भारत सरकार
Government of India
भारतीय भूवैज्ञानिक सर्वेक्षण
Geological Survey of India

कर्नाटक राज्य के दक्षिण कन्नड़ को चिक्कमगलुरु जिले से जोड़ने वाले चारमाडी घाट खंड (एनएच-73) क्षेत्र में मध्य पैमाने (१:१०,०००) पर भूस्खलन सुग्राहिता मानचित्रण।

Mesoscale (1:10,000) Landslide Susceptibility Mapping along Charmadi Ghat Stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

टोपोशीट सं: 48ओ/8, 48ओ/12
Toposheet nos.: 48O/8, 48O/12

मद संख्या: एम4एलएसएसएम/एनसी/एसआर/एसयू-केजी/2021/36786
FSP Code.: M4LSSM/NC/SR/SU-KG/2021/36786

कार्य सत्र: 2021-22 का अंतिम प्रतिवेदन
Final Report for Field Season 2021-22

नेहा कुमारी, भूवैज्ञानिक/ Neha Kumari, Geologist
एवं/&
कमल कुमार, भूवैज्ञानिक/ Kamal Kumar, Geologist

मिशन-IV/MISSION-IV

इंजीनियरिंग भूविज्ञान तथा भूस्खलन विभाग/Engineering Geology and Landslide Division
राज्य इकाई: कर्नाटक एवं गोवा/State Unit: Karnataka & Goa
बेंगलूरु/Bengaluru-560111

अक्टूबर 2022/ October 2022

"इस प्रतिवेदन का कोई भी भाग महानिदेशक,भारतीय भूवैज्ञानिक सर्वेक्षण, कोलकाता से पूर्व में लिखित अनुमति लिए बिना उद्धृत नहीं किया जाना है या किसी भी भाग की प्रतिकृति नहीं बनाई जानी है।"
No part of the report should be quoted or reproduced without prior written permission from the Director General, Geological Survey of India, Kolkata

कर्नाटक राज्य के दक्षिण कन्नड़ को चिक्कमगलुरु जिले से जोड़ने वाले चारमाडी घाट खंड (एनएच-73) क्षेत्र में मध्य पैमाने (१:१०,०००) पर भूस्खलन सुग्राहिता मानचित्रण।

Mesoscale (1:10,000) Landslide Susceptibility Mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

टोपोशीट सं: 48ओ/8, 48ओ/12
Toposheet Nos.: 48O/8, 48O/12

मद संख्या: एम4एलएसएसएम/एनसी/एसआर/एसयू-केजी/2021/36786
FSP Code.: M4LSSM/NC/SR/SU-KG/2021/36786

कार्य सत्र 2021-22 का अंतिम प्रतिवेदन
Fianl Report for Field Season 2021-22

नेहा कुमारी, भूवैज्ञानिक/ Neha Kumari, Geologist
एवं/&
कमल कुमार, भूवैज्ञानिक/ Kamal Kumar, Geologist

मिशन-IV/MISSION-IV

इंजीनियरिंग भूविज्ञान तथा भूस्खलन विभाग/Engineering Geology and Landslide Division
राज्य इकाई: कर्नाटक एवं गोवा/State Unit: Karnataka & Goa
बेंगलूरु/Bengaluru-560111

अक्टूबर 2022/ October 2022

"इस प्रतिवेदन का कोई भी भाग महानिदेशक,भारतीय भूवैज्ञानिक सर्वेक्षण, कोलकाता से पूर्व में लिखित अनुमति लिए बिना उद्धृत नहीं किया जाना है या किसी भी भाग की प्रतिकृति नहीं बनाई जानी है।"

No part of the report should be quoted or reproduced without prior written permission from the Director General, Geological Survey of India, Kolkata

Mesoscale (1:10,000) Landslide Susceptibility Mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

(FSP Code: M4LSSM/NC/SR/SU-KG/2021/36786)
Field season: 2021-22

By

Neha Kumari, Geologist
&
Kamal Kumar, Geologist

सारांश	i-iii
Abstract	iv-vi
CHAPTER 1: INTRODUCTION	**1-11**
1.1 Background Information	1-3
1.2 Objectives	3
1.3 Description of Study Area	4
1.4 Physiography and Drainage	5-6
1.5 Climate, Rainfall and Soil type	6-7
1.6 Previous Work	7-11
1.7 Acknowledgements	11
CHAPTER 2: GENERAL GEOLOGY	**12-19**
2.1 Regional Geology	12-15
2.2 Geology of the study area	15-18
CHAPTER 3: METHODOLOGY	**20-22**
3.1 Selection of Mapping units	20
3.2 Input data and Maps	20-21
3.3 Categorization of study area into Domains	21
3.4 Selection of geofactors for Domains	21-22
3.5 Ratings and Weights of geofactors themes and their classes	22
3.6 Map Integration, Classification & Validation	22
CHAPTER 4: GEO-FACTORS THEMATIC MAPS	**23-39**
4.1 Selection of Geofactor Thematic Maps	23
4.1.1 Slope Morphometry Maps (Slope, Aspect, Relative relief)	24-28
4.1.2 Geomorphon/Landform Map	29-31
4.1.3 Drainage Map	31-32
4.1.4 Distance to Drainage Buffer Map	33-34
4.1.5 Stream Power Index Map	34-35
4.1.6 Landuse and Landcover Map	36-38
4.2 Field based Geofactor Thematic Maps preparation	**38-46**
4.2.1 Geological Slope Forming Material (SFM) map	38-40
4.2.2 Regolith/Overburden Thickness Map	41-42
4.2.3 Landslide Incidence and Landslide Failure Domain Map	42-46
4.3 Sampling and Geotechnical Testing	**46-48**
4.4 Post-field Derivative Maps	**48-52**

4.2.1 Geotechnical Map	48-51
4.2.2 Kinematic failure Map	**53-83**
4.4.2.1 Kinematic Slope Failure Incidences & their Stereo plot	53-83
4.5 Rainfall Condition	87-95
CHAPTER 5: LANDSLIDE SUSCEPTIBILITY MAP	**96-103**
5.1.1 Landslide Susceptibility in Debris/Earth Domain	96-98
5.1.2 Landslide Susceptibility in Rock Domain	98-99
5.1.3 Landslide Susceptibility in Cut Slope Domain	100-101
5.1.4 Combined Landslide Susceptibility Map	102-103
CHAPTER 6: LANDSLIDE SUSCEPTIBILITY ANALYSIS	104-106
CHAPTER 7: RISK MANAGEMENT IN PROBABLE HIGH-RISK AREAS	**107-118**
CHAPTER 8: CONCLUSIONS & RECOMMENDATIONS	**120-121**
LOCALITY INDEX	**122**
REFERENCES	**123**
APPENDICES	
SYNOPSIS OF WORK DONE	
FIVE POINT PROFORMA	
CERTIFICATE OF QUALITY OF REPORT	
MOVEMENT SHEET OF REPORT	

LIST OF FIGURES:

Fig 1: Location Map of the Study Area along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

Fig 2: Geological Map (1:50,000) along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

Fig 3: Upscale Geological Map of study area mapped on 1:10,000 scale.

Fig 4: A generic methodological flow diagram showing mesoscale landslide susceptibility mapping.

Fig 5: Slope Gradient Map of the study area (1:10,000 scale).

Fig 6: Slope Aspect Map of the study area (1:10,000 scale).

Fig 7: Relative Relief Map of the study area (1:10,000 scale).

Fig 8: Landform Map of the study area (1:10,000 scale).

Fig 9: Updated Drainage Map of the study area (1:10,000 scale).

Fig 10: Distance to Drainage Buffer Map of the study area (1:10,000 scale).

Fig 11: Stream Power Index Map of the study area on (1:10,000 scale).

Fig 12: Landuse/Landcover Map of the study area (1:10000 scale).

Fig 13: Field based Geological Slope Forming Material Map of the study area (1:10,000 scale).

Fig 14: Field based Regolith/Overburden thickness Map of the study area (1:10,000 scale).

Fig 15: Landslide Incidence Map of the study area (1:10,000 scale)

Fig 16: Landslide Failure Domain Map of the study area (1:10,000 scale).

Fig 17: Sample Location on Topographic Base Map of the study area (1:10,000 scale).

Fig 18: Geotechnical Map of the study area on1:10,000 scale.

Fig 19: Rosette diagram showing the trend of the joint sets (J1) in strike direction.

Fig 20: Rosette diagram showing the trend of the joint sets (J2) in strike direction.

Fig 21: Rosette diagram showing the trend of the joint sets (J3) in strike direction.

Fig 22: Sector wise kinematic failure map (Malaya Marutha guest house to Guliga Temple) of the charmadi ghat road section on 1:10,000 scale.

Fig 23: Stereo plot for sector wise kinematic failure map Malaya Marutha guest house to Guliga Temple) on 1:10,000 scale.

Fig 24: Sector wise kinematic failure map (Guliga Temple to Attigere) of the charmadi ghat road section on 1:10,000 scale.

Fig 25: Stereo plot for sector wise kinematic failure map of Guliga Temple to Attigere charmadi ghat road) on 1:10,000 scale.

Fig 26: Planar Failure Map in Rock domain of the study area on 1:10,000 scale.

Fig 27: Wedge Failure Map in Rock domain of the study area on 1:10,000 scale.

Fig 28: Topple Failure Map in Rock domain of the study area on 1:10,000 scale.

Fig 29: Kinematic Failure Map in Rock domain of the study area on 1:10,000 scale.

Fig 30: Landslide Susceptibility Map of the study area on 1:10,000 scale in Debris/Earth domain.

Fig 31: Landslide Susceptibility Map of the study area on 1:10,000 scale in Rock domain.

Fig 32: Landslide Susceptibility Map of the study area on 1:10,000 scale in Cut Slope domain.

Fig 33: Combined Landslide Susceptibilty Map of the study area on 1:10,000 scale.

Fig 34: Probable High Risk Map in vulnerable road sector of NH-73 (Charmadi ghat road section).

LIST OF TABLES:

Table 1: Nature and Quantum of the work envisaged.

Table 2: Regional Chrono-lithostratigraphic succession covering TS nos. 48O/08 & O/12.

Table 3: Chrono-lithostratigraphic succession of the study area covering parts of TS nos. 48O/08 & 48O/12

Table 4: Percentage & frequency distribution of Landslide incidence with respect to Slope Gradient classes.

Table 5: Percentage & frequency distribution of Landslide incidence with respect to Slope Aspect classes.

Table 6: Percentage & frequency distribution of Landslide incidence with respect to Relative relief classes.

Table 7: Percentage & frequency distribution of Landslide incidence with respect to Landform units.

Table 8: Frequency distribution of Landslide incidences in the drainage basin of the catchment area.

Table 9: Frequency distribution of Landslide incidence with respect to Drainage Buffer.

Table 10: Percentage distribution of Stream Power classes in the study area.

Table 11: Percentage distribution of of Landslide incidence with respect to Landuse/Landcover Classes.
Table 12: Percentage distribution of Landslide incidences with respect to Slope Forming Material Classes.
Table 13: Percentage distribution of Landslide incidences with respect to Regolith/Overburden Thickness Classes.
Table 14: Percentage distribution of different Landslide Failure Domain Vs Landslide classes.
Table 15: Analytical results of geotechnical parameters of undisturbed soil samples.
Table 16: Structural data for kinematic failure analysis in Structural Domain.

LIST OF GRAPHS

Graph 1: Graph showing distribution of Landslides with respect to Slope Gradient classes.
Graph 2: Graph showing distribution of Landslides with respect to Slope Aspect classes.
Graph 3: Graph showing distribution of Landslides with respect to Relative Relief classes.
Graph 4: Graph showing distribution of Landslides with respect to Landform classes.
Graph 5: Graph showing distribution of Landslides with respect to Watershed/ Sub-basin.
Graph 6: Graph showing distribution of Landslides with respect to Drainage Buffer.
Graph 7: Graph showing distribution of Landslides with respect to SPI classes.
Graph 8: Graph showing distribution of Landslides with respect to Landuse/Landcover classes.
Graph 9: Graph showing distribution of Landslides with respect to Slope forming material classes.
Graph 10: Graph showing distribution of Landslides with respect to Overburden Thickness classes.
Graph 11: Graph showing distribution of Landslides with respect to Landslide Failure Domain classes.
Graph 12: Graph showing Departure between Normal & Actual Rainfall (Koppa Taluk).
Graph 13: Graph showing Antecedent rainfall distribution curve during June 2021(Koppa Taluk).
Graph 14: Graph showing Antecedent rainfall distribution curve during July 2021(Koppa Taluk).
Graph 15: Graph showing Antecedent rainfall distribution curve during August 2021(Koppa Taluk).
Graph 16: Graph showing Departure between Normal & Actual Rainfall (MudigereTaluk).
Graph 17: Graph showing Antecedent rainfall distribution curve during June 2021(MudigereTaluk).
Graph 18: Graph showing Antecedent rainfall distribution curve during July 2021(Mudigere Taluk).
Graph 19: Graph showing Antecedent rainfall distribution curve during Aug 2021(Mudigere Taluk).
Graph 20: Graph showing Departure between Normal & Actual Rainfall for Monsoon period year 2021 (Narasimharajapura Taluk).
Graph 21: Graph showing Antecedent rainfall distribution curve for the month of June 2021 (Narasimharajapura Taluk).
Graph 22: Graph showing Antecedent rainfall distribution curve for the month of July 2021 (Narasimharajapura Taluk).

Graph 23: Graph showing Antecedent rainfall distribution curve for the month of Aug 2021 (Narasimharajapura Taluk).

Graph 24: Graph showing Departure between Normal & Actual Rainfall of the year 2021 (Chikkamagaluru Taluk)

Graph 25: Graph showing Antecedent rainfall distribution curve for the month of June 2021 (Chikkamagaluru Taluk).

Graph 26: Graph showing Antecedent rainfall distribution curve for the month of July 2021 (Chikkamagaluru Taluk).

Graph 27: Graph showing Antecedent rainfall distribution curve for the month of Aug 2021 (Chikkamagaluru Taluk).

Graph 28: Graph showing percentage distribution of area under landslide susceptibility classes in Debris Domain.

Graph 29: Graph showing percentage distribution of area under landslide susceptibility classes in Rock Domain.

Graph 30: Graph showing percentage distribution of area under landslide susceptibility classes in Cut Slope Domain.

Graph 31: Graph showing percentage distribution of area under landslide susceptibility classes in Combined Landslide failure Domain.

LIST OF PHOTOGRAPHS

Photo 1: Field photograph showing Amphibolite along Charmadi Ghat road (NH-73), Mulaya Maratha Guest House.

Photo 2: Field photograph showing Dolerite along Charmadi Ghat road (NH-73).

