly triggered by toe cutting of flowing 3rd order stream due to rainfall. However, some extent of anthropogenic activity is also contributed for this slope failure.
- The prepared landslide inventory map of the study area contains a total of 87 nos. of landslides.
- The landslides in the study area are very small in dimension, hence, ideally can not to be taken into consideration for a 1:50,000 scale map. Though in Google Earth with high resolution the landslides are mapped as polygon but when representing in 1:50,000 scale landslide inventory map (**Plate –III**) the landslides are represented as point only, as the polygons are not visible in 1:50,000 scale.

Heuristic (knowledge driven) technique modelling requires fixation of individual ratings for geofactor classes and weights of geofactors for the entire area. So, these initial ratings are fixed with the knowledge of terrain and with discussion with local experts for Analytical Hierarchy Process (AHP).

Once all the ratings for geofactor classes and weights of geofactors are fixed, LOFS is calculated for all classes using pair wise comparison matrix and fraction rating and LOFS maps of the geofactors are prepared using GIS software.

Based on the landslide characteristics, a total of eight factor maps, viz., Slope morphometric (slope angle, slope aspect, slope curvature) and drainage (derived from Carto DEM

of 30 m resolution), geomorphology, land use – land cover, slope forming material and regolith thickness maps (prepared from high resolution open source Google imagery) were prepared for susceptibility analysis. All the above eight maps were used for assessment of factor class ratings. However, only five thematic maps (except aspect, curvature and drainage) were considered for validation of Landslide Susceptibility Analysis (LSA) of the study area due to the absence of identified factor classes in a particular map. The detail study of the thematic map and landslide inventory map shows the following:

- In the Slope Morphometry maps, the slope angle approx. 72.7% of the area is occupied by of $<15^\circ$ followed by slope class of 15° to 25° which occupies approx. 21.8% of the area. In case of slope curvature, Concave and Convex class covers most of the area with an area coverage of 46% and 48% respectively.
- In the land use - land cover map, thick vegetation occupies 60.37% of the area followed by sparse vegetation and plantation (HHP), extensive slope cut and settlement on modified slope which occupies 8.08%, 6.46%, 0.07%, 0.02% of the area respectively.
- In the geomorphology map, lowly dissected slope occupies 37.76% area followed by rolling plain and moderately dissected slope that occupies 16.36% and 14.70% of the area respectively. Highly dissected slopes only accounts for 5.81%
- In slope forming material map, 65.61% of the area is occupied by in-situ soil class.
- In regolith thickness map, 24.20% and 37.89 % of the area is covered by 0.5 m – 5 m, 5m to 10 m thickness class respectively.

For understanding the relative importance of every geofactor that is specific to the terrain, inter-predictor weights were calculated for the five geofactors. Analysis of the inter-predictor weights has shown that:

- Slope angle class has the maximum importance amongst all the geofactors.
- Land use – Land cover class has the second most importance followed by slope forming material, geomorphology and regolith thickness classes in descending order amongst all the geofactors.

Using these five geofactor classes, the final Landslide Susceptibility Map (LSM) is generated. Analysis of the LSM has shown that:

- About 68.03% of the area falls under low susceptibility class, 27.04% of the area falls under moderate susceptibility class, whereas only 4.93% area falls under high susceptibility class.
- The majority of the areas situated in the Eastern, North Eastern, South Eastern and Central of the study area falls under low susceptibility class with small patches of areas with moderate class within it. On the other hand, areas situated in Western, South Western and South Eastern side of the study area falls under moderate susceptibility class with considerable patches of areas with high susceptibility class within it.
- Almost all the major localities of the study area like Kogaru, Gudumakki, Chittar, Dabbod, Samsi, Nagabastikere, Jog, Talaguppe, Totakoppa, Besur, Karur, Eratti and Muchavalli etc, comes under low susceptibility class. Localities like Koppa, Muugolli, Mundki, talagadde, Hudil, Kurandur, Makodu, Gubbagodu and surrounding of Hessagi and Surimane etc comes under moderate susceptibility class. Very few localities like West of Govardhangiri fort, NE of Koppa, EW of Surimane and NW of Jog the areas comes under high susceptibility class. One important road corridor i.e. Bhatkal to Jog road, certain patches of road section falls under moderate to high susceptibility class.
- One important road corridor Bhatkal to Jog road passing nearly undulating terrain which comes under low susceptible zone, however certain stretches of the road (after crossing Nagavalli village) comes under the moderate to high susceptible because of the steep nature of the slope angle and presence of the thin soil cover over the slope
- Very few patches of area come under the high susceptible zone, those areas mostly devoid of settlements and other infrastructures. Around 42.68% of area comes under the moderate susceptible zone. This moderate susceptible area includes some settlement area also. Most of the settlement situated low susceptible zone even though the low susceptible area become moderate or high when there is a debris flow in the adjoining areas or extensive slope modification without considering any engineering aspect.

6.1 Usability of the susceptibility map

The final landslide susceptibility map is useful for:

The prepared landslide susceptibility map can be used for the following aspects:

- Perspective planning for future developmental activities (like construction of new projects) in the low susceptible areas.
- Identification and delineation of target areas for meso-scale (1:5,000/10,000) or detailed site specific studies.

- The prepared landslide inventory database along with the landslide susceptibility map can meaningfully serve as a contributing parameter for the geo-hazard assessment and evaluation of the area.
- The landslide susceptibility map when combined with temporal data can be effectively used for assessing the landslide hazard and risk scenario of the area.

6.2 Limitations

- The generated landslide susceptibility map is largely valid under the given set of geo-environmental conditions existent at the time of the study (slope conditions used as input in the susceptibility modelling). Any significant change in the spatial distribution of the geo-environmental factors can affect the susceptibility of the area.
- Field validation of the geo-parametric attributes of the study area is an integral part of the susceptibility analysis. However, the inaccessibility to certain sectors due to steep nature of the terrain brings about limitations in terms of uncertainty in few geo-parametric attributes.
- Heuristic or knowledge driven method which is employed in the current susceptibility modelling and mutual pair wise comparison of classes through Analytical Hierarchy Process comes with certain limitation. This process caters to the terrain specific needs, however, there is always an inclination for unintended biasness in the ratings assigned. Therefore, earnest attempt has been made to minimize biasness in assigning ratings to various factor classes and also factor weight for each theme through mutual discussion and re-assessment through field inputs.
- The susceptibility map gives estimation that the mapping unit will be affected by a potential future landslide. However, it may be categorically mentioned that the future landslide does not refer to any specific time frame or frequency of occurrence nor does it carry any connotation on the magnitude or scale of the failure.
- It is merely an establishment of relationship of relevant geo-environmental causative factors with landslides for the areas of interest and based on which a qualitative assessment has been reached with regard to their stability.

6.3 General Recommendations

- As a general recommendation, no public or personal utility projects should be allowed in high susceptible areas. However, susceptibility values can be lowered by adopting proper mitigation measures and a high susceptible slope can be scaled down to the next lower

susceptibility class or still lower class, based on nature / type of the mitigation measures adopted. So any project proposal in the high susceptible area should be insisted upon with the submission of proposals for suitable mitigation measures that will change the susceptibility status to low, should be thoroughly scrutinized and evaluated technically.

- A simple and economical slope protection measure may be made mandatory in any slope even in the area of low susceptibility that is going to be modified due to the reason that non-engineered slope cut or modification will change the slope as highly susceptible. It needs due understanding that the susceptibility has been arrived on the present parameters of the slope.
- In some areas low susceptible zones are arrived below the high susceptible zones. As the runout analysis is beyond the scope of this work and also has not been done, it is suggested to take precautions against the runout and the resultant damages. More particularly encroachment of the stream/river course should be avoided or should not be allowed.
- Significant anthropogenic interference through modification of slope profile has been found to be a major causative factor for inducing local instability. Hillslopes currently classified in low to moderate susceptibility are anticipated to undergo their susceptibility status when subjected to extreme anthropogenic interference without methodical approach in the near future. Under such circumstances any attempt to raise civil structures of importance on the slopes must consider the site specific suitability and criticality of the slope.
- The information depicted in the derived susceptibility map is on 1:50,000 scale and accordingly the map can serve as the basis for further investigation for the areas of interest in case civil structures are planned. It is therefore recommended that the susceptibility map showing not only the potential landslide initiation areas but adjacent upslope or downslope should be further examined (Thrideep et. al. 2016). Areas falling in high susceptibility zone should be given due attention while executing any civil constructions.
- The most dynamic causative factor considered in the study is the land use pattern. Rapid development work by way of excavation along steep slopes for road bench, public utility ground, buildings and quarrying along the road cuts and slopes of steeper angle are apparently widespread in the study area. Such slopes may become critical or unstable in the event of prolonged rainfall or saturated condition. Hence, it is recommended that efficient attempts be made to stabilize the slope during and after the excavation. Excavated

material should be disposed of in suitable locations and any precariously hanging boulders and loose debris should be removed to reduce instability.

- In the event of a disaster, loss would be immense if buildings are not safely and properly located. The only economical way of reducing 'at least' the loss of life is by making people aware of the inherent risk. Therefore, it is recommended that more priority should be given in increasing awareness amongst people through Community Based Disaster Management Programme (CBDMP). The awareness should include information about the potential danger, its identification and its communication; the physical significance of hazard and inherent uncertainties; ways to reduce landslide risk and the available local mitigation options. The villages or communities located in and around high hazard areas should be given priority in holding CBDMP.
- Landslide frequency analysis provides satisfactory hazard prediction with the statistical approach. But the approach requires a huge amount of reliable and consistent data in support of the landslide events of the recent past. Therefore, efforts should be made to preserve the data on slide occurrences, where existing so that it can facilitate further research.

6.4 Detailed Recommendations

Based on the evaluation of the geofactors and understanding their relative importance that are specific to the terrain, as well as considering the scale of the study and the observations made in the field, the following generic recommendations are suggested:

- In future if any constructional development planning like enlargement of township, public utility infrastructure, etc., may be carried out in the designated low susceptibility zones, i.e. in and around localities like Talguppa, Dombé, Ambargodlu, Tumari, Devikan, Kargal, Jalavalli etc.
- The areas situated in North, Northwest, South and Central part of the study area comes under moderate susceptibility class with considerable patches of areas under high susceptibility class within it. So, construction of public or personal utility projects should be avoided in moderate to highly susceptible areas.
- Along the road section (Bhatkal to Jog) few landslides are documented and they are in small dimension. These landslides initiated due to cutting of the slope for the road construction. With help of the susceptible map around 10-12 km of the road stretch delineated as moderated susceptible zone with in which some pockets of high susceptible zones. Although the slides

are smaller dimension, proper mitigation needs to be done like easing of the slope, construction of retaining wall with suitable height, applying some eco-friendly method like Geo-Jute and construction of toe drain and proper maintenance. Regular monitoring may be taken up for these road corridors to avoid future slope failures.

- In and around Kodani, Heggar, Ganzni, Hinnur, Magod, Gersoppa and Chaturmukha Basti some landslides are documented. Main cause of these slides is vertical cut of the slope for the road construction. A major, large scale landslide is not anticipated along this area, however intermittent and localized small scale landslide is anticipated during adverse hydrological saturation. Moderation and easing of high angle extensive cut slope may be considered. In the above mentioned area many of the settlements are situated just below the road by vertical cutting of the toe and this cut slope along section exposed highly weathered lateritic soil overlain by thin insitu soil. The exposed highly weathered rock tends to easily erode and washed away by in the event of incessant rainfall. These lateritic soils tend to form voids and furrow, this voids and furrow enlarge and subsequently leading to caving in of lateritic soil and slide. Adequate masonry stone retaining walls are to be provided to protect the slope failure may be considered along this section.
- A road leading to SRVP power station which is coming under moderate to high susceptible zone because of high slope angle, vertical cutting of the toe for road construction and weak unconsolidated slope forming material. In this area it may be recommended that the construction of retaining wall, proper maintenance of toe drain and construction of adequate culvert in the valley side. Vicinity to the power station (left hand side) debris slide noticed and this area appears to be chance of large slide in the future in the event of prolonged rainfall. To prevent the slope from the future slide it may be recommended that channelizing of all stream around this area and divert the surface runoff by constructing contour drain. Just above the power station right side of the penstock area small soil slide observed due to weak slope forming material, indecorous maintenance of the surface runoff and impulsive slope modification. For this area it may be recommended that easing of the slope by multiple benching, divert the surface runoff and maintenance of earlier hill side drain. It is also recommended that the detailed study to be carried in and around the power station to avoid future slope failure.
- Around 15-20 nos of landslides are documented in and around Baukuli, Kandravali, Kalur, Sulemakki, Kolegodu, Muchavalli, Arodi, Ramaagadde, Honnagodu, Samase and Murakatte. These documented landslides are larger in dimension when compared to the cut slope failure

and interestingly those landslides are initiated vicinity to the cultivation. The noticed landslides are mainly triggered by toe cut of the hill slope by flowing 2nd or 3rd streams and rainfall. To avoid any further landslide in this area it may be recommended that the construction of settlement/house or any other infrastructure towards hill side or where the slope angle increases from the toe of the hill it should be avoided and hill side drainage/toe drain to be constructed to protect the hill slope from toe cut by stream.

- Around Jog falls, along the NH-206 few slides were documented. These landslides are mainly because of the extension of road by cutting of the slope without any engineering consideration, weak slope forming material and having the Regolith thickness is more than 5m. In this area it may be recommended that construction of boulder gabion wall to be provided or easing of the slope to be done in this area.

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LOCALITY INDEX

Sr. No	Village	TS Nos	Lat In Dec. Deci	Long In Dec. Deci	Sr. No	Village	TS Nos	Lat In Dec. Deci	Long In Dec. Deci
1	Gudumakki	48J/12	14.09	74.75	101	Nadudara	48J/12	14.02	74.72
2	Kogaru	48J/12	14.05	74.74	102	Hirebail	48J/12	14.03	74.72
3	Hadavalli	48J/12	14.03	74.63	103	Savalejaddu	48J/12	14.04	74.72
4	Kotkhand	48J/12	14.02	74.59	104	Ikkemane	48J/12	14.04	74.73
5	Agrahole	48J/12	14.08	74.51	105	Kedagodu	48J/12	14.06	74.71
6	Honnebar	48J/12	14.18	74.52	106	Sulemane	48J/12	14.06	74.71
7	Dabbod	48J/12	14.19	74.52	107	Chandemane	48J/12	14.05	74.7
8	Jalavalli	48J/12	14.25	74.52	108	Kalkeri	48J/12	14.07	74.71
9	Belemakki	48J/12	14.21	74.57	109	Harvadi	48J/12	14.07	74.7
10	Kudrige	48J/12	14.23	74.62	110	Horulisal	48J/12	14	74.55
11	Hadi	48J/12	14.18	74.61	111	Kindikodla	48J/12	14.01	74.56
12	Hoggaru	48J/12	14.19	74.65	112	Bilavalakhand	48J/12	14.01	74.57
13	Hosarbail	48J/12	14.1	74.67	113	Kitre	48J/12	14.02	74.58
14	Kadkodu	48J/12	14.14	74.73	114	Hutkala	48J/12	14.01	74.6
15	Herkane	48J/12	14.18	74.74	115	Marukeri	48J/12	14.02	74.61
16	Surimane	48J/12	14.18	74.71	116	Belurmane	48J/12	14.01	74.62
17	Hirni	48J/12	14.22	74.74	117	Kuntvan	48J/12	14.01	74.63
18	Nagarbastikere	48J/12	14.24	74.66	118	Kuntvani	48J/12	14.02	74.62
19	Jalavallikarki	48J/12	14.24	74.52	119	Aruvaki	48J/12	14.01	74.65
20	Karavalli	48J/12	14.24	74.54	120	Totadamakki	48J/12	14.03	74.64
21	Melin Mudkani	48J/12	14.25	74.55	121	Indragiri Betta	48J/12	14.03	74.63
22	Kaigunde	48J/12	14.24	74.57	122	Vonibagilu	48J/12	14.03	74.64
23	Allanki	48J/12	14.24	74.57	123	Kurandur	48J/12	14.03	74.66
24	Adkar	48J/12	14.24	74.56	124	Kulvad	48J/12	14.02	74.65

25	Upponi	48J/12	14.24	74.6	125	Halyani	48J/12	14.04	74.64
26	Konamane	48J/12	14.24	74.59	126	Murkodi	48J/12	14.04	74.63
27	Herangadi	48J/12	14.23	74.58	127	Arkala	48J/12	14.04	74.66
28	Kurve	48J/12	14.23	74.59	128	Megani	48J/12	14.06	74.67
29	Samsi	48J/12	14.23	74.6	129	Hasarvalli	48J/12	14.06	74.65
30	Mavinhole	48J/12	14.24	74.62	130	Belegi	48J/12	14.06	74.68
31	Valgod	48J/12	14.24	74.62	131	Gandalki	48J/12	14.05	74.62
32	Jaddi	48J/12	14.24	74.62	132	Badabag	48J/12	14.06	74.63
33	Devargadde	48J/12	14.25	74.63	133	Basti	48J/12	14.07	74.64
34	Jinpal	48J/12	14.24	74.63	134	Aggal	48J/12	14.07	74.63
35	Saralgi	48J/12	14.24	74.63	135	Henjlla	48J/12	14.09	74.64
36	Uppinguli	48J/12	14.24	74.64	136	Hosadu	48J/12	14.09	74.65
37	Krishnakere	48J/12	14.25	74.64	137	Nagavalli	48J/12	14.09	74.67
38	Kumbeshvar	48J/12	14.25	74.65	138	Nagodi	48J/12	14.08	74.69
39	Hulegar	48J/12	14.25	74.65	139	Salamakki	48J/12	14.1	74.69
40	Gersoppa	48J/12	14.24	74.66	140	Bachodi	48J/12	14.09	74.69
41	Gundibail	48J/12	14.21	74.75	141	Totadamane	48J/12	14.1	74.68
42	Begodi	48J/12	14.23	74.7	142	Hegganamakki	48J/12	14.1	74.68
43	Ottangadde	48J/12	14.23	74.69	143	Devgar	48J/12	14.11	74.69
44	Kundramakki	48J/12	14.22	74.69	144	Sautakeri	48J/12	14.11	74.68
45	Bankodu	48J/12	14.22	74.69	145	Bellur	48J/12	14.14	74.7
46	Kuntodi	48J/12	14.22	74.67	146	Gujaralli	48J/12	14.14	74.71
47	Galagur	48J/12	14.21	74.68	147	Kallugodlu	48J/12	14.14	74.71
48	Mutkanda	48J/12	14.21	74.68	148	Kanur	48J/12	14.15	74.7
49	Gersi	48J/12	14.21	74.69	149	Dindemane	48J/12	14.14	74.68
50	Nirodi	48J/12	14.21	74.69	150	Hessagi	48J/12	14.18	74.64
51	Atumudi	48J/12	14.2	74.69	151	Heggaru	48J/12	14.19	74.65
52	Salipal	48J/12	14.2	74.69	152	Kandoddi	48J/12	14.21	74.66

53	Taktimbail	48J/12	14.2	74.69	153	Talatota	48J/12	14.22	74.67
54	Battalmuli	48J/12	14.2	74.7	154	Heggargadde	48J/12	14.23	74.67
55	Hadgeri	48J/12	14.19	74.7	155	Nerekuli	48J/12	14.24	74.64
56	Nadabag	48J/12	14.19	74.7	156	Aigod	48J/12	14.23	74.64
57	Haruri	48J/12	14.19	74.7	157	Karadgar	48J/12	14.23	74.64
58	Balegadde	48J/12	14.19	74.71	158	Hanjahmakki	48J/12	14.23	74.63
59	Geripal	48J/12	14.17	74.73	159	Shirkur	48J/12	14.21	74.63
60	Nanniru	48J/12	14.16	74.73	160	Sampolikatte	48J/12	14.21	74.63
61	Dabbe	48J/12	14.15	74.74	161	Utgeri	48J/12	14.22	74.63
62	Totaduru	48J/12	14.15	74.74	162	Gaddemaneshirkur	48J/12	14.22	74.62
63	Kundoti	48J/12	14.14	74.74	163	Taltotashirkur	48J/12	14.2	74.61
64	Hemdigadde	48J/12	14.14	74.75	164	Kirval	48J/12	14.21	74.6
65	Budigar	48J/12	14.14	74.74	165	Golikal	48J/12	14.21	74.6
66	Halme	48J/12	14.14	74.73	166	Bajekere	48J/12	14.21	74.59
67	Byalnakodu	48J/12	14.13	74.75	167	Kodlagadde	48J/12	14.19	74.6
68	Chapparmane	48J/12	14.13	74.73	168	Ashikere	48J/12	14.17	74.59
69	Yeravanti	48J/12	14.12	74.74	169	Halolli	48J/12	14.16	74.57
70	Kelgere	48J/12	14.13	74.74	170	Murgolli	48J/12	14.19	74.56
71	Guddabalu	48J/12	14.12	74.75	171	Mundki	48J/12	14.19	74.57
72	Yadakeri	48J/12	14.13	74.72	172	Jainmasti	48J/12	14.16	74.57
73	Kirgaru	48J/12	14.12	74.72	173	Adkekuli	48J/12	14.15	74.56
74	Hosgadde	48J/12	14.12	74.72	174	Sampoli	48J/12	14.15	74.55
75	Kanapagaru	48J/12	14.12	74.72	175	Gujmav	48J/12	14.13	74.58
76	Kanchigadde	48J/12	14.11	74.73	176	Banglodi	48J/12	14.11	74.58
77	Nelnele	48J/12	14.11	74.74	177	Kameshvar	48J/12	14.12	74.59
78	Gubagodu	48J/12	14.1	74.74	178	Kakke	48J/12	14.13	74.6
79	Halkanda	48J/12	14.1	74.74	179	Ondalasu	48J/12	14.12	74.6
80	Bilgar	48J/12	14.1	74.75	180	Balehalli	48J/12	14.13	74.61

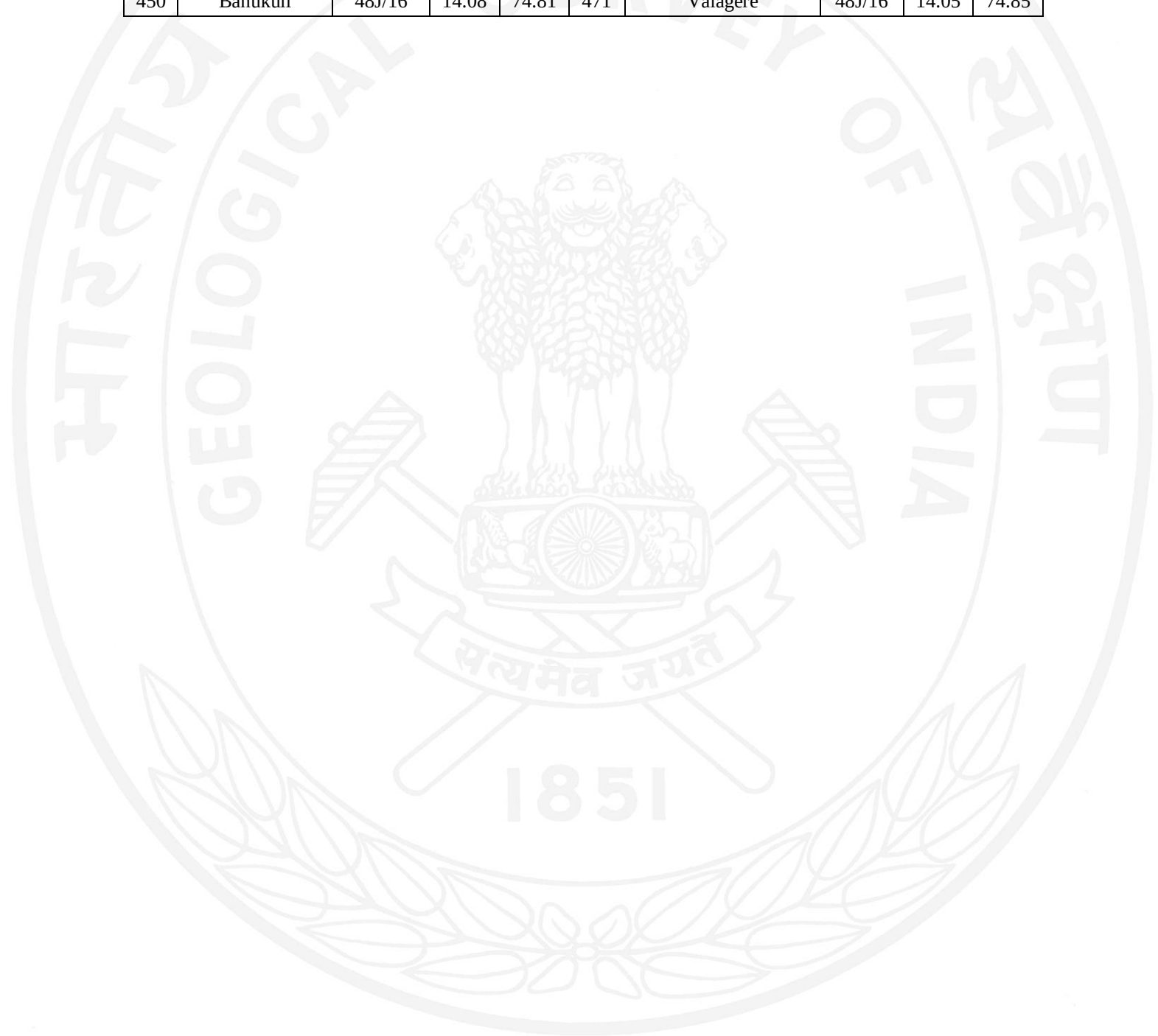
81	Halgodu	48J/12	14.09	74.74	181	Nayakankatte	48J/12	14.12	74.61
82	Kavati	48J/12	14.08	74.74	182	Kollikan	48J/12	14.12	74.62
83	Mayalli	48J/12	14.08	74.73	183	Koppa	48J/12	14.12	74.62
84	Melmanji	48J/12	14.07	74.74	184	Kannehalli	48J/12	14.1	74.61
85	Kangodu	48J/12	14.06	74.73	185	Salkodu	48J/12	14.14	74.66
86	Bhlmeshvara	48J/12	14.06	74.72	186	Chikkanhalli	48J/12	14.13	74.65
87	Hale Kogaru	48J/12	14.05	74.74	187	Hebbankere	48J/12	14.16	74.67
88	Darigadde	48J/12	14.05	74.74	188	Gundlakatte	48J/12	14.1	74.59
89	Kamagaru	48J/12	14.04	74.74	189	Sadkeri	48J/12	14.09	74.59
90	Uriga	48J/12	14.03	74.74	190	Konkinibail	48J/12	14.09	74.59
91	Halur	48J/12	14.03	74.74	191	Talahonda	48J/12	14.09	74.58
92	Kurukodlu	48J/12	14	74.69	192	Katikallu	48J/12	14.08	74.58
93	Bommane	48J/12	14.01	74.69	193	Ulval	48J/12	14.08	74.58
94	Chingodu	48J/12	14.01	74.7	194	Mullipal	48J/12	14.08	74.59
95	Kolegodu	48J/12	14.02	74.7	195	Attibal	48J/12	14.07	74.59
96	Dombeshvara	48J/12	14.01	74.71	196	Hudil	48J/12	14.06	74.61
97	Yemagale	48J/12	14	74.73	197	Kanki	48J/12	14.06	74.58
98	Abbinale	48J/12	14.01	74.72	198	Hainole	48J/12	14.05	74.58
99	Kuppadi	48J/12	14.02	74.71	199	Kodalamakki	48J/12	14.05	74.63
100	Benchlgodu	48J/12	14.02	74.71	200	Antravalli	48J/12	14.04	74.6
201	Korkod	48J/12	14.04	74.59	301	Jaddinakoppa	48J/16	14.01	74.99
202	Talgod	48J/12	14.21	74.51	302	Anandur	48J/16	14.01	75
203	Guddemakki	48J/12	14.2	74.51	303	Kuruvante	48J/16	14.02	74.99
204	Nilgiri	48J/12	14.19	74.5	304	Kolur	48J/16	14.03	74.99
205	Upli	48J/12	14.19	74.51	305	Golikoppa	48J/16	14.02	74.98
206	Vadgeri	48J/12	14.19	74.51	306	Situr	48J/16	14.02	74.97
207	Arle	48J/12	14.17	74.5	307	Kauti	48J/16	14.03	74.99
208	Mulegod	48J/12	14.17	74.51	308	Banagodu	48J/16	14.05	74.99
209	Tumbebail	48J/12	14.16	74.51	309	Gullehalli	48J/16	14.05	74.99
210	Mullimane	48J/12	14.15	74.52	310	Bilagalli	48J/16	14.06	75
211	Talagadde	48J/12	14.15	74.53	311	Mattikoppa	48J/16	14.07	74.99
212	Hosagadde	48J/12	14.16	74.52	312	Divarahara	48J/16	14.07	74.99
213	Ganjigere	48J/12	14.17	74.52	313	Niragodu	48J/16	14.08	75

214	Sashigod	48J/12	14.17	74.53	314	Ravana Mattikoppa	48J/16	14.07	74.98
215	Tattimule	48J/12	14.17	74.51	315	Kreamatte	48J/16	14.08	74.98
216	Kanchikodal	48J/12	14.18	74.52	316	Hallikeradi	48J/16	14.07	74.97
217	Mundar	48J/12	14.18	74.53	317	Chikka Mattur	48J/16	14.08	74.97
218	Chittar	48J/12	14.19	74.52	318	Varansari	48J/16	14.09	74.97
219	Adukai	48J/12	14.19	74.52	319	Basrani	48J/16	14.09	74.98
220	Mundarmasti	48J/12	14.18	74.52	320	Terinikoppa	48J/16	14.08	74.99
221	Kandumakki	48J/12	14.19	74.53	321	Hunali Madike	48J/16	14.09	74.99
222	Hasagadde	48J/12	14.17	74.55	322	Balagodu	48J/16	14.08	75
223	Halegadde	48J/12	14.17	74.55	323	Nadabedur	48J/16	14.1	74.99
224	Bommankere	48J/12	14.18	74.53	324	Gollarkoppa	48J/16	14.1	74.98
225	Hadikal	48J/12	14.18	74.54	325	Kumbaragoli	48J/16	14.1	74.98
226	Yettinoli	48J/12	14.19	74.53	326	Brahmana Bedur	48J/16	14.11	74.99
227	Kerekuli	48J/12	14.2	74.52	327	Kumbaragoli	48J/16	14.1	74.97
228	Nagankal	48J/12	14.2	74.52	328	Sidebail	48J/16	14.1	74.97
229	Adukai	48J/12	14.2	74.53	329	Dasarakoppa	48J/16	14.11	74.97
230	Jinnod	48J/12	14.21	74.53	330	Naduvaddahalli	48J/16	14.11	74.98
231	Bolugudde	48J/12	14.21	74.53	331	Vaddahalli	48J/16	14.12	74.99
232	Benkull	48J/12	14.22	74.53	332	Jigalemane	48J/16	14.13	74.99
233	Hinnur	48J/12	14.22	74.54	333	Venkatavalli	48J/16	14.12	74.98
234	Nisalnr	48J/12	14.2	74.55	334	Choudimane	48J/16	14.12	74.97
235	Balemettu	48J/12	14.2	74.56	335	Ramanagadde	48J/16	14.12	74.97
236	Manalekeri	48J/12	14.24	74.5	336	Murakatte	48J/16	14.13	74.96
237	Balkur	48J/12	14.24	74.52	337	Tumbe	48J/16	14.13	74.97
238	Heggar	48J/12	14.23	74.53	338	Hulakodu	48J/16	14.13	74.96
239	Gazni	48J/12	14.23	74.53	339	Kesavinamane	48J/16	14.13	74.95
240	Kelagin Mannige	48J/12	14.23	74.52	340	Varadalli	48J/16	14.13	74.99
241	Devar Ganzi	48J/12	14.22	74.53	341	Karkikoppa	48J/16	14.14	74.99
242	Melin Mannige	48J/12	14.22	74.53	342	Gijagaru	48J/16	14.14	74.98
243	Beranki	48J/12	14.23	74.55	343	Settisara	48J/16	14.14	74.99
244	Kodani	48J/12	14.23	74.56	344	Galipur	48J/16	14.17	74.98
245	Masabag	48J/12	14.23	74.57	345	Dombe	48J/16	14.16	74.98
246	Kosanki	48J/12	14.22	74.57	346	Kugve	48J/16	14.17	74.99
247	Birangod	48J/12	14.23	74.58	347	Kerehalli	48J/16	14.13	74.94
248	Magod	48J/12	14.22	74.59	348	Hakkare	48J/16	14.14	74.94
249	Kachodi	48J/12	14.23	74.6	349	Makodu	48J/16	14.14	74.94
250	Mahishasuramar dhini	48J/12	14.09	74.57	350	Mungalimane	48J/16	14.14	74.95
251	Golikumbri	48J/12	14.09	74.57	351	Nitli	48J/16	14.15	74.92
252	Hegdegadde	48J/12	14.09	74.56	352	Mundukodu	48J/16	14.15	74.93
253	Talagadde	48J/12	14.08	74.56	353	Gubbagodu	48J/16	14.15	74.92
254	Kabre	48J/12	14.02	74.56	354	Gotagaru	48J/16	14.16	74.92
255	Kembre	48J/12	14.02	74.55	355	Hosahalli	48J/16	14.17	74.92