Photo 3: Weathered rock fragment and soil in Debris domain.

Photo 4: Soil cover in Earth domain exposed on vertical road cut.

Photo 5: Field photograph showing sample collection, packing, weighing, and sealing of sample in Iron tubes and plastic bags.

Photo 6: Field photograph showing planar, wedge and topple failure in rock cut slope domain along Charmadi ghat road section.

LIST OF ANNEXURES

Annexure I: 42-points geoparametric landslide inventory datasheet.

कर्नाटक राज्य के दक्षिण कन्नड़ को चिक्कमगलुरु जिले से जोड़ने वाले चारमाडी घाट खंड (एनएच-73) क्षेत्र में मध्य पैमाने (१:१०,०००) पर भूस्खलन सुग्राहिता मानचित्रण।

(मद संख्या: एम4एलएसएसएम/एनसी/एसआर/एसयू-केजी/2021/36786)

कार्य सत्र: 2021-22

द्वारा

नेहा कुमारी, भूवैज्ञानिक
एवं
कमल कुमार, भूवैज्ञानिक

कार्य सत्र: 2021-22 के द्वारान कर्नाटक राज्य के दक्षिण कन्नड़ को चिक्कमगलुरु जिले से जोड़ने वाले चारमाडी घाट खंड (NH-73) क्षेत्र में मध्य पैमाने (१:१०,०००) पर भूस्खलन सुग्राहिता मानचित्रण का कार्य किया गया। कार्य का उद्देश्य ढलान-विफलता डोमेन की पहचान करना और विभिन्न भूस्खलन विफलता डोमेन में ढलान विफलता को प्रभावित करने वाले कारक भू-कारकों को आवंटित दर और वजन के आधार पर डोमेन-विशिष्ट भू-कारक मानचित्र तैयार करना और डोमेन-विशिष्ट भूस्खलन संवेदनशीलता मानचित्र तैयार करना है। चारमाडी घाट (एनएच -73) जो एक महत्वपूर्ण सड़क क्षेत्र है जिसकी लम्बाई 25 लाइन किमी है , यह चार्माडी गांव (उजीरे से 11 किमी), दक्षिण कन्नड़ जिले के बेलटांगडी तालुक से शुरू होती है और कोट्टीगेहारा (मुदिगेरे से 14 किमी), मुदिगेरे पर समाप्त होती है। यह घाट कर्नाटक राज्य के दक्षिण कन्नड़ जिले को चिक्कमगलुरु जिले से जोड़ता है। अध्ययन क्षेत्र के भीतर महत्वपूर्ण इलाके सोमनाकाडु, होराट्टी, अलेकन एस्टेट, कोडेकल्लू, जेनुकल्लू, बिदारतले, चार्माडी हैं। भौगोलिक दृष्टि से, यह क्षेत्र पश्चिमी घाट पहाड़ी श्रृंखला का हिस्सा है, और चारमाडी घाट नामक एक घाट सड़क पर्वत श्रृंखलाओं से होकर गुजरती है, जो NE-SW दिशा में प्रवृत्त होती हैं। लकीरें और खड़ी चट्टानी ढलानों के साथ दुर्गम खड़ी ऊंची पहाड़ी बंजर और कम वनस्पति वाले हैं, उत्तर-पश्चिमी भाग कॉफी बागान और सिल्वर ओक से आच्छादित है, और शेष क्षेत्र घने जंगल और घने मिश्रित जंगल से आच्छादित है। कुछ प्रमुख चोटियाँ उत्तरी भाग में 1302 मीटर, 1278 मीटर, मध्य भाग (जेनुकल्लू) में 1005 मीटर की ऊंचाई पर हैं, और सबसे कम ऊंचाई अध्ययन क्षेत्र के दक्षिणी भाग में एमएसएल से 400 मीटर ऊपर है।

भूगर्भीय रूप से, आर्कियन युग का ग्रेनाइट गनीस प्रमुख लिथो-इकाई है, जो अत्यधिक पत्तेदार, संयुक्त, खंडित, कतरनी, मुड़ा हुआ है, और गनीस बैंडिंग को दर्शाता है। एम्फीबोलाइट एनडब्ल्यू-एसई, एन-एस, और एनई-एसडब्ल्यू दिशाओं में उन्मुख ग्रेनाइट गनीस के साथ एन्क्लेव / ज़ेनोलिथ के रूप में पाया जाता है। डोलराइट डाइक अलग-अलग प्रवृत्तियों यानी एनई-एसडब्ल्यू, एन-एस, एनएनडब्ल्यू-एसएसई दिशाओं में प्रायद्वीपीय गनीस-I प्रायद्वीपीय गनीस के आर-पार काट रहा है। तलीय संरचनाओं का प्रतिनिधित्व चट्टानों में बिस्तर, नीसोसिटी, फ्रैक्चर, दरार और जोड़ों द्वारा किया जाता है। क्षेत्रीय पत्ते 50°-60° की पश्चिमी गिरावट के साथ NW-SE से NNW-SSE तक जाते हैं। इस क्षेत्र में एक

पतली ओवरबर्डन मोटाई है जो मुख्य रूप से अत्यधिक अपक्षय चट्टान और मिट्टी से युक्त एक ओवरबर्डन से ढकी खड़ी ढलान पर .5-3 मीटर और चारमाडी घाट सड़क खंड के साथ बंजर चट्टानी पहाड़ियों पर <0.5 मीटर के बीच भिन्न होती है। अलेखन होरट्टा कॉफी एस्टेट में, ओवरबर्डन की मोटाई 5-10 मीटर और > 10 मीटर है।

जीआईएस प्लेटफॉर्म में कार्टोडेम (10 मीटर), कार्टोपैन (2.5 मीटर), और एलआईएसएस IV उपग्रह डेटा की मदद से जियोफैक्टर विषयगत मानचित्र तैयार किए जाते हैं और फील्ड अध्ययन के दौरान मान्य होते हैं। जियोफैक्टर मैप्स यानी लैंडफॉर्म यूनिट्स, स्लोप मॉर्फोमेट्रिक पैरामीटर (ढलान, पहलू, वक्रता और सापेक्ष राहत), भूमि उपयोग / भूमि कवर, जल निकासी मॉर्फोमेट्रिक पैरामीटर; पानी की आमद, जल निकासी की दूरी और भाप शक्ति क्षरण सूचकांक, जल-भूवैज्ञानिक सेटिंग: ढलान की पानी की स्थिति, लिथोलॉजी और संरचनात्मक असंतुलन, कतरनी ताकत पैरामीटर (सामंजस्य और घर्षण प्रतिरोध) और ढलान बनाने वाली सामग्री संपत्ति जो ढलान स्थिरता की स्थिति को नियंत्रित करती है। भू-स्खलन से जुड़े अंतर्निहित और बाहरी कारक भू-कारकों के पूर्व-निपटान के शुद्ध प्रभाव को समझने के लिए विस्तृत क्षेत्र मूल्यांकन के दौरान जांच की गई।

कुल 184 नग भूस्खलन विशेषताओं के 42-बिंदु भू-पैरामीटर के साथ पुराने, नए और पुन: सक्रिय भूस्खलन का दस्तावेजीकरण किया गया है। अधिकांश भूस्खलन उथला, ट्रांसलेशनल, मलबे की स्लाइड हैं जो चारमाडी घाट रोड के साथ दर्ज की गई हैं और कुछ रॉक स्लाइड हैं, और मलबे का प्रवाह है। अधिकांश पुराने, निलंबित मलबे के भूस्खलन को फिर से सक्रिय कर दिया गया है। भू-कारक विषयगत मानचित्रों और भूस्खलन वितरण के साथ उनके वर्गों के स्थानिक सहसंबंध का विश्लेषण भूस्खलन संवेदनशीलता मानचित्र बनाने के लिए वेटेज और रेटिंग प्रदान करने के लिए किया जाता है। भूस्खलन का स्थानिक वितरण इंगित करता है कि अधिकांश भूस्खलन पहाड़ी के ढलान, स्पर और खोखले भागों से शुरू होते हैं। भूस्खलन की घटनाएं और कट ढलान विफलता मुख्य रूप से अत्यधिक अपक्षय, खंडित, और संयुक्त व्यापक ऊर्ध्वाधर सड़क की ऊंचाई >10 मीटर और ढलान कोण > 65 डिग्री पर मूल ढलान कोण पर 25-35 डिग्री के बीच बदलती पर अत्यधिक विच्छेदित चारमाडी घाट के खड़ी ढलान तक ही सीमित हैं। सड़क निर्माण के लिए ढलान संशोधन ने मूल ढलान ज्यामिति, ढाल और सापेक्ष राहत को बिगाड़ दिया है । पहले और दूसरे क्रम की धाराओं के साथ कुछ चैनल कटाव सड़क को काट रहे हैं और सितंबर 2019 के महीने में भारी लगातार बारिश के दौरान स्थानों पर नाला / धारा भंग एनएच -73 सड़क खंड के प्रवाह पथ के साथ मलबे के प्रवाह के रूप में विकसित हुए हैं। मानसून में भारी वर्षा के दौरान बिदरतले, अलेखन एस्टेट और होराती गांव क्षेत्र उच्च जोखिम में हैं।

चारमाडी घाट खंड के साथ मुड़े हुए ग्रेनाइट गनीस में समानांतर परतों के बीच संपर्कों के साथ फ्लेक्सुरल स्लिप देखी गई है। फ्लेक्सुरल स्लिप डिसकंटिन्यूअस सिंपल शीयर मैकेनिज्म ग्रेनाइट गनीस में बेड प्लेन या क्लीवेज प्लेन के साथ हो सकता है और ग्रेनाइट गनीस में अन्य संयुक्त सेटों के साथ फोलिएशन या फोलिएशन जॉइंट के बीच ऑर्थोगोनल संबंध ढलान की विफलता के कारण महत्वपूर्ण भूमिका निभा रहा है। ढलान कोण के साथ संयुक्त सेटों के उन्मुखीकरण के कारण चारमाड़ी घाट सड़क के साथ स्थानों पर कमजोर संयुक्त चट्टानी ढलान पर तलीय, पच्चर और टॉपिंग सड़क की ओर झुक गया। सड़क के हिस्सों के साथ अत्यधिक अपक्षयित, संयुक्त और विकृत चट्टान ढलान की

विफलता के प्रति संवेदनशील पाई जाती है। कहीं-कहीं सड़क की ओर सिलवटों का ढोना सुभेद्य स्लिप प्लेन हैं। ढलान के पानी का रिसाव और पानी की संतृप्ति उच्च हाइड्रोस्टेटिक/छिद्र के पानी के दबाव का निर्माण करती है जिससे ढलान बनाने वाली सामग्री की एकजुट और कतरनी ताकत में कमी आती है। चरम मानसून अवधि के दौरान गहरे व्यापक संयुक्त सेटों में अत्यधिक जल घुसपैठ के कारण संयुक्त सेटों का चौड़ा होना ढलान अस्थिरता को काफी हद तक प्रेरित करता है। रोड कट सेक्शन के साथ, कमजोर संयुक्त सेट प्रतिनिधि ढलान पहलू की पहचान करने के लिए क्षेत्र-वार गतिज विश्लेषण किया जाता है, जहां उच्च जोखिम वाले क्षेत्रों के सीमांकन के लिए ढलान की विफलता की संभावना अधिकतम होती है। रॉक मास कैरेक्टराइजेशन के लिए कुल 30 नग अविक्षुब्ध मिट्टी के नमूने और 7 नग रॉक के नमूने भू-तकनीकी जांच के लिए विभिन्न रॉक/ओवरबर्डन सामग्री का प्रतिनिधित्व करने वाले भूस्खलन क्षेत्रों और कमजोर ढलान वाले पहलुओं से उन्मुख चट्टान के नमूने एकत्र किए गए थे। भूस्खलन की घटनाओं के कारण, दरारें विकसित हो जाती हैं और घाट रोड के साथ स्थानों पर रिटेनिंग संरचनाएं क्षतिग्रस्त हो जाती हैं। ढलान स्थिरता की स्थिति मुख्य रूप से ढलान मोर्फोमेट्री और इलाके की जल-भूवैज्ञानिक सेटिंग द्वारा नियंत्रित पूर्व-निपटान इलाके की स्थितियों से प्रभावित होती है। जल निकासी के दोनों ओर 25-30 मीटर का बफर, स्थानों पर घुसपैठ करने वाले लिथो-संपर्क क्षेत्रों ने भारी बारिश की घटना के दौरान भूस्खलन की शुरुआत के लिए अनुकूल लोकी/संभावित क्षेत्र के रूप में काम किया।

ऐतिहासिक भूस्खलन सूची डेटाबेस के अनुसार, अधिकांश भूस्खलन मुख्य रूप से चरम मानसून अवधि के दौरान भारी लगातार वर्षा के दौरान ट्रिगर होते हैं। क्षेत्र की जांच के दौरान सभी पिछली और नई भूस्खलन घटनाओं का विस्तार से अध्ययन किया जाता है और महत्वपूर्ण भूस्खलन संभावित क्षेत्रों के लिए जोखिम कम करने के उपायों का सुझाव दिया जाता है। साइट की स्थिति के अनुसार एक उपयुक्त रिटेनिंग स्ट्रक्चर, पहाड़ी ढलान के निचले हिस्से में वीप होल के साथ लाइनेड ड्रेनेज की व्यवस्था, स्लोप रिग्रेडेशन, उचित ड्रेनेज मैनेजमेंट सिस्टम और घाट रोड के साथ खाई की चौड़ाई में वृद्धि का सुझाव दिया गया है। भूस्खलन प्रबंधन मानचित्र नीति निर्माताओं और हितधारकों द्वारा सतत विकास और आपदा प्रबंधन के लिए प्रभावी निर्णय लेने के लिए एक रोड मैप प्रदान करेगा। भूस्खलन संवेदनशीलता मानचित्र दर्शाता है कि मानचित्र में लगभग 74.05% क्षेत्र निम्न संवेदनशील क्षेत्र में, 17.04% मध्यम संवेदनशील क्षेत्र में और 8.91% क्षेत्र उच्च अतिसंवेदनशील क्षेत्र में आता है।

Mesoscale (1:10,000) Landslide Susceptibility Mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

(FSP Code: M4LSSM/NC/SR/SU-KG/2021/36786)
Field Season: 2021-22

By

Neha Kumari, Geologist
&
Kamal Kumar, Geologist

ABSTRACT

In pursuance of FS: 2021-22, Meso-scale (1:10,000) landslide susceptibility mapping was carried out along Charmadi ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka. The objective of the work is to identify slope-failure domains and to prepare domain-specific geofactor maps based on the rate and weight assigned to the causative geofactors influencing slope failure in different landslide failure domains and integrated to generate a domain-specific landslide susceptibility map. The 25 line km ghat road named Charmadi ghat (NH-73) is an important road sector and stretch starts from Charmadi village (11 km from Ujire), Beltangady taluk of Dakshin Kannada district and ends at Kottigehara (14 km from Mudigere), Mudigere taluk of Chikkamgaluru District. The Charmadi ghat (NH-73)connects Dakshin Kannada with the Chikkamagaluru district of Karnataka. The important localities within the study area are Somanakadu, Horatti, Alekan Estate, Kodekallu, Jenukallu, Bidaratale, Charmady. Physiographically, the area forms the part of the Western Ghat hill ranges, and a ghat road named Charmadi ghat passes through the mountain ranges trending NE-SW direction comprised of ridges and steep dissected hillslope with intermittent valleys. The inaccessible steep high hill ranges with ridges and steep rocky slopes are barren and sparsely vegetated, the north-western part is covered with coffee plantation and silver oak, and the remaining area is covered with thick forest and dense mixed jungle. Some prominent peaks are at elevations of 1302m, 1278m in the northern part, 1005m in the central part (Jenukallu), and the lowest elevation is 400m above MSL in the southern part of the study area.