256	Hulladevankodlu	48J/12	14.04	74.55	356	Marahankuli	48J/16	14.16	74.93
257	Katagar	48J/12	14.05	74.56	357	Arehadda	48J/16	14.17	74.93
258	Chikkankod	48J/12	14.04	74.55	358	Chikkatata	48J/16	14.17	74.94
259	Betkur	48J/12	14.06	74.55	359	Jaddagadde	48J/16	14.18	74.92
260	Abri	48J/12	14.07	74.54	360	Kibbachalu	48J/16	14.18	74.94
261	Konakaru	48J/12	14.07	74.54	361	Pur	48J/16	14.18	74.94
262	Belur	48J/12	14.08	74.54	362	Hunasur	48J/16	14.18	74.93
263	Siranikeri	48J/12	14.08	74.53	363	sirur	48J/16	14.19	74.95
264	Mullemane	48J/12	14.08	74.53	364	Bellenne	48J/16	14.19	74.9
265	Halebad	48J/12	14.09	74.53	365	Hamsagaru	48J/16	14.17	74.91
266	Midal	48J/12	14.09	74.54	366	Mugimane	48J/16	14.18	74.88
267	Balasuttu	48J/12	14.09	74.55	367	Dindinakaru	48J/16	14.19	74.89
268	Kodahalasu	48J/12	14.09	74.53	368	Kaulamane	48J/16	14.18	74.88
269	Ankolehonda	48J/12	14.09	74.54	369	Kolichgar	48J/16	14.18	74.87
270	Duggodi	48J/12	14.08	74.54	370	Mavinkai	48J/16	14.19	74.87
271	Koralikan	48J/12	14.08	74.54	371	Kugirmane	48J/16	14.19	74.87
272	Devikan	48J/12	14.09	74.52	372	Eduvani	48J/16	14.19	74.85
273	Mulegatte	48J/12	14.08	74.52	373	Hulinkai	48J/16	14.19	74.85
274	Kambaluru	48J/12	14.09	74.52	374	Horabail	48J/16	14.19	74.84
275	Kotadamakki	48J/12	14.09	74.51	375	Ambugallu	48J/16	14.19	74.83
276	Hongehalla	48J/12	14.1	74.52	376	Korkodu	48J/16	14.2	74.84
277	Adla	48J/12	14.11	74.53	377	Honnegodu	48J/16	14.21	74.84
278	Madangol	48J/12	14.11	74.51	378	Kantota	48J/16	14.22	74.84
279	Mundremav	48J/12	14.12	74.52	379	Jogin Math	48J/16	14.23	74.82
280	Kallagoli	48J/12	14.11	74.52	380	Padambail	48J/16	14.22	74.83
281	Herali	48J/12	14.12	74.53	381	Adukatte	48J/16	14.23	74.84
282	Kochodi	48J/12	14.12	74.55	382	Koralkai	48J/16	14.24	74.84
283	Mavinasag	48J/12	14.15	74.5	383	Musavalli	48J/16	14.23	74.86
284	Annebail	48J/12	14.16	74.5	384	Kalgar	48J/16	14.22	74.86
285	Mallari	48J/12	14.06	74.53	385	Talavata	48J/16	14.22	74.87
286	Sirvante	48J/16	14.18	74.97	386	Bechagar	48J/16	14.21	74.86
287	Muruttur	48J/16	14.2	74.92	387	Gonuru	48J/16	14.21	74.88
288	Talguppa	48J/16	14.21	74.91	388	Hiremane	48J/16	14.2	74.88
289	Hulidevarabana	48J/16	14.02	75	389	Banjagaru	48J/16	14.2	74.88
290	Ambargodlu	48J/16	14.07	74.95	390	Manjinakanu	48J/16	14.2	74.88
291	Kerodi	48J/16	14.08	74.93	391	MAlavalli	48J/16	14.24	74.9
292	Aralagodu	48J/16	14.14	74.82	392	Hangeri	48J/16	14.25	74.91
293	Kargal	48J/16	14.19	74.82	393	Hasavante	48J/16	14.24	74.9
294	Jog	48J/16	14.22	74.8	394	Honkeri	48J/16	14.23	74.93
295	Kudukunji	48J/16	14.18	74.76	395	Manmane	48J/16	14.22	74.89
296	Bilkandur	48J/16	14.14	74.78	396	Purad Math	48J/16	14.25	74.87
297	Konjavalli	48J/16	14.11	74.75	397	Heggekoppa	48J/16	14.25	74.85
298	Marlagodu	48J/16	14.07	74.79	398	Madivalajiddi	48J/16	14.24	74.84

299	Belamakki	48J/16	14.01	74.82	399	Kodkani	48J/16	14.24	74.8
300	Hunagallu	48J/16	14	74.79	400	Melinkai	48J/16	14.24	74.79
401	Kotekoppa	48J/16	14.25	74.79	451	Hesige	48J/16	14.08	74.79
402	Halgadde	48J/16	14.25	74.79	452	Halki	48J/16	14.09	74.8
403	Nogalli	48J/16	14.25	74.77	453	Kiruvase	48J/16	14.01	74.9
404	Hanjakki	48J/16	14.22	74.76	454	Karur	48J/16	14.02	74.89
405	Gundibail	48J/16	14.21	74.75	455	Murakai	48J/16	14.01	74.87
406	vodenbail	48J/16	14.21	74.77	456	Bramanakeppige	48J/16	14	74.87
407	Golgodu	48J/16	14.21	74.8	457	Kodasarur	48J/16	14	74.85
408	Iragi	48J/16	14.2	74.8	458	Honnagodu	48J/16	14.01	74.87
409	Mallakki	48J/16	14.19	74.8	459	Bidarakoppa	48J/16	14.02	74.86
410	Edadalli	48J/16	14.18	74.84	460	Keppige	48J/16	14.02	74.88
411	Malali	48J/16	14.18	74.83	461	Araballi	48J/16	14.03	74.87
412	Linganamakki colony	48J/16	14.17	74.82	462	Vandagadde	48J/16	14.03	74.86
413	Talaguni	48J/16	14.16	74.82	463	Hulkodu	48J/16	14.03	74.85
414	Hattigar	48J/16	14.16	74.83	464	Basti	48J/16	14.02	74.84
415	Bidarur	48J/16	14.17	74.81	465	Berala	48J/16	14.02	74.85
416	Hukkalu	48J/16	14.16	74.8	466	Tumari	48J/16	14.03	74.85
417	Gadigere	48J/16	14.17	74.81	467	Kunchi	48J/16	14.02	74.83
418	Halavalli	48J/16	14.13	74.77	468	Kudarur	48J/16	14.02	74.83
419	Makkimane	48J/16	14.14	74.76	469	Arodi	48J/16	14.01	74.82
420	Aravadi	48J/16	14.14	74.79	470	Samase	48J/16	14.05	74.86
421	Mandavalli	48J/16	14.14	74.8	471	Valagere	48J/16	14.05	74.85
422	Kasakoppa	48J/16	14.14	74.81	472	Toremane	48J/16	14.05	74.87
423	Alagodu	48J/16	14.14	74.82	473	Chukodu	48J/16	14.06	74.86
424	Ittige	48J/16	14.14	74.83	474	Hunasemane	48J/16	14.05	74.88
425	Vatemadake	48J/16	14.15	74.83	475	Kalasavalli	48J/16	14.06	74.88
426	Sampa	48J/16	14.14	74.83	476	Gumagodu	48J/16	14.06	74.87
427	Nandodi	48J/16	14.14	74.84	477	Sigandur	48J/16	14.08	74.87
428	Yalagodu	48J/16	14.13	74.85	478	Sulemakki	48J/16	14.06	74.83
429	Kanagalghatta	48J/16	14.14	74.85	479	Murakki	48J/16	14.07	74.84
430	Honnemakki	48J/16	14.14	74.85	451	Hesige	48J/16	14.08	74.79
431	Kanchikai	48J/16	14.15	74.85	452	Halki	48J/16	14.09	74.8
432	Bannumane	48J/16	14.15	74.84	453	Kiruvase	48J/16	14.01	74.9
433	Dombekai	48J/16	14.15	74.85	454	Karur	48J/16	14.02	74.89
434	Muppani	48J/16	14.12	74.8	455	Murakai	48J/16	14.01	74.87
435	Hebbali	48J/16	14.01	74.77	456	Bramanakeppige	48J/16	14	74.87
436	Sigalu	48J/16	14.02	74.77	457	Kodasarur	48J/16	14	74.85
437	Keshavapur	48J/16	14.02	74.77	458	Honnagodu	48J/16	14.01	74.87
438	Madanagodu	48J/16	14.03	74.76	459	Bidarakoppa	48J/16	14.02	74.86
439	Eratti	48J/16	14.02	74.79	460	Keppige	48J/16	14.02	74.88
440	Ambalasaru	48J/16	14.02	74.79	461	Araballi	48J/16	14.03	74.87
441	Kadakunda	48J/16	14.03	74.78	462	Vandagadde	48J/16	14.03	74.86

442	Munchavalli	48J/16	14.04	74.8	463	Hulkodu	48J/16	14.03	74.85
443	Bangodi	48J/16	14.04	74.8	464	Basti	48J/16	14.02	74.84
444	Kolegodu	48J/16	14.05	74.8	465	Berala	48J/16	14.02	74.85
445	Chadravalli	48J/16	14.04	74.82	466	Tumari	48J/16	14.03	74.85
446	Insodi	48J/16	14.06	74.83	467	Kunchi	48J/16	14.02	74.83
447	Kalur	48J/16	14.06	74.81	468	Kudarur	48J/16	14.02	74.83
448	Mankandur	48J/16	14.06	74.78	469	Arodi	48J/16	14.01	74.82
449	Kandravalli	48J/16	14.08	74.82	470	Samase	48J/16	14.05	74.86
450	Banukuli	48J/16	14.08	74.81	471	Valagere	48J/16	14.05	74.85



SYNOPSIS OF THE WORK

1.Title of the report	Macro Scale (1:50000) Landslide Susceptibility Mapping In Parts Of Toposheet No.'S 48J/12 And 16, Uttara Kannada And Shimoga Districts, Karnataka.	
2.Item No./Code No	M4LSSM/NC/SR/SU-KG/2018/20207	
3.Field Season	2018-19	
4.Date of commencement	14-11-2018	
5.Date of completion of Project	31-03-2019	
6.Officers associated with the investigation and number of days spent in the field	(a) K.Senthil Kumar, Geologist (b) Salu S., Senior Geologist	Field Days- 120 Field Days- 60
7. Quantum of work done	: a) Slope Forming Material map	1399 sq.km
	b)Geomorphology & Lineament map	1399 sq.km
	c)Slope Morphometry (slope, aspect & curvature) map	1399 sq.km
	d)Landuse / Land cover map	1399 sq.km
	e)Drainage map	1399 sq.km
	f)Regolith depth map	1399 sq.km
	ii)Landslide inventory map	1399 sq.km
	i)Field checking of all thematic maps	1399 sq.km
	ii)Field checking and collection of landslide inventory attributes (41 point geo -parametric sheet)	1399 sq.km
	i)Updation of thematic and landslide inventory maps	1399 sq.km
	ii)Landslide susceptibility modelling and finalization of landslide susceptibility map in GIS	1399 sq.km
	4.Collection of rainfall data	Collected last ten year rainfall data
8. Analysis carried out quantitative	NA	
9. Elements analyzed	NIL	
10.Expenditure	1) Wages	Rs. 34,524/-
	2) OC	Rs. 36798/-
	Total	RS. 71,322/-

K.Senthil Kumar
Geologist

Salu S.
Senior Geologist

K.V. Maruthi
Director

FIVE POINT PROFORMA

Title of the report: Macro-scale (1: 50, 000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 48J/12 and 16, Uttara Kannada and Shimoga Districts, Karnataka	
1. Background of the investigation at whose instance or with what particular objective in view the investigation was undertaken.	The item was taken up as per the annual programme of GSI vide FSP Code No: M4LSSM/NC/SR/SU-KG/2018/20207 with an objective to prepare seamless Landslide Susceptibility Map of India.
2. Whether the item of investigation was included in the approved programme for the year concerned. If so, particulars, such as item No. page reference etc. may be given.	Item Document Number: yes FS ID.M4LSSM/NC/SR/SU-KG/2018/20207
3. Date of commencement of the investigation with month and year, and exact number of days spent by the officer(s) in the field in connection with the investigation.	14.11.18 1. K. Senthil Kumar, Geologist -120 days 2.Salu S., Senior Geologist - 60 days
4. Brief comments by Director / Supervisory officer on the conclusion and recommendation by the author(s) with suggestion for implementing the same.	
5. Please state specifically how the results of the investigation were achieved compared with the objective for which it was undertaken	The objective of the investigation is fully achieved.
Place: Date:	Shri K.V. Maruthi Director State Unit: Karnataka & Goa Bangalore

GEOLOGICAL SURVEY OF INDIA

CERTIFICATE OF QUALITY OF THE REPORT

Project/ Division:NLSM **FSP No.:** M4LSSM/NC/SR/SU-KG/2018/2020 **Mission : IV**

Title of the report: - Macro Scale (1:50000) Landslide Susceptibility Mapping in Parts of Toposheet No.'S 48J/12 And 16, Uttara Kannada and Shimoga Districts, Karnataka.

Part – A:

This is to certify that the following Officer(s) have carried out the above mentioned FSP and are responsible for collection of field data, carrying out required laboratory analysis, compilation and synthesis of field data, collation of the data and writing of the report as per the approved guidelines. The duration of field stay of each Officer is as against his/ her name.

Name and designation of the Officer	Total field stay during the FSP (No. of days)	Signature
1. K. Senthil Kumar, Geologist	120 days	
2.Salu S., Senior Geologist	60 days	

Part-B:

This is to certify that drilling has been carried out and completed as per the table given below:

Not Applicable

Drilling Unit No	Date of commencement of drilling	Date of completion of drilling	Name and signature of the Director Drilling
1.			
2.			

Part-C

This is to certify that geophysical component of the item has been carried out as per the table given below: **Not Applicable**

Name(s) Designation of the geophysicist	Date of commencement of work	Date of completion of work	Signature of the Geophysicist with date
1.			
2.			
Name of the Director (Geophysics)			
Signature with date			

Part-D

This is to certify that the chemical analysis of the geological samples has been carried out as per the table given below - **Not applicable.**

Name of the Director in charge of the Laboratory	Date of receipt of samples from the Field Officer/ party	Date of providing complete analytical results to the Field Officer/ party	Signature with date

Part –E

This is to certify that the Supervisory Officer(s) mentioned below have supervised the above item and have provided guidance to the Field Officer(s). The number of inspection visits and total duration of field visits is as per the table below. It is also certified that the work carried out under the project is of high standards, the norms of field work, lab work etc. have been followed. It is also certified that thorough scrutiny of the report for maintaining the scientific contents and its quality has been overseen

Name(s) and designation of the Supervisory Officers	No. of inspection visits	Total No. of days spent on inspection visit	Signature with date
Shri K.V.Maruthi, Director(G)	02	06	

Part-F

This is to certify that the report has been thoroughly scrutinized at the Regional Mission Head level. The scientific contents and the quality of the report are certified. The report has been peer reviewed and the needful corrections have been attended to.

Name and designation of the Regional Mission Head	Signature with date

Part-G

This is to certify that the report has been scrutinized at various levels and has also been peer reviewed. On being satisfied regarding the scientific content and quality of the report, the undersigned has accorded approval for its circulation.

Name and designation of the Regional HOD	Signature with date

GEOLOGICAL SURVEY OF INDIA

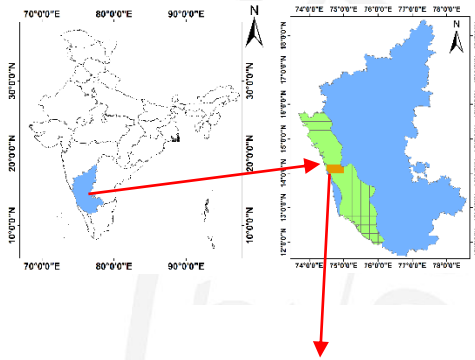
DATA SHEET ON REPORT MOVEMENT IN CONNECTION WITH ITS SCRUTINY

Project / Division:NLSM	FSP No: M4LSSM/NC/SR/SU-KG/2018/20207	Mission:IV
Title of the report: Macro Scale (1:50000) Landslide Susceptibility Mapping In Parts Of Toposheet No.'S 48J/12 And 16, Uttara Kannada And Shimoga Districts, Karnataka.		
Names of author(s) (a) K.Senthil Kumar, Geologist (b) Salu S., Senior Geologist	Date of submission to the Supervisory Officer: (Signature of the senior most author):	30-06-2019
Name of the Supervisory Officer: Shri.K.V. Maruthi, Director	Date of receipt of the report:	
	Date of completion of scrutiny:	
	Date of handing over the report to the author(s) after scrutiny:	
	Signature:	
Name of the author to whom the report has been handed over by the Supervisory Officer:	Date of receipt after scrutiny:	
	Signature:	
	Date of resubmission:	
	Signature:	
Supervisory Officer: Shri.K.V. Maruthi, Director	Date of receipt after modification:	
	Date of handing over the report to the Regional Mission Head:	
	Signature:	
Name of the Regional Mission Head:	Date of receipt of the report:	
	Date of handing over the report to the Project Director after peer review:	
	Signature:	
Supervisory Officer: Shri.K.V. Maruthi, Director	Date of receipt of the report from the Regional Mission Head after peer review:	
	Date of handing over to the author(s)	
	Signature:	
Name of the author(s)	Date of receipt of the report from the Supervisory Officer:	
	Date of resubmission to the Supervisory Officer after modification:	
	Signature:	

Name of the Supervisory Officer: Shri.K.V. Maruthi, Director	Date of receipt of the report after modification:	
	Date of handing over the report to the Regional Mission Head:	
	Signature:	
Name of the Regional Mission Head:	Date of receipt of the report from the Project Director after modification:	
	Date of handing over the report to the HOD of the Region for approval:	
	Signature:	
Name of the HOD of the Region:	Date of receipt of the report for approval:	
	Date of approval:	
	Date of sending back report to Project Director:	
	Signature :	
Name of the Project Director:	Date of receipt of the report after approval of the HOD:	
	Date of circulation of the report	
	Signature:	

LIST OF PLATES

Plate-I. Location map of the study Area (TS- 48J/12 & 16)



Location map of the study area (TS- 48J/12 & 16)

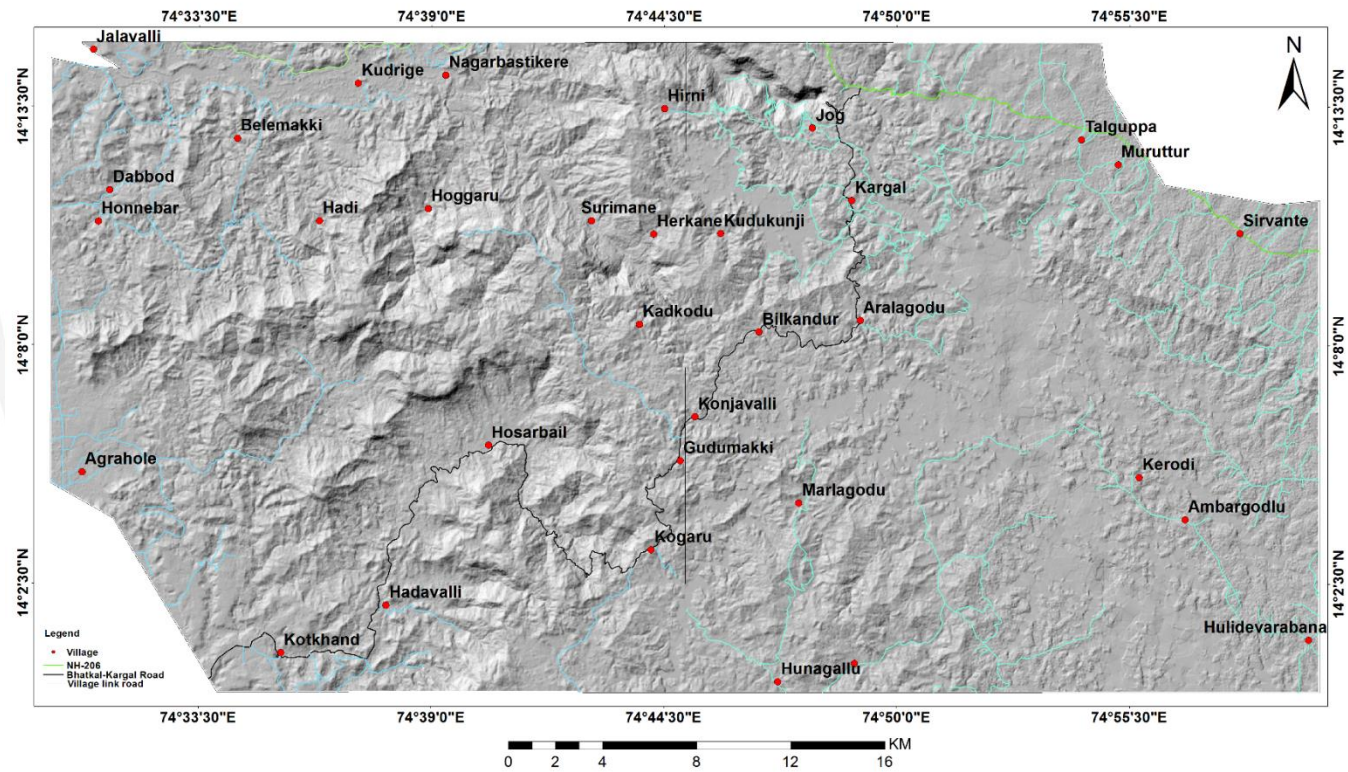


Plate-II. Geological map of the study Area (TS- 48J/12 & 16)

Geological map of the study area TS- 48J/12 & 16

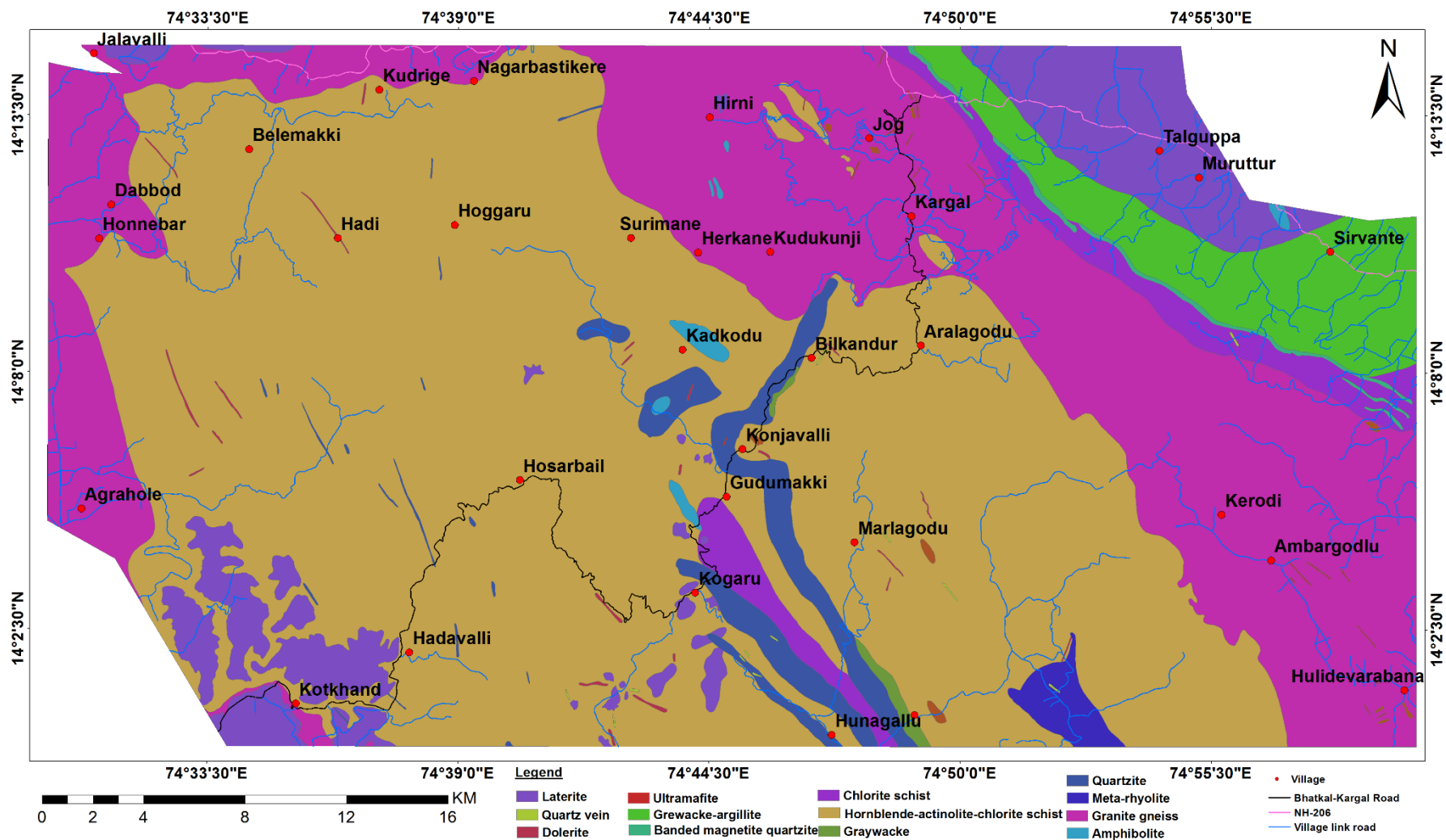


Plate-III. Landslide Inventory Map of the study area (TS- 48J/12 &16)

Landslide Inventory Map of the study area (TS- 48J/12 &16)

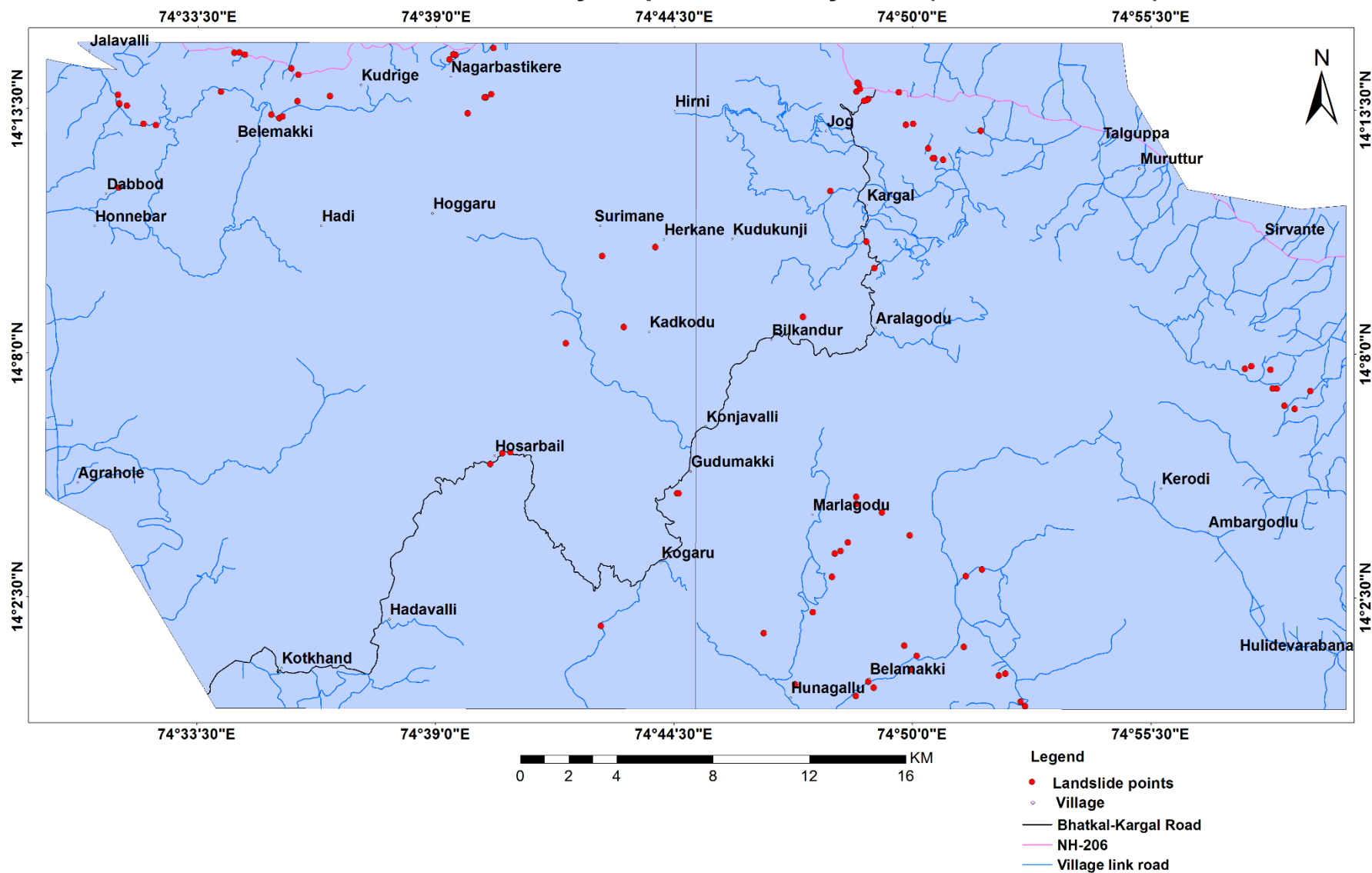


Plate-IV. Drainage map of the study area (TS- 48J/12 &16)