Geologically, granite gneiss of the Archean age is the predominant litho-unit, which is highly foliated, jointed, fractured, sheared, folded, and shows gneissic banding. Amphibolite is occurring as enclave/xenolith with granite gneiss oriented in NW-SE, N-S, and NE-SW directions. Basic intrusives are represented by dolerite dyke criss crossing Peninsular Gneiss-I with varying trends i.e. NE-SW, N-S, NNW-SSE directions. The planar structures are represented by bedding, gneissosity, fracture, cleavage, and joints in rocks. The regional foliation trends NW-SE to NNW-SSE with a westerly dip

of 50°-60°. The area has a thin overburden thickness that varies between .5-3m on an overburden-covered steep slope mainly consisting of highly weathered rock and soil and <0.5m on barren rocky hillslope along the Charmadi ghat road section. In the Alekhan Horatta coffee estate, the overburden thickness varies from 5-10m and >10m.

The geofactor thematic maps are prepared with the help of CartoDEM (10m), CartoPAN (2.5m), and LISS IV satellite data in the GIS platform and validated during field studies. The geofactor maps i.e. landform units, slope morphometric parameters (slope, aspect, curvature, and relative relief), land use/land cover, drainage morphometric parameters; the influx of water, distance to drainage and steam power erodibility index, hydro-geological setting: water condition of slope, lithology and structural discontinuity, shear strength parameters (cohesion and angle of internal friction) and slope forming material property which governs the slope stability condition are investigated during detailed field assessment to understand the net effect of predisposing inherent & external causative geofactors associated with landsliding.

A total of 184 nos. of old, new, and reactivated landslides with 42-point geoparameters of landslide attributes are documented. The majority of landslides are shallow, translational, debris slide recorded along Charmadi ghat road and few are rock slide, and debris flow. Most of the old, suspended debris landslides are reactivated. The spatial correlation of geofactor thematic maps and their classes with landslide distribution are analyzed to assign the weightage and rating to produce a susceptibility map. The spatial distribution of landslides indicates that the majority of the landslides are initiated from the slope, spur, and hollow parts of the hill. The landslide incidences and cut slope failure are mainly confined to the highly dissected steep slope on highly weathered, fractured, and jointed extensive vertical road cut of height >10m and slope angle >65° made at original slope angle varying between 25-35° modified for road construction. The slope modification for road construction has disturbed the original slope geometry, gradient, and relative relief. A few channel erosion along stream channels are cross-cutting the road and prograded as debris flow along the flow path of nala/stream that breached NH-73 road section at places during heavy incessant rainfall event in the month of September 2019. The Bidartale, Alekhan estate, and Horrati village area are at high risk during heavy rainfall in monsoon.

The flexural slip along the contacts between parallel layers in folded granite gneisses along Charmadi ghat stretch is observed. The flexural slip/discontinuous simple shear mechanism may occur along bedding planes or cleavage planes in granite gneiss and the orthogonal relationship between the foliation or foliation joint with other joint sets in granite gneiss is playing a vital role in causing the slope failure. The orientation of joint sets with slope angle caused planar, wedge, and toppling at vulnerable jointed rocky slope face dipping towards the road at places along the Charmadi ghat road. The highly weathered, jointed, and deformed rock along the road stretches is found vulnerable to slope failure. At places, the plunge of the fold is dipping towards the road are identified as vulnerable slip

plane. The water seepage and water saturation of the slope build high hydrostatic/pore water pressure that leads to a decrease in the cohesive and shear strength of slope forming material. The widening of joint sets due to excessive water infiltration into the deep pervasive joint sets during the peak monsoon period induces slope instability to a greater extent. Along the road cut section, sector-wise kinematic analysis is carried out to identify the vulnerable joint sets representative slope facet where the probability of slope failure is maximum for demarcating high-risk zones. For rock mass characterization; total of 30 nos. of undisturbed and 7 nos. of oriented rock samples were collected from landslide zones and vulnerable slope facets representing different rock/overburden materials for geotechnical investigation. Due to landslide incidence, cracks are developed and retaining structures at places were damaged along the ghat road. The slope stability condition is mainly influenced by pre-disposing terrain conditions mainly governed by slope morphometry and the hydro-geological setting of the terrain. The buffer of 25-30m on either side of the drainage, intrusive litho-contact zones at places acted as favorable loci/potential zone for landslide initiation during a heavy incessant rainfall event.

According to the historic landslide inventory database, the majority of the landslides are triggered during heavy incessant rainfall during the peak monsoon period. All past and new landslide incidences are studied in detail during field investigation and risk reduction mitigation measures are suggested for critical landslide-prone areas. A suitable retaining structure, lined drainage should be provided at the toe part of the hill slope with weep holes, slope re-gradation, proper drainage management system, and an increase in ditch width along ghat road are suggested as per site condition. The landslide management map will provide a road map for the effective decision-making by policymakers and stakeholders for sustainable development and disaster management.The final landslide susceptibility map illustrates that in combined susceptibility map about 74.05% of the area falls in Low Susceptible Zone, 17.04% in Moderate Susceptible and 8.91% of the area falls in high susceptible zone.

Meso-scale (1:10,000) Landslide Susceptibility Mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

(FSP Code: M4LSSM/NC/SR/SU-KG/2021/36786)
Field season: 2021-22

By

Neha Kumari, Senior Geologist
&
Kamal Kumar, Geologist

CHAPTER 1

INTRODUCTION

1.1. Background Information:

Large scale landslides incidences involving major natural hazards/disasters in the hilly terrain of the Himalayas of extra-Peninsular India and Western Ghat hill ra nges of the Indian Peninsula are of prime societal concern in the recent past, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands. In India, nearly 15% (0.49 million sq. km.) area is landslide-prone, which is spread over 1112 Survey of India Topographic map sheets (NDMA 2009). Geological Survey of India, being the nodal agency for landslide studies in India since 2004, vigorously and swiftly implemented the NLSM programme in the hilly terrain of the Himalayas and Western Ghat regions to implement the proposed action plan 2006 of the National Disaster Management Authority (NDMA) on landslide hazard as well as risk mitigation. For wide-scale planning and management by stakeholders critically high landslide susceptible areas are identified based on macro-scale (1:50,000) landslide susceptibility mapping carried out by GSI using knowledge-driven AHP methods using multi-class index overlay method where weightage is assigned to causative geofactor thematic maps and their classes influencing landslides and slope instability, and are prioritized for mesoscale (1:10,000) landslide susceptibility mapping which is based on terrain specific rating criteria and causative factors to provide upscaled geoinformation to help administrators, planners, and policymakers.

As per the MoM-approved Landslide Vision and Strategy Document 2020-2030, the Geological Survey of India (GSI) has planned Mesoscale (1:10,000) landslide susceptibility mapping as one of its major programme on landslide investigations in different parts of India. The Geological Survey of India has already completed the national susceptibility mapping in 1:50,000 scale for the entire landslide-prone terrain in the southern region under the NLSM program. A substantial area has been

identified as highly susceptible to landslides in the region, and up-scaled landslide susceptibility information will provide appropriate geo-information for any stakeholder for use in local infrastructure and mitigation planning.

Landslide susceptibility maps spatially depict the areas where future slope failures are likely to occur due to specific environmental conditions. Given the landslide disaster in the year 2019, during heavy incessant rainfall conditions the Western Ghats hill ranges mainly Kodagu, Dakshin Kannada and Chikkamagaluru districts of Karnataka were badly affected. So, to prepare a road map for administrators, planners, and policymakers for developmental work and overcoming such natural disasters leading to loss of life and property in high landslide-prone areas, mesoscale (1:10,000 scale) landslide susceptibility mapping is taken up on a priority basis by GSI in the public interest to carry out detail field assessment to identify the causative geofactors and to suggest remedial and mitigation measures in landslide susceptible/unstable zones.

During the monsoon period mainly from July to September landslide incidences along the road cuts section along NH-SH ghat roads are commonly seen/frequently occurring in western ghat hills. In the year 2019, during peak monsoon season, Chikkamangalur and Dakshin Kannada districts of Karnataka received very heavy rainfall which caused several landslides in different parts of the districts mainly along ghat road section and a few in coffee estates which resulted in the loss of plantation and . As per the NLSM map generated on 1:50,000 scale, the area selected for the detailed investigation comes under moderate to high landslide susceptible zone in specific terrain conditions, and many landslides along the road sections were recorded during this disaster. The landslides are rock slide, earth slides and debris slides. During the southwest monsoon, Kothigera-Charmadi National Highway (NH-73) was severely affected by landslide incidences and at many places, communication corridors were blocked/breached. There were considerable losses of life, property, agriculture, plantation and forest land due to landslide disaster.

In view of the ever-increasing developmental pressures, the mean of communication networks like roads, railways, and other construction works are in progress in the hilly terrain of Western Ghats. The landuse/landcover changes, whether of natural origin or anthropogenic, can influence the susceptibility of slopes to landslides all along NH and SH ghat road sections in the Western Ghat. The road cut failure/cut slope failure is most commonly occurring phenomenon all along NH and SH ghat road sections in the Western Ghat hills. The high intensity rainfall, change in rainfall pattern, ineffective drainage management, and pronounced weathering phenomenon triggers the landslides in topographically unstable and landslide susceptible slopes in Western Ghats. The specter of climatic change i.e. rainfall pattern necessitates a greater focus on slope failures, identification of hillsides prone to slope failures, identification of causative and triggering factors, depiction of vulnerable areas by field investigation, and categorizing hillslopes as high moderate, and low landslide susceptible zones based on causative geofactors responsible for slope failure by data integration and modeling

using multi-class index overlay technique in GIS platform. So, risk analysis and landslide management map will be of greater help to the administration to make a road map for future development and management-related work. So, as per the request from the State Government and KSDMA Karnataka, a mesoscale landslide susceptibility mapping work is taken up along Charmadi Ghat stretch of NH-73, the important lifeline communication network connecting Dakshin Kannada with Chikkamagaluru district, Karnataka vide FSP code: M4LSSM/NC/SR/SU-KG/2021/36786. The objective of the present study is to categorize hillslopes as high, moderate, and low landslide susceptible zones based on possible causative geofactors influencing slope stability to understand triggering mechanisms responsible for the landslides/mass failures in each landslide failure domain. All past and new landslide incidences are studied in detail during field investigation and risk reduction mitigation measures are suggested for critical landslide-prone areas. The landslide management map will provide a road map for the effective decision-making by policymakers and stakeholders for sustainable development.

1.2 Objectives:

The objective of the present work is to carry out meso-scale (1:10,000) landslide susceptibility mapping along the Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka is mentioned below and details of the nature and quantum of work envisaged are listed in **Table 1**.

(i) To identify slope-failure domains and to prepare domain-specific geofactor maps in GIS.

(ii) To rate and weigh relevant geofactor maps for different failure domains.

(iii) To integrate the rated and weighted geofactor maps per identified failure domain in a GIS.

(iv) To combine the domain-specific landslide susceptibility models into a combined and classified landslide susceptibility map on a 10k scale.

(v) To qualitatively/quantitatively assess the landslide risk and to frame a generic mitigation/ management plan on a 10k scale for relevant value addition and direct use by the stakeholders.

Table 1: Details of the nature and quantum of work envisaged during FS: 2021-22.

Nature of Work	Target envisaged (in sq. km)
1. **Detailed pre-field landslide inventory map including ground deformation, creeps, etc., and identification of failure domains.**	15.75 sq. km
2. Preparation of pre-field thematic geofactor maps on 10k based on failure domains	15.75 sq. km
a) Landuse/Landcover Map	15.75 sq. km

b) Drainage Map	15.75 sq. km
c) Geomorphon/Landform Map	15.75 sq. km
d). Slope Morphometry Maps (Slope Angle, Slope Aspect, and Relative Relief)	15.75 sq. km
e). Slope forming material Map (Geological)	15.75 sq. km
f). Stream Power Index Map	15.75 sq. km
g) Landslide domain Map	15.75 sq. km
h) Overburden thickness map	15.75 sq. km
i) Slope Facet Map	15.75 sq. km
3. Field-based studies	
a). Validation and updation of all thematic maps and landslide inventory in the field	15.75 sq. km (184 nos. of LS)
b). Data collection for preparation of Geotechnical map	15.75 sq. km
c). Geotechnical field sample collection for determination of geotechnical parameters	15.75 sq. km (37nos.)
4. Post-field studies and modelling	15.75 sq. km
a). Updation and finalization of thematic maps and landslide inventory in GIS platform.	15.75 sq. km
b). Preparation of Geotechnical map #	15.75 sq. km
5. Preparation of landslide susceptibility map in GIS platform.	15.75 sq. km
6. Collection of Rainfall data	Rainfall data collected from available rain gauge stations.

1.3 Description of the Study Area

The study area lies in SOI T.S. nos. 48O/08 and 48O/12 and is bounded between latitudes 13°03'43.05"N to 13°07'56.44"N and longitudes 75°26'44.92"E to 75°30'31.23"E (Fig-1). The Charmadi ghat road stretch (NH-73) covers parts of Chikkamagalur and Dakshin Kannada district of Karnataka. The Charmadi Ghat (Charmady) falls in Mudigere taluk of Chikkamagaluru and Belthangady taluk of Dakshina Kannada district connecting Dakshin Kannada with Chikkamagaluru district. The Charmadi Ghat road (NH-73) is an important road corridor that passes through dissected hillslope with steep ridges connecting Dakshina Kannada with the Chikkamagaluru district. The 25 Lkm Charmadi Ghat road (NH-73) is an important road that stretches from area are Somanakadu, Horatti, Alekan Estate, Kodekallu, Jenukallu, Bidaratale, Charmadi.