Drainage map of the study area TS- 48J/12 & 16

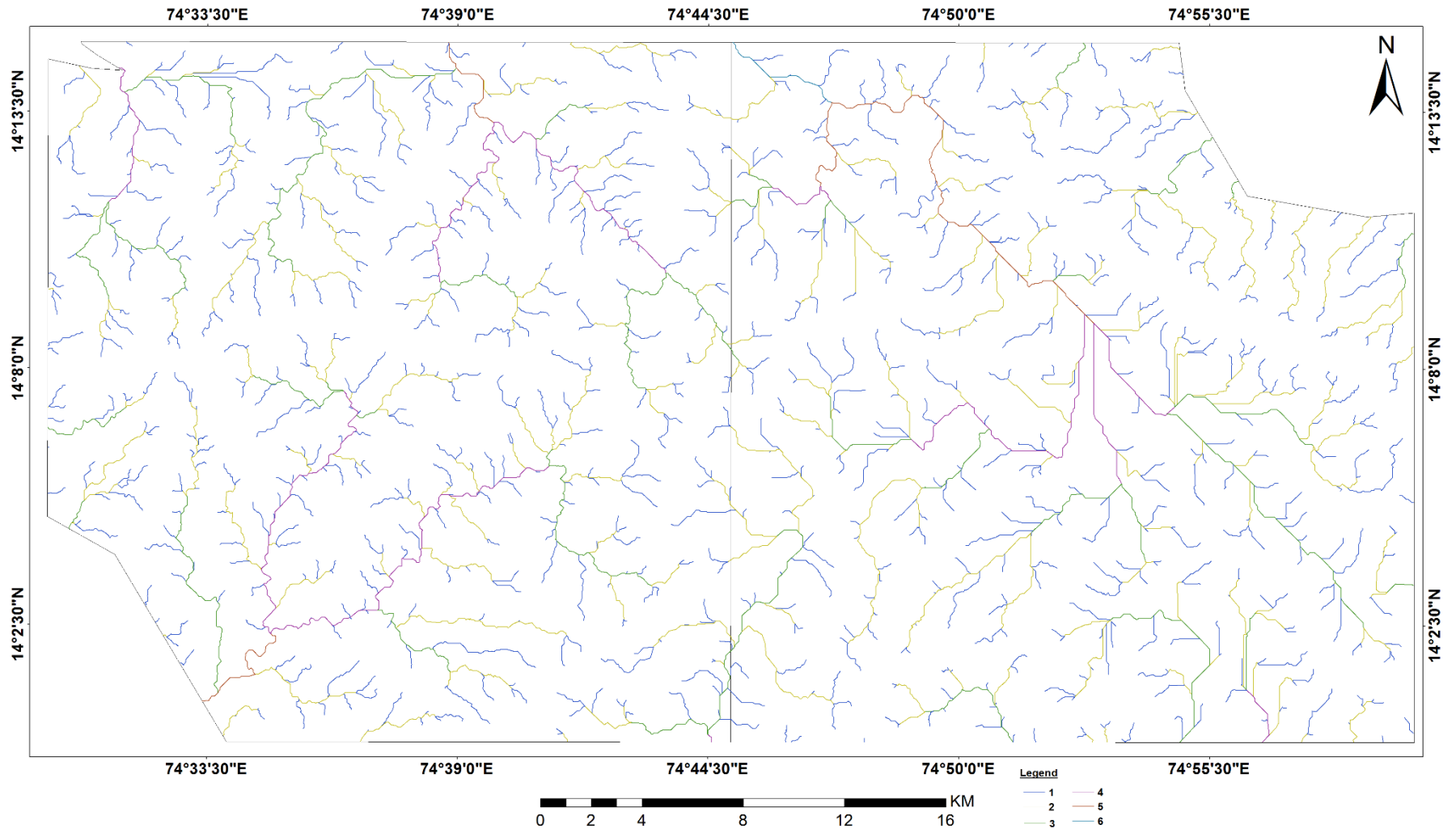


Plate-V. Curvature map of the study area (TS- 48J/12 &16)

Curvature map of the study area TS- 48J/12 & 16

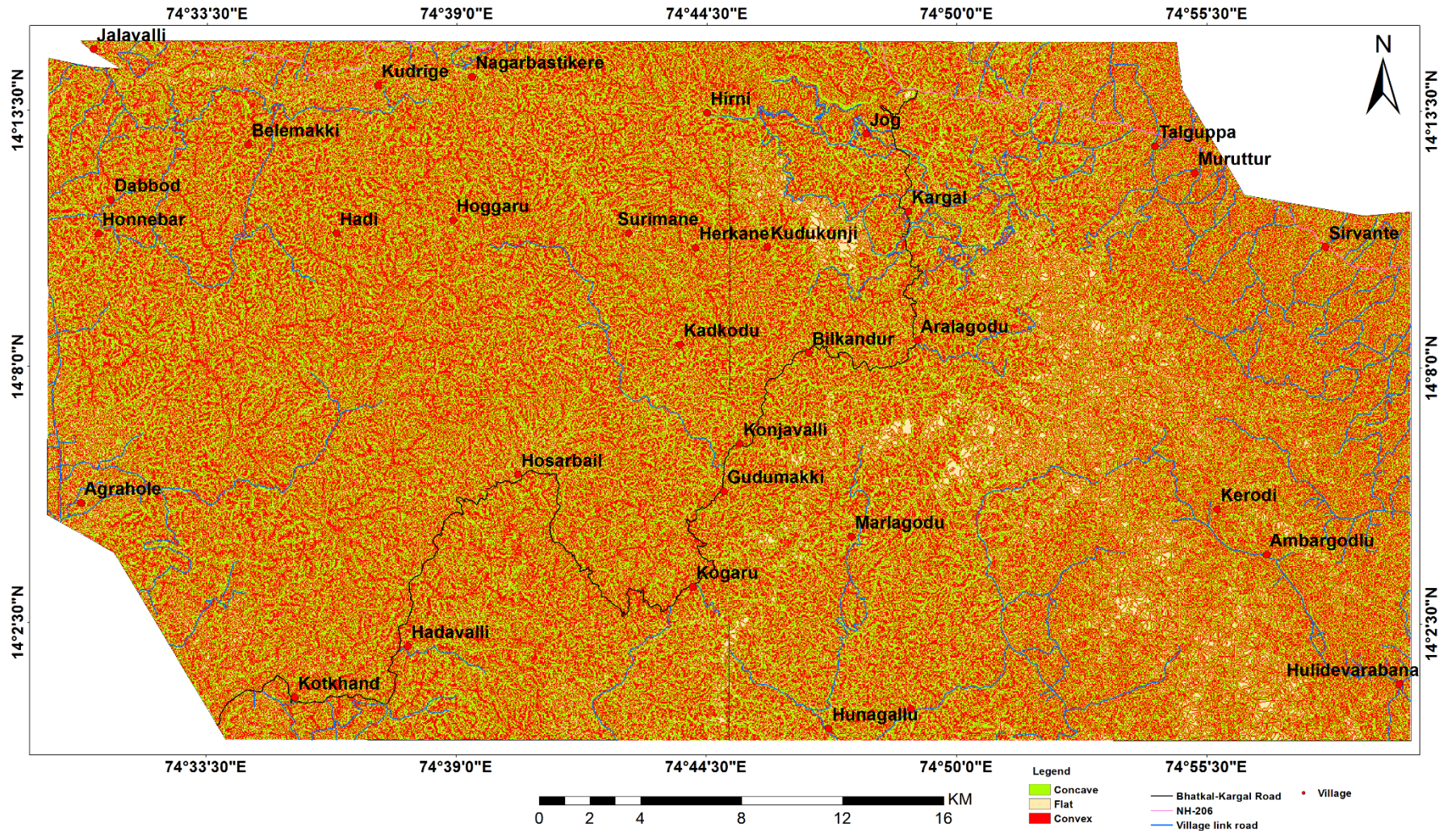


Plate-VI. Slope morphometry map of the study area (TS- 48J/12 &16)

Slope morphometry map of the study area TS- 48J/12 & 16

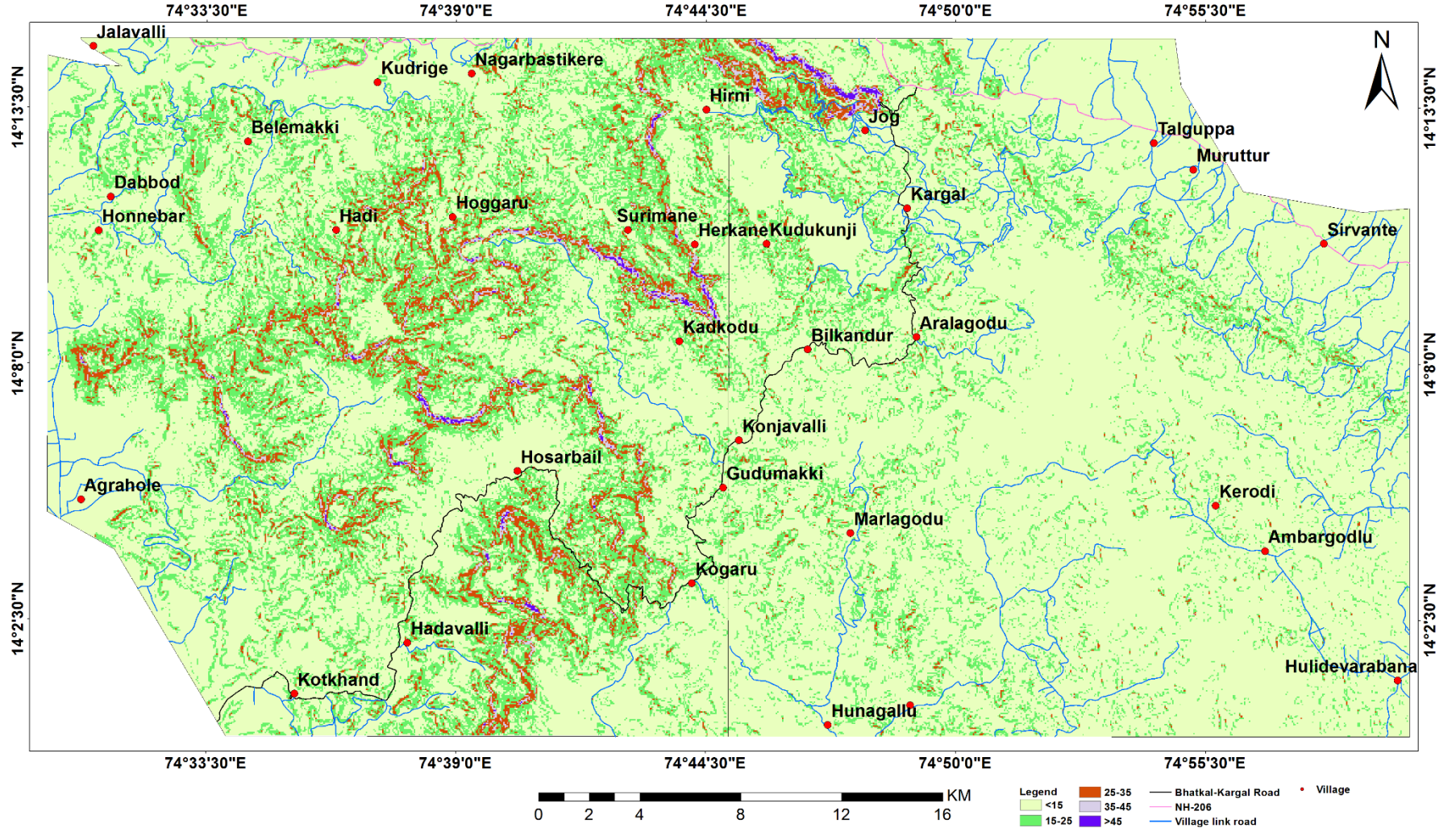


Plate-VII. LULC map of the study area (TS- 48J/12 &16)

LULC map of the study area TS- 48J/12 & 16

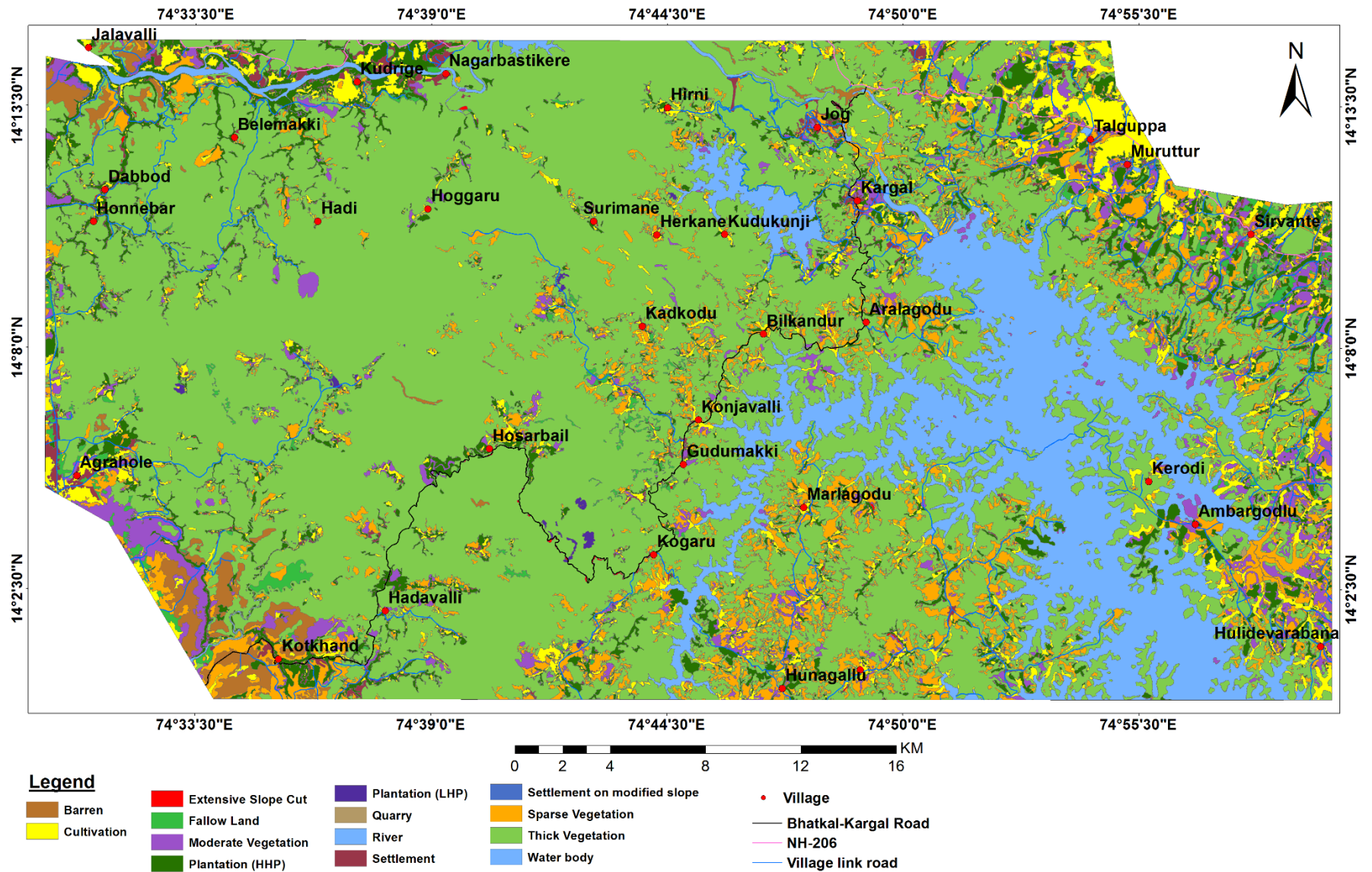


Plate-VIII. Geomorphological map of the study area (TS- 48J/12 &16)

Geomorphology map of the study area TS- 48J/12 & 16

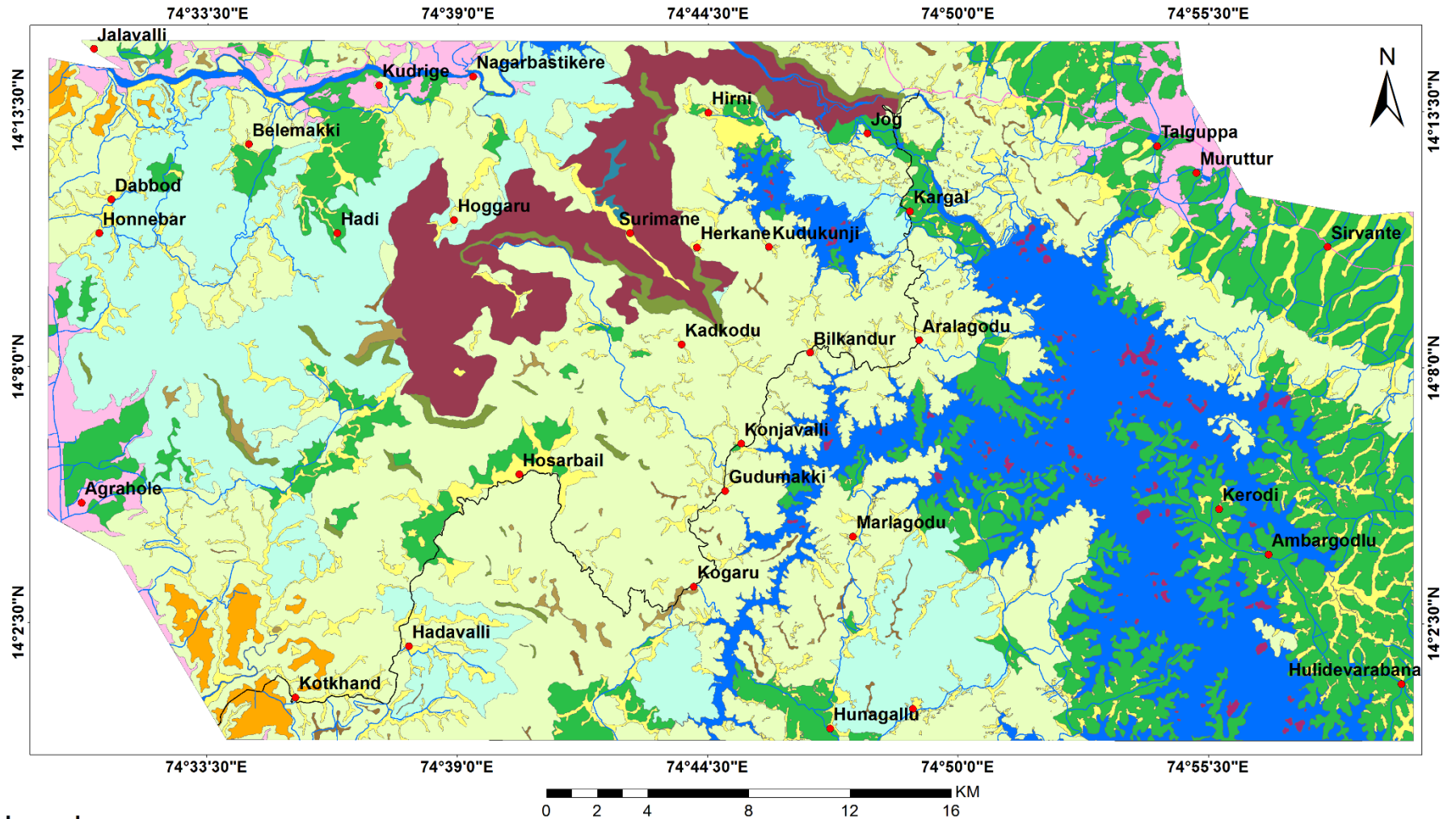


Plate-IX. SFM map of the study area (TS- 48J/12 &16)

SFM map of the study area TS- 48J/12 & 16

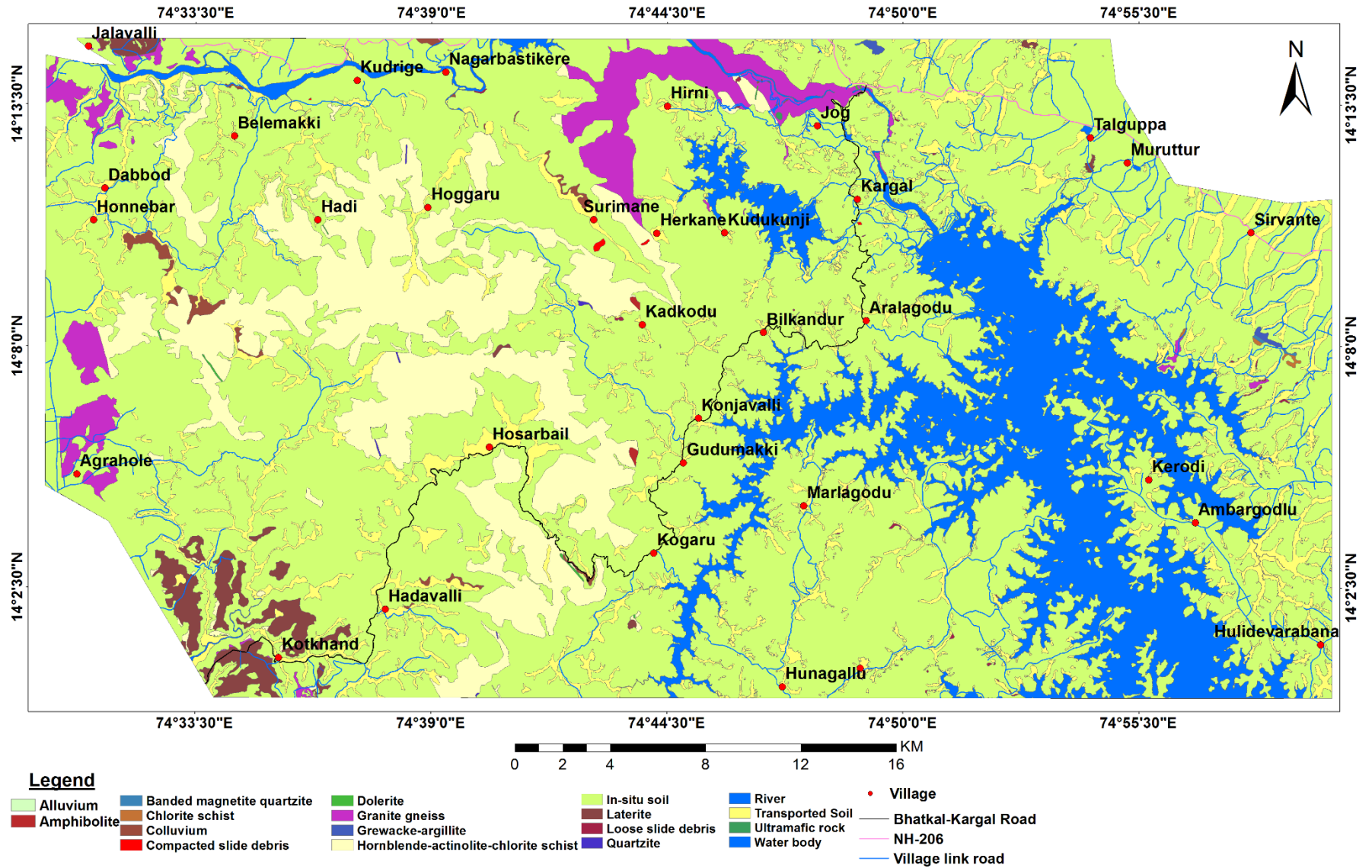
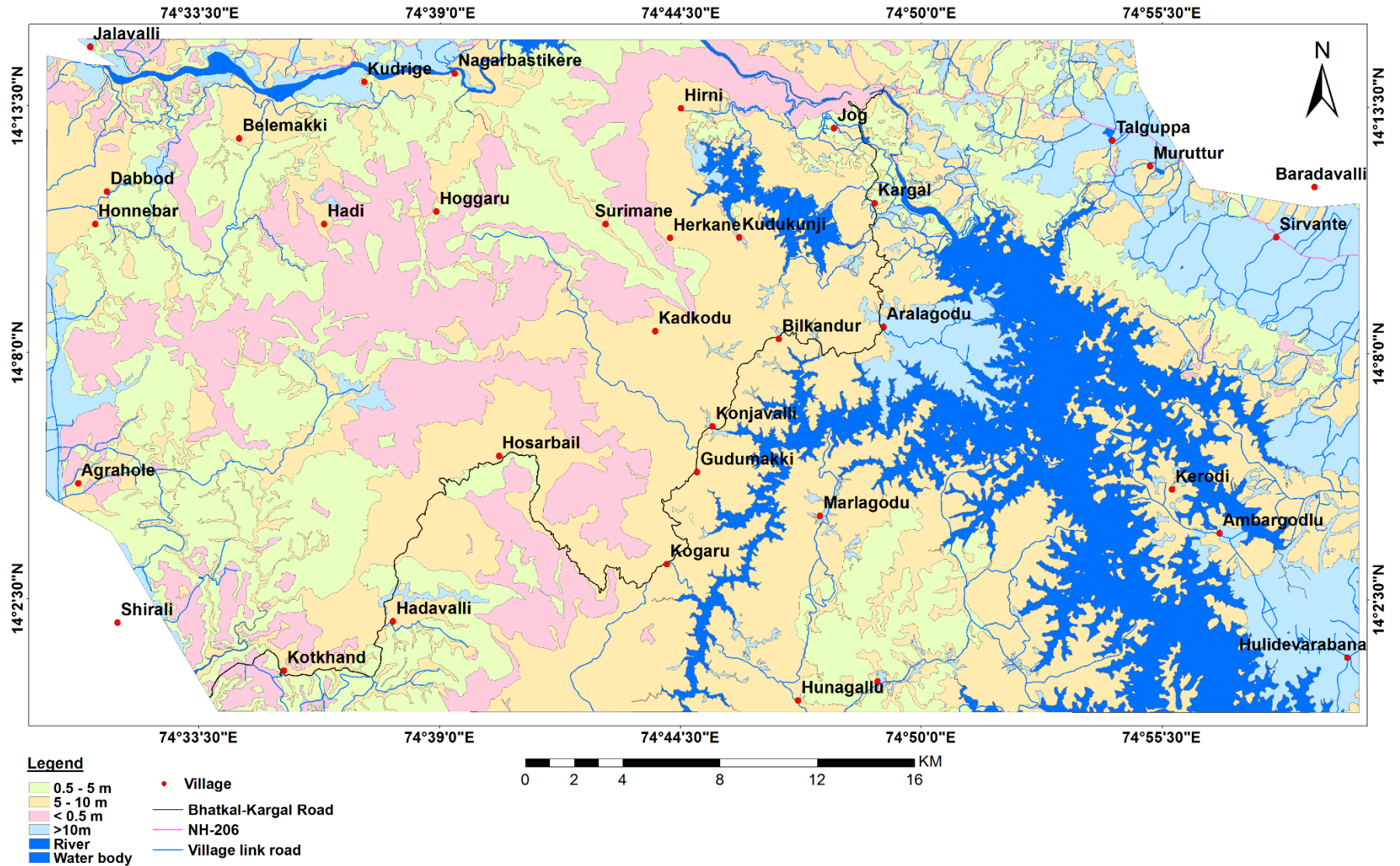


Plate-X. Regolith thickness map of the study area (TS- 48J/12 &16)

Regolith thickness map of the study area TS- 48J/12 & 16



Landslide susceptibility map of the study area TS- 48J/12 & 16



Field Photographs



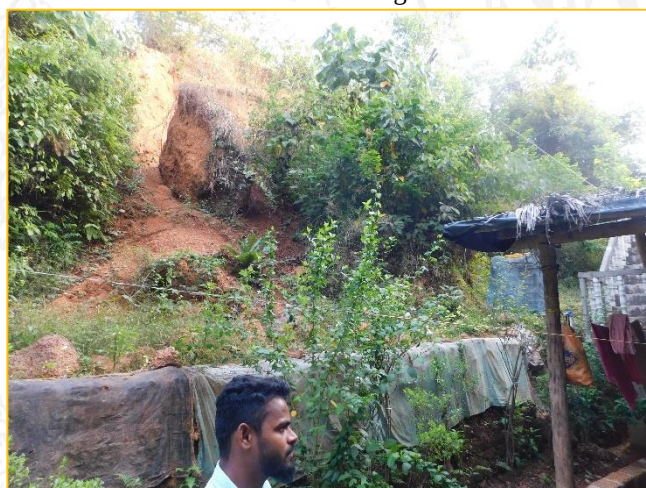
*Photo 3. 1, Old land slide observed near Magod village
Lat: 14° 13' 34.2 Long: 74° 3' 1 51.6"*



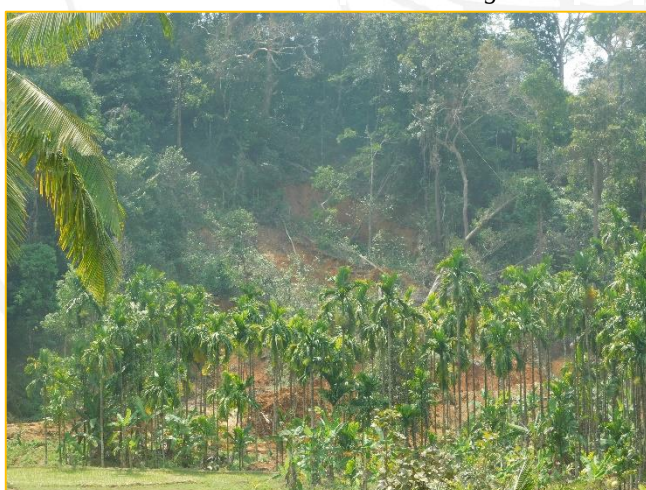
*Photo 3. 2a, Slope cut failure near Kodani village
Lat: 14° 13' 53.24" Long: 74° 34' 1.88"*



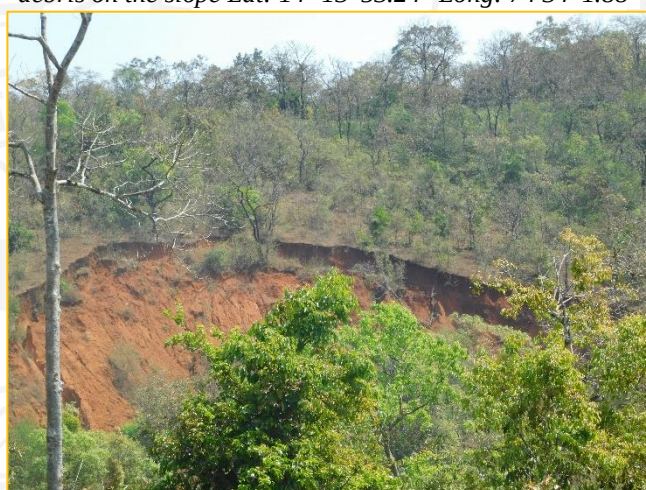
*Photo 3. 3b, Slope cut failure near Kodani village-
Ground cracks Lat: 14° 1'3 53.24" Long: 74 34' 1.88"*



*Photo 3. 4c, Slope cut failure near Kodani village- Loose
debris on the slope Lat: 14° 13' 53.24" Long: 74 34' 1.88"*



*Photo 3. 3a, Soil slide
Lat: 14°13' 9.88 "Long: 74° 49 50.71"*



*Photo 3. 3a1, Soil slide
Lat: 14° 01' 23.98" Long: 74° 51 11.25"*



Photo 3. 3c, Soil slide
Lat: 14°4' 37.36 "Long: 74° 48' 42.21"



Photo 3. 3d, Soil slide
Lat: 14°4' 46.78 "Long: 74° 48' 42.22"



Photo 3. 4a, Soil slide along NH-206
Lat: 14°13' 44.85 "Long: 74° 48' 58.51"



Photo 3. 4b, Soil slide along NH-206
Lat: 14°13' 43.31"Long: 74° 48' 56.64"



Photo 3. 5, Towards Mahatma Gandhi power station- Iron crib wall to prevent the rock slides.