Charmadi Ghat stretch starts from Charmadi village (11 km from Ujire), Beltangady taluk, Dakshin Kannada district and ends at Kottigehara (14 km from Mudigere), Mudigere taluk Chikkamgaluru District. The nearest places to the study area are Charmadi village, Ujire, Belthangady, Kottigehara, and Balur. The important locations within the study area are Somanakadu, Horatta, Alekan Coffee Estate, Kodekallu, Jenukallu, and Bidaratale. Charmadi Ghat connects the

northeastern part of Dakshina Kannada to the Chikkamagaluru district and the prominent highway is connecting Ujire (9 km from Dharmasthala) to Kottigehara (about 50 km from Chikkamagaluru).

The study area covers parts of Balur Reserve Forest with dense mixed jungle. Fairly good weathered and cart tracks are connected to human settlements in forest areas and coffee estates in Sommankadu, Banjar, Alekhan, and Horrati village areas.

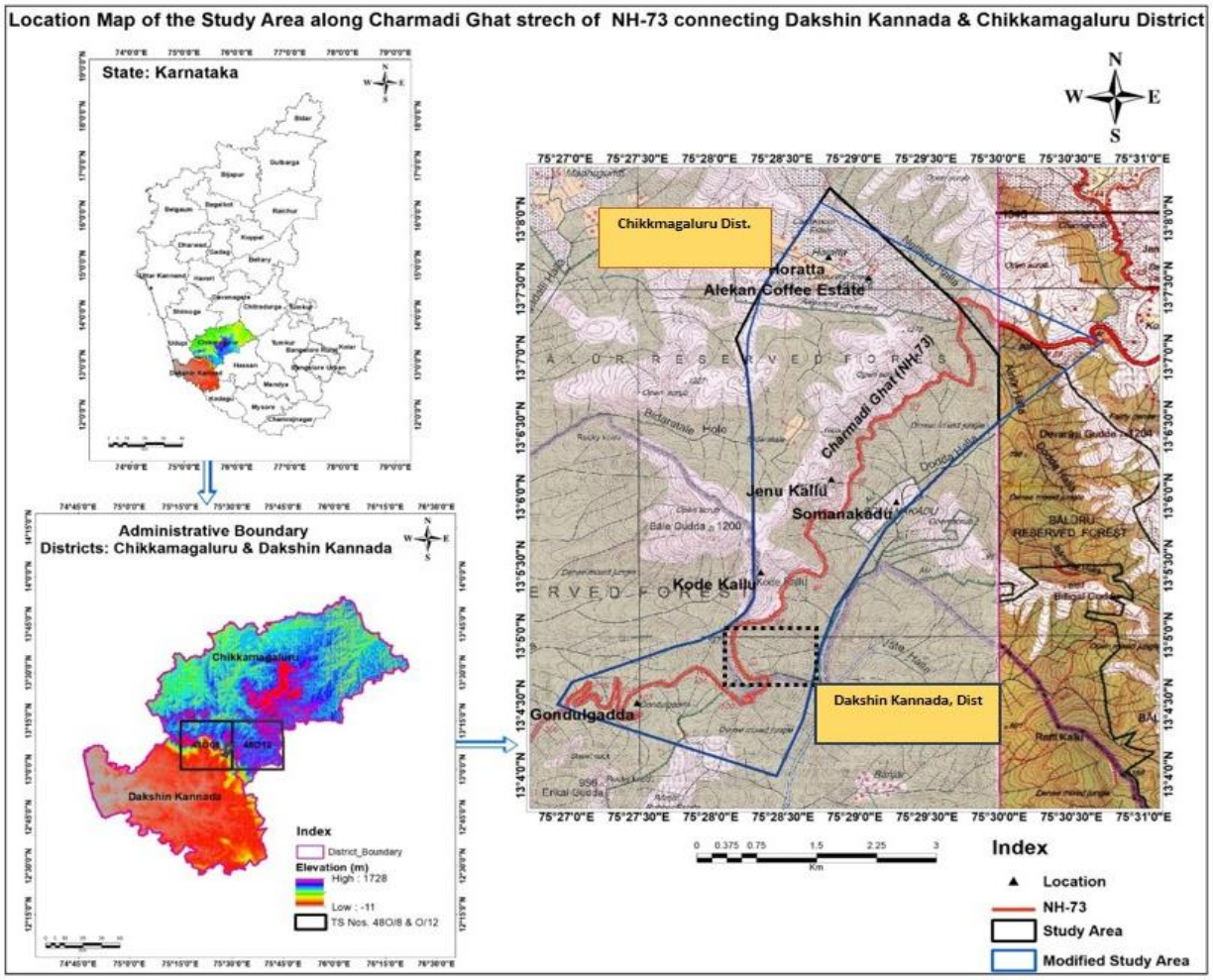


Fig 1: Location Map of the Study along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.

1.4 Physiography and Drainage

Physiographically, the area forms part of the Western Ghat hill ranges. The terrain is highly rugged with several linear and arcuate hill ranges with dissected steep slopes intermittent with the valley. The hill ranges along Charmadi ghat road comprise ridges and steep slopes trending NE-SW and steep valleys dipping towards the road. The prominent topographic feature in the eastern parts of the area is formed by the precipitous scarps of the Eastern Ghats. The area's inaccessible high hillocks i.e. steep high hill ranges are covered with thick forest and dense mixed jungle. Some prominent peaks are at elevations of 1302m, 1278m in the northern part, 1005m in the central part (Jenu Kallu), and the lowest elevation is 400m above MSL in the southern part of the study area.

The area is well drained by Nellitalu Halla, Dodda Halla, and its tributaries in the northern and eastern parts of the study area respectively. The Nellitalu Halla, Dodda Halla, and its tributaries are contributing to the Aniyur hole in the south-eastern part of toposheet no. 48O/8 in the valley portion. The drainage pattern of the stream is dendritic, trellis, and parallel in nature indicating sub-surface structural and lithological control of the terrain.

Geomorphologically, the hill range along Charmadi ghat road is highly dissected with moderately steep hillslope with ridges and intermittent valleys. The geomorphic units are classified into different landform classes. Landforms are defined as specific features on the Earth's surface ranging from major types such as mountains, hills, plateaus, basins, and plains to minor types such as gullies, valleys, shorelines, slopes, ridges, canyons, cliffs, spurs and depressions. The landforms form over a long period by tectonic, erosional, and depositional processes. Landforms are characterized and classified by visualizing different dynamic features controlled on a regional or local scale by lithology, climate, erosion, tectonic activities, and to some extent by man-made activities.

1.5 Climate, Rainfall, and Soil Type

The climate of the study area is moderate to hot in summer and cool in winter. Throughout the year the climate is pleasant. During the summer months from March to May, the maximum day temperature is around 30°C and the night temperature is around 19°C. December and January are the coldest months, the mean maximum temperature ranges from 5-15°C. The annual variation of temperature is small in the Ghats. In the cold weather season from November to February, dry continental winds prevail over the hills. The dry winter season is followed by the pre-monsoon transition period of a hot summer extending from March to the beginning of June. The average annual rainfall of the Chikmangaluru district is 1904mm. The eastern belts receive rainfall of about 600mm/yr only, while the western belt receives around 3000mm/yr. During the southwest monsoon, the state receives 80% of its rainfall. Rainfall in the winter season (January to February) is lesser than in the hot weather season (March to May). The distribution of rainfall in August follows the same general pattern as in July but the amounts are generally less. The distribution of September rainfall over the area is similar to that of August but amounts are less. Subsequently, the monsoon withdraws and retreats by October. About this time the winter season of northeast monsoon begins but is generally dry in this area. With the advent of the monsoon rains, the maximum temperatures fall rapidly in the Ghats. The monsoon period has almost uniform temperature with very little variation. The autumn weather follows the rains in the Ghats from November to January. The area receives average rainfall during the rainy season. The Ghat section receives very heavy rainfall of over 7000 mm during the monsoon. Climate will be cold in winter and moderately hot in summer. Past 10 years of rainfall data obtained from different rain gauge stations of different taluks for the

period (2008-2017) indicates that Kotigehara and Mudigere taluk (1055mm) receives maximum average rainfall in June and July influenced by advancing southwest monsoon that triggers landslip/landslide incidences.

The peninsular hill soils are categorized into four main types viz, red soil, black soil, lateritic soil, and alluvial soil by Raychaudury et al. (1963). The major soil type in the study area is red loamy & sandy soil. Laterite is generally reddish and often has a vermicular structure. They are formed under conditions of high rainfall with alternating wet and dry periods. The sub-soil contains hydrated oxides of aluminum and iron. The soils of this group are well developed on the summits of hills. Alluvial soils are formed by transportation by streams and rivers and deposited over plains and valleys. The escarpment of the Ghats is made up of a succession of sub-vertical rocky crags and zones. ***(Source: Central Ground Water Board, Chikkmagaluru Brochure)***

1.6. Previous Work:

Given the ever-increasing developmental pressures and human interferences in the hilly terrain of Western Ghats instability of hillslopes and hillside collapse leading to landslides all along National Highway (NH) and State Highway (SH) Ghat road sections are the most common phenomenon. The parts of Kodagu, Chikmagalur, Hassan, Shimoga, Dakshin Kannada, and Uttar Kannada Districts in the state of Karnataka are well affected by landslides/landslips incidences, especially during heavy rainfall in monsoon due to improper and ineffective drainage, and a high degree of weathering phenomenon prevailing in the study area.

The vulnerable stretches of the western ghat hill ranges of Karnataka are landslide prone during peak monsoon season. Our present study area, being a part of western Karnataka, has also been affected by landslide events rather frequently, especially during monsoons. Moreover, the Geological Survey of India, being the nodal agency for landslide studies in India, has been working in the area for a few years for preparing landslide inventory and landslide hazard zonation. Additionally, few site-specific and post-disaster studies had also been taken up. The present study area covers parts of the Chikmangaluru and Dakshin Kannada districts, Karnataka.

To update the landslide inventory database along National Highway (NH) and State Highway (SH) roads in Western Ghat sections the proposal was taken up in Mission-IV under the Engineering Geology and geotechnical investigation programme of GSI: Landslide Hazard Evaluation. In order to implement the proposed action plan for the landslide hazard and risk mitigation, the landslide inventory database for preparation of the future models was carried out. In the first phase of the inventory of landslides, the landslides along the National Highways (NH) and State Highways (SH) of the Western Ghat section in parts of Goa state and parts of Karnataka state in toposheets no. 48I/2, I/3, E/14, 15 & 16, and J/7, J/6, J/9, and L/13 were taken up during F.S: 2007-08 to develop

a landslide database for future landslide zonation and modelling as a part of the action plan of the MHA on landslide Hazard and risk mitigation.

During FS: 2008-09, Maruthi K.V; Pradhan U.P and Mishra A.K carried out "Landslide inventory along NH & SH of ghat roads in Chikmagalur, Coorg and Shimoga districts, Karnataka". During investigation Landslide inventory mapping among the vulnerable stretches of ghat road sections which include parts of Kothighere to Kalasa and Kothighere to Charmudi Ghat section. Total 45 nos. of landslide incidences were recorded along Kothighere to Charmudi Ghat section road section within 15km stretches of this ghat section. Most of the landslides are shallow debris/earth slumps confined to vertical road cuts. The cut slope height and slope angle play a very important role in landslide initiation. The average overburden thickness of soil varies from 4-5m mostly consisting of soil and highly weathered rock. The proper drainage management system, slope gradation, and suitable retaining structure are suggested as per site conditions.

During FS: 2008-09 and 2009-10, Mishra A.K; Pradhan U.P and Maruthi K.V carried out "Landslide hazard zonation on macro-scale (1:25,000 scale) along Charmudi ghat section from Charmudi to Kotigehara, Kotigehara to Kalasa and Sakleshpur to Uppinangadi in Dakshin Kannada and Chikmagalur districts, Karnataka". Total 45 nos. of landslide incidences were recorded along Kothighere to Charmudi Ghat section road section within 15km stretches of the Charmadi ghat section. The majority of the landslides are shallow debris slides of translational nature and 6 rock slides initiated by wedge failure were recorded along the nearly vertical (70-80°) road cut. The hillslope along Charmadi ghat is covered with thick to moderate vegetation cover. The depth of the overburden ranges from 0.5m to 2m comprises of soil and weathered rock. Most of the landslides are grouped as new slides (76 slides or 69.09% of the total) followed by old slides (30 slides or 27.27% of the total) and reactivated slides (4 slides or 3.64% of the total landslide incidences).

During the F.S: 2009-10 (K.V. Maruthi et. al, 2011) Landslide inventory was carried out along NH & SH of ghat roads covering parts of toposheet nos. 48O/7, 48O/8, 48O/11, 48P/7, 48P/11 & 48P/15 in Chikmagalur, Coorg, Dakshina Kannada, Udupi, and Shimoga Districts, Karnataka. In this report among the various road sections, parts of the Chikmagalur district boundary to Belthangdy, Aldur to Balehonnur, and Balehonnur to Koppa come under the present study area. The authors recorded a total of 42 nos. of landslides along these road sections. As per their observation, all slides studied were caused due to human interference with natural slopes. The main cause of landslides in the Western Ghats are toe cutting of hill slopes for the construction of roads, modification for human settlement, highly weathered rock mass, and high amount of rainfall during monsoons. All landslides are shallow debris slides. The authors recommended a proper drainage management system as several blockages were observed. They also suggested avoiding vertical slope cuts in the future and to construct the retaining wall as per site conditions.

During F.S: 2010-12, the landslide inventory was carried out by (K.V. Maruthi et. al, 2012) along the road sections of the Western Ghat in Uttar Kannada and Chikmangalur districts covering parts of Toposheets no. 48 J/1, 6, 7, 10, 11, 14 & 15; 48 O/6, 7, 8, 10, 11, 14 & 15. The study reveals that most of the landslides are shallow (<2m depth) debris slides/slumps with the height of the cut slope as well as the inclination playing a major role in triggering the slides as the slides are confined to cut-slopes between the Crown to Toe of the slope. The study also reveals that the majority of the slides are restricted to the cut slopes having more than 10m elevation and quite a steep slope angle varying between 70° and 90°. The relative relief from the cut-slope has also been low to moderate varying between 5m to 20m at all sections with relatively a heavy overburden varying from 0.5-10m.