Photo 4.a, Cultivation
 Lat: 14°0' 48.9 "Long: 74° 36' 27.30"



Photo 4.b, Low height plantation (Cashew)
 Lat: 14°6' 10.68 " Long: 74° 30' 57.20"



Photo 4.c, Barren
 Lat: 14°0' 52.17 "Long: 74° 34' 2.27"



Photo 4.d, High height plantation
 Lat: 14°5' 26.97 "Long: 74° 59' 20.66"

Photo. 4. (a-d) Field photographs of some of the representative LULC classes



Photo 4.e, Lowly dissected slope
 Lat: 14°0' 44.37 "Long: 74° 52' 47.99"



Photo 4.f, Escarpment
 Lat: 14°05' 25.9 "Long: 74° 38' 51.8"



Photo 4.g, Highly dissected slope
 Lat: 14°0' 52.17 "Long: 74° 34' 2.27"



Photo 4.h, Pediment pediplain complex
 Lat: 14°0' 52.17 "Long: 74° 34' 2.27"

Photo. 4. (e-h) Field photographs of some of the representative geomorphological classes



Photo 4.i, Insitu soil

Lat: 14°0' 52.17 "Long: 74° 34' 2.27"



Photo 4.j, Insitu soil

Lat: 14°04' 29.75 "Long: 74° 52' 27.69"



Photo 4.k, Loose slide debris

Lat: 14°0' 45.32 "Long: 74° 51' 59.99"



Photo 4.l, Transported soil

Lat: 14°12' 25.23" Long: 74° 50' 26"

Photo. 4. (i-l) Field photographs of some of the representative Slope forming material classes



Photo 4.m, Regolith thickness 0.5-5m
 Lat: 14°2' 31.2" Long: 74° 36' 18"



Photo 4.n, Regolith thickness 5-10m
 Lat: 14°14' 3.10" Long: 74° 46' 5.36"



Photo 4.o, Regolith thickness >10
 Lat: 14°3' 20.02" Long: 74° 47' 28.06"

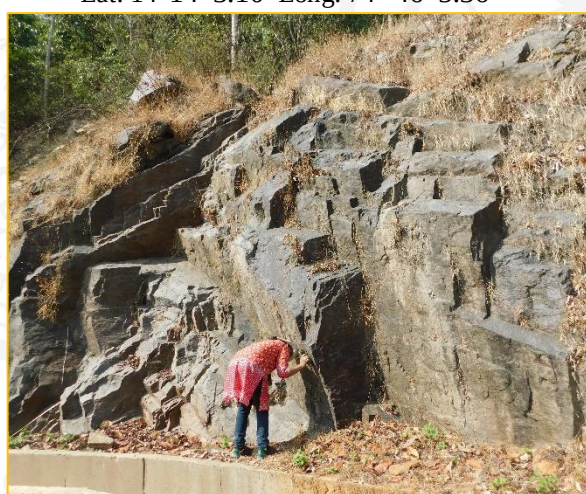


Photo 4.p, Regolith thickness <0.5m
 Lat: 14°13' 21.74" Long: 74° 46' 52.11"

Photo. 4. (m-p) Field photographs of some of the representative Regolith thickness classes

Annexure-I. Rainfall data

Details of past ten-year rainfall data of Uttar Kannada and Shimoga Districts

1. Uttar Kannada District

Year - 2009

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	0	5	0	0	20	0	0	
2	0	0	0	0	0	0	10	3	2.5	12	0	0	
3	0	0	0	5	0	0	14.5	2	2.5	45.5	0	0	
4	0	0	0	0	0	0	32	0.5	22.5	3	0	0	
5	0	0	0	0	0	0	34	0	20.5	0.5	0	0	
6	0	0	0	0	0	0	7.5	0.5	42.5	0	0	0	
7	0	0	0	0	0	0	7	0	0.5	0	0	0	
8	0	0	0	52.5	0	0	16.5	0	4	0	0	0	
9	0	0	0	28	0	0	35.5	0	0	0	0.5	0	
10	0	0	0	0	0	0	30	1	17	0	2.5	0	
11	0	0	0	0	0	2.5	3.5	0.5	0	0	18.5	0	
12	0	0	0	0	0	2.5	11.5	9	7.5	4.5	34	0	
13	0	0	1	0	0	114	4.5	1.5	0	9	0	0	
14	0	0	1	5.5	0	114	15	0	0	12.5	0	0	
15	0	0	0	0	0	4.5	71.5	8.5	11.5	0	0	0	
16	0	0	0.5	0	0	4.5	27.5	3.5	0.5	0	7	0	
17	0	0	2.5	0	0.5	0	11	7.5	30	0	1.5	0	
18	0	0	0	0	6	0	5	8.5	0	0	0	0	
19	0	0	7	0	0	0	7.5	2	0	0	0	0	
20	0	0	18	0	0.5	0	8	0	0.5	0	4	0	
21	0	0	0	0	4	0		4.5	13.5	0	0.5	0	
22	0	0	0	0	28.5	0	0	13	1	0	0	0	
23	0	0	0	0	0	0	0	5	0	0	0	0	
24	0	0	0	0	0	0	0	2.5	0	0	0	0	
25	0	0	1	0	0	0	0	0	7.5	0	0	0	
26	0	0	0	0	0	0	0	0	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	2.5	0	0	0	0	2.5	0	0	0	
29	0	0	0	6.5	8	1	0	0	33	0	0	0	
30	0	0	1	2.5	0	1	0	0	14.5	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	0	32	102.5	47.5	244	357	73	234	107	68.5	0	1265.5

Year - 2010

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	0	2.5	6	5.5	7	0	0	
2	0	0	0	0	0	0	31.5	5.5	4.5	0	0	0	
3	0	0	0	0	6	0	5.5	5.5	3	48.5	7.5	0	
4	0	0	0	0	0	0	14.5	27	14	26	2	0	
5	0	0	0	0	0	0	4	0	8	27	27.5	0	
6	0	0	0	0	0	0	13	0.5	17	1.5	0.5	0	
7	0	0	0	0	0	0	2.865	0	3.5	12.5	1.5	0	
8	0	0	0	0	9	8.488	0	2.5	10	0	12.5	0	
9	10.64	0	0	8.998	2.845	0.5	11	6.694	5.059	3.5	21.5	0	
10	0	0	0	26.13	0	22	3.5	0	2	3	0	0	
11	0	0	0	0	0	2.5	23.5	5.5	6	0	0	2.5	
12	0	0.5	0	0	0	0	22.5	0.5	0.5	0	0.5	0.5	
13	0	0	0	0	0	6.5	12	0	0	0	1.5	0	
14	0	0	0	0	0	47.5	35	10.5	0.5	0	0	0	
15	0	0	0	0	0	14.5	8	5	0	0	0	0	
16	0	0	0	0	0	20.5	39.5	12	11.76	7	0	0	
17	0	0	0	13	0	36	40.5	0.5	1	4.5	0	0	
18	0	0	0	0	0	17	19.5	11.5	4.5	4	0	0	
19	0	0	0	0	0	5	24	2.5	7	0.5	0	0	
20	0	0	0	0	0.5	0.5	20	0	2.058	0.5	0	0	
21	0	0	0	0	4	0	10.5	0.5	0	0	0	0	
22	0	0	0	0	28.5	0		6	20	0	0	0	
23	0	0	0	14	0	0.5		0	0	0	0	0	
24	0	0	0	0	0	11.5		4	33.5	16	2.5	0	
25	0	0	0	0.5	0	10		0.5	0	0	0	0	
26	0	0	0	0	0	2		16	0.5	0.5	0	0	
27	0	0	0	0	0	0.5		1	3.5	0	0	0	
28	0	0	0	0.5	0	2.5		3	6	0	0	0	
29	0		0	34.5	8	0.5		2	1	0	0	0	
30	0		0	11	0	1		8.5	0	0	0	0	
31	0	0	0		0	0		18.5		0		0	
Total	10.64	0.5	0	108.628	58.845	209.488	343.365	161.694	170.377	162	77.5	3	1306.04

Year - 2011

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	0	3.5	5	27.5	2	0	0	
2	0	0	0	0	0	0.5	34	4.5	45	0	0	0	
3	0	0	0	0	0	19	7.5	17	38	1	0	0	
4	0	0	0	0	0	24	6	27.5	8.5	0	0	0	
5	0	0	0	0	0	16.5	8	13.5	2	0	0	0	
6	0	0	0	0	0	3.5	0	6	3.5	0	0	0	
7	0	0	0	0	0	14.5	3.5	10	4.5	0	0	0	
8	0	0	0	0	0	1.5	21	9	7	9.5	0	0	
9	0	0	0	0	0	3.5	4.8	7	9	0	0	0	
10	0	0	0	50	0	32.5	0.5	2.5	0	2	0	0	
11	0	0	0	0	0	31.5	5	2.5	0	10	0	0	
12	0	0	0	0	0	0.5	0.5	2	4.5	0	0	0	
13	0	0	0	1	0	1	12.5	8.5	0	25.5	0	0	
14	0	0	0	0	0	4	2.5	0	17	7	0	0	
15	0	0	0	4.5	0	13.5	6	3	8.5	3	0	0	
16	0	0	0	22	0	16	21.5	14.5	7.3	0	0	0	
17	0	0	0	0	0	22.5	68	2	1	25.5	0	0	
18	0	0	0	25.5	3.5	66	36	0.5	2.5	0	0	0	
19	0	0	0	0	0	0	32.5	28	6.5	0	0	0	
20	0	0	0	0	0	1	5.5	3.5	0.5	4	0	0	
21	0	0	0	0	0	1.5	6	20	1	0	0	0	
22	0	0	0	0	0	14.5	0.5	0	0	0	0	0	
23	0	0	0	0	0	55	7.5	0	0	0	0	0	
24	0	49.5	0	0	0	16.5	15	9.2	0	0	0	0	
25	0	0	0	0	0	5.5	2	5.1	0	0	0	0	
26	0	0	0	0	0	10	0	2.4	0	2.5	0	0	
27	0	0	0	0	65	9	6.5	4	0	0	0	0	
28	0	0	0	0	0	6.5	3	4	0	3	0	0	
29	0		0	0	0	2	6.5	25	0	0	31	0	
30	0		0	0	13	0	5.5	30	0	1.5	47.5	0	
31	0		0		0.5	0	14	6.5		0		0	
Total	0	49.5	0	103	82	392	345.3	272.7	193.8	96.5	78.5	0	1613.3

Year - 2012

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	0	3	1.5	7.5	22.5	0	0	
2	0	0	0	9	0	0	4	0	3	0	30	0	
3	0	0	0	0	0	0	36	19.5	4	10	14.5	0	
4	0	0	0	0	0	0	8.5	45.5	24.5	4	1	0	
5	0	0	0	2	0	1	2	27	1.5	0.5	0	0	
6	0	0	0	0	0	3.5	2.5	14	0.5	3.5	0	0	
7	0	0	0	0	0	22	9.5	22	11	0.5	0	0	
8	0	0	0	0	0	0	5	6	7	0	0	0	
9	0	0	0	0	0.5	4.5	0	6.5	2	0	0	0	
10	0	0	0	0	0	0	1.5	10	0	0	1	0	
11	0	0	0	1.5	0	0	0	22.5	4	0	0	0	
12	0	0	0	0	11	0.5	2.5	15	0.5	0	0	0	
13	0	0	0	0	0	4	0.5	14.5	2	0	0	0	
14	0	0	0	0	0.5	0	0	3	0	0	0	0	
15	0	0	0	0	0	8.5	0.5	1	0.5	0	0	0	
16	0	0	0	0	0	3	0.5	1	0	0	0	0	
17	0	0	0	8	0	3	0	1	1	0	0	0	
18	0	0	0	0	0	26	37.5	1	12.5	0	0	0	
19	0	0	0	26.5	0	9	6	1	0	0	0	0	
20	0	0	0	0	0	0	1	2	0	0	0	0	
21	0	0	0	0	0	0	14	11.5	0	0	0	0	
22	0	0	0	0	0	3	4	2	0	0	0	0	
23	0	0	0	0	0	0	4	13	0	0	0	0	
24	0.5	0	0	0	0	12.5	2.5	2	0	0	0	0	
25	0	0	0	0	0	16.5	2	0	0	0	0	0	
26	0	0	0	0	0	1	9	15.5	0	0	0	0	
27	0	0	0	0	0	11.5	101	0.5	0	0	0	0	
28	0	0	0	0	0	5	1	4	14.5	0	0	0	
29	0	0	0	0	0	2.5	0.5	13	0.5	0	0	0	
30	0		0	0	0	29.5	1.5	4	17.5	0	0	0	
31	0		0		0	0	0.5	2.5		0		3	
Total	0.5	0	0	47	12	166.5	260.5	282	114	41	46.5	3	973

Year - 2013

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1.5	0	0	0	2	6	9.5	54.5	0	1.5	0	0	
2	13.5	0	0	0	0	0	5	21	0	0	0	0	
3	0	0	0	0	2	0.5	81	10	0	0	0	0	
4	0	0	0	0	0	0	0.5	3.5	0	1	0	0	
5	0	0	0	0	0	0	10	2.5	0	2.5	0	0	
6	0	0	0	0	0	20	9.5	1	0	29.5	0	0	
7	0	0	0	0	0	0	4	0	11.5	0	0	0	
8	0	0	0	0	0	6.5	3	1	1	0	0	0	
9	0	0	0	0	0	5.5	1.5	1	5	0	0	0	
10	0	0	0	0	0	4	2	1	2.5	0	0	0	
11	0	0	0	0	0	4.5	11.5	4.8	3.5	0	0	0	
12	0	0	0	0	0	3	30.5	1.5	1	0	0	0	
13	0	0	0	0	0	1.5	14.5	3	6.5	0	0	0	
14	0	0	0	0	0	6	8	3.5	0	0	0	0	
15	0	0	0	0	0	7.5	2	2	0	0	0	0	
16	0	0.5	9.5	0	0	3.5	3	1	1.5	0	0	0	
17	0	5	0	0	0	2.5	5	10.5	25.5	0	0	0	
18	0	0	0	0	0	13	17	9	4.5	0	0	0	
19	0	0	0	0	0	10.5	9.5	4.5	0.5	19.5	0	0	
20	0	0	0	0	0	1.5	48	7.5	33.5	0	0	0	
21	0	0	0	0	4.5	11	45.5	1.5	0	0	0	0	
22	0	0	0	0	0	0.5	24	1	0	0	0	0	
23	0	0	0	0	0	1.5	42	11	22	7.5	0	0	
24	0	0	0	0	0	7.5	38.5	8	7.5	25	0	0	
25	0	0	0	0	0	3	57	2	5.5	0	1.5	0	
26	0	0	0	2	0	16.5	20.5	1	8	40.5	0	0	
27	0	0	0	0	0	19.5	26	3	0.5	0	0	0	
28	0	0	0	0	39.5	4	31.5	0.5	1.5	0	0	0	
29	0	0	0	0	9.5	0.8	7	1.5	1.5	0	0	0	
30	0		0	0	26	3.5	9.5	0	3	0	0	0	
31	0		0		0	0	8	0		0		0	
Total	15	5.5	9.5	2	83.5	163.8	584.5	172.3	146	127	1.5	0	1310.6

Year - 2014

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	6.5	0	0	26	1.5	8.5	0	0	
2	0	0	0	0	17	0.5	0	21	1	0	0	0	
3	0	0	0	0	39	8.5	0	3	2	0	0	0	
4	0	0	0	0	0	0	0	8.5	5	0	0	0	
5	0	0	0	0	0	0	1	30.5	3	0	0	0	
6	0	0	0	0	0	0	0	13.5	2	1.5	0	0	
7	0	0	0	0	0	1.5	0.5	30.5	4.5	2.5	0	0	
8	0	0	0	0	6	0	18	21	0	0	0	0	
9	0	0	0	0.5	30.5	1	1	7	3.5	0	0	0	
10	0	0	0	1	0.5	2	3.5	11	2	0	0	0	
11	0	0	0	0	0	3	2.5	1.5	0.5	22	0	0	
12	0	0	1	0	0	5.5	2.5	1	0	6.5	0.5	0	
13	0	0	0	0	0	0	1.5	2.5	0	0	0	35	
14	0	0	0	0	0	0.5	4	0.5	0.5	0	11	0	
15	0	0	0	0	0	35.5	2	0	0	0	51	0	
16	0	0	0	0	0	1.5	15	1.5	0	0	0	0	
17	0	0	0	0	0	17.5	3	12	0	0	0	0	
18	0	0	0	0	2.5	1.5	7.5	0.5	0	0	0	0	
19	0	0	0	2	8.5	10	10	1	9	0	0	0	
20	0	0	0	0.5	18.5	15.5	6	0	1	0	0	0	
21	0	0	0	0	0	7	10	0.5	0	0	0	0	
22	0	0	0	0	40	0	23.5	2.5	0	0	0	0	
23	0	0	0	0	0	0.5	31	29	0	0	0	0	
24	0	0	0	0	0	0	48.5	0.5	0	0	0	0	
25	0	0	0	5.5	0	0	5	3.5	3	7	0	0	
26	0	0	0	0.5	0	0	17.5	32.5	0	53.5	0	0	
27	0	0	0	3.5	0	0	0.5	5.5	16	4	0	0	
28	0	0	0	0.5	0	0	1.5	10.5	2.5	2	0	0	
29	0	0	0	0.5	2	0	12	13.5	0	0	0	0	
30	0		0	1	0	0	11.5	4	5	0	0	0	
31	0		0		0	0	59	3.5		0		0	
Total	0	0	1	15.5	171	111.5	298	298	62	107.5	62.5	35	1162

Year - 2015

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	7.5	15	0	2	6.6	26	0	0	14.2	0	
2	0	0	2	0	0	0	1.3	21	0	9.5	0	0	
3	0	0	0	0	0	0	0	3	16	1.5	0	0	
4	0	0	0	0	0	0	0	8.5	0	15.5	2.5	0	
5	0	0	0	0	5.5	0	0	30.5	0	15.5	0.2	0	
6	0	0	0	0	36.5	0	0.5	13.5	0	13	0	0	
7	0	0	0	0	0	0	0	30.5	0	26.5	0	0	
8	0	0	0	0	1	0	2.5	21	3.5	12	0	0	
9	0	0	8.5	0	21.5	0	2.5	7	13	0	0	0	
10	0	0	11.5	0	2	8.1	3	11	0.5	0	0	0	
11	0	0	0	0	1.5	0	5.5	1.5	1.5	0	0	0	
12	0	0	0	0	0	0	2.5	1	0.5	0	0	0	
13	0	0	0	0	47	0	0.5	2.5	5	0	0	0	
14	0	0	0	0	1	9.4	0	0.5	16	1	0	0	
15	0	0	0	0	0	23.4	0	0	6.5	0	0	0	
16	0	0	0	0	6.5	0	0	1.5	2.5	0	0	0	
17	0	0	0	0	0	0.5	5	12	3	0.2	0	0	
18	0	0	0	0	4	0	0.5	0.5	1.5	2	0	0	
19	0	0	0	0	0	14	5	1	0.2	0	0	0	
20	0	0	0	0	0	10	15.5	0	0	0	0	0	
21	0	0	0	0	0	12.9	3.5	0.5	0	0	0	0	
22	0	0	0	0	0	16.5	3	2.5	0	0	0.2	0	
23	0	0	0	0	0	3	3	29	0	0	0	0	
24	0	0	7.5	4	0	12.9	4	0.5	0	0	0	0	
25	0	0	0	0	0	8.4	6.5	3.5	0	0	0	0	
26	0	0	0	0	0	0.8	1.5	32.5	0	0	0	0	
27	0	0	0	0	0	2	4	5.5	0	0	0	0	
28	0	0	0	32	0	0.5	4	10.5	3.8	0	0	0	
29	0	0	0	0.5	0	0	0.5	13.5	1	0	0	0	
30	0	0	0	0	1	0	3	4	0	0	0	0	
31	0	0	0	0	0	0	2.5	3.5	0	11.2	0	0	
Total	0	0	37	51.5	127.5	124.4	86.4	298	74.5	107.9	17.1	0	924.3

Year - 2016

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	1.5	0	8.5	3	0.5	0	0	0	
2	0	0	0	0	0	14	12.5	3	0.5	0	0	0	
3	0	0	0	0	0	0	4	2.5	7	0	0	0	
4	0	0	0	0	0	16.5	5.5	16.5	0	0.5	0	0	
5	0	0	0	0	0	0	32	16.5	0	0	0	0	
6	0	0	0	0.5	0	0	2	7.5	0	0	0	0	
7	0	0	0	2.5	0	29	1	8	0.5	0	0	0	
8	0	0	0	0	0	0	0.5	1.5	0	0	0	0	
9	0	0	0	0.5	0	27	10	5	0	1.5	0	0	
10	0	0	0	0	0	4.5	7.5	0.5	0	1.5	0	0	
11	0	0	0	0	0	0	4	2.5	0	9.5	0	0	
12	0	0	0	0	7.5	6.5	5	4.5	0	0	0	0	
13	0	0	0	0	0	0	7	8	0	0	0	0	
14	0	0	0	0	5	5	1.5	5	0	0	0	0	
15	0	0	0	0	30	5.5	0.5	3.5	0	0	5.5	0	
16	0	0	0	0	3.5	0	0	6	2	0	1	0	
17	0	0	0	0	0	0	0	1	3	0	0	0	
18	0	0	0	0	0	0	5	1	1	0	0	0	
19	0	0	0	0	16	0	16.5	1	4.5	0	0	0	
20	0.5	0	0	0	0	0	1	1.5	9	0	0	0	
21	0	0	0	0	0	4	7	0.5	0	0	0	0	
22	0	0	0	0	0	4	7.5	7	3	0	0	0	
23	0	0	0	0	0	0	5.5	3.5	0.5	0	0	0	
24	0	0	0	0	0	4.5	6.5	17	1	0	0	0	
25	0	0	0	0	0	6	8	1.5	13	0	0	0	
26	0	0	0	0	0	1.5	3	0.5	0	0	0	0	
27	0	0	0	0	0	4	1	0	0	0	0	0	
28	0	0	0	0	0	14	1	0	1.5	0	0	0	
29	0	0	0	0	0	33.5	0.5	8	2	0	0	0	
30	0		0	0	0	25.5	2.5	0.5	0	0	0	0	
31	0		0		0	0	2	0		0		0	
Total	0.5	0	0	3.5	63.5	205	168.5	136.5	49	13	6.5	0	646

Year - 2017

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	11	2.5	0	19	46.5	0	0	
2	0	0	0	15	0	0	3	0	0	34.5	0	0	
3	0	0	0	0	1	5.5	2	2	0	0	0	0	
4	0	0	0	0	0	0.5	2	7.4	0	4.5	0	0	
5	0	0	0	0	6.5	0	2	4.8	0	29.5	0	0	
6	0	0	0	0	1.5	0	1	0.2	0	0	0	1.5	
7	0	0	0	0	0.5	0	2.5	0.5	0	0.5	0	0	
8	0	0	0	0	1	1	1.5	0	3.5	0	0	0	
9	0	0	0	0.5	0.5	0	0	0	0	0	0	0	
10	0	0	0	0	0.5	2	3.5	0	0	0	0	0	
11	0	0	0	2.5	0.5	0.5	1.5	0.5	8.5	0.5	0	0	
12	0	0	0	0	0	19	2.5	0	0	0	0	0	
13	0	0	0	0	0.5	13.5	1.5	0.5	24	1	0	0	
14	0	0	0	0	0	1	17.3	0	0.5	14	0	0	
15	0	0	0	0	56.9	2	1.5	0	3.5	6.5	0	0	
16	0	0	0	0	0.2	7	10.9	1.5	0	2	0	0	
17	0	0	0.5	0	0	2	0.8	0	18.5	37	0	0	
18	0	0	0	0	0	1.5	9.6	10	19	0	0	0	
19	0	0	0	0	0	0.5	35.8	7	4	0	0	0	
20	0	0	0	0	0	0	59	3	3.5	0	1	0	
21	0	0	0	0	0	1.5	6.5	11	7	0	0	0	
22	0	0	0	0	0.5	1	0	7.5	0.5	0	0	0	
23	0	0	0	0	0	0.5	0	0	0	0	1.5	0	
24	0	0	0	0	4.5	3	1	6	0	1.5	0	0	
25	0	0	0	0	2	3	0	2	3	0	0	0	
26	0	0	0	0	0	11	0	4	5	0.5	0	0	
27	0	0	0	0	0	15.5	0	11.5	8	0	0	0	
28	0	0	0	0	0	2	14.2	4.5	6	0	0	0	
29	0	0	0	0	0	4	4.8	9.5	16	0	0	0	
30	0		0	1	0	3	0	14.5	0.5	0	0	0	
31	0		0		22	0	0.8	3		0		0	
Total	0	0	0.5	19	98.6	111.5	187.7	110.9	150	178.5	2.5	1.5	860.7

Year - 2018

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0	0	0	1	0.5	0.5	0	0	
2	0	0	0	0	0	7	0.8	5	0	3.5	0	0	
3	0	0	0	0	0	6	0.8	3	0.5	0	0	0	
4	0	0	0	0	0	1	0.5	4.5	1	2.5	0	0	
5	0	0	0	0.5	6.5	0.5	3.8	2	0	0	0	0	
6	0	0	0	0	0	0	21.5	11.5	0.5	4.5	0	0	
7	0	0	0	0	0	1	4	5.5	1.5	0	0	0	
8	0	0	0	0	12.5	5	8.5	5.5	0.5	0	0	0	
9	0	0	0	0	0	8.5	9.5	7	0	0	0	0	
10	0	0	0	0	3.5	48	14.5	6.5	0	0	0	0	
11	0	0	0	2	13	56.5	17	14	0	0	0	0	
12	0	0	0	0	0	2	14	22	0	0	0	0	
13	0	0	0	3.5	0	1	35	30.5	0	0	0	0	
14	0	0	0	30	0.5	1	11.5	11.5	0	0	0	0	
15	0	0	1	0	1.5	0	11.5	16.5	0	0	0	0	
16	0	0	1	0.5	0	0	24	13	0	0	0	0	
17	0	0	0	0	13	1	23	24.5	0	8.5	0	0	
18	0	0	3	14.5	34.5	2	5	2	1.5	37.5	0	0	
19	0	0	9	0	0	13	6	8	0	0.5	4	0	
20	0	0	2.5	0	0	7	5.5	9	0	7.5	0	0	
21	0	0	0	0	0	2.5	7	13	0	0	0	0	
22	0	0	0	0	0	0	13.5	15.5	0	0	0	0	
23	0	0	0	0	0	0	16.5	3.5	0	0	0	0	
24	0	0	0	0	31	0	12	4	0	0	0	0	
25	0	0	0	0	0.5	0	4.5	0.5	0	15	0	0	
26	0	0	0	0	0	1.5	2.5	0.5	1.5	0	0	0	
27	0	0	0	0	22.5	0.8	7.5	8.5	12	0	0	0	
28	0	0	0	0	21.5	0	0.5	19.5	19	0	0	0	
29	0	0	0	0	0	0.8	1.5	2	19.5	0	0	0	
30	0		0	0	4.5	1	0	6.5	2.5	0	0	0	
31	0		0	0	0	0	2	2.5		0		0	
Total	0	0	16.5	51	165	167.1	283.9	278.5	60.5	80	4	0	1106.5

2. Shimoga District

Year - 2009

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0.0	0.0	0.0	0.0	0.0	1.0	4.0	9.6	7.5	18.5	0.0	0.0	
2	0.0	0.0	0.0	2.0	0.0	2.0	34.0	1.6	15.5	9.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.5	114.5	2.0	14.5	89.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	77.0	0.0	44.5	21.5	0.0	0.4	
5	0.0	0.0	0.0	0.0	0.0	10.0	30.1	8.0	76.0	3.5	0.0	0.5	
6	0.0	0.0	0.0	0.0	0.0	23.0	97.0	0.0	53.0	0.0	0.5	0.0	
7	0.0	0.0	0.0	0.0	0.0	86.0	76.5	1.0	13.3	1.5	0.0	0.0	
8	0.0	0.0	0.0	0.0	1.0	3.5	43.5	3.5	10.0	0.0	0.5	0.0	
9	0.0	0.0	0.0	0.0	0.0	1.0	64.0	1.5	0.5	0.5	4.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.5	96.0	0.0	0.5	0.0	17.5	0.0	
11	0.0	0.0	0.0	0.0	0.0	0.0	54.5	1.5	0.0	0.0	15.0	0.0	
12	0.0	0.0	0.2	0.0	0.0	0.0	26.5	2.0	0.5	0.0	10.5	0.0	
13	0.0	0.0	5.5	0.0	0.0	0.0	23.5	0.0	0.3	28.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	32.0	0.0	0.0	9.5	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	59.5	0.0	0.0	0.0	0.0	0.0	
16	0.0	0.0	0.0	0.0	0.0	0.0	127.0	3.0	0.0	0.0	26.0	0.0	
17	0.0	0.0	0.5	0.0	0.0	7.5	62.0	24.0	0.0	0.0	5.5	0.0	
18	0.0	0.0	0.0	0.0	43.0	0.5	87.5	11.0	0.0	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	0.5	0.0	47.5	20.4	9.0	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	4.0	4.5	56.0	21.0	0.0	0.0	31.5	0.0	
21	0.0	0.0	0.0	0.0	0.0	5.5	4.5	1.0	0.5	0.0	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.0	0.5	3.5	10.6	2.5	0.0	0.5	0.0	
23	0.0	0.0	0.0	0.0	0.0	7.5	8.0	1.0	0.0	0.0	0.0	0.0	

24	0.0	0.0	0.0	0.0	0.0	9.0	14.5	4.0	0.0	0.0	0.0	0.5	
25	0.0	0.0	11.5	0.0	0.0	3.0	2.5	17.2	25.5	0.0	0.0	0.0	
26	0.0	0.0	0.0	0.0	3.0	13.0	0.0	6.8	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	4.5	11.0	6.2	4.5	0.0	0.0	0.0	
28	0.0	0.0	0.0	23.0	0.0	8.5	18.5	2.0	2.0	0.0	0.0	0.0	
29	0.0	0.0	0.0	10.5	36.0	1.5	53.5	1.0	0.5	0.0	0.0	0.0	
30	0.0	0.0	16.5	0.0	15.5	1.0	59.5	0.5	41.0	9.5	0.0	0.0	
31	0.5	0.0	0.0	0.0	0.0	0.0	16.5	1.5	0.0	0.0	0.0	0.0	
Total	0.5	0.0	34.2	35.5	103.0	194.0	1404.6	161.9	321.6	190.5	111.5	1.4	2558.7

Name of the Villages	Annual rainfall data	
	2010	2011
TIRTHAHALLI	1338.2	3461.3
AGRAHARA	837.0	2847.1
AGUMBE	897.8	5425.0
MANDAGADDE	895.2	1769.1
MALUR	757.9	2506.4