As the frequent landslide occurrences have taken place in the recent past in the hilly terrains of the Himalayas that have caused the national sorrow. Ministry of Mines, Government of India has taken up a nationwide programme on "National Landslide Susceptibility Mapping" on a 1:50,000 scale in 2014 for delineating the landslide susceptible zones for the societal benefits. Geological Survey of India, being the nodal agency for landslide studies in India has taken the nationwide programs for generating the baseline data in the field of landslide hazard study and macro-scale (1:50,000) Landslide Susceptibility Mapping.

During FS: 2017-18 Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/7 & O/8 Chikmangaluru, Dakshin Kannad districts, Karnataka on 1:50,000 scale by Tavi Gupta et. al, 2018. A total of 115 landslides were recorded along different road sections and the root cause of all the landsides are slope modification and heavy rainfall as triggering factors during monsoons. Out of 115 landslides, 75 nos. of landslides are recorded along the NH – 73 in Kothighere – Ujire road section (Charmadi Ghat section). The majority of the slides are shallow translational debris slides. As per the final landslide susceptibility map, 63% of the area falls under the low susceptibility zone, followed by 28% and 9% of the area that falls under the moderate and high susceptibility zone respectively. Among the 115 landslides recorded in the study area, 66 (57%) landslides fall under high susceptibility areas followed by 38 (33%) and 11 (10%) landslides falling in moderate and low susceptibility zones respectively. So, as a whole, out of 115 landslides, a total of 104 (90%) landslides fall under high and moderate susceptibility zones which indicates that the final susceptibility map derived by the knowledge-driven method is perfectly fitting with our present study area. A total of 75 nos. of landslide incidences have been recorded in the Charmadi Ghat of 20 km road corridor and all of the landslides are the result of the toe cutting of the slope for road construction. Moreover, most of the landslides are active or reactivated in nature, with few landslides in suspended or dormant conditions. Charmadi Ghat of 20 km road corridor is showing low angle valley side dipping major joint at many places.

During FS: 2017-18 Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/11 & 12 Chikmangaluru, Dakshin Kannad and Hassan districts of Karnataka were carried out on a 1:50,000 scale by Neha Kumari et.al, 2018. A total of 58 landslides were recorded in the study area. Along Mudigere-Kotigehara road section: 5 nos. of shallow rock slides and 2 nos. of debris slides covering parts of Toposheet no. 48O/12 were studied. Major slope failures are restricted to "Extensive cut slope" with a steep slope angle between 70°-85° and vertical height >10m. Most of the slope failures are occurring on loose material (in-situ soil), highly weathered, fractured and jointed rocks. The water seepage and water saturation of the slope leading to a decrease in the cohesive and shear strength of slope forming material. The road cut failure triggered by incessant rainfall is the causative factor for landsliding. The remedial measures required to stabilize the disturbed zones are retaining wall, lined drainage at the toe part of the hill slope with weep holes, and slope re-gradation.

The Bangalore-Mangalore National Highway (NH-234) passes through the Mudigere-Attigere-Kotigehara-Beltangadi road section. A total of 8 landslide incidences were recorded, in which 2 nos. of debris slide, and 2 nos. of rock-cum-debris slides recorded on Piedmont Slope and 4 nos. of rock slides were recorded on a moderately dissected hillslope. The western part of the study area on NH-234 covering T.S nos. 48O/12 and about 3 km from Kotigehara 4 nos. of debris/ rock slides were recorded within a 0.5 km range. The landslide incidences and cut slope failure have occurred on slopes varying from 15°-25° & 25°-35°. The area to the west of Channahodlu, Devanagulu, Hebbraige and Sabli village are moderate to highly susceptible. The areas along Hulukumale Halla are highly susceptible zones.

The triggering factors for slope failures are weathering and increased pore water pressure in highly weathered rock mass, jointed and fractured rocks that greatly reduce shearing resistance of underlying rock units during heavy rainfall. The presences of very prominent penetrative joint sets allow deep infiltration during the rainy season and propel the processes of weathering. These conditions were very favourable for the occurrences of landslides during incessant rainfall. The poor drainage maintenance and management, increase in pore water pressure and saturation of overburden material lead to shear failure of hillslope during incessant rainfall events during high rainfall in the peak SW monsoon period.

Taking into account the vulnerability of hilly terrains of the Western Ghats, especially during heavy rainfall, post-disaster landslide studies are carried out to identify causative geofactors responsible for the initiation of a landslide and slope instability. Based on geo-scientific causes of slope failure, site-specific short and long-term cost-effective remedial measures are suggested for slope stabilization at landslide locations/sites. In the year 2019, Kapil Singh & Kamal Kumar, Geologists carried out post-disaster landslide studies in Chikkamagaluru and Mudigere taluks, Chikkamagalur district, Karnataka during the landslide disaster triggered by the SW monsoon

during the month of July-August 2019. A total of 4 landslide incidences were recorded along Harman ghat road and 2 nos. of debris slide in Alekhan Horatti estate. During the post-disaster landslide studies in the year, 2019 carried out in Mudigeri and Koppa taluk of Chikkmagalur district, a total of 46 landslide incidences were recorded including Alekan coffee estate and parts of Charmadi ghat road. In the year 2021, a preliminary assessment of Landslides in Mudigere, Koppa, Chikkamagaluru, Narasimharajapura taluks of Chikkamagaluru District, Karnataka state was carried out by Shri Aijaz Ahmad Bhat and Neha Kumari, Geologists. A total of 13 landslide sites/locations were studied. Among them, most of the landslides occurred along the vulnerable stretches of the road section during the peak monsoon period. Mostly the landslides are debris/earth slides of shallow translational in nature. The landslides are mainly triggered by heavy incessant rainfall during the peak monsoon season in the month of July-August 2021. The shear failures of rock mass resulted due to excessive infiltration and slope saturation during an incessant rainfall event. Based on field assessment and observations at landslide sites, a 42-point parametric landslide inventory database is generated, and site-specific cost-effective remedial measures are suggested as per the existing site condition. In Mudigere taluk: Total 2 nos. of landslide incidences recorded along Kalasa-Sunkasale-Hornadu (SH-106) road section and 5 nos. of landslide recorded along Charmadi Ghat (NH-73) road section and one in Beltangady taluk of Dakshin Kannada district.

1.7 Acknowledgements

The authors feel immense pleasure in extending their sincere thanks to Shri Janardan Prasad, ADG & HoD, Southern Region, Shri S. K. Tripathi, Dy. Director General & RMH-IV, Southern Region for giving us an opportunity to work on this project. The authors are grateful to the than Shri Debkumar Bhattacharya, Dy.DG, SU: K&G, and Dr. S. Ravi, Dy. DG, SU: K&G, GSI, Bengaluru for their administrative and financial support for the successful execution and completion of the assigned work.

The authors are highly indebted to the project supervisor Shri R. Sajeev, Director (G) for his encouragement, technical guidance, and constant motivation and also for imparting valuable field knowledge during the course of field investigation.

The authors feel privileged in extending their sincere thanks to specialized domain experts of Landslide Division, (GHRM) Cell, CHQ, Kolkata for their technical support and valuable guidance fot generating quality output.

The authors extend their especial thanks to colleagues, local residents and supporting staffs in the field for their co-operation, sharing valuable informations and team effort during the field investigations.

CHAPTER 2

GENERAL GEOLOGY

2.1 Regional Geology

Geologically, the area exposes rocks belonging to the Sargur Group, Peninsular Gneiss –I, Bababudan Group, and Chitradurga Group of rocks intruded by granite, quartz veins, and dolerite dykes. The area is known as the type area for the Bababudan Group of rocks. The brief descriptions of the litho units are given below (Source: Geological note of compiled 1:50000 geological map of GSI). The regional geology of the study area is shown in geological map on 1:50,000 scale covering toposheet nos.48O/8, 0/12 (**Fig-2)**.

2.1 Sargur Group:

Sargur Group is mostly seen in the western segment of the area as envelopes of varying dimensions within PG-I and it consists of banded magnetite quartzite, kyanite muscovite schist, & amphibolite.

2.2 Peninsular Gneissic Complex (PGC):

PGC is represented by granite & granite gneiss and is occupying the major part of the area. The gneisses are medium to coarse-grained, mesocratic consists of quartz, plagioclase, and biotite. They also exhibit migmatitic banding in places.

2.3 Dharwar Supergroup

The Dharwar Supergroup in the area is represented by the Bababudan Group of rocks and the Chitradurga Group of rocks.

2.3.1. Bababudan Group:

Bababudan Group of rocks is represented by Kudremukh Formation, Kodachadri Formation, Kalasapura Formation, Santhaveri Formation, and Mullaingiri Formation in the study area. Kudremukh and Kodachadri Formations are exposed in the central part of the area while Kalasapura, Santhaveri and Mullaingiri Formations are exposed in the eastern part of the area.

2.3.1.1 Kudremukh Formation consists of amphibolite, meta basalt, quartzite, banded magnetite quartzite & metaultramafite. Amphibole is fine to medium-grained, dark green in colour, amygdular occurring as a small lensoidal body along with meta basalt 2km south west of Venigudda Δ 1026 m hill. Meta basalt is the major litho unit in this segment of the Western Ghat schist belt. Meta basalt is fine-grained, and greenish consisting of chlorite, actinolite, epidote and plagioclase. Quartzites occur as a small linear/lensoidal body in the eastern margin of the schist belt and are exposed at the

top of Δ 1157 m hill. Persistent bands of banded magnetite quartzite occur along with meta basalt confined to the central part of the area. Meta ultramafics occur as linear folded bands in the western part and as tabular bodies within meta basalt near the eastern margin of the schist belt. Meta ultramafics are greyish green in colour, fine-grained consisting of talc-actinolite-tremolite and chlorite.

2.3.1.2 Kodachadri Formation consists of banded magnetite quartzite and chlorite schist with bands of banded magnetite quartzite and is exposed in the southwestern corner near Jamble.

2.3.1.3 Kalasapura Formation consists of amphibolite that occurs along the eastern margin as linear bands and as lensoidal bodies within meta basalt of Mullaingiri Formation. Amphibolite is fine-grained, dark green, and consists of hornblende, plagioclase, and minor amounts of quartz and biotite.

2.3.1.4 Santhaveri Formation consists of meta basalt and bands of magnetite quartzite are confined to the western margin of the Bababudan schist belt in this segment. Metabasalt is fine-grained and consists of chlorite, actinolite, epidote and plagioclase.

2.3.1.5 Mullaingiri Formation is represented by metabasalt, banded magnetite quartzite, carbonaceous phyllite, and ferruginous phyllite. Metabasalt occupies the central part of the schist belt and is fine-grained, schistose consists of chlorite, actinolite, epidote and plagioclase. A small lensoidal body of limestone is exposed along the western margin of the schist belt in the southeastern part of the area. Limestone is fine to medium-grained, grey coloured, and consists mainly of recrystallized calcite. A lensoidal body of carbonaceous phyllite is present within ferruginous phyllite which is exposed 1.5 km east of Maduguni.

2.3.2.Chitradurga Group: Chitradurga Group is represented by Jhandimatti and Joladhal Formations in the study area.

2.3.2.1 Jhandimatti Formation occupies the central part of the area and consists of conglomerate, amphibolite, banded magnetite quartzite, chlorite schist, and garnet biotite schist. A small band of conglomerate is exposed in the southern part of the area south of Basarikatte at the contact of Kudremukh and Jhandimatti Formations. Amphibolite occurs as small outcrops in the eastern margin of the belt in the northern part of the area. Amphibolite is fine-grained, and dark green and consists of hornblende, plagioclase, and minor amounts of quartz and biotite. Amphibolite is followed by banded magnetite quartzite and chlorite schist. Chlorite schist is a major unit in this

segment. It is fine-grained, light green, well foliated and mostly consists of quartz –chlorite. Chlorite schist is followed by the garnet biotite schist in this segment.

2.3.2.2 Joldhal Formation consists of ferruginous phyllites and banded magnetite quartzite. Ferruginous phyllite is fine-grained, well foliated, fissile, and confined to the central part of the schist belt. Iron and manganese quartzite occurs as persistent bands within phyllites.

2.4 Younger Intrusives: The younger intrusives comprises of acidic intrusives mainly quartz veins and intrusive granite and basic intrusives dolerite and gabbro dykes.

2.4.1 Granites*:* Granite intruding into PG – I and schist belts is observed in the central part of the area. It is grey coloured, mesocratic, and coarse-grained rock. It consists of quartz, plagioclase, and minor amounts of biotite. It is exposed near Hornadu and Galigandi.

2.4.2 Basic Intrusives: Basic intrusive is represented by dolerite and gabbro dykes trending in the northwest – south east and north-south directions. Dolerite is fine to medium-grained; dark green consists mainly of pyroxenes and plagioclase.

2.4.3 Acidic Intrusives: Acid intrusive is represented by quartz veins and intrusive granite in the central part of the area.

2.5 Laterite: Due to the high degree of tropical weathering, lateralization is observed in a few places in the study area. The laterites are reddish in colour and rich in ferric/aluminium oxides. The lateritic weathering profiles exhibit three zones viz. duricrust, underlying clays, and bottom saprolite unit. Variation in mineralogy and texture of the parent rock has resulted in the formation of ferruginous, manganiferous, and aluminous laterite. Laterite body is exposed in the southwestern part of the study area.

STRUCTURE:

Bedding (S0) in banded magnetite quartzite, schistosity (S1) in schist rocks, and gneissosity (S1) in gneisses are the major planar features. The bedding in banded magnetite quartzite is striking in the north-south direction and dipping easterly in Shimoga schist belt rocks, north west – south east in Western ghat schist belt, north-south to NNE -SSW dipping steeply to west in Bababudan belt. A major synformal fold is plunging towards the south is recorded within the Shimoga belt in the southern part. Gneissosity in gneiss varies from N-S to N10°W to S10°E with steep dips towards the east.