Year - 2012

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0.00	0.00	0.00	0.00	0.00	0.00	22.10	7.80	47.30	13.00	8.10	0.00	
2	0.00	0.00	0.00	2.10	0.30	0.10	46.20	8.40	1.20	6.40	67.50	0.00	
3	0.00	0.00	0.00	2.10	0.00	0.10	8.50	34.70	38.90	13.30	6.60	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.30	1.50	58.40	1.90	6.80	3.80	0.00	
5	0.00	0.00	0.00	0.50	0.00	17.10	8.50	35.40	4.80	4.20	0.00	0.00	
6	0.00	0.30	0.00	0.00	0.00	6.80	1.50	97.90	9.30	0.30	0.20	0.00	
7	0.00	0.00	0.00	0.00	0.00	8.20	6.30	92.70	8.80	0.00	0.00	0.00	
8	0.00	0.00	0.00	0.00	0.00	3.00	21.90	40.90	11.30	0.00	0.00	0.00	

9	0.30	0.00	0.00	1.30	0.00	2.90	10.60	21.30	3.00	0.00	0.30	0.00	
10	0.00	0.00	0.00	0.00	0.00	16.7 0	14.10	13.10	12.80	0.00	2.00	0.00	
11	0.00	0.00	0.00	0.00	4.70	0.90	10.80	40.90	35.30	0.00	0.00	0.00	
12	0.00	0.00	0.00	0.50	0.00	9.90	11.90	59.70	22.70	0.00	2.40	0.00	
13	0.00	0.00	0.00	0.00	0.00	14.0 0	7.20	50.30	16.20	0.00	0.00	0.00	
14	0.00	0.00	0.00	2.10	0.00	1.70	0.60	7.50	2.80	0.00	0.00	0.30	
15	0.00	0.00	0.00	0.10	0.20	2.10	7.70	23.90	7.60	0.00	0.00	0.00	
16	0.00	0.00	0.00	19.9 0	0.00	0.10	12.60	2.40	7.60	0.00	0.00	0.00	
17	0.00	0.00	0.00	0.10	0.00	9.00	6.50	4.70	5.60	0.00	0.00	0.00	
18	0.00	0.00	0.00	6.70	0.00	62.1 0	11.70	1.50	3.10	0.00	0.00	0.00	
19	0.00	0.00	0.00	3.40	0.00	32.0 0	14.70	3.40	0.50	0.00	0.00	0.00	
20	0.00	0.00	0.00	0.00	0.00	42.1 0	15.10	0.70	0.00	0.00	0.00	0.00	
21	0.00	0.00	0.00	0.60	0.00	3.70	55.30	0.70	0.10	8.30	0.00	0.00	
22	0.00	0.00	0.00	0.00	0.00	17.7 0	82.00	0.30	0.00	0.10	0.00	0.00	
23	0.00	0.00	0.00	0.10	0.00	6.30	24.10	0.80	0.00	0.00	0.00	0.00	
24	0.00	0.00	0.00	0.00	0.00	23.5 0	38.00	0.00	0.00	0.00	0.00	0.00	
25	0.00	0.00	0.00	12.6 0	0.00	28.7 0	7.10	0.00	0.20	0.00	0.00	0.00	
26	0.00	0.00	0.00	26.3 0	0.00	4.90	47.10	15.00	0.00	0.30	0.00	0.00	
27	0.00	0.00	0.00	4.10	0.00	22.9 0	104.5 0	12.20	0.00	0.00	0.00	0.00	
28	0.00	0.00	0.00	8.70	0.00	11.0 0	32.00	3.50	0.00	0.00	0.00	0.00	

29	0.00	0	0.00	0.70	0.00	12.3 0	19.50	65.90	0.90	0.10	0.00	0.00	
30	0.30	0	0.00	0.00	0.10	32.3 7	8.90	21.70	3.40	0.00	0.00	0.00	
31	0.00	0	0.00		0.00		4.60	36.00	0	0.00	0	0.10	
Tot al	0.60	0.30	0.00	91.9 0	5.30	392. 47	663.1 0	761.70	245.30	52.8 0	90.90	0.40	2304.77

Year - 2013

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1.83	0	0	0	0	14.4	12.15	67.12	0	0.37	0	0	
2	0	0	0	0	0	3.36	42.6	87.15	0.06	0.24	0	0	
3	0	0	0	0	0.85	0.9	227.45	17.56	0.33	0	2.59	3.73	
4	0.28	0	0	0	0	1.01	118.59	29.49	3.87	0.28	0.28	0.01	
5	0.01	0	0	0	0	0	33.92	10.55	3.42	2.73	0.28	0	
6	0	0	0	0	0.06	0.27	68.52	11.53	5.48	31.18	0	0	
7	0	0	0	0	0	0.72	34.42	16.16	1.65	0.14	0	0	
8	0	0	0	0.01	0	16.97	14.65	18.91	6.82	0.06	0	0	
9	0.01	0	0	0	4.4	15.03	6.6	7.62	1.26	0.01	0	0	
10	0	1.63	0	0	0	17.4	22.15	5.14	2.87	0.01	0	0	
11	0	0	0	0	0	35.9	38.85	20.93	3.6	0.34	0	0	
12	0	0	0	0	0	8.11	57.95	4.92	1.21	0.01	0	0	
13	0	0	0	0	0	7.71	14.31	9.91	0.63	6.55	0	0	
14	0	0	0	0	0	63.78	7.92	29.52	2.86	4.8	0.01	0	
15	0	3.27	0	0	0	15.88	14.82	9.75	2.46	0.04	0	0	
16	0	0.12	0	0	0	28.5	26.1	20.65	0	0	0	0	
17	0	18.46	0.01	0	0	27.3	39.06	54.89	6.74	15.05	0	0	
18	0	0.58	0	0	0	31.68	76.28	34.14	107.25	1.51	0	0	
19	0	0	0	0	0.84	13.07	67.59	8.6	6.95	12.15	0	0	

20	0	0	0.03	0	0	17.74	106.14	24.68	42.67	0.08	0	0	
21	0	0	0	0	4.84	5.17	36.27	24.33	25.24	0	0	0	
22	0	0	0	0	0	28.63	37.95	15.84	13.1	0	0	0	
23	0	0	0	0	0	9.68	69.35	45.97	0.85	1.14	0	0	
24	0	0	0	0	0	59.83	49.13	5.79	9.76	32.58	0	0	
25	0	0.01	0	0.82	0.01	57.16	59.61	10.9	3.88	0.5	0.28	0	
26	0	0	0	2.1	0	53.57	64.96	2.81	0.18	3.36	0.03	0	
27	0	0	0	0	0	26.03	25.69	0.59	0.02	0.31	0.48	0	
28	0.01	0.01	0	0	7.62	18.85	46.43	1.69	0.03	0.02	0.01	0	
29	0		0	7.38	14.88	7.95	46.79	3.72	0.02	0.04	0	0	
30	0		0	0.48	0	2.37	12.79	0.34	4.77	0.32	0	0	
31	0		0		3.15		32.98	3.45		0		0	
Total	2.14	24.08	0.04	10.79	36.65	588.97	1512.02	604.65	257.98	113.82	3.96	3.74	3158.84

Year - 2014

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0	0.35	0	0	129.32	22.85	22.74	0	0	
2	0	0	0	0.09	6.81	0.02	9.53	62.09	17.79	9.6	0	0	
3	0	0	0	0	0	4.43	0.89	20.74	20.15	0.02	0	0	
4	0	0	0	0.02	0.2	0.53	4.1	37.7	13.64	0.01	0	0	
5	0	0	0	0	0	0	0.58	82.49	16.08	0	0.01	0	
6	0.01	0	0	0	2.61	0	0.5	111.26	18.08	5.42	0	0	
7	0	0	0	0	3.97	0	1.53	57.04	46.79	1.78	0.01	0	
8	0	0	0	0.06	23.14	0	15.11	44.58	9.44	0.02	0	0	
9	0	0	0	0	33.05	0.35	6.59	11.74	7.02	0.21	0	0	
10	0	0	0.06	0	0.02	2.16	18.94	16.52	2.2	2.45	0	0.93	
11	0	0	0.02	0	0	2.85	9.41	9.32	4.13	5.53	0	0.59	
12	0	0	0.35	0	0	13.69	18.11	17.87	3.27	21.37	0	1.17	

13	0	0	0	0	0.01	11.91	56.09	15.12	0.67	0.01	0	24.41	
14	0	0	0	0	0	2.93	133.9	4.78	2.11	0.01	0.22	9.02	
15	0	0	0	0	0.02	27.3	42.85	6.78	0.01	0	14.09	0.35	
16	0	0	0	0.12	0	0.93	80.12	4.14	0.76	0	0.01	0	
17	0	0	0	0	0	36.45	22.18	16.98	2.17	0	0	0	
18	0	0	0	0	0	10.61	25.29	1.56	0	0	0	0	
19	0	0	0	1.43	0	41.52	62.41	0.37	0.58	0	0	0	
20	0	0	0.01	0.53	0.66	44.98	20.14	1.76	1.9	0.17	0	0	
21	0	0	0	0	0	54.15	46.43	3.4	2.33	0.07	0	0	
22	0	0	0	0	0.1	69.65	94.09	4.95	0.64	0	0	0	
23	0	0	0	0	0	28.26	77.77	42.41	0.25	0	0	0	
24	0	0	0	0	0	7.98	55.72	0.36	0.12	0.12	0	0.01	
25	0	0	0.01	0.36	0.05	0.64	45.13	4.29	1.81	19.93	0	0	
26	0	0.68	0	0.35	0	0	56.3	16.2	30.87	16.61	0	0.01	
27	0	0.01	0	7.15	0.06	0	16.84	20.19	7.43	1.67	0.01	0	
28	0	0	0	0.65	0.13	0	36.81	15.28	0	2.85	0	0	
29	0		0	0	0.18	0	17.95	30.24	15.34	0.01	0	0	
30	0		0	29.9	15.4	0	29.83	16.01	36.44	0	0	0	
31	0		0		0.01		89.32	43.34		0.01		0	
Total	0.01	0.69	0.45	40.66	86.77	361.34	1094.46	848.83	284.87	110.61	14.35	36.49	2879.53

Year - 2015

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0	0	0	0.66	0.0	0.1	2.8	13.7	0.3	10.6	2.5	0.0	
2	0	0.01	0.57	6.54	0.0	0.0	7.2	11.1	0.0	8.0	0.4	0.0	
3	0	0	0.28	0.13	0.0	0.1	8.1	10.9	0.5	0.1	24.8	0.0	
4	0.58	0	0	0.04	0.0	0.0	9.4	8.6	1.1	0.1	0.3	0.0	

5	0.28	0	0	0.01	1.7	0.4	1.4	33.9	0.6	6.2	7.6	0.0	
6	0	0	0	0	9.8	0.4	0.2	51.4	0.1	15.1	0.2	0.0	
7	0	0	0	0	0.0	0.0	0.7	55.1	2.8	15.0	0.1	0.0	
8	0	0	0.17	0	6.6	4.3	13.1	14.7	2.3	2.5	0.0	0.0	
9	0	0	7.44	0	0.0	9.9	16.9	8.4	2.0	0.0	0.0	0.0	
10	0.28	0	20.5	0.04	6.4	8.3	45.0	12.2	2.7	0.1	0.0	0.0	
11	0	0	0.01	0	0.0	0.0	14.9	17.8	8.7	0.0	0.0	0.0	
12	0	0	0	0.04	3.4	3.1	24.7	24.9	0.2	1.1	0.0	0.0	
13	0	0	0	0.5	13.9	0.2	3.1	22.0	3.6	0.0	0.0	0.0	
14	0	0	0	0.82	13.3	18.1	4.0	15.0	18.0	0.8	0.0	0.0	
15	0	0	1.69	0	0.0	16.7	1.8	13.1	31.5	0.0	0.0	0.0	
16	0	0.08	0	0.07	13.5	1.3	10.6	8.0	32.0	0.0	0.0	0.0	
17	0	0.17	0	0	31.5	6.2	24.1	4.0	4.0	0.0	0.0	0.0	
18	0	0	0	0.03	0.3	18.5	30.4	1.4	21.8	0.0	0.0	0.0	
19	0	0	0	0	0.0	19.7	21.6	0.4	7.4	0.0	0.0	0.0	
20	0	0	0	0.03	0.0	50.3	68.9	5.4	3.9	0.0	0.0	0.1	
21	0	0	0	0	0.0	66.4	11.1	0.0	2.4	0.1	1.0	0.1	
22	0	0	0	0	0.0	94.4	22.4	6.7	0.0	0.0	0.0	0.0	
23	0	0	0	0	0.0	66.7	12.6	9.5	0.4	0.1	0.0	0.0	
24	0.01	0	0	14.75	0.0	87.3	7.4	2.8	0.0	0.0	0.0	0.0	
25	0.01	0	0	0.03	0.0	56.1	3.1	4.4	0.0	0.0	0.0	0.1	
26	0.01	0	2.32	0	0.0	50.8	11.5	4.1	0.2	0.0	0.0	0.0	
27	0.01	0	0.53	1.11	0.0	8.5	11.1	21.0	0.0	0.0	0.0	0.0	
28	0.01	0	0	0.32	0.0	12.3	5.8	8.1	1.0	0.0	0.0	0.0	
29	0	0	0	3.72	0.0	4.7	3.7	2.2	1.3	0.0	0.0	0.0	
30	0	0	0	0	25.1	1.7	2.9	8.3	2.9	0.2	0.0	0.0	
31	0	0	13.69	0	0.0	0	14.3	0.3	0	1.0	0	0.0	

Total	1.19	0.26	47.2	28.84	125.5	606.5	414.6	399.3	151.4	61.0	36.9	0.3	1872.95
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Year - 2016

Sl. Nos.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	0.0	0.0	0.0	0.0	0.0	0.0	49.9	9.5	10.1	0.5	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	1.6	23.5	4.6	5.3	0.4	0.1	0.0	
3	0.0	0.0	0.0	0.0	0.0	9.0	36.1	17.5	3.1	0.0	6.1	0.0	
4	0.0	0.0	0.0	0.0	0.0	5.6	56.8	30.4	7.9	0.0	0.0	0.1	
5	0.0	0.0	0.0	0.0	0.0	0.0	63.0	40.9	1.8	0.1	0.0	0.0	
6	0.0	0.0	0.0	0.0	0.0	0.1	18.1	17.6	3.0	0.1	0.0	0.0	
7	0.0	0.0	0.0	0.5	0.0	0.2	8.7	21.7	2.8	0.1	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.6	4.2	23.9	2.0	0.1	0.0	0.0	
9	0.0	0.0	0.0	0.0	0.0	33.0	6.3	20.2	0.2	4.4	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	8.2	5.1	10.6	0.0	6.3	0.0	0.0	
11	0.0	0.0	0.0	0.0	0.0	12.1	20.9	5.1	0.0	13.6	0.0	0.0	
12	0.0	0.0	0.0	0.0	1.4	9.8	12.6	17.5	0.2	3.4	0.0	0.0	
13	0.0	0.0	0.0	0.0	18.4	18.3	9.2	11.3	0.0	0.1	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	7.9	8.9	10.3	3.1	9.7	0.0	0.4	
15	0.0	0.0	0.0	0.0	4.1	1.3	4.8	8.4	4.2	0.2	20.0	1.6	
16	0.0	0.0	0.0	0.3	0.0	2.4	3.8	12.7	2.8	0.0	28.9	0.0	
17	0.0	0.0	0.0	0.0	7.6	0.4	4.1	8.2	6.0	0.1	0.0	0.0	
18	0.0	0.0	0.0	0.0	28.2	0.1	2.2	11.7	5.2	0.0	0.0	0.0	
19	0.2	0.0	0.0	0.0	0.4	0.1	3.6	10.3	5.1	0.0	0.0	0.0	
20	2.3	0.0	0.0	0.0	0.7	0.4	6.3	2.9	3.5	0.0	0.0	0.0	
21	0.0	0.0	0.0	0.0	0.0	32.8	22.5	1.0	5.8	0.1	0.0	0.0	

22	0.0	0.0	0.0	0.0	0.0	20.7	13.4	15.9	1.1	0.1	0.0	0.0	
23	0.0	0.0	0.0	0.0	0.0	12.2	20.6	7.7	2.2	0.3	0.1	0.0	
24	0.0	0.0	0.0	0.0	0.0	8.4	6.7	12.2	9.8	0.0	0.0	0.0	
25	0.0	0.0	0.0	0.0	0.0	10.2	8.7	13.8	8.9	0.0	0.1	0.0	
26	0.0	0.0	0.0	0.0	0.0	14.8	2.3	1.6	23.2	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	55.0	0.2	17.3	3.3	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	51.9	7.8	4.7	0.0	0.0	0.0	0.0	
29	0.0	0.0	0.0	0.0	0.0	109.3	1.9	6.9	0.5	0.0	0.1	0.0	
30	0.0		0.0	0.0	0.0	63.0	7.0	1.3	0.0	0.2	0.1	0.0	
31	0.0		0.0		0.0		10.2	1.7		0.0		0.0	
Total	2.5	0.0	0.0	0.9	60.7	489.2	449.4	379.0	120.9	39.7	55.3	2.2	1599.8

Year - 2017

Village name	Annual rain fall
Bhadravathi Hobli	794.76
Bhadravathi (2) Hobli	840.55
Holehonnuru (1) Hobli	703.9
Holehonnuru (2) Hobli	775.9
Holehonnuru (3) Hobli	651.84
Kudaligere Hobli	690.86
Hosanagar Hobli	2034.97
Huncha Hobli	1906.26
Kerehalli Hobli	1262.49
Nagar Hobli	3739.24
Sagar Hobli	1308.75
Anandapuram Hobli	1127.7
Baragadde Hobli	3449.46
Anahalli Hobli	1456.17
Karauru Hobli	3400.49
Talguppa Hobli	1786.29
Shikaripur Hobli	810.17
Anjanapura Hobli	779.88
Husuru Hobli	696.67
Udagani Hobli	892.95
Talagunda Hobli	909.04
Shimoga (1) Hobli	700.99
Shimoga (2) Hobli	885.61

Haranahalli Hobli	899.22
Holalur (1) Hobli	725.05
Holalur (2) Hobli	724.88
Kumsi Hobli	851.82
Nidige Hobli	880.38
Nidige (2) Hobli	906.61
Sorab Hobli	1097.95
Anavatti Hobli	764.7
Chandragutti Hobli	1473.96
Jade Hobli	774.04
Kuppagadde Hobli	897.61
Ulvi Hobli	1116.89
Tirthahalli Hobli	2754.55
Agrahara Hobli	2188.17
Agumbe Hobli	3805.57
Mandagadde Hobli	1389.22
Malur Hobli	1854.59
Total	54710.15

Annexure-II. Landslide Inventory 42-point proforma.

1	Slide No.	KAR/UTK/48J/12/2018-19/01
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22676111
6	Longitude	74.528025
7	Slide Name	Gazni
8	NH / SH	Balkur-Benkull interlink road
9	Length	10
10	Width	10
11	Height	10
12	Area	100
13	Depth	1
14	Volume	100
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive/widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall/anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Vertical cutting of the slope for the road construction without any toe support. Poor slope forming material coupled with continuous rain fall may leads to increase of the pore pressure.
38	Remedial Measures	Proper toe support construction of toe drain and proper maintenance. Construction of hill side drainage and proper maintenance.
39	Remarks	-
40	Summary	The slide initiated due to the extension of road and the slide aggravated due to heavy rainfall.
41	Category	Category-III
42	Photos	1832-1833



1	Slide No.	KAR/UTK/48J/12/2018-19/02
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22698
6	Longitude	74.52803
7	Slide Name	Gazni 1
8	NH / SH	Balkur-Benkull interlink road
9	Length	6
10	Width	9
11	Height	6
12	Area	54
13	Depth	1
14	Volume	54
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall/anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Vertical cutting of the slope for the road construction without any toe support. Poor slope forming material coupled with continuous rain fall may leads to increase of the pore pressure.
38	Remedial Measures	Proper toe support construction of toe drain and proper maintenance. Hanging of the tree to be removed. Geo-jute to be applied to protect the slope from further erosion. Construction of hill side drainage and proper maintenance.
39	Remarks	-
40	Summary	Vertical cutting of the slope for the road construction without any toe support. Poor slope forming material coupled with continuous rain fall may leads to increase of the pore pressure. The slides are smaller dimension but it may leads to further soil erosion.
41	Category	Category-III
42	Photos	1834



1	Slide No.	KAR/UTK/48J/12/2018-19/03
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.23019
6	Longitude	74.52753
7	Slide Name	Gazni 2
8	NH / SH	Balkur-Benkull interlink road
9	Length	7
10	Width	9
11	Height	6
12	Area	63
13	Depth	1
14	Volume	63
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Confined
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall/anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	
37	Geo-Scientific Causes	Vertical cutting of the slope for the road construction or road widening without any toe support. Poor slope forming material coupled with continuous rain fall may leads to increase of the pore pressure.
38	Remedial Measures	Removal of the debris construction of retaining wall with sufficient height with sufficient weep hole or easing of the slope and construction and proper maintenance of hill side drainage.
39	Remarks	Cutting of trees and loose rolled boulders are observed in the upslope.
40	Summary	Predisposing factor for the slide is presence of weak slope forming material and slope. During the rainy season the slide aggravated.
41	Category	Category-III
42	Photos	1835-1837



1	Slide No.	KAR/UTK/48J/12/2018-19/04
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22617
6	Longitude	74.531
7	Slide Name	Devar Gazni
8	NH / SH	Balkur-Benkull interlink road
9	Length	20
10	Width	18
11	Height	20
12	Area	360
13	Depth	4
14	Volume	1440
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2012
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Village link road blocked for few hours.
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Highly weathered rock mass coupled with steep slope prolonged rain fall may cause the improvement of local hydrostatic pressure Cutting of the slope for the road widening and poor slope forming material.
38	Remedial Measures	Removal of the debris easing of the slope construction of hill side drainage and proper maintenance.
39	Remarks	Slide material not removed presently there is no any significant movement observed.
40	Summary	The slide occurred on 2012 and slide initiated due to road cut and presence of weak slope forming material. Length, width and height of the soil slide is 20, 18 and 20 respectively.
41	Category	Category-II
42	Photos	1845-1848



1	Slide No.	KAR/UTK/48J/12/2018-19/05
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.21941
6	Longitude	74.53736
7	Slide Name	Hinnur
8	NH / SH	Balkur-Magod interlink road
9	Length	10
10	Width	10
11	Height	6
12	Area	100
13	Depth	1
14	Volume	100
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Thick over burden material coupled with incessant rainfall may cause for the slides soil losses its strength due to increase in pore pressure
38	Remedial Measures	Removal of the debris easing of the slope and maintenance of culvert to be done properly.
39	Remarks	Anthropogenic activity also one of the factor for this landslide.
40	Summary	Soil slide occurred on 2017. Thick over burden material coupled with incessant rainfall may cause for the slides soil losses its strength due to increase in pore pressure. Removal of the debris easing of the slope and maintenance of culvert to be done properly.
41	Category	Category-III
42	Photos	1857-1859



1	Slide No.	KAR/UTK/48J/12/2018-19/06
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.21888
6	Longitude	74.54216
7	Slide Name	Hinnur 1
8	NH / SH	Balkur-Magod interlink road
9	Length	8
10	Width	10
11	Height	7
12	Area	80
13	Depth	1
14	Volume	80
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Unknown
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Cutting of the slope for the road widening highly weathered rock and increase in the pore pressure.
38	Remedial Measures	Geo jute to be applied or suitable grass planted to reduce the soil erosion.
39	Remarks	At present condition there is no any visible movement
40	Summary	Small soil slide occurred along the road side and its aggravated due to incessant rainfall.
41	Category	Category-III
42	Photos	1860-1861



1	Slide No.	KAR/UTK/48J/12/2018-19/07
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.23146
6	Longitude	74.56719
7	Slide Name	Masabag
8	NH / SH	Balkur-Magod interlink road
9	Length	6
10	Width	8
11	Height	6
12	Area	48
13	Depth	3
14	Volume	144
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Aug-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Incessant rain fall may cause to increase the pore pressure and vertical toe cut for road construction weak slope forming material.
38	Remedial Measures	Divert the surface runoff and construction toe drain and proper maintenance. Slope angle to be reduce by benching. Constructing hill side drainage. Debris material to be removed from the hill slope. Proper benching to be done in the above the settlement.
39	Remarks	Slide may reactivate may be in the future rainy season.
40	Summary	Soil slide occurred on Aug-2018. Very smaller dimension and occurred due to incessant rain fall may cause to increase the pore pressure and vertical toe cut for road construction weak slope forming material. During the rainy season slide occurred over the road bench and cracks developed over the road bench. Road the road bench slope having an angle of 30-45 degree. Further down the slope 2-3 settlement situated. Loose debris are lying over the slope. The cracks may reactivate in the future rainfall and it may damage the settlement.

41	Category	Category-I
42	Photos	1864-1870



1	Slide No.	KAR/UTK/48J/12/2018-19/08
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.19543
6	Longitude	74.52785
7	Slide Name	Adukul
8	NH / SH	Chittar -Adukul interlink road
9	Length	13
10	Width	12
11	Height	10
12	Area	156
13	Depth	1
14	Volume	156
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive/widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Unknown
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Vertical cut slope for settlement construction. Weak slope forming material incessant rainfall.
38	Remedial Measures	Avoid construction of settlement over this place. If needed proper slope protection to be done.
39	Remarks	Above the road bench the vertical toe cut observed. If any slope failure above the hills that will affect the settlement which is located below the road bench. it is reported that during the rain time the slide occurred and surface cracks developed down
40	Summary	Soil slide initiated due to vertical cutting of the thick slope forming material for settlement construction.
41	Category	Category-II
42	Photos	1885-1888



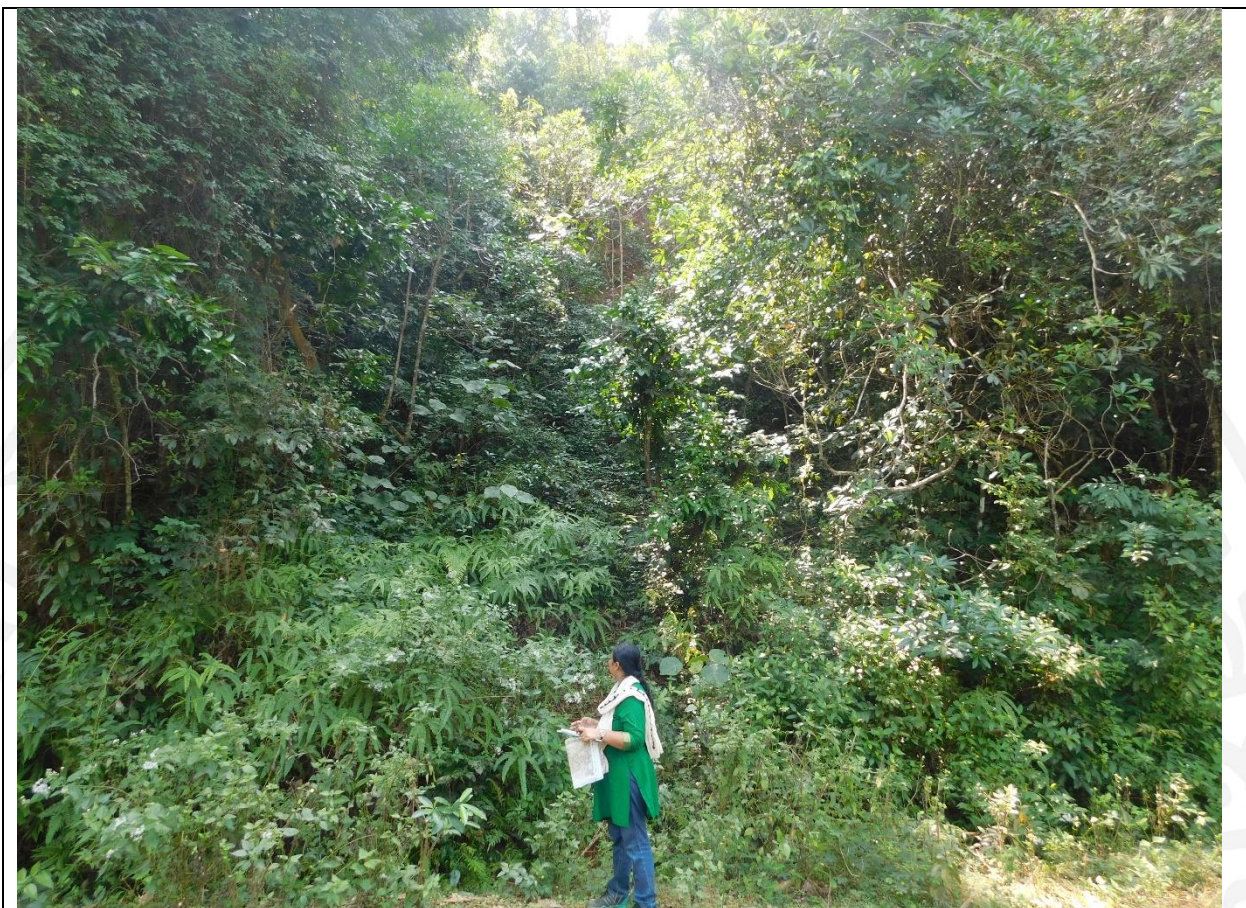
1	Slide No.	KAR/SMG/48J/12/2018-19/09
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.09189
6	Longitude	74.67099
7	Slide Name	Nagavalli
8	NH / SH	Bhatkal-Kargal road
9	Length	10
10	Width	12
11	Height	8
12	Area	120
13	Depth	2.5
14	Volume	300
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Unknown
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Vertical to cut for road construction and weak thick slope forming material on the slope.
38	Remedial Measures	Construction of hill drain and proper maintenance.
39	Remarks	-
40	Summary	Small soil slide occurred due to cutting of the slope for the road construction
41	Category	Category-III
42	Photos	1912-1913



1	Slide No.	KAR/SMG/48J/12/2018-19/10
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.096
6	Longitude	74.67553
7	Slide Name	Nagavalli 1
8	NH / SH	Bhatkal-Kargal road
9	Length	15
10	Width	25
11	Height	10
12	Area	375
13	Depth	1
14	Volume	375
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Unknown
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Thick insitu soil associated with rainfall may increase the pore pressure and the soil losses its strength.
38	Remedial Measures	Easing the slope by making multiple benching and construction of retaining wall with sufficient weep holes.
39	Remarks	-
40	Summary	Cut slope failure occurred due to thick insitu soil associated with rainfall may increase the pore pressure and the soil losses its strength.
41	Category	Category-II
42	Photos	1914-1915



1	Slide No.	KAR/SMG/48J/12/2018-19/11
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.09625
6	Longitude	74.67868
7	Slide Name	Nagavalli 2
8	NH / SH	Bhatkal-Kargal road
9	Length	12
10	Width	7
11	Height	11
12	Area	84
13	Depth	2
14	Volume	168
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Confined
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2014
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Vertical slope cut for road construction. Incessant rain fall may cause the improvement of local hydrostatic or pore pressure.
38	Remedial Measures	Reducing the slope angle and construction of toe drain.
39	Remarks	-
40	Summary	Vertical slope cut for road construction. Incessant rain fall may cause the improvement of local hydrostatic or pore pressure. Reducing the slope angle and construction of toe drain.
41	Category	Category-III
42	Photos	1916



1	Slide No.	KAR/UTK/48J/12/2018-19/12
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22297
6	Longitude	74.58658
7	Slide Name	Magod
8	NH / SH	Nagarbastikere road
9	Length	7
10	Width	15
11	Height	5
12	Area	105
13	Depth	1
14	Volume	105
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Wet
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Vertical toe cut for the road construction and poor slope forming material continuous rainfall may cause for the increase of the pore pressure.
38	Remedial Measures	Applying geo jute to avoid the slope failure. Construction of toe drain and proper maintenance.
39	Remarks	-
40	Summary	
41	Category	Category-II
42	Photos	1961-1964



1	Slide No.	KAR/UTK/48J/12/2018-19/13
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22156
6	Longitude	74.58967
7	Slide Name	Magod 1
8	NH / SH	Nagarbastikere road
9	Length	7
10	Width	5
11	Height	5
12	Area	35
13	Depth	0.5
14	Volume	17.5
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Toe cut for road construction.
38	Remedial Measures	Removal of the slide material construction of hill side drain and proper maintenance.
39	Remarks	-
40	Summary	-
41	Category	Category-III
42	Photos	1965



1	Slide No.	KAR/UTK/48J/12/2018-19/14
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22221
6	Longitude	74.59092
7	Slide Name	Magod 2
8	NH / SH	Nagarbastikere road
9	Length	6
10	Width	12
11	Height	5
12	Area	72
13	Depth	1
14	Volume	72
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Vertical road cut for road construction and weak slope forming material.
38	Remedial Measures	Construction of hill side drain and proper maintenance.
39	Remarks	-
40	Summary	Slide occurred on 2018 during the monsoon season because of the soil losses its strength by increasing the pore pressure. Construction of hill side drain and proper maintenance.
41	Category	Category-III
42	Photos	1990-1991



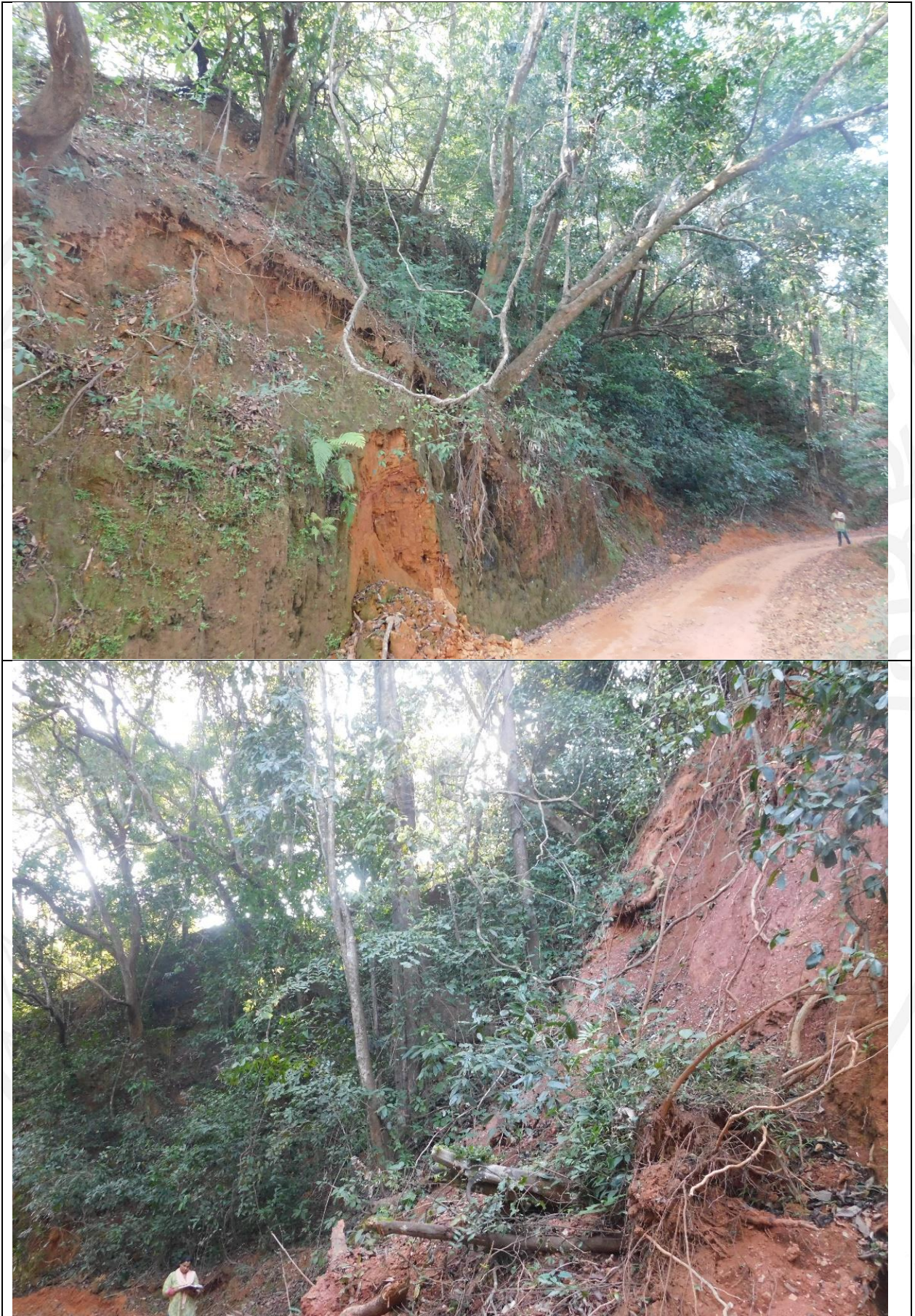
1	Slide No.	KAR/UTK/48J/12/2018-19/15
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22801
6	Longitude	74.59666
7	Slide Name	Kachodi
8	NH / SH	Nagarbastikere road
9	Length	12
10	Width	40
11	Height	10
12	Area	480
13	Depth	2
14	Volume	960
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Weak slope forming material and toe cut for road construction incessant rainfall may cause for the slide.
38	Remedial Measures	Removal of debris material and construction of hill side drain.
39	Remarks	-
40	Summary	Weak slope forming material and toe cut for road construction incessant rainfall may cause for the slide. Removal of debris material and construction of hill side drain.
41	Category	Category-III
42	Photos	2004-2009



1	Slide No.	KAR/UTK/48J/12/2018-19/16
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22995
6	Longitude	74.60915
7	Slide Name	Samsi
8	NH / SH	Nagarbastikere road
9	Length	15
10	Width	40
11	Height	12
12	Area	600
13	Depth	1
14	Volume	600
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Steep slope coupled with vertical cut for the settlement construction and weak slope forming material. Incessant rain fall may cause for the increment of pore pressure in the soil.
38	Remedial Measures	Benching needs to done in this area. Hill side drainage to be constructed.
39	Remarks	It's reported that every year there is a small localized slide happen during the rainfall.
40	Summary	This soil slide occurred every year during monsoon season and near the slide one settlement situated. Benching needs to done in this area. Hill side drainage to be constructed.
41	Category	Category-I
42	Photos	2018-2028



1	Slide No.	KAR/UTK/48J/12/2018-19/17
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22348
6	Longitude	74.66213
7	Slide Name	Nagarbastikere
8	NH / SH	-
9	Length	18
10	Width	25
11	Height	16
12	Area	450
13	Depth	2
14	Volume	900
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Wet
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Vertical slope cut for road construction Incessant rain fall may cause the improvement of local hydrostatic or pore pressure. Weak slope forming material over the slope and dynamic load given by the tree.
38	Remedial Measures	Easing of the slope by benching and construction of toe drain.
39	Remarks	Road may be shifted towards the hill side.
40	Summary	Vertical slope cut for road construction Incessant rain fall may cause the improvement of local hydrostatic or pore pressure. Weak slope forming material over the slope and dynamic load given by the tree. Easing of the slope by benching and construction of toe drain.
41	Category	Category-II
42	Photos	2036-2040



1	Slide No.	KAR/UTK/48J/12/2018-19/18
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24605
6	Longitude	74.57229
7	Slide Name	Allanki
8	NH / SH	NH-206
9	Length	7
10	Width	5
11	Height	6
12	Area	35
13	Depth	5
14	Volume	175
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Toe cut for road construction.
38	Remedial Measures	Removal of the soil.
39	Remarks	-
40	Summary	Small dimension of soil slide occurred on 2017 due to toe cut for road construction.
41	Category	Category-III
42	Photos	2070



1	Slide No.	KAR/UTK/48J/12/2018-19/19
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24619
6	Longitude	74.57425
7	Slide Name	Allanki 1
8	NH / SH	NH-206
9	Length	8
10	Width	10
11	Height	8
12	Area	80
13	Depth	0.5
14	Volume	40
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Confined
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Toe cut for road construction.
38	Remedial Measures	Removal of the soil.
39	Remarks	-
40	Summary	Small landslide happened due to toe cut for road construction.
41	Category	Category-III
42	Photos	2071-2072



1	Slide No.	KAR/UTK/48J/12/2018-19/20
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24543
6	Longitude	74.57637
7	Slide Name	Allanki 2
8	NH / SH	NH-206
9	Length	8
10	Width	12
11	Height	6
12	Area	96
13	Depth	0.5
14	Volume	48
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Confined
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Toe cut for road construction.
38	Remedial Measures	Removal of the slide material.
39	Remarks	-
40	Summary	The slide occurred along the NH_206 due to cutting of the slope for road construction.
41	Category	Category-III
42	Photos	2073-2074



1	Slide No.	KAR/UTK/48J/12/2018-19/21
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24024
6	Longitude	74.59423
7	Slide Name	Upponi
8	NH / SH	NH-206
9	Length	12
10	Width	25
11	Height	10
12	Area	300
13	Depth	1
14	Volume	300
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Toe cut for road construction. Weak slope forming material and incessant rainfall.
38	Remedial Measures	Construction of toe drain and easing of the slope.
39	Remarks	Small trees have grown over the slide material. At present no visible movement
40	Summary	Landslide happened due to toe cut for road construction. Weak slope forming material and incessant rainfall. Construction of toe drain and easing of the slope are may recommended for this slide.
41	Category	Category-II
42	Photos	2081-2082



1	Slide No.	KAR/UTK/48J/12/2018-19/22
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.2379
6	Longitude	74.59699
7	Slide Name	Upponi 1
8	NH / SH	NH-206
9	Length	12
10	Width	40
11	Height	10
12	Area	480
13	Depth	1
14	Volume	480
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Toe cut for the road construction and delighted weak slope forming material leads to soil erosion in this area.
38	Remedial Measures	Easing of the slope applying the geo-jute over the slide area. Construction of toe drain.
39	Remarks	-
40	Summary	Soil slide occurred on 2016 along the NH-206 due to toe cut for road construction.
41	Category	Category-II
42	Photos	2083-2085



1	Slide No.	KAR/UTK/48J/12/2018-19/23
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.2454
6	Longitude	74.65746
7	Slide Name	Hulegar
8	NH / SH	Gersoppa interlink road
9	Length	7
10	Width	30
11	Height	6
12	Area	210
13	Depth	2
14	Volume	420
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	damp
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak slope forming material and incessant rainfall may cause for the slide.
38	Remedial Measures	Removal of debris and proper maintenance of hill side drainage.
39	Remarks	-
40	Summary	Presence of soft clayey soil coupled with rainfall may leads to soil erosion and increase of the pore pressure in the soil.
41	Category	Category-III
42	Photos	2098-2102



1	Slide No.	KAR/UTK/48J/12/2018-19/24
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.2457
6	Longitude	74.65654
7	Slide Name	Hulegar 1
8	NH / SH	Gersoppa interlink road
9	Length	18
10	Width	10
11	Height	12
12	Area	180
13	Depth	5
14	Volume	900
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2013
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Blocking of the natural flowing stream and weak slope forming material excavated for construction of infrastructure and incessant rain fall aggravated the slide.
38	Remedial Measures	Removal of the debris and easing of the slope both flank.
39	Remarks	-
40	Summary	
41	Category	Category-III
42	Photos	2105-2110



1	Slide No.	KAR/UTK/48J/12/2018-19/25
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24374
6	Longitude	74.65508
7	Slide Name	Shree Maruthi residential school
8	NH / SH	Gersoppa interlink road
9	Length	10
10	Width	35
11	Height	8
12	Area	350
13	Depth	3
14	Volume	1050
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Jul-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Settlement
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Nil
37	Geo-Scientific Causes	Weak slope forming material and incessant rain fall.
38	Remedial Measures	Removal of the debris from the slide area and construction of retaining wall.
39	Remarks	Early constructed fencing wall damaged by the slide.
40	Summary	Weak slope forming material and incessant rain fall are the reason for this soil slide.
41	Category	Category-II
42	Photos	2111-2114



1	Slide No.	KAR/SMG/48J/12/2018-19/26
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.03113
6	Longitude	74.71364
7	Slide Name	Hirebail
8	NH / SH	Kokaru-Chingodu interlink road
9	Length	7
10	Width	12
11	Height	7
12	Area	84
13	Depth	0.5
14	Volume	42
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	-
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Cutting of slope for the road construction and local increment of pore water pressure during the incessant rainfall.
38	Remedial Measures	Removal of debris and construction of hill side drain. Easing of the slope.
39	Remarks	-
40	Summary	Cutting of slope for the road construction and local increment of pore water pressure during the incessant rainfall. Removal of debris and construction of hill side drain. Easing of the slope are suggested.
41	Category	Category-II
42	Photos	2274-2276



1	Slide No.	KAR/UTK/48J/12/2018-19/27
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.24808
6	Longitude	74.67205
7	Slide Name	Hulegar 3
8	NH / SH	NH-206
9	Length	10
10	Width	8
11	Height	7
12	Area	80
13	Depth	0.5
14	Volume	40
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Toe cut for the road construction and delighted weak slope forming material it leads to erosion in this area.
38	Remedial Measures	Precarious removal of up rooted trees and construction of toe drain.
39	Remarks	-
40	Summary	The soil slide occurred along the NH-206 near Hulegar village on 2017. The slide occurred due to cutting of the toe for road construction.
41	Category	Category-III
42	Photos	2277-2278



1	Slide No.	KAR/UTK/48J/12/2018-19/28
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.23075
6	Longitude	74.67117
7	Slide Name	Heggargadde
8	NH / SH	-
9	Length	8
10	Width	18
11	Height	8
12	Area	144
13	Depth	0.5
14	Volume	72
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Extensive slope cut coupled with steep slope highly weathered rock and weak slope forming material. Incessant rain fall may cause for the increase of the pore water pressure.
38	Remedial Measures	Construction of toe drain and easing of the slope. Applying geo-jute over the slide area.
39	Remarks	-
40	Summary	Thick, weak slope forming material losses its strength due to increase of the local pore pressure. Construction of toe drain and easing of the slope. Applying geo-jute over the slide area may be recommended for this slide
41	Category	Category-III
42	Photos	2282-2286



1	Slide No.	KAR/UTK/48J/12/2018-19/29
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.22955
6	Longitude	74.66907
7	Slide Name	Chaturmukha Basti
8	NH / SH	-
9	Length	35
10	Width	12
11	Height	30
12	Area	420
13	Depth	4
14	Volume	1680
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Extensive slope cut coupled with steep slope highly weathered rock weak slope forming material. Incessant rain fall may cause for the increase of the pore water pressure.
38	Remedial Measures	Construction of toe drain and easing of the slope. Applying geo-jute over the slide area. Easing of the slope by multiple benching.
39	Remarks	Above the slide material small bushes grown
40	Summary	The slide occurred on 2017. For constructing the village inter link road the toe disturbed and the presence of weak slope forming material delighted. Rain fall aggravated the landslide in this area. Construction of toe drain and easing of the slope. Applying geo-jute over the slide area. Easing of the slope by multiple benching are suggested for this slide.
41	Category	Category-II
42	Photos	2294-2297



1	Slide No.	KAR/UTK/48J/12/2018-19/30
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.2295
6	Longitude	74.66859
7	Slide Name	Chaturmukha Basti 1
8	NH / SH	-
9	Length	35
10	Width	15
11	Height	25
12	Area	525
13	Depth	3
14	Volume	1575
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Weak geological formation/highly weathered rock. Cutting of the toe for road benching. Over saturation of weak overburden material due to continuous rainfall and development of local hydrostatic pressure in the weak slope forming material which leads to failure of the slope.
38	Remedial Measures	Constructing of hill side drainage and proper maintenance. Easing of the slope by multiple benching and construction of retaining wall.
39	Remarks	-
40	Summary	Weak geological formation/highly weathered rock. Cutting of the toe for road benching. Over saturation of weak overburden material due to continuous rainfall and development of local hydrostatic pressure in the weak slope forming material which leads to failure of the slope. Constructing of hill side drainage and proper maintenance. Easing of the slope by multiple benching and construction of retaining wall.
41	Category	Category-II



1	Slide No.	KAR/UTK/48J/16/2018-19/31
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.23183
6	Longitude	74.81175
7	Slide Name	Jog fall PWD
8	NH / SH	-
9	Length	12
10	Width	45
11	Height	11
12	Area	540
13	Depth	1
14	Volume	540
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Cutting of toe for infrastructure and weak slope forming material incessant rain fall.
38	Remedial Measures	Removal of the debris form the slide and construction of retaining wall with sufficient height.
39	Remarks	Earlier constructed retaining wall not sufficient.
40	Summary	The soil slide occurred near to Jog PWD guest house. Cutting of toe for infrastructure and weak slope forming material incessant rain fall reason for this slide. Removal of the debris form the slide and construction of retaining wall with sufficient height are suggested.
41	Category	Category-II
42	Photos	2305-2311



1	Slide No.	KAR/SMG/48J/12/2018-19/32
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.08086
6	Longitude	74.74288
7	Slide Name	Kavati
8	NH / SH	Bhatkal-Kargal road
9	Length	8
10	Width	35
11	Height	7
12	Area	280
13	Depth	1
14	Volume	280
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak slope forming material cut by flowing of the stream and some amount of anthropogenic activity also play role to initiate the landslide.
38	Remedial Measures	Blocking of stream should be avoided.
39	Remarks	-
40	Summary	Weak slope forming material cut by flowing of the stream and some amount of anthropogenic activity also play role to initiate the landslide. Blocking of stream should be avoided.
41	Category	Category-III
42	Photos	2339-2345



1	Slide No.	KAR/SMG/48J/12/2018-19/33
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.08092
6	Longitude	74.74348
7	Slide Name	Kavati 1
8	NH / SH	Bhatkal-Kargal road
9	Length	12
10	Width	20
11	Height	10
12	Area	240
13	Depth	1
14	Volume	240
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak slope forming material cut by flowing of the stream and some amount of anthropogenic activity also play role to initiate the landslide.
38	Remedial Measures	Blocking of stream should be avoided and lining of the stream also suggested.
39	Remarks	-
40	Summary	Landslide occurred vicinity to the agricultural land and the slide aggravated due to rain fall and anthropogenic activity.
41	Category	Category-III
42	Photos	2350-2351



1	Slide No.	KAR/SMG/48J/12/2018-19/34
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.14339
6	Longitude	74.72223
7	Slide Name	Togachi
8	NH / SH	-
9	Length	35
10	Width	40
11	Height	25
12	Area	1400
13	Depth	5
14	Volume	7000
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive/widening
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2008
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Natural slope modified by cutting of the steep slope for plantation purpose presence of weak thick slope forming material delighed and it increase the surficial erosion during the rainfall.
38	Remedial Measures	Easing of the slope both the flank as well as crown portion and further modification of slope to be avoided at the adjoining area.
39	Remarks	Presently there is no any visible movement but in future it may reactivate due to incessant rainfall.
41	Summary	The slide occurred on 2018 and the natural slope modified for agricultural purpose by multiple benching. During the monsoon season the rainwater percolated in soil and it increased the pore pressure. Due to which the soil strength reduced and the material failed. Easing of the slope both the flank as well as crown portion and further modification of slope to be avoided at the adjoining area recommended to avoid the future land slide in this area.
42	Category	Category-II
43	Photos	2366-2374



1	Slide No.	KAR/SMG/48J/12/2018-19/35
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.13721
6	Longitude	74.70003
7	Slide Name	Bellur
8	NH / SH	Bilagar-Bellur interlink road
9	Length	10
10	Width	5
11	Height	8
12	Area	50
13	Depth	0.5
14	Volume	25
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Damp
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Poor slope forming material coupled with incessant rainfall.
38	Remedial Measures	Nil.
39	Remarks	-
40	Summary	-
41	Category	Category-III
42	Photos	2413-2420



1	Slide No.	KAR/SMG/48J/16/2018-19/36
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.00918
6	Longitude	74.78826
7	Slide Name	Hunagallu
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	12
10	Width	35
11	Height	10
12	Area	420
13	Depth	3
14	Volume	1260
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	very rapid
19	Activity	Suspended
20	Distribution	Retrogressive/widening
21	Style	Single
22	Failure Mechanism	shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Barren
37	Geo-Scientific Causes	Thick slope forming material coupled with incessant rainfall and toe cut by small stream.
38	Remedial Measures	Lining of stream to be done to reduce further toe cut by stream and diverting the surface runoff over the crown portion.
39	Remarks	-
41	Summary	Thick slope forming material coupled with incessant rainfall and toe cut by small stream. Lining of stream to be done to reduce further toe cut by stream and diverting the surface runoff over the crown portion.
41	Category	Category-III
42	Photos	2452-2459



1	Slide No.	KAR/SMG/48J/16/2018-19/37
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.02847
6	Longitude	74.77625
7	Slide Name	Kadakunda
8	NH / SH	Bakkod-Kadakunda interlink road
9	Length	15
10	Width	6
11	Height	12
12	Area	90
13	Depth	0.5
14	Volume	45
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Quartzite
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak geological formation highly weathered rock local improvement of pore pressure.
38	Remedial Measures	Modification of slope or construction of any infrastructure to be avoided towards the slide direction
39	Remarks	
40	Summary	
41	Category	Category-III
42	Photos	2470-2472



1	Slide No.	KAR/SMG/48J/16/2018-19/38
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.03633
6	Longitude	74.79513
7	Slide Name	Muchavalli
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	10
10	Width	6
11	Height	10
12	Area	60
13	Depth	1
14	Volume	60
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Quartzite
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak slope forming material and toe cut for road construction incessant rainfall may cause for the slide.
38	Remedial Measures	Lining of stream to be done to reduce further toe cut by stream. Precariously hanging tree to be removed easing of the slope.
39	Remarks	Above adjacent to the slide road was observed that should be shifted towards the hill side.
40	Summary	Landslide occurred June 2018. They are smaller dimension occurred due to incessant rainfall and toe cut by the flowing stream.
41	Category	Category-III
42	Photos	2478



1	Slide No.	KAR/SMG/48J/16/2018-19/39
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.00485
6	Longitude	74.81166
7	Slide Name	1Km SW of Arodi
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	12
10	Width	15
11	Height	8
12	Area	180
13	Depth	5
14	Volume	900
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive/widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	July-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Quartzite
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak slope forming material cut by flowing of the stream and incessant rainfall also cause for the landslide.
38	Remedial Measures	Removal of the debris and easing of the slope and lining of the stream.
39	Remarks	-
40	Summary	Weak slope forming material cut by flowing of the stream and incessant rainfall also cause for the landslide. Removal of the debris and easing of the slope and lining of the stream.
41	Category	Category-III
42	Photos	2516-2524



1	Slide No.	KAR/SMG/48J/16/2018-19/40
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.008
6	Longitude	74.81845
7	Slide Name	Arodi
8	NH / SH	Bakkod-Tumari interlink road
9	Length	13
10	Width	13
11	Height	12
12	Area	169
13	Depth	1
14	Volume	169
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Steep slope coupled with weak slope forming material and incessant rainfall. Toe cut by flowing stream.
38	Remedial Measures	Lining if the stream and removal of the debris and applying geo jute to reduce the soil erosion.
39	Remarks	-
40	Summary	Debris slide occurred due to Steep slope coupled with weak slope forming material and incessant rainfall. Toe cut by flowing stream. Lining if the stream and removal of the debris and applying geo jute to reduce the soil erosion.
41	Category	Category-III
42	Photos	2525-2526



1	Slide No.	KAR/SMG/48J/16/2018-19/41
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.01026
6	Longitude	74.81639
7	Slide Name	Belamakki
8	NH / SH	Bakkod-Tumari interlink road
9	Length	12
10	Width	20
11	Height	12
12	Area	240
13	Depth	1
14	Volume	240
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	-
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	weak slope forming material cut by flowing stream
38	Remedial Measures	Lining of the Stream.
39	Remarks	-
40	Summary	-
41	Category	Category-III
42	Photos	2529-2530



1851

1	Slide No.	KAR/SMG/48J/16/2018-19/42
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.02005
6	Longitude	74.83503
7	Slide Name	1Km NE of Kudarur
8	NH / SH	Bakkod-Tumari interlink road
9	Length	5
10	Width	8
11	Height	5
12	Area	40
13	Depth	3
14	Volume	120
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	--
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak geological formation incessant rain fall may cause increase of pore pressure
38	Remedial Measures	Removal of the debris.
39	Remarks	-
40	Summary	-
41	Category	Category-III
42	Photos	2542-2541



1	Slide No.	KAR/SMG/48J/16/2018-19/43
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.02385
6	Longitude	74.83025
7	Slide Name	Kunchi
8	NH / SH	Bakkod-Kunchi interlink road
9	Length	30
10	Width	40
11	Height	20
12	Area	1200
13	Depth	5
14	Volume	6000
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak geological formation steep slope coupled incessant rainfall local improvement of pore pressure and toe cut by flowing stream.
38	Remedial Measures	Easing of the slope and removal of the debris lining of the stream
39	Remarks	-
40	Summary	Debris slide occurred near to Kunchi village and the slide aggravated due to incessant rainfall and presence of poor slope forming material coupled with steep slope. Large volume of the debris material lying on the slope that should be removed.
41	Category	Category-II
42	Photos	2543-2553



1	Slide No.	KAR/SMG/48J/16/2018-19/44
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.01473
6	Longitude	74.83301
7	Slide Name	0.5Km E of Kudarur
8	NH / SH	Bakkod-Tumari interlink road
9	Length	45
10	Width	45
11	Height	40
12	Area	2025
13	Depth	5
14	Volume	10125
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Steep slope and weakly slope forming material local improvement of pore pressure. Toe cut by the stream.
38	Remedial Measures	Surface runoff to be diverted from the crown portion flowing stream to be lined to reduce the toe cut construction of any infrastructure to be avoided above the crown and both the flank of the slide.
39	Remarks	Above the crown one road was observed that road should be shifted to hill side.
40	Summary	Soil slide occurred near to 0.5Km E of Kudarur village and the slide aggravated due to incessant rainfall and presence of poor slope forming material coupled with steep slope. Large volume of the debris material lying on the slope that should be removed.
41	Category	Category-II
42	Photos	2581



1	Slide No.	KAR/SMG/48J/16/2018-19/45
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.04962
6	Longitude	74.80239
7	Slide Name	Kolegodu
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	7
10	Width	50
11	Height	4
12	Area	350
13	Depth	0.5
14	Volume	175
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Huge thickness of weak slope forming material failed due to cutting of the slope for road construction and the slide aggravated by incessant rainfall.
38	Remedial Measures	Debris and uprooted trees to be removed and increasing of the retaining wall and also construction of toe train and proper maintains.
39	Remarks	-
40	Summary	Soil slide occurred near to 0.5Km E of Kolegodu village and the slide aggravated due to incessant rainfall and presence of poor slope forming material coupled with steep slope. Debris and uprooted trees to be removed and increasing of the retaining wall and also construction of toe train and proper maintains.
41	Category	Category-III
42	Photos	2583-2587



1	Slide No.	KAR/SMG/48J/16/2018-19/46
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.05839
6	Longitude	74.8035
7	Slide Name	Kalur
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	8
10	Width	35
11	Height	8
12	Area	280
13	Depth	0.5
14	Volume	140
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Poor slope forming material failed due to toe cut by stream. Incessant rainfall also played a major role by increasing the pore pressure.
38	Remedial Measures	Stream to be lined to reduce the toe cut.
39	Remarks	-
40	Summary	Soil slide occurred near to Kalur village on 2016 and the slide aggravated due to incessant rainfall and presence of poor slope forming material coupled with steep slope.
41	Category	Category-III
42	Photos	2589-2591



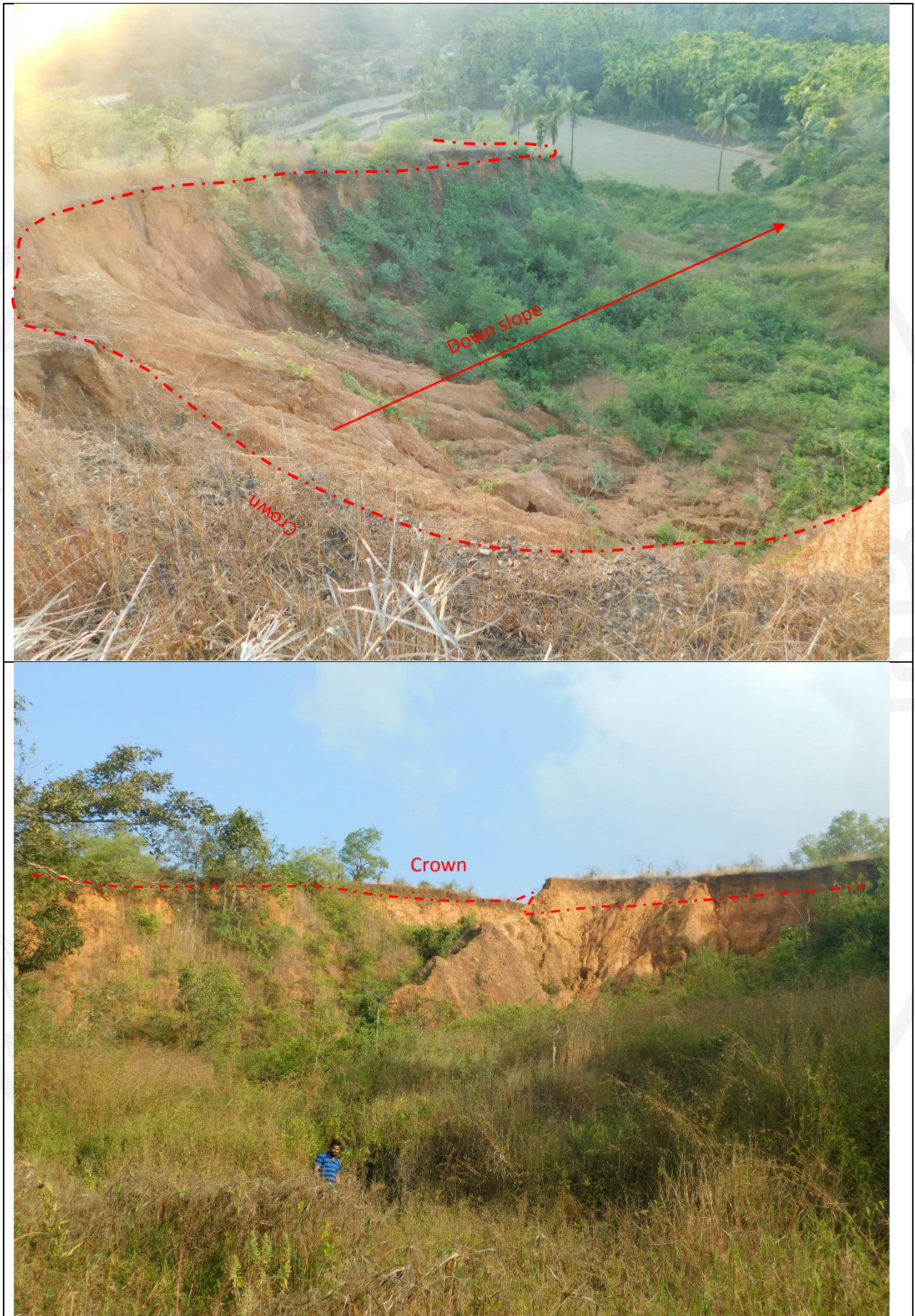
1	Slide No.	KAR/SMG/48J/16/2018-19/47
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.05935
6	Longitude	74.80565
7	Slide Name	Kalur 1
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	10
10	Width	25
11	Height	10
12	Area	250
13	Depth	1
14	Volume	250
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak slope forming material which is eroded by the stream coupled with incessant rainfall may leads to increase the pore pressure locally.
38	Remedial Measures	Stream to be lined to reduce the toe cut.
39	Remarks	-
40	Summary	Soil slide occurred near to Kalur village on june 2018 and the slide aggravated due to incessant rainfall and presence of poor slope forming material coupled with steep slope.
41	Category	Category-III
42	Photos	2593-2596