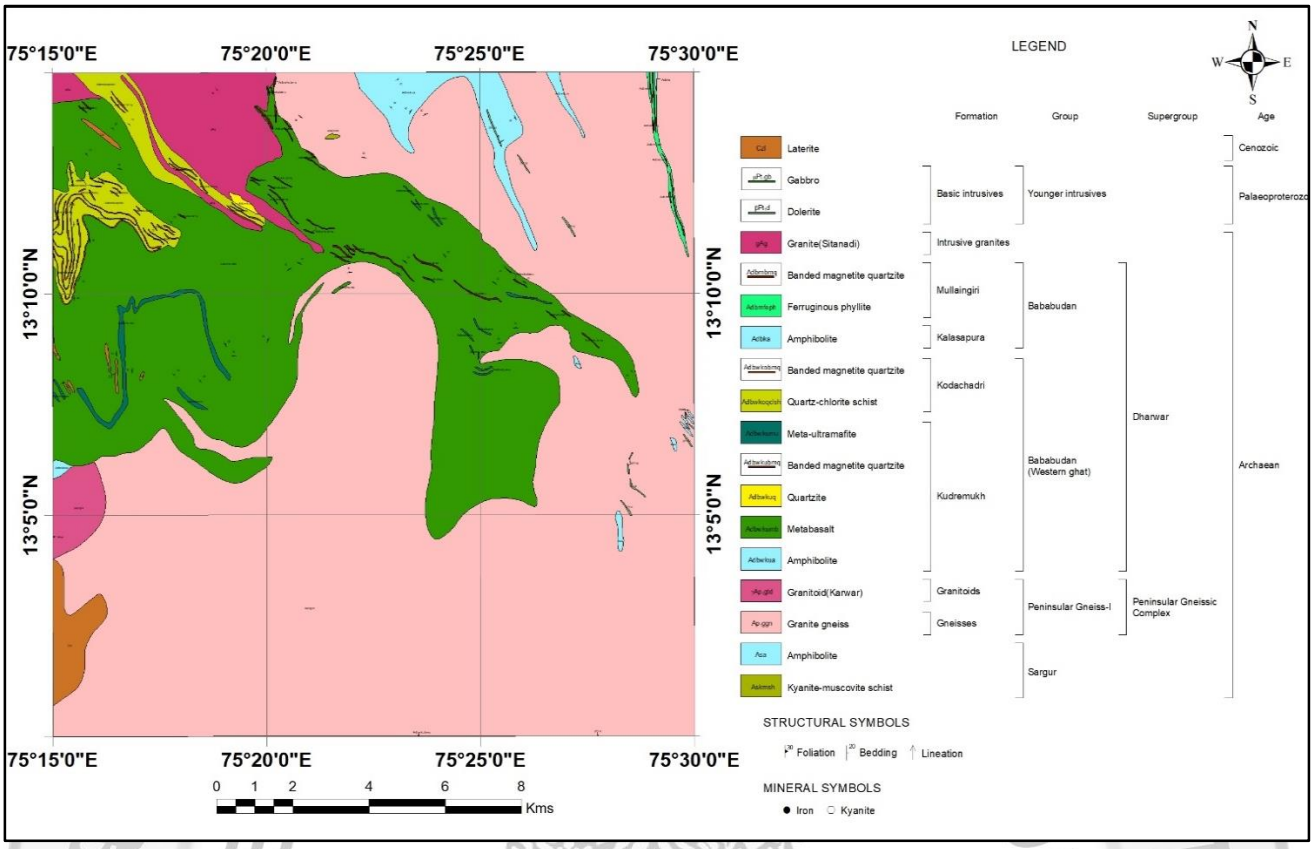


Fig 2: Geological Map (1:50,000 scale) covering TS nos. 48O/8 and O/12 (Source:GSI)

2.2. GEOLOGY OF THE STUDY AREA:

Geologically, the area exposes rocks belonging to the Sargur Group, Peninsular Gneiss-I, Bababudan Group, and Chitradurga Group of rocks intruded by granite, quartz veins, and dolerite dykes. The brief descriptions of the lithounits are given below (Source: Geological note of compiled 1:50000 geological map of GSI). The geologiacl map of the study area is updated on 1:10,000 scale based on physical propoerties of litho-unit mapped during geological mapping. The lithological sucession is shown is shown in **Table 3** and updated geologicl map is shown in **Fig-3**.

2.2.1 Sargur Group:

Sargur Group of rock is consists of amphibolite and is mostly seen in the western segment of the area. Amphibolites occurring as enclave within granite gneiss of PG-I.The area exposes rocks belonging to the Sargur Group, represented by rock type amphibolite and muscovite schist occurring as a minor lensoidal enclave within PG-I exposed along the road cut section of Charmadi ghat along the hill slopes at places.

a) Amphibolite: Amphibolite is fine to medium-grained, dark green, showing salt and pepper texture and typical spheroidal weathering pattern. It is occurring as an enclave/xenolith with Peninsular Gneiss-I. Based on the physical properties of rock, it is identified that the amphibolite is

fine-grained, dark green consists of hornblende, and plagioclase as essential minerals and epidote, biotite and quartz as accessory minerals. The amphibolite enclaves are oriented in NW-SE, N-S, and NE-SW directions exposed along Charmadi ghat road.





Photo 1: Field photograph showing Amphibolite along Charmadi Ghat road (NH-73), Mulaya Maratha Guest House.

2.2.2 Peninsular Gneissic Complex (PGC):

PGC is represented by granite & granite gneiss and is occupying the major part of the area. The gneisses are medium to coarse-grained, mesocratic consists of quartz, plagioclase, and biotite. They also exhibit migmatitic banding in places.Major part of the study area is represented by granite gneiss of Peninsular gneiss-Iand Migmatite gneiss are observed at places.

a). Gneisses: Peninsular gneiss is represented by gneiss and older granite. Gneiss is medium to coarse-grained, mesocratic mainly consists of quartz, plagioclase, and a minor amount of biotite. Migmatitic features and banding are observed at places. Migmatite gneiss is medium to coarse-grained, mesocratic consists of quartz, plagioclase, biotite, and a minor amount of hornblende. At places, unmapped units of older granite (Chikamagalur) are exposed which are found intrusive into gneisses. Shearing in migmatite gneiss is noticed along the contacts with basic enclaves.

2.2.3. Dharwar Supergroup: The Dharwar Supergroup in the area is represented by the Bababudan Group of rocks and the Chitradurga Group of rocks.

2.2.3.1 Bababudan Group: Bababudan Group of rocks is represented by Kudremukh Formation, Kodachadri Formation, Kalasapura Formation, Santhaveri Formation and Mullaingiri Formation in the study area.

2.2.3.1.1 Kudremukh Formation consists of amphibolite, metabasalt, quartzite, banded magnetite quartzite & metaultramafite. Amphibole is fine to medium-grained, dark green in colour, amygdular

occurring as a small lensoidal body along with metabasalt 2km southwest of Venigudda Δ 1026 m hill. Meta basalt is the major litho unit in this segment of the Western Ghat schist belt. Metabasalt is fine-grained, and greenish consisting of chlorite, actinolite, epidote and plagioclase. Quartzites occur as a small linear/lensoidal body in the eastern margin of the schist belt and are exposed at the top of Δ 1157 m hill. Persistent bands of banded magnetite quartzite occur along with metabasalt confined to the central part of the area. Meta ultramafics occur as linear folded bands in the western part and as tabular bodies within metabasalt near the eastern margin of the schist belt.

2.2.3.2 Chitradurga Group: Chitradurga Group is represented by Jhandimatti and Joladhal Formations in the study area.

2.2.3.2.1 Jhandimatti Formation occupies the central part of the area and consists of conglomerate, amphibolite, banded magnetite quartzite, chlorite schist, and garnet biotite schist. Amphibolite occurs as small outcrops in the eastern margin of the belt in the northern part of the area. Amphibolite is fine-grained, and dark green consists of hornblende, plagioclase and minor amounts of quartz and biotite.

2.2.4 Basic Instrusives: Basic intrusive is represented by dolerite dykes trending in northwest-southeast & north-south directions. Basic intrusives are represented by dolerite dyke criss crossing Peninsular Gneiss-I with varying trends i.e. NE-SW, N-S, NNW-SSE directions. Dolerite is fine to medium-grained; dark green consists mainly of pyroxenes and plagioclase. A Bouldery outcrop of dolerite is observed along the Charmadi ghat hill section along the slope and valley portion and in the Alekhan-Horaata coffee state.



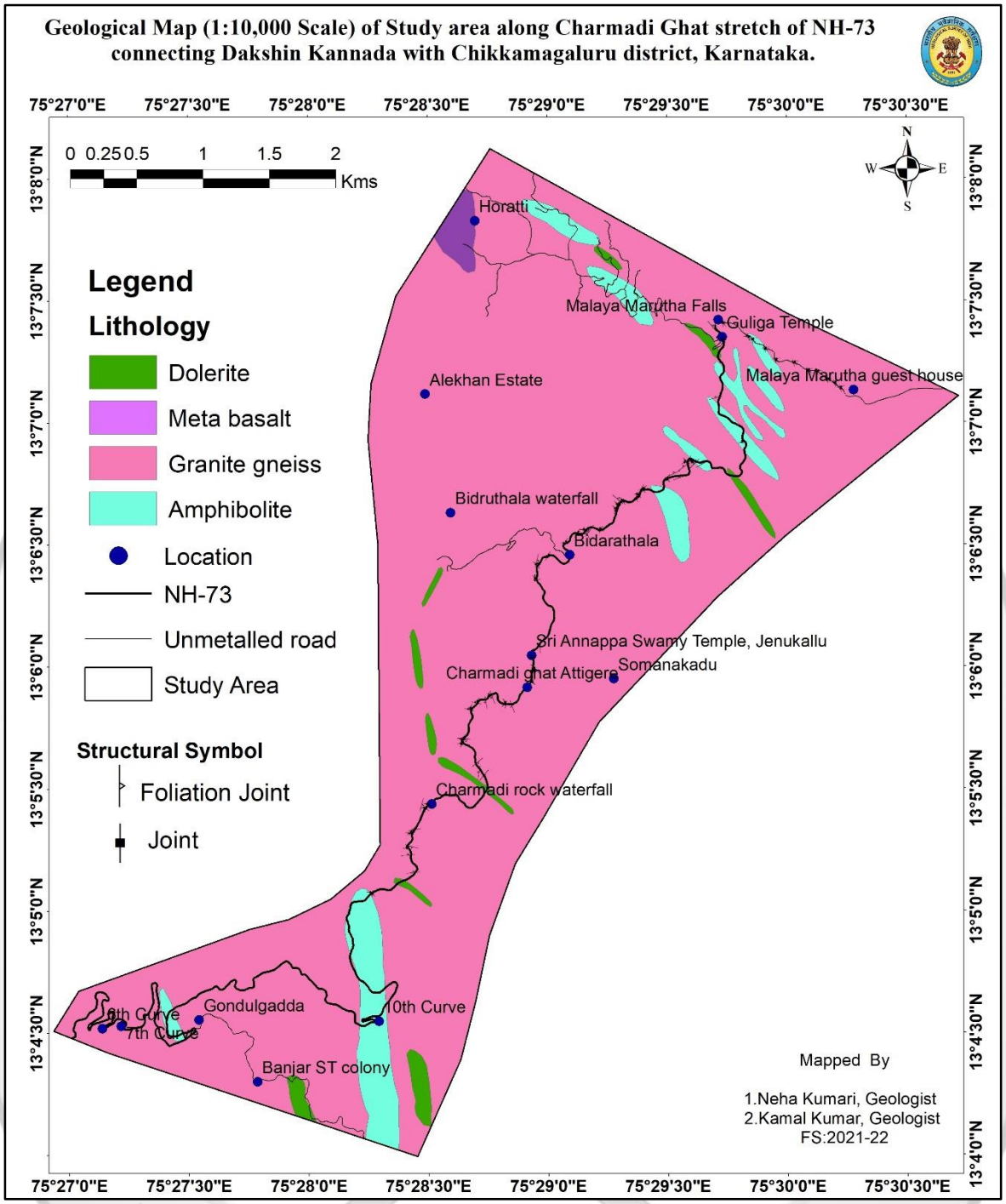
Photo 2: Field photograph showing Dolerite along Charmadi Ghat road (NH-73).

STRUCTURE AND METAMORPHISM:

The gneissosity trends in NW-SE dipping 60-70° westerly. Ptygmatic fold and magmatic features are observed at places. The planar structures are represented by bedding, gneissosity, fracture, cleavage, and joints. Minor folds are recorded within the gneiss. The regional foliation trends NW-SE to NNW-SSE with a westerly dip of 50°-60°. Gneissosity is the most dominant planar fabric in the area. The granite gneisses show well-developed foliation. The strike of the foliation varies from N65°W-S65°E to E-W, with steep northerly dips of 60° to 70°. The lineation in the gneisses trend N-S with a plunge of 30°-40° towards the south. The foliations and joints are prominent secondary planar structures observed in exposed rocks. In general two sets of prominent joints are present trending NE-SW and ESE-WNW.

Table 3: Chrono-lithostratigraphic succession of the study area covering parts of T.S nos. 48O/08 & 48O/12.

Lithology	Formation	Group	Supergroup	Age
Quartz vein and Younger granite	Acid Intrusive	Younger Intrusive		Palaeo proterozoic
Dolerite	Basic Intrusive			
Metabasalt	Kudremukh	Bababudan	Dharwar	Archean
Granite Gneiss	Gneisses	Peninsular Gneiss-I	Peninsular Gneissic Complex	
Amphibolite		Sargur		



	Formation	Group	Supergroup	Age
βPt₅d Dolerite		Basic intrusives	Younger intrusives	Palaeoproterozoic
Adbwkumb Metabasalt	Kudremukh	Bababudan (Western ghat)	Dharwar	Archean
Ap₅ggn Granite gneiss	Gneisses	Peninsular Gneiss-I	Peninsular Gneissic Complex	
Asa Amphibolite		Sargur		
Study Area				

Fig 3: Upscale 1:50K Geological map of study area on 1:10,000 scale with few modifications.

CHAPTER 3

METHODOLOGY

3.1 Selection of mapping units:

Before the evaluation of landslide susceptibility, the mapping unit should be selected first, which directly determines the extraction accuracy of the influencing factors and the suitability of the final evaluation results. Currently, common mapping units include grid units, slope units, and watershed units. Among them, slope units can more closely reflect the topography of the study area, so they are widely used in landslide susceptibility mapping. Therefore, slope units were adopted for landslide susceptibility mapping. The basic principle of slope units is the division of the study area into map units by ridge lines and valley lines. The slope facet map is prepared with the help of contour, ridges, spur, gullies and drainage as major topographical boundaries and slope break to delineate slope facets with similar/homogeneous slope inclination and slope direction.

3.2 Input data and maps:

For the mesoscale landslide susceptibility mapping on 1:10000 scale, the work is divided into three stages i). Pre-field map preparation, ii). Field-based thematic map preparation and updation of the pre-field thematic maps iii). Post-field data modelling and analysis. The input data and maps required for landslide susceptibility analysis are described below:

Thematic Geofactor Maps Preparation:

I. **Pre-field Studies:** The pre-field thematic maps prepared for field validations are Landuse/ Landcover, Landform, Drainage, and Slope Morphometry (Aspect, Curvature, Slope & Relief) maps, Landslide inventory maps prepared from satellite imagery.

- **Topographic Base Map** is prepared with DEM-derived contour, important location, road, river and slope facet in GIS platform. CartoDEM (10m resolution) georeferenced satellite data product (UTM projection using WGS84 datum). Topographic map sheet and CartoDEM (10m resolution) is used for generating Topographic base maps on a 1:10,000 scale. The contour interval of preferably 10m interval is used for the preparation of the base map.
- **Slope Facet Map** is prepared semi-automatically by digitizing facet boundaries in a GIS by visualising the hillshades, drainage boundaries, and contour intervals, and their spatial disposition, etc.
- **Landuse/Landcover Map** is prepared with the aid of satellite data and multi-temporal Google imagery in a GIS platform

- **Landform, Stream Power Index, Drainage, and Slope Morphometry (Aspect, Curvature, Slope & Relative Relief) Maps** are DEM derivative categorical maps prepared from CartoDEM data of 10m resolution.
- **42 point geoparametric Landslide inventory database** are prepared with the help of multi-temporal satellite data, Google Earth imagery, historical and event-based data reported in earlier GSI reports, and other relevant papers/articles.

II. Field-based studies: The field-based studies includes pre-field thematic map validated during the mapping and preparation of field-based thematic maps.

- **Pre-field Map validation:** Land use/Land cover, drainage, and slope facet are modified after field validation
- **Field-Based Maps**: **a**. Geological map, **b**. Regolith Thickness map **c**. Slope Forming Material (SFM) map and **d**. Geotechnical map using the point maps with location and data of RMR_{basic}, regolith thickness, and feature/polygon maps with landslides and instability features on the ground are prepared in the field. The above maps are prepared by taking close field observations, and vital field-based data on lithology and structure are plotted onto the pre-field maps for updating lithological boundaries and other details.

III. Post-field Derivative Maps: The post-field derivative map is prepared from field-based data i.e. structural and RMR data collected during mapping.

- **Kinematic Map:** The kinematic map is prepared from structural data collected during field studies to determine the probability of planar, wedge, and topple failure along vulnerable joint/foliation planes with respect to the slope angle.
- **Geotechnical Map**: The geotechnical map is prepared from geotechnical results of soil/rock samples obtained from geotechnical sample analysis (Laboratory-based) for the determination of shear parameters of slope forming material.

3.3 Categorization of the study area into Domains:

Based on slope forming material type and landslide failure mechanism, the landslide/slope failure domain is classified into the following domain such as rocky slope is classified as rock domain, soil/debris-covered areas are classified under earth/debris domain, the extensive vertical cut slope is classified as cut slope domain whereas river and water body where there is no probability of occurrence of landslides is classified under no landslide domain.

3.4 Selection of geo-factors for Domains:

Based on detailed mapping and field-based investigations, the geofactors influencing the slope stability condition are determined and selected for each landslide failure domain for the domain-based landslide susceptibility map generation. For the rock domain, the kinematic failure map and geotechnical map are selected, for the cut slope domain, relative relief is considered apart from other geofactors associated with slope failure.

3.4 Ratings and Weights of Geofactors Maps and their Classes: Ratings of geofactor classes and weights of geofactor maps are determined heuristically considering the different failure domains, the prevalent terrain conditions, and landslide inventory data. The spatial correlation of geofactor thematic maps and their classes and their role in the occurrence of landslides are explicitly studied during mapping for terrain-specific landslide susceptibility map generation.

3.5 Map integration, Classification, and Validation: To get the total estimated landslide susceptibility evaluation value (TESV), foe each domain LSER value is assigned separately for the preparation of a landslide susceptibility map on a 1:10,000 scale in the GIS platform. The heuristic knowledge-driven modelling and data integration using a multi-class index overlay of different thematic maps for each landslide failure domain are done. The validation of the model/success curve is determined using landslide incidences, surface cracks and subsidences with respect to the landslide susceptibility map.

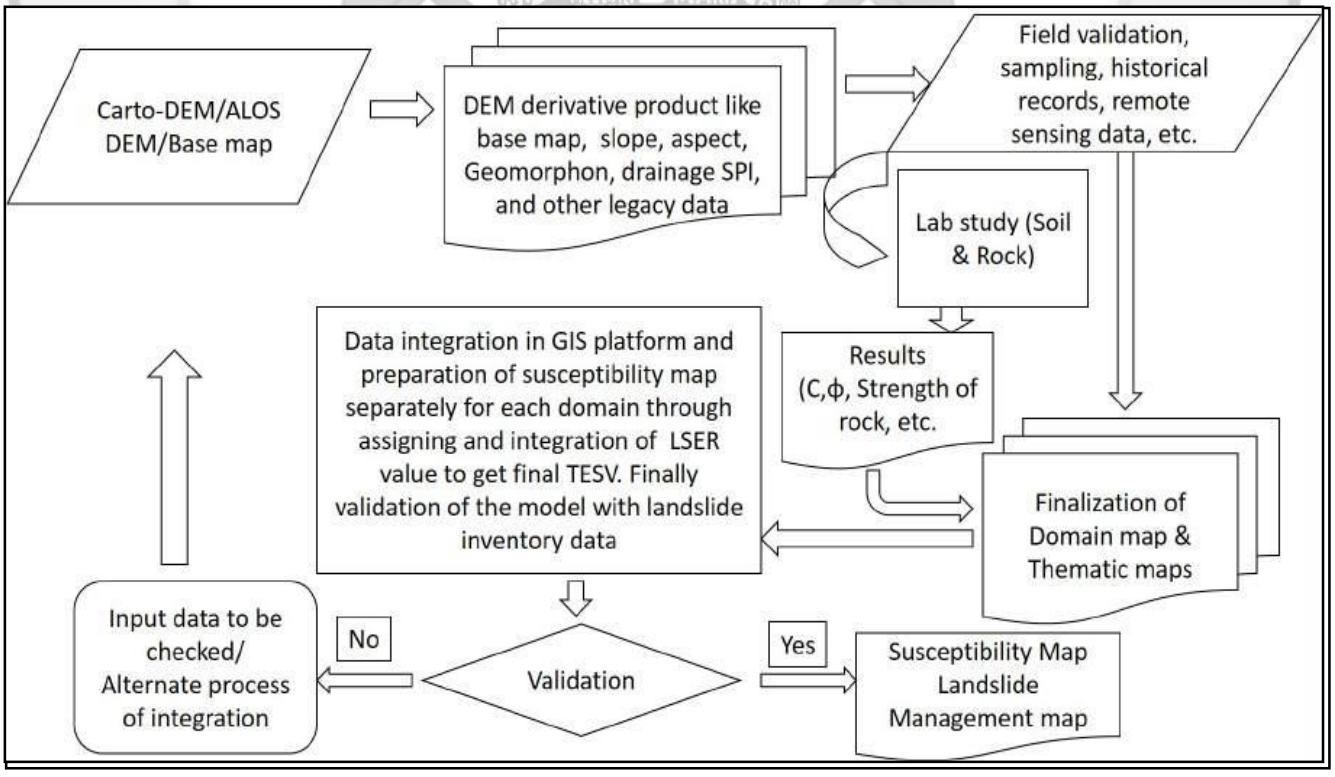


Fig 4: A generic flow diagram of mesoscale (1:10,000) landslide susceptibility mapping.

CHAPTER 4

GEO-FACTORS THEMATIC MAPS

4.1 Selection of Geofactor Thematic Maps:

Landslide occurrences in any terrain are governed by various factors. So, multivariate analysis is taken into account for landslide susceptibility mapping which includes different terrain specific causative geofactor themes and are taken into consideration which include:

(i) Physical state of slope morphometric parameters: slope gradient, slope aspect, and slope curvature, and relative relief.

(ii) Geological slope forming material/lithology.

(iii) Spatial variation in thickness of slope forming material.

(iv) Geotechnical Shear parameters of slope forming material.

(v) Geomorphic features i.e. landform units

(vi) Geology and rock structure: orientation of planar/linear discontinuities in the rock mass (rock kinematics) in relation to the topography.

(vii) Drainage/Distance to drainage buffer.

(viii) Stream erodibility parameters (Stream Power Index).

(ix) Landuse/Landcover.

Based on the estimation of the above pre-disposing geofactors, the preparatory geofactors and their possible factor classes are considered for the preparation of the geofactor thematic maps for GIS-based landslide susceptibility analysis. Thematic data layers corresponding to the six causative geofactors were prepared in GIS. The data used to prepare these maps were collected from the topographic maps available on (1:25,000 scale), remote sensing data (Cartosat satellite imagery and multi-temporal satellite image accessed through Google Earth), published literature, and field data collected during field-based mapping.

As per the data model, some of the geofactor themes landslide inventory, land use/land cover, Geological slope forming material, overburden thickness maps are categorical and DEM derivative maps i.e. slope morphometric parameters such as slope gradient, slope aspect, and slope curvature and relative relief, drainage and landform map are continuous data. These different spatial geofactor thematic maps are prepared using various source data and employing different mapping techniques. The different thematic maps are described below and only significant geofactor thematic maps are incorporated for data modelling and landslide susceptibility map generation on 1:10,000 scale selected for each landslide failure domain.

4.1.1 Slope Morphometry Maps (Slope, Aspect, Relative relief): Raster maps of Slope, Curvature, Aspect, and relative relief are DEM derivative geofactor maps generated from CartoDEM (10m resolution) using Spatial Analyst/3D Analyst Module of ArcGIS software.

(a) **Slope Gradient Map (Fig 5):** Slope gradient is the deterministic geofactor governing the slope stability condition. The slope gradient of the study area varies from 0-75° and is classified into 7 classes; 0°-15°, 15-25°, 25°-35°, 35°-45°, 45°-55°, 55-65°, 65-75°. Based on spatial distribution with landslide incidence, high weightage and rating are assigned to the slope classes 25-35° and 35-45°. According to the classified slope gradient map of the landscape, 31.95% of the area falls in 0-15°, 34.25% in 15-25°, 23.21 % in 25-35°, 9.01% in 35-45°, 1.47% in 45-55° and .08% in >55° slope angle. The percentage distribution of different slope gradient classes is mentioned in **Table 4** The landslide susceptibility evaluation rating is assigned to causative geofactor classes based on landslide susceptibility criteria.

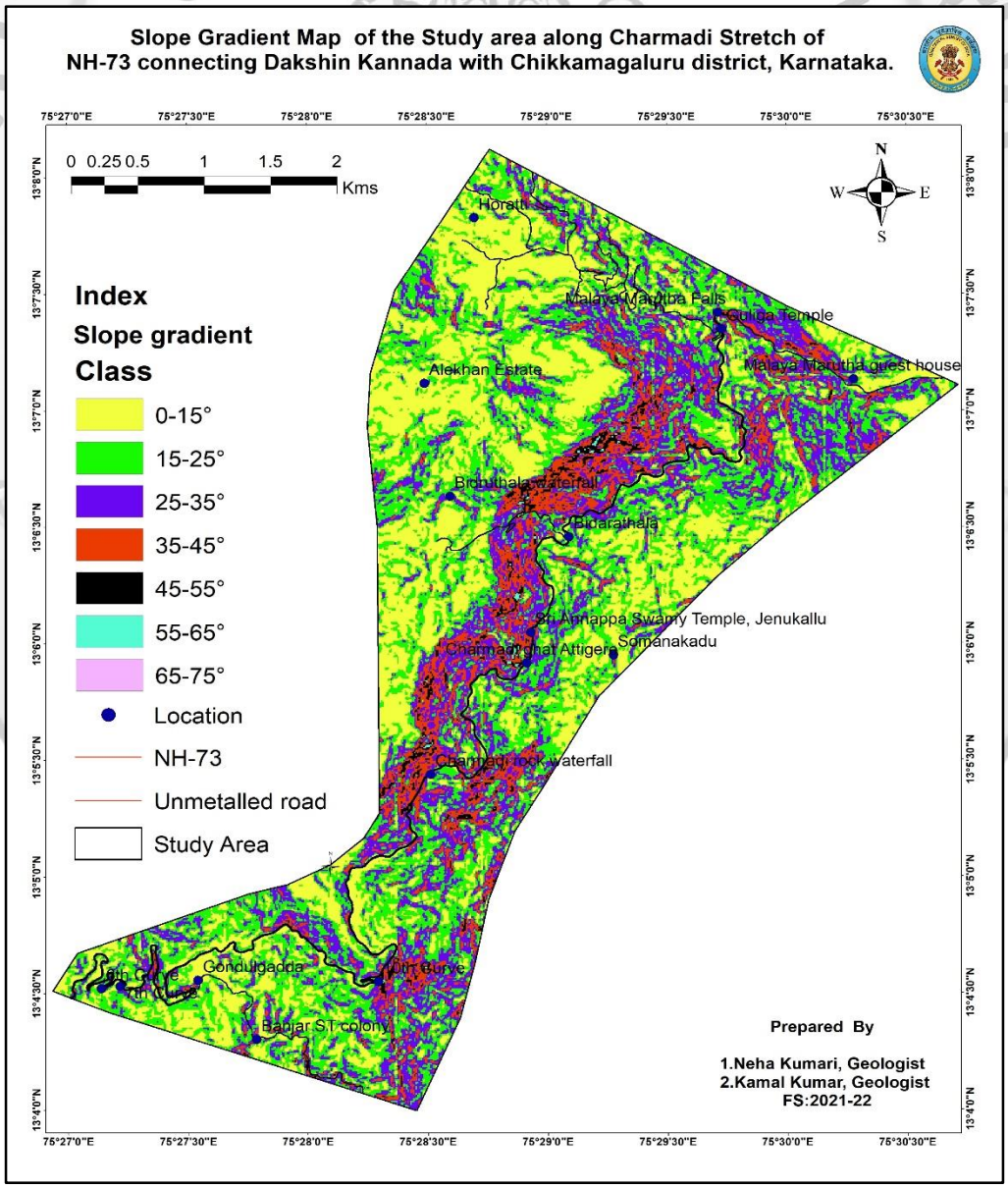
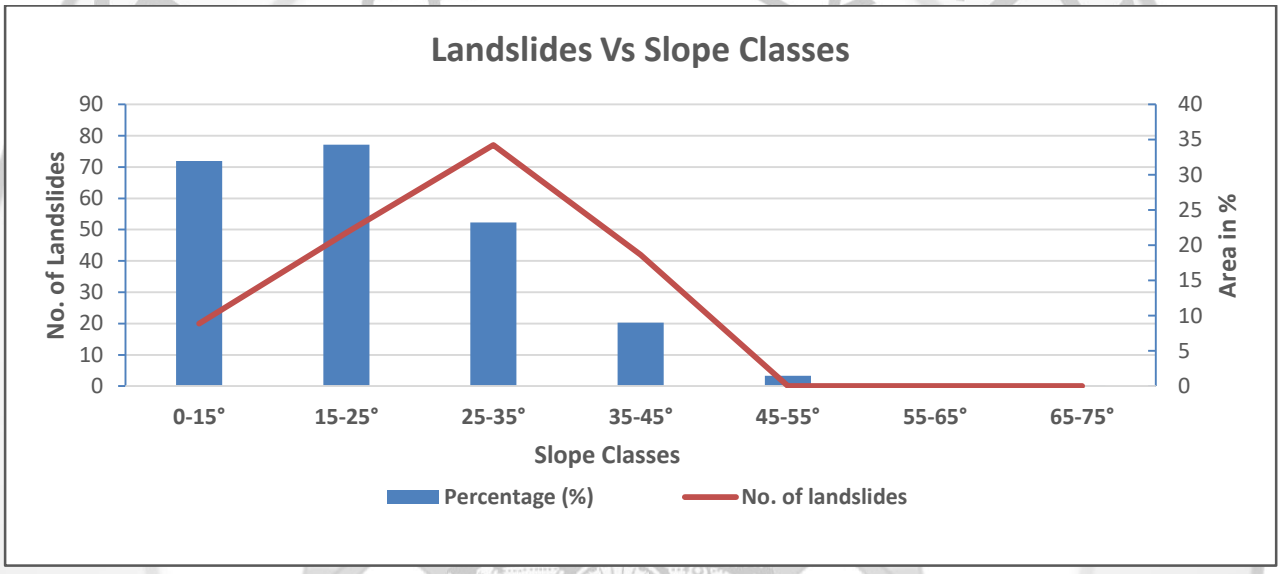


Fig 5: Slope gradient Map of the study area (1:10,000 scale).