1	Slide No.	KAR/SMG/48J/16/2018-19/48
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.0625
6	Longitude	74.80858
7	Slide Name	Kalur 2
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	8
10	Width	20
11	Height	8
12	Area	160
13	Depth	0.5
14	Volume	80
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak slope forming material which is eroded by the stream coupled with incessant rainfall may leads to increase the pore pressure locally.
38	Remedial Measures	Stream to be lined to reduce the toe cut.
39	Remarks	-
40	Summary	Weak slope forming material which is eroded by the stream coupled with incessant rainfall may leads to increase the pore pressure locally. Stream to be lined to reduce the toe cut.
41	Category	Category-III
42	Photos	2599-2600



1	Slide No.	KAR/SMG/48J/16/2018-19/49
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.07704
6	Longitude	74.81173
7	Slide Name	Banukuli
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	12
10	Width	30
11	Height	10
12	Area	360
13	Depth	7
14	Volume	2520
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2011
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Barren
37	Geo-Scientific Causes	Steep slope with weak slope forming material and incessant rain fall may cause the increase of pore pressure and its leads to failure of the slope.
38	Remedial Measures	Divert the surface runoff around the slide area and easing of the slope from the crown as well as flank. Applying geo jute also helpful to reduce the soil erosion.
39	Remarks	-
40	Summary	Soil slide occurred near to Banukuli village and the length, width and height is 12, 30 and 10m respectively. This slide is deep translational slide. Steep slope with weak slope forming material and incessant rain fall may cause the increase of pore pressure and its leads to failure of the slope. Divert the surface runoff around the slide area and easing of the slope from the crown as well as flank. Applying geo jute also helpful to reduce the soil erosion.
41	Category	Category-II
42	Photos	2606-2610



1	Slide No.	KAR/SMG/48J/16/2018-19/50
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.07966
6	Longitude	74.81173
7	Slide Name	Banukuli 1
8	NH / SH	Bakkod-Banakuli interlink road
9	Length	13
10	Width	25
11	Height	12
12	Area	325
13	Depth	3
14	Volume	975
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Barren
37	Geo-Scientific Causes	Steep slope coupled with weak slope forming material and incessant rain fall may cause increase of local pore pressure.
38	Remedial Measures	Slide material to be removed and easing of the slope and construction of retaining wall flowing stream to be lined to reduce the toe erosion.
39	Remarks	Crown cracks and displacement observed and they are very persistent. Well-developed successive cracks are seen in the field.
40	Summary	Soil slide occurred near to Banukuli village. Steep slope coupled with weak slope forming material and incessant rain fall may cause increase of local pore pressure are main cause for the slide . Slide material to be removed and easing of the slope and construction of retaining wall flowing stream to be lined to reduce the toe erosion.
41	Category	Category-II
42	Photos	2611-2624



1	Slide No.	KAR/SMG/48J/16/2018-19/51
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.06531
6	Longitude	74.83234
7	Slide Name	0.8 KM NNw of Sulemakki
8	NH / SH	Murakki-Chadravalli interlink road
9	Length	7
10	Width	15
11	Height	5
12	Area	105
13	Depth	3
14	Volume	315
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Jun-18
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak slope forming material which is eroded by the stream coupled with incessant rainfall may leads to increase the pore pressure locally.
38	Remedial Measures	Stream to be lined to reduce the toe cut.
39	Remarks	-
40	Summary	Slide occurred 0.8 KM NNW of Sulemakki village and length and width, height of the slide is 7, 15 and 5 respectively the slide occurred due to presence of weak slope forming material which is eroded by the stream coupled with incessant rainfall may leads to increase the pore pressure locally.
41	Category	Category-III
42	Photos	2645-2650



1	Slide No.	KAR/UTK/48J/16/2018-19/52
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.23514
6	Longitude	74.81212
7	Slide Name	0.4Km N of Jog falls
8	NH / SH	NH-206
9	Length	10
10	Width	12
11	Height	10
12	Area	120
13	Depth	1
14	Volume	120
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Jun-18
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Weak slope forming material coupled with incessant rainfall may leads to increase the pore pressure locally. Toe cut for construction of road.
38	Remedial Measures	Slide material to be removed and construction of retaining wall to be done to avoid the further failure.
39	Remarks	-
40	Summary	Slide occurred 0.4Km N of Jog falls along the NH-206. Soil slide smaller in dimension and initiated due to Weak slope forming material coupled with incessant rainfall may leads to increase the pore pressure locally. Toe cut for construction of road. Slide material to be removed and construction of retaining wall to be done to avoid the further failure.
41	Category	Category-III
42	Photos	2670-2674



1	Slide No.	KAR/UTK/48J/16/2018-19/53
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.23474
6	Longitude	74.81252
7	Slide Name	0.3Km Jog falls
8	NH / SH	NH-206
9	Length	12
10	Width	20
11	Height	12
12	Area	240
13	Depth	1
14	Volume	240
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Weak slope forming material coupled with incessant rainfall may leads to increase the pore pressure locally. Toe cut for construction of road.
38	Remedial Measures	Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure.
39	Remarks	-
40	Summary	Slide occurred 0.3Km from the Jog falls along the NH-206. The slide aggravated due to disturbance of toe and incessant rainfall. Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure.
41	Category	Category-II
42	Photos	2675-2676



1	Slide No.	KAR/UTK/48J/16/2018-19/54
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.23293
6	Longitude	74.81301
7	Slide Name	0.3Km NE of Jog falls
8	NH / SH	NH-206
9	Length	5
10	Width	35
11	Height	5
12	Area	175
13	Depth	0.5
14	Volume	87.5
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive cut slope
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Toe cut for construction of road. Weak slope forming material coupled with incessant rainfall may leads to increase the pore pressure locally.
38	Remedial Measures	Removal of the debris. Precariously hanging tree to be removed.
39	Remarks	-
40	Summary	Soil slide occurred 0.3Km NE of Jog falls and the slide initiated due to cutting of the toe for road construction. The slide aggravated due to incessant rainfall and presence of weak slope forming material.
41	Category	Category-II
42	Photos	0001-0002



1	Slide No.	KAR/SMG/48J/16/2018-19/55
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.22913
6	Longitude	74.81625
7	Slide Name	0.6KM SE of jog falls
8	NH / SH	Jog -kargal road
9	Length	11
10	Width	20
11	Height	10
12	Area	220
13	Depth	1
14	Volume	220
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope highly weathered rock coupled with incessant rainfall may cause increment of local pore pressure and the toe disturbed for construction or extension of road.
38	Remedial Measures	Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure.
39	Remarks	-
40	Summary	Steep slope highly weathered rock coupled with incessant rainfall may cause increment of local pore pressure and the toe disturbed for construction or extension of road. Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure.
41	Category	Category-II
42	Photos	0003-0004



1	Slide No.	KAR/SMG/48J/16/2018-19/56
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.2287
6	Longitude	74.81571
7	Slide Name	0.6KM SE of jog falls 1
8	NH / SH	Jog -kargal road
9	Length	8
10	Width	15
11	Height	8
12	Area	120
13	Depth	0.5
14	Volume	60
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope highly weathered rock coupled with incessant rainfall may cause increment of local pore pressure and the toe disturbed for construction or extension of road.
38	Remedial Measures	Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure. Applying Geo-jute is effective methods to reduce the soil erosion.
39	Remarks	-
40	Summary	Soil slide occurred along the Jog-Kargal road around 0.6KM SE of jog falls. Steep slope highly weathered rock coupled with incessant rainfall may cause increment of local pore pressure and the toe disturbed for construction or extension of road. Slide material and uprooted trees to be removed and construction of retaining wall to be done to avoid the further failure. Applying Geo-jute is effective methods to reduce the soil erosion.
41	Category	Category-III
42	Photos	0005-0006



1	Slide No.	KAR/SMG/48J/16/2018-19/57
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.22833
6	Longitude	74.81463
7	Slide Name	0.6KM SE of jog falls 2
8	NH / SH	Jog -Kargal road
9	Length	12
10	Width	25
11	Height	10
12	Area	300
13	Depth	1
14	Volume	300
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	-
24	Year Reactivation	
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Presence of soft clay material and steep slope are the predisposing factors. Incessant rainfall and toe cut for road widening are the triggering factor for the slide
38	Remedial Measures	Removal of the debris and easing of slope by benching and construction of retaining wall with sufficient weep holes and proper maintenance may reduce the slope failure.
39	Remarks	-
40	Summary	Soil slide occurred along the jog-Kargal road around 0.6KM SE of jog falls. Length, width and height of the slide is 12, 25 and 10 m respectively. Presence of soft clay material and steep slope are the predisposing factors. Incessant rainfall and toe cut for road widening are the triggering factor for the slide. Removal of the debris and easing of slope by benching and construction of retaining wall with sufficient weep holes and proper maintenance may reduce the slope failure.
41	Category	Category-III
42	Photos	0007-0009



1	Slide No.	KAR/SMG/48J/16/2018-19/58
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.19444
6	Longitude	74.80167
7	Slide Name	Iragi
8	NH / SH	Kargal-Mallakki road
9	Length	10
10	Width	22
11	Height	8
12	Area	220
13	Depth	1
14	Volume	220
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope and toe cut for the road construction are the main factors to initiate the landslide. Incessant rainfall aggravated the slide.
38	Remedial Measures	Construction of gabion retaining wall and toe drain.
39	Remarks	-
40	Summary	Slide occurred near to Iragi village. Steep slope and toe cut for the road construction are the main factors to initiate the landslide. Incessant rainfall aggravated the slide. Construction of gabion retaining wall and toe drain.
41	Category	Category-III
42	Photos	0084-0092



1	Slide No.	KAR/SMG/48J/16/2018-19/59
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.21053
6	Longitude	74.83936
7	Slide Name	Kantota
8	NH / SH	Korkodu-Kontota link road
9	Length	10
10	Width	20
11	Height	8
12	Area	200
13	Depth	1
14	Volume	200
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope modified by cutting of the toe for the road construction and presence of delighted thick overburden material eroded by incessant rainfall and infiltration of excess of water in the soil the soil losses its strength by increasing pore water pressure
38	Remedial Measures	Construction of retaining wall or boulder gabion wall. Applying geo-jute to reduce the soil erosion
39	Remarks	-
40	Summary	Soil Slide occurred near to Kantota village. To make the village interlink road the toe cut has been done. Toe cut coupled with incessant rainfall and presence of weak slope forming material leads to fail the slope. Construction of retaining wall or boulder gabion wall. Applying geo-jute to reduce the soil erosion
41	Category	Category-III
42	Photos	0115-0119



1	Slide No.	KAR/SMG/48J/16/2018-19/60
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.21969
6	Longitude	74.83354
7	Slide Name	Padambail
8	NH / SH	Korkodu-Kontota link road
9	Length	12
10	Width	35
11	Height	8
12	Area	420
13	Depth	3
14	Volume	1260
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Presence of clayey soil and incessant rain fall cause for the landslide.
38	Remedial Measures	Removal of the debris easing of the slope and construction of retaining wall.
39	Remarks	-
40	Summary	Slide occurred near to Padambail village and the soil slide happened due to presence of clayey soil and incessant rain fall cause for the landslide. Removal of the debris easing of the slope and construction of retaining wall.
41	Category	Category-II
42	Photos	0125-0126



1	Slide No.	KAR/SMG/48J/16/2018-19/61
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.21941
6	Longitude	74.83075
7	Slide Name	Padambail 1
8	NH / SH	Korkodu-Kontota link road
9	Length	35
10	Width	50
11	Height	20
12	Area	1750
13	Depth	8
14	Volume	14000
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	Aug-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Thick regolith thickness coupled with steep slope incessant rainfall and toe cut by the small stream.
38	Remedial Measures	Easing of slope and removal debris and channelizing of the stream applying Geo-jute to reduce the surface erosion by rainfall. Uprooted trees to be removed.
39	Remarks	-
40	Summary	Soil slide occurred near to Padambail village and the soil slide happened due to presence of clayey soil and incessant rain fall cause for the landslide. Easing of slope and removal debris and channelizing of the stream applying Geo-jute to reduce the surface erosion by rainfall. Uprooted trees to be removed.
41	Category	Category-II
42	Photos	0127-0141



1	Slide No.	KAR/SMG/48J/16/2018-19/62
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.20681
6	Longitude	74.84167
7	Slide Name	Korkodu
8	NH / SH	Korkodu-Kontota link road
9	Length	25
10	Width	50
11	Height	20
12	Area	1250
13	Depth	3
14	Volume	3750
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2014
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Barren
37	Geo-Scientific Causes	Slope forming material having a regolith thickness of 18-20m and incessant rain fall may cause improvement of pore pressure steep slope and toe cut by the stream during the rainfall.
38	Remedial Measures	Easing of slope construction of hill side drain and proper maintains.
39	Remarks	Above the crown observed presence of Power line. Over the slide material rill erosion observed
40	Summary	Debris slide occurred near to Korkodu village. The length width and height of the slide is 25, 50 and 20m respectively. Slope forming material having a regolith thickness of 18-20m and incessant rain fall may cause improvement of pore pressure steep slope and toe cut by the stream during the rainfall. Easing of slope construction of hill side drain and proper maintains
41	Category	Category-II
42	Photos	0205-0207



1	Slide No.	KAR/SMG/48J/16/2018-19/63
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.20687
6	Longitude	74.84118
7	Slide Name	Korkodu
8	NH / SH	Korkodu-Kontota link road
9	Length	15
10	Width	35
11	Height	13
12	Area	525
13	Depth	2
14	Volume	1050
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2014
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall/anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Barren
37	Geo-Scientific Causes	Toe cut by stream in clayey soil slope forming material having a regolith thickness of 12m and incessant rain fall may cause improvement of pore pressure steep slope and toe cut by the stream during the rainfall.
38	Remedial Measures	Easing of slope construction of hill side drain and proper maintains.
39	Remarks	-
40	Summary	Soil slide occurred near to Korkodu village. The length width and height of the slide is 15, 35 and 13m respectively. Slope forming material having a regolith thickness of 18-20m and incessant rain fall may cause improvement of pore pressure steep slope and toe cut by the stream during the rainfall. Easing of slope construction of hill side drain and proper maintains
41	Category	Category-III
42	Photos	0208-0210



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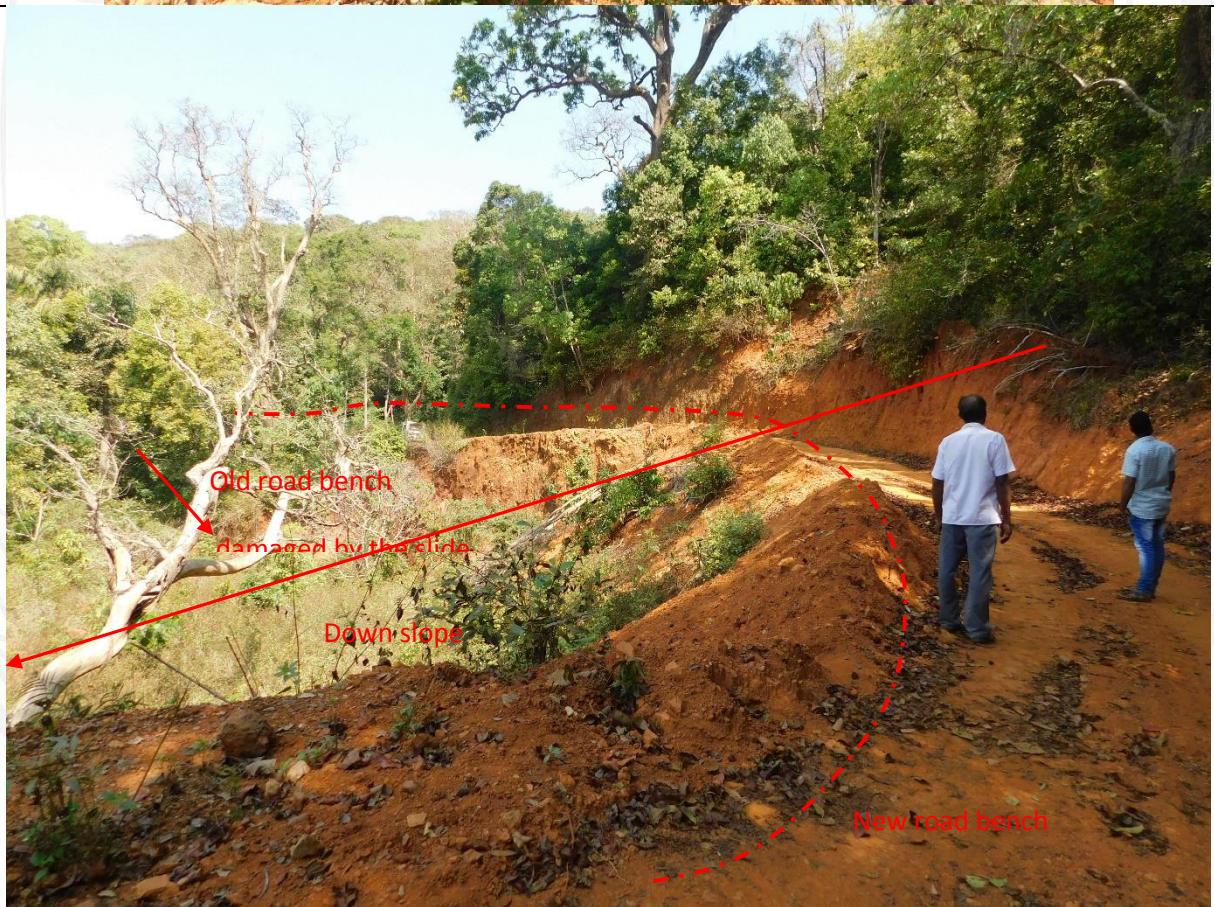
1	Slide No.	KAR/SMG/48J/16/2018-19/64
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.20628
6	Longitude	74.84504
7	Slide Name	Honnegodu
8	NH / SH	Korkodu-Kontota link road
9	Length	35
10	Width	40
11	Height	30
12	Area	1400
13	Depth	8
14	Volume	11200
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2010
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Weak slope forming material and huge regolith thickness continuous rainfall may increase the poor water pressure in the soil
38	Remedial Measures	Removal of soil from the slide area and easing of the slope channelizing of the stream. Divert the surface runoff from the crown portion.
39	Remarks	-
40	Summary	Soil slide occurred near to Honnegodu village. The length width and height of the slide is 35, 40 and 30m respectively. Weak slope forming material and huge regolith thickness continuous rainfall may increase the poor water pressure in the soil. Removal of soil from the slide area and easing of the slope channelizing of the stream.
41	Category	Category-III
42	Photos	0213-0214



1	Slide No.	KAR/SMG/48J/16/2018-19/65
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.17545
6	Longitude	74.81556
7	Slide Name	0.7Km NNW of Linganamakki colony
8	NH / SH	Jog-Kargal road
9	Length	8
10	Width	45
11	Height	8
12	Area	360
13	Depth	0.5
14	Volume	180
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Toe disturbed for extension of road presence of weak slope forming material and incessant rain fall aggravated the slide.
38	Remedial Measures	Applying Geo-Jute may reduce the soil erosion.
39	Remarks	-
40	Summary	Slide occurred near to 0.7Km NNW of Linganamakki colony along the Jog-Kargal road. Toe disturbed for extension of road presence of weak slope forming material and incessant rain fall aggravated the slide. Applying Geo-Jute may reduce the soil erosion.
41	Category	Category-III
42	Photos	0260-0262



1	Slide No.	KAR/SMG/48J/16/2018-19/66
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.14719
6	Longitude	74.79114
7	Slide Name	Aravadi
8	NH / SH	Aravadi-Hukklu inter link road
9	Length	40
10	Width	40
11	Height	25
12	Area	1600
13	Depth	6
14	Volume	9600
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Vertical toe cut for the road construction and poor slope forming material continuous rainfall may cause for the increase of the pore pressure.
38	Remedial Measures	Slide material to be removed and easing of the slope. Surface water flow to be diverted or toe drain to be constructed to avoid the infiltration of rainwater in the slide area. Easing of the crown portion and removal of the trees over the crown portion.
39	Remarks	Earlier road and retaining wall damaged by the slide
40	Summary	Slide occurred near to Aravadi village. The length width and height of the slide is 40, 40 and 25m respectively. Vertical toe cut for the road construction and poor slope forming material continuous rainfall may cause for the increase of the pore pressure. Slide material to be removed and easing of the slope. Surface water flow to be diverted or toe drain to be constructed to avoid the infiltration of rainwater in the slide area. Easing of the crown portion and removal of the trees over the crown portion.
41	Category	Category-II



1	Slide No.	KAR/SMG/48J/16/2018-19/67
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.16557
6	Longitude	74.81863
7	Slide Name	0.62Km NNW of Talaguni
8	NH / SH	Jog-Kargal road
9	Length	10
10	Width	30
11	Height	10
12	Area	300
13	Depth	1
14	Volume	300
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	inactive
20	Distribution	Confined
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall/anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Vertical toe cut for the road construction and presence of steep slope with weak slope forming material. Incessant rainfall aggravated the slide.
38	Remedial Measures	Removal of the debris from the slide area and construction of retaining wall or easing of the slope.
39	Remarks	-
40	Summary	The debris slide happened along the Jog-Kargal road section. The dimension of the slide 10 m length, 30 width and 10m height. The slide happened due to vertical toe cut for the road construction and presence of steep slope with weak slope forming material. Incessant rainfall aggravated the slide.
41	Category	Category-III
42	Photos	0332-0334



1	Slide No.	KAR/UTK/48J/16/2018-19/68
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.2316
6	Longitude	74.82804
7	Slide Name	Jogin Math
8	NH / SH	NH-206
9	Length	10
10	Width	25
11	Height	8
12	Area	250
13	Depth	1
14	Volume	250
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Poor slope forming material and toe cut for the road construction incessant rainfall may cause for the landslide.
38	Remedial Measures	Slide material to be removed. construction of retaining wall and proper drainage maintenance
39	Remarks	-
40	Summary	The debris slide happened along the Jog-Kargal road section. The dimension of the slide 10 m length, 25width and 8m height. The slide happened due to Poor slope forming material and toe cut for the road construction incessant rainfall may cause for the landslide.
41	Category	Category-III
42	Photos	0339-0346



1	Slide No.	KAR/UTK/48J/16/2018-19/69
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/16
5	Latitude	14.21717
6	Longitude	74.85947
7	Slide Name	Kalgar
8	NH / SH	Talguppa-Kalgar interlink road
9	Length	12
10	Width	30
11	Height	10
12	Area	360
13	Depth	2
14	Volume	720
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	20th June 2018
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Grewacke-argillite
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Cutting of the slope for the settlement construction without any protection and presence of very soft thick slope forming material and incessant rainfall.
38	Remedial Measures	Easing of the slope and construction of retaining wall to be done to avoid any further slope moment in this area.
39	Remarks	-
40	Summary	The debris slide found near to Kalgar village. The dimension of the slide is 12 m length, 30 width and 10m height. The slide initiated vicinity to the settlement and the initiation due to cutting of the slope for the settlement construction without any protection and presence of very soft thick slope forming material and incessant rainfall.
41	Category	Category-II
42	Photos	0367-0362



1	Slide No.	KAR/SMGK/48J/16/2018-19/70
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.02333
6	Longitude	74.85313
7	Slide Name	1Km NE of Basti
8	NH / SH	Tumari-Bakkod inter link road
9	Length	45
10	Width	50
11	Height	20
12	Area	2250
13	Depth	7
14	Volume	15750
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	anthropogenic
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Thick slope forming material coupled with incessant rainfall may cause for the slide.
38	Remedial Measures	Slide material to be removed and easing of the slope or planting of suitable grass or Geo jute may reduce the further soil erosion. Surface runoff to be diverted over the crown portion.
39	Remarks	-
40	Summary	The soil slide occurred in and around 1Km NE of Basti and the dimension of the slide is 45 m length, 50 width and 20m height. The slide initiated due to thick slope forming material coupled with incessant rainfall may cause for the slide.
41	Category	Category-III
42	Photos	0509-0527





1	Slide No.	KAR/SMG/48J/16/2018-19/71
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.00284
6	Longitude	74.87495
7	Slide Name	Bramanakeppige
8	NH / SH	Tumari-Bramanakeppige interlink road
9	Length	12
10	Width	55
11	Height	11
12	Area	660
13	Depth	2
14	Volume	1320
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	moderate
19	Activity	Suspended
20	Distribution	retrogressive/widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-2018
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Meta-Rhyolite
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Presence of clayey soft slope forming material and incessant rainfall cause for this landslide.
38	Remedial Measures	All along the stream boulder gabion to be constructed or lining of stream to be done. Easing of the slope to be done and suitable plantation to be planted in the slide area.
39	Remarks	Rill erosion observed over the presence of soft clayey materials.
40	Summary	The soil slide occurred in and around Bramanakeppige and the dimension of the slide is 12 m length, 55 width and 11 m height. The slide initiated due to presence of clayey soft slope forming material and incessant rainfall cause for this landslide.
41	Category	Category-II
42	Photos	0532-0555



1	Slide No.	KAR/SMG/48J/16/2018-19/72
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.00114
6	Longitude	74.87667
7	Slide Name	Bramanakeppige 1
8	NH / SH	Tumari-Bramanakeppige interlink road
9	Length	30
10	Width	80
11	Height	27
12	Area	2400
13	Depth	10
14	Volume	24000
15	Run Out Distance	-
16	Material Type	soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	reactivated
20	Distribution	retrogressive
21	Style	multiple
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2009
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Meta-Rhyolite
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Presence of weak slope forming material with huge thickness of overburden. Incessant rainfall aggravated the landslide by increasing of the local pore pressure.
38	Remedial Measures	Slide material to be removed and easing of the slope to be done. Surface runoff to be diverted from the crown portion to avoid the infiltration of rain water.
39	Remarks	-
40	Summary	The soil slide occurred in and around Bramanakeppige and the dimension of the slide is 30 m length, 80 width and 27 m height. Geo scientific cause for the slide is presence of weak slope forming material with huge thickness of overburden. Incessant rainfall aggravated the landslide by increasing of the local pore pressure.
41	Category	Category-II
42	Photos	0556-0565





1	Slide No.	KAR/SMG/48J/16/2018-19/73
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.01326
6	Longitude	74.86913
7	Slide Name	Honnagodu
8	NH / SH	Tumari-Honnagodu interlink road
9	Length	30
10	Width	25
11	Height	28
12	Area	750
13	Depth	2
14	Volume	1500
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	reactivated
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2009
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Meta-Rhyolite
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Presence of weak slope forming material with huge thickness of overburden cut by flowing stream. Incessant rainfall aggravated the landslide by increasing of the local pore pressure.
38	Remedial Measures	Easing of the slope and flowing stream to be lined.
39	Remarks	-
40	Summary	The slide occurred near Honnagodu village on 2009 due to presence of weak slope forming material with huge thickness of overburden cut by flowing stream. Incessant rainfall aggravated the landslide by increasing of the local pore pressure.
41	Category	Category-III
42	Photos	0583-0591



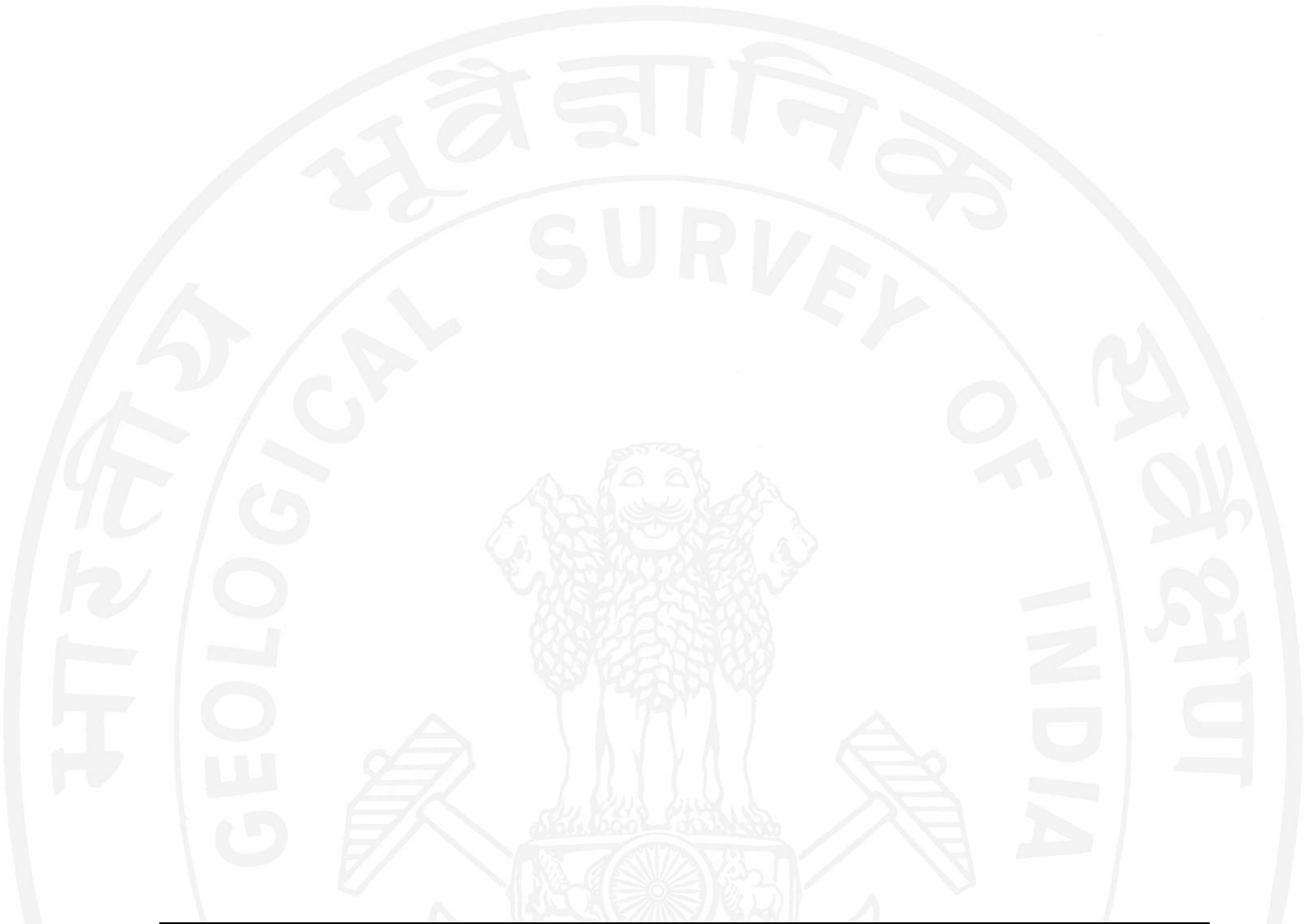
1	Slide No.	KAR/SMG/48J/16/2018-19/74
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.01259
6	Longitude	74.86666
7	Slide Name	Honnagodu 1
8	NH / SH	Tumari-Honnagodu interlink road
9	Length	120
10	Width	65
11	Height	100
12	Area	7800
13	Depth	8
14	Volume	62400
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	reactivated
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2003
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Meta-Rhyolite
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope presence of weak slope forming material having huge thickness of soil. The slide aggravated by incessant rain fall.
38	Remedial Measures	Removal of the debris from the slide area and easing of the slope by multiple benching. Toe drain to be constructed and maintenance to be done properly.
39	Remarks	-
40	Summary	The slide occurred near Honnagodu village on 2003 due to presence of weak slope forming material with huge thickness of overburden cut by flowing stream. Incessant rainfall aggravated the landslide by increasing of the local pore pressure.
41	Category	Category-III
42	Photos	0593, 0620-0621





1	Slide No.	KAR/SMG/48J/16/2018-19/75
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.05247
6	Longitude	74.86016
7	Slide Name	Samase
8	NH / SH	Tumari-Kalasavalli inter link road
9	Length	9
10	Width	30
11	Height	8
12	Area	270
13	Depth	1
14	Volume	270
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive/widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Thick overburden toe cut for road construction and incessant main cause for the slide.
38	Remedial Measures	Retaining wall with sufficient weep holes to be provided to avoid further slide in the area.
39	Remarks	-
40	Summary	The slide documented near to Samase village. The dimension of the slide is 9 m length, 30 width and 8 m height. Geo scientific cause for the slide is presence of thick overburden toe cut for road construction and incessant main cause for the slide.
41	Category	Category-III
42	Photos	0650-0654





1	Slide No.	KAR/SMG/48J/16/2018-19/76
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.04991
6	Longitude	74.85391
7	Slide Name	0.3Km SW of Samase
8	NH / SH	Tumari-Kalasavalli inter link road
9	Length	20
10	Width	18
11	Height	40
12	Area	360
13	Depth	3
14	Volume	1080
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive

21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2016
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	dry
30	Triggering Intensity	anthropogenic/rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Thick overburden material and toe cut by the stream vibration of the vehicle and incessant rainfall major cause for the landslide.
38	Remedial Measures	Stream to be lined and easing of the slope to be done to avoid.
39	Remarks	Earlier road situated vicinity to the slide. At present the road shifted towards hillside.
40	Summary	The slide documented near to 0.3Km SW of Samase village. The dimension of the slide is 20 m length, 18 width and 40 m height. Geo scientific cause for the slide is presence of thick overburden toe cut for road construction and incessant main cause for the slide.
41	Category	Category-III
42	Photos	0655-0662



1	Slide No.	KAR/SMG/48J/16/2018-19/77
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.07376
6	Longitude	74.82168
7	Slide Name	Kandavalli
8	NH / SH	Tumari-Banukulli inter link road
9	Length	25
10	Width	120
11	Height	18
12	Area	3000
13	Depth	6
14	Volume	18000
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	moderate
19	Activity	reactivated
20	Distribution	Widening
21	Style	Multiple
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2018
24	Year Reactivation	-
25	Geomorphology	Moderately dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Extensive slope cut
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Presence of thick over burden material losses its strength by increasing local pore water pressure due to incessant rainfall and toe cut by flowing stream.
38	Remedial Measures	Stream to be lined to reduce the toe cut.
39	Remarks	Presently there is any visible movement.
40	Summary	The slide documented near to Kandavalli village. The dimension of the slide is 25 m length, 120 m width and 18 m height. Geo scientific cause for the slide is presence of thick over burden material losses its strength by increasing local pore water pressure due to incessant rainfall and toe cut by flowing stream.
41	Category	Category-III
42	Photos	0681-0691





1	Slide No.	KAR/SMG/48J/16/2018-19/78
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.11942
6	Longitude	74.98636
7	Slide Name	Vaddahalli
8	NH / SH	Karkikoppa-Naduvaddahalli inter link road
9	Length	30
10	Width	45
11	Height	28
12	Area	1350
13	Depth	8
14	Volume	10800
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive/widening
21	Style	single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2017
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite-schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Steep slope coupled with incessant rainfall and toe cutting by stream and weak slope forming material.
38	Remedial Measures	Slide materials to be removed and lining of the stream to be done. Soil nailing to be carried to protect the road which located above the crown portion.
39	Remarks	-
40	Summary	The slide documented near to Vaddahalli village. The dimension of the slide is 30 m length, 45 m width and 28 m height. Geo scientific cause for the slide is presence of Steep slope coupled with incessant rainfall and toe cutting by stream and weak slope forming material.
41	Category	Category-II
42	Photos	0785-0793





1	Slide No.	KAR/SMG/48J/16/2018-19/79
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.11274
6	Longitude	74.98033
7	Slide Name	Naduvaddahalli
8	NH / SH	Karkikoppa-Naduvaddahalli inter link road
9	Length	20
10	Width	45
11	Height	18
12	Area	360
13	Depth	3
14	Volume	1080
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2004
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Weak slope forming material (clayey soil) coupled with incessant rainfall may cause for the local increase of pore water pressure leads to failure of the slope. Due to incessant rainfall excess water in the stream which leads to toe cut.
38	Remedial Measures	Lining of the stream to be carried and loose debris to be removed from the slide area.
39	Remarks	Over the slide material vegetation growth observed and the slide are retrogressive in nature. At places fresh scars observed.
40	Summary	The slide documented near to Naduvaddahalli village. The dimension of the slide is 20 m length, 45 m width and 18 m height. Geo scientific cause for the slide is weak slope forming material (clayey soil) coupled with incessant rainfall may cause for the local increase of pore water pressure leads to failure of the slope. Due to incessant rainfall excess water in the stream which leads to toe cut.
41	Category	Category-III
42	Photos	798





1	Slide No.	KAR/SMG/48J/16/2018-19/80
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.12037
6	Longitude	74.97187
7	Slide Name	Ramanagadde
8	NH / SH	Tumbe-Ramanagadde inter link road
9	Length	10
10	Width	40
11	Height	10
12	Area	400
13	Depth	3
14	Volume	1200
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	moderate
19	Activity	dormant
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2000
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Weak slope forming material coupled with incessant rainfall may cause for the local increase of pore water pressure leads to failure of the slope. Due to incessant rainfall excess water in the stream which leads to toe cut.
38	Remedial Measures	Removal of the debris from the slide area and easing of slope Lining of the stream will reduce the toe cut.
39	Remarks	-
40	Summary	The slide documented near to Ramanagadde village. The dimension of the slide is 10 m length, 40 m width and 10 m height. Geo scientific cause for the slide is weak slope forming material coupled with incessant rainfall may cause for the local increase of pore water pressure leads to failure of the slope. Due to incessant rainfall excess water in the stream which leads to toe cut.
41	Category	Category-III
42	Photos	0804-0809



1	Slide No.	KAR/SMG/48J/16/2018-19/81
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.12743
6	Longitude	74.97097
7	Slide Name	Tumbe
8	NH / SH	Tumbe-Ramanagadde inter link road
9	Length	20
10	Width	50
11	Height	15
12	Area	1000
13	Depth	2
14	Volume	2000
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-18
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Incessant rainfall coupled with thick overburden material over the slope and toe cut by the flowing stream Steep slope also one of the reason for the slide.
38	Remedial Measures	Reduce the slope angle by benching and flowing stream to be lined to reduce the toe erosion
39	Remarks	-
40	Summary	The slide documented near to Tumbe village. The dimension of the slide is 20 m length, 50 m width and 15 m height. Incessant rainfall coupled with thick overburden material over the slope and toe cut by the flowing stream Steep slope also one of the reason for the slide.
41	Category	Category-III
42	Photos	0846-0833



1	Slide No.	KAR/SMG/48J/16/2018-19/82
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.12037
6	Longitude	74.9734
7	Slide Name	Ramanagadde 1
8	NH / SH	Tumbe-Ramanagadde inter link road
9	Length	20
10	Width	45
11	Height	18
12	Area	900
13	Depth	5
14	Volume	4500
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	reactivated
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2004
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope and weak slope forming material (soft clay) coupled with incessant rainfall may leads to increase the hydrostatic pressure locally. Excess rainwater in the stream which cut the toe and it leads to failure of the slope.
38	Remedial Measures	Reduce the slope angle by benching to avoid further slide in this area. Removal of the debris and channelizing of the stream also recommended to avoid the future slide.
39	Remarks	Last 10years back the slide has initiated after that the slide reactivated every year during the rainfall.
40	Summary	The slide documented near to Ramanagadde village. The dimension of the slide is 20 m length, 45 m width and 18 m height. Steep slope and weak slope forming material (soft clay) coupled with incessant rainfall may leads to increase the hydrostatic pressure locally. Excess rainwater in the stream which cut the toe and it leads to failure of the slope.
41	Category	Category-II
42	Photos	0860-0878





1	Slide No.	KAR/SMG/48J/16/2018-19/83
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.12783
6	Longitude	74.96116
7	Slide Name	Marakatte
8	NH / SH	Karikikoppa-Kerehalli interlink road
9	Length	25
10	Width	35
11	Height	15
12	Area	875
13	Depth	5
14	Volume	4375
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Widening
21	Style	Single
22	Failure Mechanism	Deep Translational Failure
23	Year of Occurrence	2012
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	-
37	Geo-Scientific Causes	Steep slope and weak slope forming material (soft clay) coupled with incessant rainfall may leads to increase the hydrostatic pressure locally. Excess rainwater in the stream which cut the toe and it leads to failure of the slope.
38	Remedial Measures	Reduce the slope angle by benching to avoid further slide in this area. Removal of the debris and channelizing of the stream also recommended to avoid the future slide. Plantation of the suitable grass or geo-jute technique also can be applied.
39	Remarks	-
40	Summary	The slide documented near to Marakatte village. The dimension of the slide is 25 m length, 35 m width and 15 m height. Steep slope and weak slope forming material (soft clay) coupled with incessant rainfall may leads to increase the hydrostatic pressure locally. Excess rainwater in the stream which cut the toe and it leads to failure of the slope.
41	Category	Category-II





1	Slide No.	KAR/SMG/48J/16/2018-19/84
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.12872
6	Longitude	74.96366
7	Slide Name	0.4Km NNE of Marakatte
8	NH / SH	-
9	Length	12
10	Width	8
11	Height	25
12	Area	96
13	Depth	4
14	Volume	384
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	-
24	Year Reactivation	-
25	Geomorphology	Lowly dissected slope
26	Geology	Chlorite schist
27	Structure	-
28	LULC	Moderate vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Poor slope forming material and incessant rainfall.
38	Remedial Measures	Divert the surface runoff from the slide area.
39	Remarks	-
40	Summary	The slide documented near to 0.4Km NNE of Marakatte village. The dimension of the slide is 15 m length, 08 m width and 25 m height. Poor slope forming material and incessant rainfall.
41	Category	Category-III
42	Photos	0908-0909





1	Slide No.	KAR/SMG/48J/16/2018-19/85
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/16
5	Latitude	14.114
6	Longitude	74.97643
7	Slide Name	Naduvaddahalli
8	NH / SH	Karkikoppa-Sidebail inter link road
9	Length	8
10	Width	25
11	Height	8
12	Area	200
13	Depth	3
14	Volume	600
15	Run Out Distance	-
16	Material Type	Soil
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	retrogressive
21	Style	single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	June-18
24	Year Reactivation	-
25	Geomorphology	Rolling plain
26	Geology	Granite Gneiss
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Agriculture
37	Geo-Scientific Causes	Thick overburden coupled with incessant rainfall may increase the pore pressure and subsequently the soil losses the strength. Toe cut by flowing stream.
38	Remedial Measures	Easing of the slope and channelizing of the stream to be suggested to avoid to further slide in this area.
39	Remarks	-
40	Summary	The slide documented near to Naduvaddahalli village. The dimension of the slide is 08 m length, 25 m width and 08m height. Thick overburden coupled with incessant rainfall may increase the pore pressure and subsequently the soil losses the strength. Toe cut by flowing stream.
41	Category	Category-III
42	Photos	0926-0936



1851

1	Slide No.	KAR/UTK/48J/12/2018-19/86
2	State	Karnataka
3	District	Uttar Kannada
4	Toposheet	48J/12
5	Latitude	14.17003
6	Longitude	74.71387
7	Slide Name	1.2Km Surimane
8	NH / SH	Nagarbastikere-Surimane interlink road
9	Length	400
10	Width	100
11	Height	350
12	Area	40000
13	Depth	3
14	Volume	120000
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	slide
18	Rate Of Movement	Very rapid
19	Activity	Suspended
20	Distribution	Relict
21	Style	confined
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	Unknown
24	Year Reactivation	-
25	Geomorphology	Highly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Sparse vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	Rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope and incessant rainfall may leads to failure of the slope
38	Remedial Measures	Divert the surface runoff from the slide area.
39	Remarks	The slide occurred near to the Surimane village, slide generated on the natural slope. In the field the slide unable to validate due to presence thick vegetation growth.
40	Summary	The slide occurred near to 1.2Km Surimane village.
41	Category	III
42	Photos	-



1	Slide No.	KAR/SMG/48J/12/2018-19/87
2	State	Karnataka
3	District	Shimoga
4	Toposheet	48J/12
5	Latitude	14.17341
6	Longitude	74.73438
7	Slide Name	1.04Km NE of Geripal
8	NH / SH	Nagarbastikere-Surimane interlink road
9	Length	240
10	Width	50
11	Height	150
12	Area	12000
13	Depth	3
14	Volume	36000
15	Run Out Distance	-
16	Material Type	Debris
17	Movement Type	Slide
18	Rate Of Movement	Very rapid
19	Activity	suspended
20	Distribution	retrogressive
21	Style	Single
22	Failure Mechanism	Shallow Translational Failure
23	Year of Occurrence	2011
24	Year Reactivation	-
25	Geomorphology	Highly dissected slope
26	Geology	Hornblende-actinolite-chlorite schist
27	Structure	-
28	LULC	Thick vegetation
29	Hydrological Condition	Dry
30	Triggering Intensity	rainfall
31	Persons Death	Nil
32	People Affected	Nil
33	Live Stock Loss	Nil
34	Communication	Nil
35	Infrastructure	Nil
36	Agriculture/Forest/Barren	Forest
37	Geo-Scientific Causes	Steep slope and incessant rainfall may leads to failure of the slope
38	Remedial Measures	Divert the surface runoff from the slide area.
39	Remarks	The slide occurred near to the Geripal village, slide generated on the natural slope. In the field the slide unable to validate due to presence thick vegetation growth.
40	Summary	The slide occurred near to the Geripal village and the dimension of the slide is 240 m length, 50 m width and 150 m height.
41	Category	II
42	Photos	-

Annexure-III.

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 10: Slope angle classes with LOFS rating

I. Pair-wise comparison matrix of Slope Angle classes

Slope Angle	<15°	15-25°	25°-35°	35°-45°	>45°
<15°	1.00	0.33	0.14	0.20	1.00
15°-25°	3.00	1.00	0.20	0.33	3.00
25°-35°	7.00	5.00	1.00	3.00	7.00
35°-45°	5.00	3.00	0.33	1.00	5.00
>45°	1.00	0.33	0.14	0.20	1.00
Cumulative Sum	17.00	9.67	1.82	4.73	17.00

II. LOFS rating for Slope Angle class

Slope Angle	<15°	15-25°	25-35°	35-45°	>45°	Sum	Frac. Rate	LOFS rating
<15°	0.05882	0.034483	0.078534	0.042254	0.058824	0.272917	0.054583	0.1081
15-25°	0.17647	0.103448	0.109948	0.070423	0.176471	0.63676	0.127352	0.2523
25-35°	0.41176	0.517241	0.549738	0.633803	0.411765	2.524312	0.504862	1.0000
35-45°	0.29412	0.310345	0.183246	0.211268	0.294118	1.293094	0.258619	0.5123
>45°	0.05882	0.034483	0.078534	0.042254	0.058824	0.272917	0.054583	0.1081

Slope Angle class	Rank	LOFS Rating
<15°	2	0.1081
15°-25°	4	0.2523
25°-35°	8	1.0000
35°-45°	6	0.5123
>45°	2	0.1081

Table 11: Slope Curvature classes with LOFS rating

I. Pair-wise comparison matrix of Slope Curvature classes

Curvature	Concave	Flat	Convex
Concave	1.00	3.00	0.33
Flat	0.33	1.00	0.20
Convex	3.00	5.00	1.00
Cumulative Sum	4.33	9.00	1.53

II. LOFS rating for Slope Curvature classes (not included in modelling part)

Curvature	Concave	Flat	Convex	Sum rows	Frac. rate	LOFS Rating
Concave	0.230769	0.333333	0.217391	0.781494	0.260498	0.4113
Flat	0.076923	0.111111	0.130435	0.318469	0.106156	0.1676
Convex	0.692308	0.555556	0.652174	1.900037	0.633346	1.0000

CLASS	Rank	LOFS Rating
Concave	4	0.4113
Flat	2	0.1676
Convex	6	1.0000

Table 12: Landuse and Landcover classes with LOFS rating

I. Pair-wise comparison matrix of Landuse-Landcover classes

LULC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV
B	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.20	1.00	0.14	0.25	0.14
CL	2.00	1.00	0.13	2.00	0.25	0.33	0.50	0.25	2.00	0.17	0.33	0.17
ESC	9.00	8.00	1.00	9.00	5.00	6.00	7.00	5.00	9.00	3.00	6.00	3.00
FL	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.20	1.00	0.14	0.25	0.14
MV	5.00	4.00	0.20	5.00	1.00	2.00	3.00	1.00	5.00	0.33	2.00	0.33
HHP	4.00	3.00	0.17	4.00	0.50	1.00	2.00	0.50	4.00	0.25	1.00	0.25
LHP	3.00	2.00	0.14	3.00	0.33	0.50	1.00	0.33	3.00	0.20	0.50	0.20
QR	5.00	4.00	0.20	5.00	1.00	2.00	3.00	1.00	5.00	0.33	2.00	0.33
S	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.50	1.00	0.14	0.25	0.14
SM	7.00	6.00	0.33	7.00	3.00	4.00	5.00	3.00	7.00	1.00	4.00	1.00
TV	4.00	3.00	0.17	4.00	0.50	1.00	2.00	0.50	4.00	0.25	1.00	0.25
SV	7.00	6.00	0.33	7.00	3.00	4.00	5.00	3.00	7.00	1.00	4.00	1.00
Cumulative Sum	49.00	38.50	3.00	49.00	15.18	21.58	29.50	15.48	49.00	6.96	21.58	6.96

II. LOFS rating for Landuse-Landcover classes

LU /LC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV	Sum rows	Frac rate	LOFS
B	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.012917	0.020408	0.02052	0.011583	0.02052	0.212828	0.017736	0.0626
CL	0.040816	0.025974	0.04165	0.040816	0.016465	0.015444	0.016949	0.016146	0.040816	0.02394	0.015444	0.02394	0.318402	0.026533	0.0937
ESC	0.183673	0.207792	0.333201	0.183673	0.329308	0.277992	0.237288	0.322928	0.183673	0.430917	0.277992	0.430917	3.399356	0.28328	1.0000
FL	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.012917	0.020408	0.02052	0.011583	0.02052	0.212828	0.017736	0.0626
MV	0.102041	0.103896	0.06664	0.102041	0.065862	0.092664	0.101695	0.064586	0.102041	0.04788	0.092664	0.04788	0.989888	0.082491	0.2912
LU /LC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV	Sum rows	Frac rate	LOFS

HHP	0.081633	0.077922	0.055534	0.081633	0.032931	0.046332	0.067797	0.032293	0.081633	0.03591	0.046332	0.03591	0.675857	0.056321	0.1988
LHP	0.061224	0.051948	0.0476	0.061224	0.021954	0.023166	0.033898	0.021529	0.061224	0.028728	0.023166	0.028728	0.46439	0.038699	0.1366
QR	0.102041	0.103896	0.06664	0.102041	0.065862	0.092664	0.101695	0.064586	0.102041	0.04788	0.092664	0.04788	0.989888	0.082491	0.2912
S	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.032293	0.020408	0.02052	0.011583	0.02052	0.232204	0.01935	0.0683
SM	0.142857	0.155844	0.111067	0.142857	0.197585	0.185328	0.169492	0.193757	0.142857	0.143639	0.185328	0.143639	1.91425	0.159521	0.5631
TV	0.081633	0.077922	0.055534	0.081633	0.032931	0.046332	0.067797	0.032293	0.081633	0.03591	0.046332	0.03591	0.675857	0.056321	0.1988
SV	0.142857	0.155844	0.111067	0.142857	0.197585	0.185328	0.169492	0.193757	0.142857	0.143639	0.185328	0.143639	1.91425	0.159521	0.5631

CLASS	Rank	LOFS Rating
Barren	1	0.0626
Barren Sand	0	0.0000
Cultivation	2	0.0937
Extensive Slope Cut	9	1.0000
Fallow Land	1	0.0626
Moderate Vegetation	5	0.2912
Plantation (HHP)	4	0.1988
Plantation (LHP)	3	0.1366
Quarry	5	0.2912
Settlement	1	0.0683
Settlement on modified slope	7	0.5631
Swamp	0	0.0000
Thick Vegetation	4	0.1988
Sparse Vegetation	7	0.5631
Water body	0	0.0000
Salt Pan	0	0.0000

Table 13: Geomorphology classes with LOFS rating

I. Pair-wise comparison matrix of Landuse-Landcover classes

CLASS	DS	ESC	MOUND	CFS	LDS	MDS	HDS	PIED SLOPE
DS	1	8	8	7	6	4	2	6
ESC	0.125	1	1	0.5	0.33333333	0.2	0.142857143	0.33333333
MOUND	0.125	1	1	0.5	0.33333333	0.2	0.142857143	0.33333333
CFS	0.142857143	2	2	1	0.5	0.25	0.166666667	0.5
LDS	0.166666667	3	3	2	1	0.33333333	0.2	1
MDS	0.25	5	5	4	3	1	0.33333333	3
HDS	0.5	7	7	6	5	3	1	5
PIED SLOPE	0.166666667	3	3	2	1	0.33333333	0.2	1
Sum total	2.476190476	30	30	23	17.16666667	9.316666667	4.185714286	17.16666667

II. LOFS rating for Geomorphology classes

CLASS	DS	ESC	MOUND	CFS	LDS	MDS	HDS	PIED SLOPE	Sum Rows	Frac rate	LOFS
DS	0.403846154	0.266667	0.266666667	0.30435	0.349514563	0.429338104	0.4778157	0.34951456	2.8477102	0.35596	1
ESC	0.050480769	0.033333	0.033333333	0.02174	0.019417476	0.021466905	0.034129693	0.01941748	0.2333181	0.02916	0.08193
MOUND	0.050480769	0.033333	0.033333333	0.02174	0.019417476	0.021466905	0.034129693	0.01941748	0.2333181	0.02916	0.08193
CFS	0.057692308	0.066667	0.066666667	0.04348	0.029126214	0.026833631	0.039817975	0.02912621	0.3594079	0.04493	0.12621
LDS	0.067307692	0.1	0.1	0.08696	0.058252427	0.035778175	0.04778157	0.05825243	0.5543288	0.06929	0.19466
MDS	0.100961538	0.166667	0.166666667	0.17391	0.174757282	0.107334526	0.07963595	0.17475728	1.144693	0.14309	0.40197
HDS	0.201923077	0.233333	0.233333333	0.26087	0.291262136	0.322003578	0.23890785	0.29126214	2.072895	0.25911	0.72792
PIED SLOPE	0.067307692	0.1	0.1	0.08696	0.058252427	0.035778175	0.04778157	0.05825243	0.5543288	0.06929	0.19466

GEOMORPHOLOGY CLASSES	Rank	LOFS Rating
Denudational Slope (DS)	9	1
Escarpment(ESC)	2	0.0819
Mound	2	0.0819
Colluvial Footslope (CFS)	3	0.1262
Lowly Dissected Slope (LDS)	4	0.1947
Moderately Dissected Slope (MDS)	6	0.402
Highly Dissected Slope (HDS)	8	0.7279
Piedmont Slope (PIED SLOPE)	4	0.1947
Ridge-top	0	0
Tidal Flat	0	0
Water body	0	0
Plateau Top (Flat)	0	0
Rolling Plain	0	0
Valley Fill	0	0
Alluvial Plain	0	0
Beach	0	0
Coastal Plain	0	0
Pediment-Pediplain Complex	0	0
Hilltop	0	0

Table 14: Slope Forming Material map with LOFS rating

I. Pair-wise comparison matrix of slope forming material classes

SFM CLASSES	CSD	INSITU	COL	LSD	R(Type-1)	R(Type-2)	R(Type-3)	TS	WR	Sum Rows	Frac rate	LOFS
CSD	0.05042	0.03681	0.036563	0.064486	0.083333333	0.072727273	0.036809816	0.050420168	0.041436	0.473006521	0.052556	0.150594949
INSITU	0.10084	0.07362	0.054845	0.077384	0.111111111	0.109090909	0.073619632	0.100840336	0.055249	0.756598876	0.084067	0.240884562
COL	0.151261	0.147239	0.109689	0.09673	0.138888889	0.145454545	0.147239264	0.151260504	0.082873	1.17063473	0.130071	0.372704538
LSD	0.302521	0.368098	0.438757	0.386918	0.222222222	0.254545455	0.36809816	0.302521008	0.497238	3.140918908	0.348991	1
R(Type-1)	0.016807	0.018405	0.021938	0.048365	0.027777778	0.018181818	0.018404908	0.016806723	0.027624	0.214309818	0.023812	0.068231567
R(Type-2)	0.02521	0.02454	0.027422	0.055274	0.055555556	0.036363636	0.024539877	0.025210084	0.033149	0.307264657	0.034141	0.097826358
R(Type-3)	0.10084	0.07362	0.054845	0.077384	0.111111111	0.109090909	0.073619632	0.100840336	0.055249	0.756598876	0.084067	0.240884562
TS	0.05042	0.03681	0.036563	0.064486	0.083333333	0.072727273	0.036809816	0.050420168	0.041436	0.473006521	0.052556	0.150594949
WR	0.201681	0.220859	0.219378	0.128973	0.166666667	0.181818182	0.220858896	0.201680672	0.165746	1.707661092	0.18974	0.543682006

II.LOFS rating for Slope Forming material classes

SFM CLASSES	CSD	INSITU	COL	LSD	R (Type-1)	R (Type-2)	R (Type-3)	TS	WR
CSD	1	0.5	0.333333	0.166667	3	2	0.5	1	0.25
INSITU	2	1	0.5	0.2	4	3	1	2	0.333333
COL	3	2	1	0.25	5	4	2	3	0.5
LSD	6	5	4	1	8	7	5	6	3
R(Type-1)	0.333333	0.25	0.2	0.125	1	0.5	0.25	0.333333333	0.166667
R(Type-2)	0.5	0.333333	0.25	0.142857	2	1	0.333333333	0.5	0.2
R(Type-3)	2	1	0.5	0.2	4	3	1	2	0.333333
TS	1	0.5	0.333333	0.166667	3	2	0.5	1	0.25
WR	4	3	2	0.333333	6	5	3	4	1
SUM	19.83333	13.58333	9.116667	2.584524	36	27.5	13.58333333	19.83333333	6.033333

CLASS	Rank	LOFS
In-situ soil	4	0.2409
Banded magnetite quartzite (R1)	1	0.0682
Granite gneiss (R1)	1	0.0682
Quartzite (R1)	1	0.0682
Ultramafic rock (R1)	1	0.0682
Dolerite (R1)	1	0.0682
Transported Soil	3	0.1506
Water body	0	0.0000
River	0	0.0000
Laterite (R3)	4	0.2409
Amphibolite (R3)	4	0.2409
Chlorite schist (R3)	4	0.2409
Hornblende-actinolite-chlorite schist (R3)	3	0.2409
Grewake-argillite (R2)	4	0.2404
Loose slide debris	8	1
Compacted slide debris	3	0.1506
Alluvium	0	0
Colluvium	4	0.3727

Table 15: Regolith Thickness classes with LOFS rating

I. Pair-wise comparison matrix of Regolith Thickness classes

Regolith Thickness	0.5 - 5 m	5 - 10 m	>10 m
0.5 - 5 m	1.00	4.00	6.00
5 - 10 m	0.25	1.00	3.00
>10 m	0.17	0.33	1.00
Sun Cumulative	1.42	5.33	10.00

II. LOFS rating for Regolith Thickness classes

Regolith Thickness	0.5 - 5 m	5 - 10 m	>10 m	Sum rows	Frac rate	LOFS
0.5 - 5 m	0.705882	0.75	0.6	2.055882	0.685294	1.0000
5 - 10 m	0.176471	0.1875	0.3	0.663971	0.221324	0.3230
>10 m	0.117647	0.0625	0.1	0.280147	0.093382	0.1363

Regolith Thickness classes (in mts)	Rank	LOFS Rating
<0.5m	0	0
0.5-5m	7	1
5-10m	4	0.322961
>10m	2	0.136266

Table 16: Table showing Pair-wise comparison matrix of individual geofactor maps and weights.

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Factor Classes	Rank
Slope	1.00	6.00	0.33	2.00	5.00	3.00	Slope	7
Curvature	0.17	1.00	0.13	0.20	0.50	0.25	Curvature	2
SFM	3.00	8.00	1.00	4.00	7.00	5.00	SFM	9
LULC	0.50	5.00	0.25	1.00	4.00	2.00	LULC	6
Geom	0.20	2.00	0.14	0.25	1.00	0.33	Geomorphology	3
RT	0.33	4.00	0.20	0.50	3.00	1.00	Regolith Thickness	5
Sum Cumulative	5.20	26.00	2.05	7.95	20.50	11.58		

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Sum rows	Frac rate	Weight	Weight WN
Slope	0.19231	0.23077	0.16098	0.25157	0.24390	0.25907	1.33859	0.2230991	6.5073541	7
Curvature	0.03269	0.03846	0.06341	0.02516	0.02439	0.02159	0.20570	0.0342842	1	1
SFM	0.57692	0.30769	0.48780	0.50314	0.34146	0.43178	2.64881	0.4414679	12.876734	13
LULC	0.09615	0.19231	0.12195	0.12579	0.19512	0.17271	0.90403	0.1506721	4.3948026	4
Geom	0.03846	0.07692	0.06829	0.03145	0.04878	0.02850	0.29240	0.0487336	1.4214622	1
RT	0.06346	0.15385	0.09756	0.06289	0.14634	0.08636	0.61046	0.1017432	2.9676444	3

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Sum rows	CV
Slope	0.223099109	0.205704903	0.1456844	0.3013441	0.2436681	0.3052295	1.4247302	6.3860863
Curvature	0.037926849	0.034284151	0.0573908	0.0301344	0.0243668	0.0254358	0.2095388	6.1118283
SFM	0.669297328	0.274273204	0.4414679	0.6026883	0.3411354	0.5087158	2.8375779	6.4275977
LULC	0.111549555	0.171420753	0.110367	0.1506721	0.1949345	0.2034863	0.9424302	6.254843
Geom	0.044619822	0.068568301	0.0618055	0.037668	0.0487336	0.0335752	0.2949705	6.0527105
RT	0.073622706	0.137136602	0.0882936	0.075336	0.1462009	0.1017432	0.622333	6.1167052
							Sum CV	37.349771