Table 4: Percentage distribution of Classified Slope Gradient Map of the study area.

Slope Classes	Area in (sq. km.)	Percentage (%)	No. of Landslides
0-15°	5.488	31.954	20
15-25°	5.883	34.257	49
25-35°	3.988	23.219	77
35-45°	1.548	9.016	42
45-55°	0.253	1.472	0
55-65°	0.014	0.080	0
65-75°	0.000	0.001	0



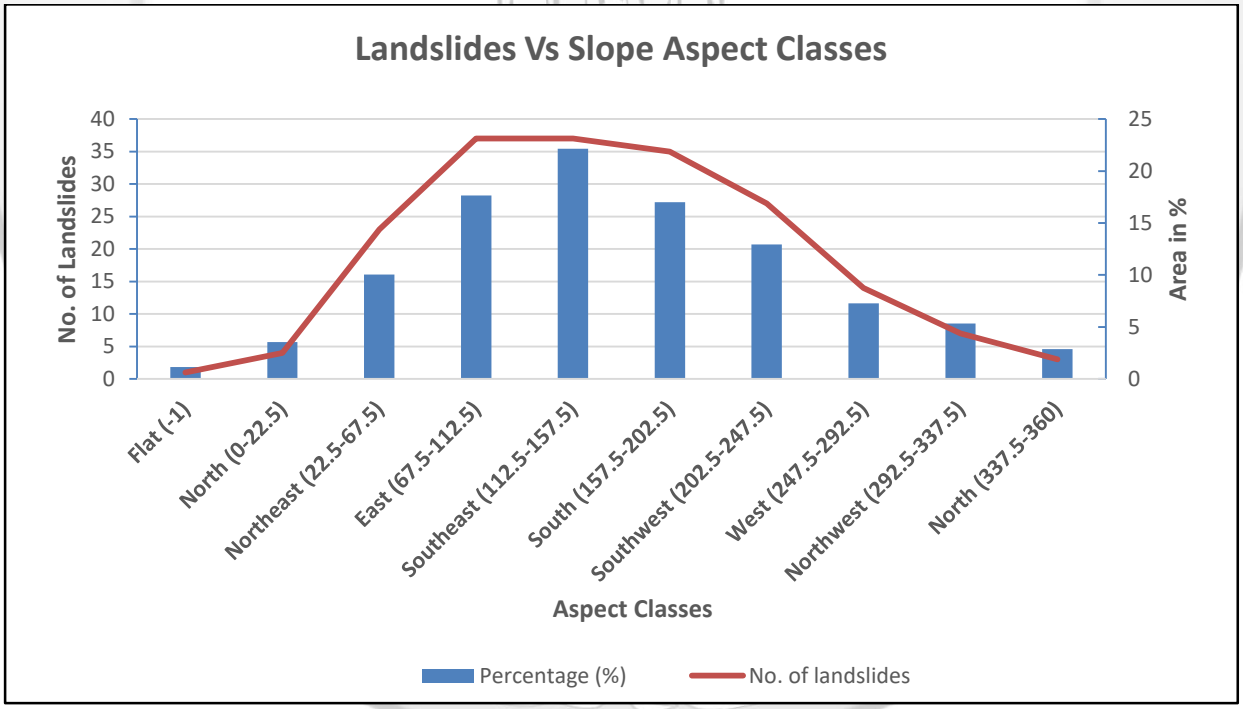
Graph 1: Graph showing distribution of Landslides with repect to Slope Gradient Classes.

(c) Slope Aspect Map (Fig 6): The slope aspect is the important factor for landslide occurrences as it significantly influences the solar insolation, vegetation cover, and soil erosion which in turn control slope instability (Varnes, 1984). Geofactor theme aspect is categorized into 10 classes viz. Flat (-1), North (0-22.5), Northeast (22.5-67.5), East (67.5-112.5), Southeast (112.5-157.5), South (157.5-202.5), Southwest (202.5-247.5), West (247.5-292.5), Northwest (292.5-337.5), North (337.5-360). The percentage distribution of different slope aspect classes is mentioned in **Table 5** Raster maps of Aspect are generated for analyzing the slope morphometry. The computed aspect values are categorical data, discretized into 10 classes extracted from CartoDEM of 10m resolution. The aspect parameter is not taken into consideration in the analysis as it has very less influence or no effect on the final landslide Susceptibility Map. Aspect describes the maximum rate of change in the elevations or the slope direction. It is measured in positive integer degrees from 0 to 360 clockwise from the North. Aspects of cells (pixels) of zero slope (flat areas) are assigned a value of -1. The spatial correlation of Slope Aspect with landslide incidence indicates that the frequency of

landslide incidence is more in North, East, Northeast, Northwest facing hillslope facets. More over Slope aspect hasn't had a significant influence in determining the slope stability condition in the prevailing terrain conditions.

Table 5: Percentage distribution of Slope Aspect classes for the study area.

Slope Aspect Classes	Area in (sq.km)	Percentage (%)	No. of landslides
Flat (-1)	0.1958	1.140	1
North (0-22.5)	0.6097	3.550	4
Northeast (22.5-67.5)	1.7255	10.047	23
East (67.5-112.5)	3.0322	17.656	37
Southeast (112.5-157.5)	3.8055	22.158	37
South (157.5-202.5)	2.9222	17.015	35
Southwest (202.5-247.5)	2.2226	12.942	27
West (247.5-292.5)	1.2509	7.284	14
Northwest (292.5-337.5)	0.9153	5.330	7
North (337.5-360)	0.4944	2.879	3



Graph 2: Graph showing distribution of Landslide with repect to Slope Aspect classes.

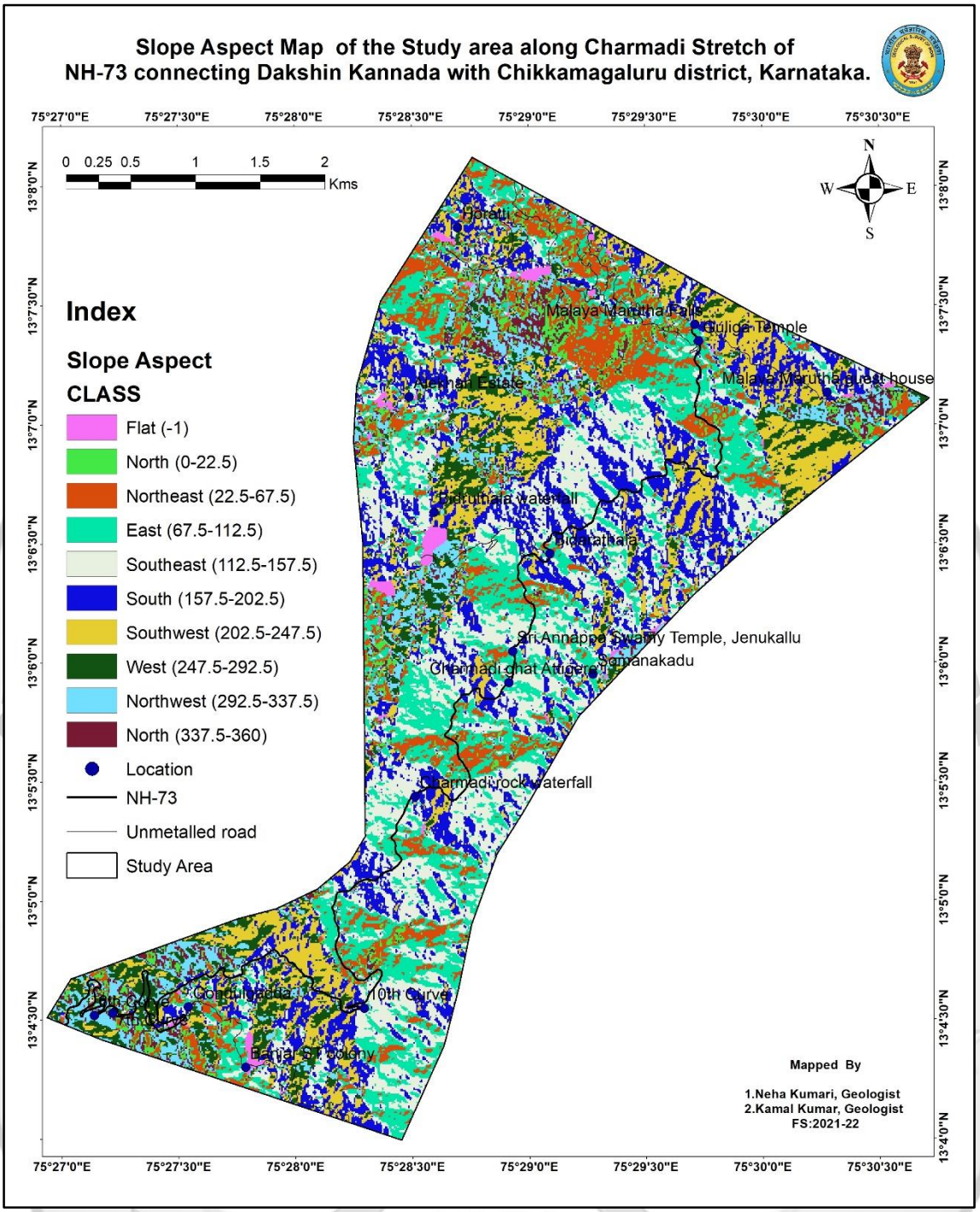
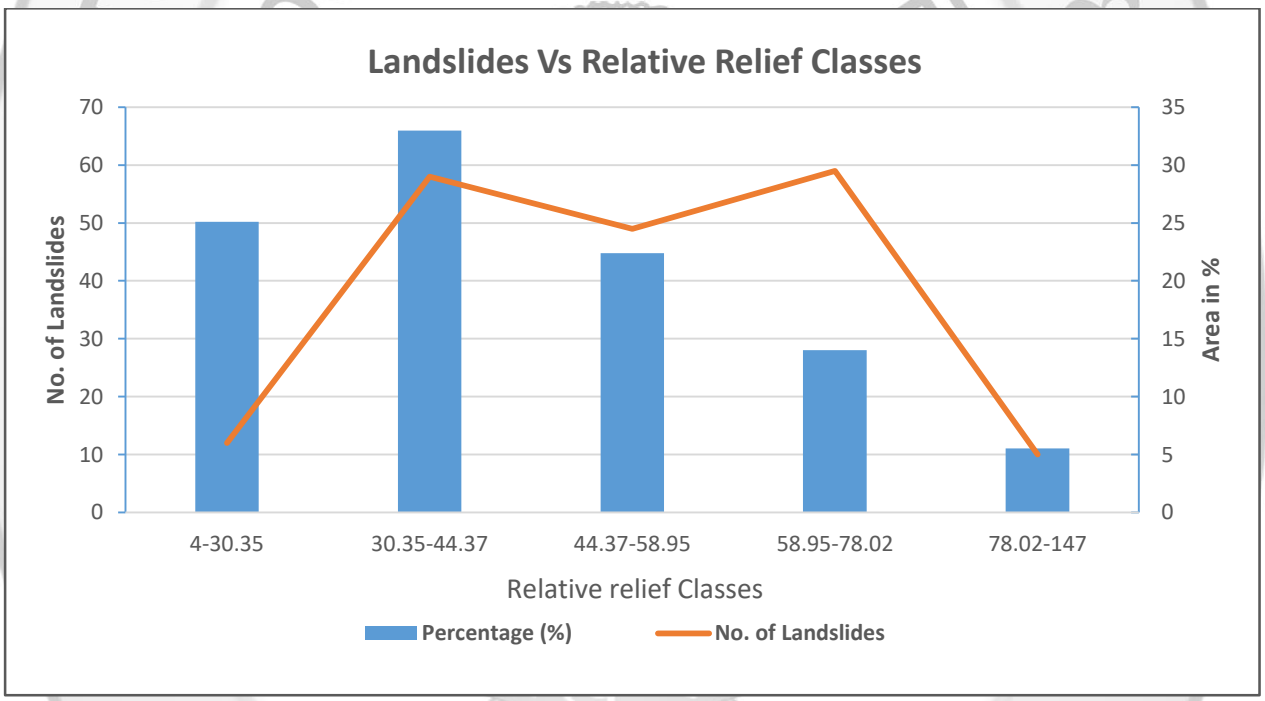


Fig 6: Slope Aspect Map of the study area (1:10,000 scale)

(c) Relative Relief Map (Fig 7): The relative relief of an area represents the ranges between the highest and lowest points in a unit area. The relative relief is classified into 5 classes as mentioned in **Table 6.** The relative relief difference varies from 4m to 147m in the study area.The relative relief difference plays a key role in studying the cut slope failure along the Charmadi ghat road sector. The spatial distribution of landslides with relative relief indicates that the maximum frequency of landslide incidences is relatively more in relative relief class between 58-78m and 78-147m respectively. If the slope geometry in modified the relative relief changes that will affect the slope stability condition.

Table 6: Percentage distribution of Relative relief classes for the study area.

Relative relief Classes	Area in (sq. km.)	Percentage (%)	No. of Landslides
4-30.35	4.31	25.09	12
30.35-44.37	5.66	32.98	58
44.37-58.95	3.84	22.38	49
58.95-78.02	2.41	14.01	59
78.02-147	0.95	5.54	10



Graph 3: Graph showing distribution of Landslide with repect to Relative Relief classes.

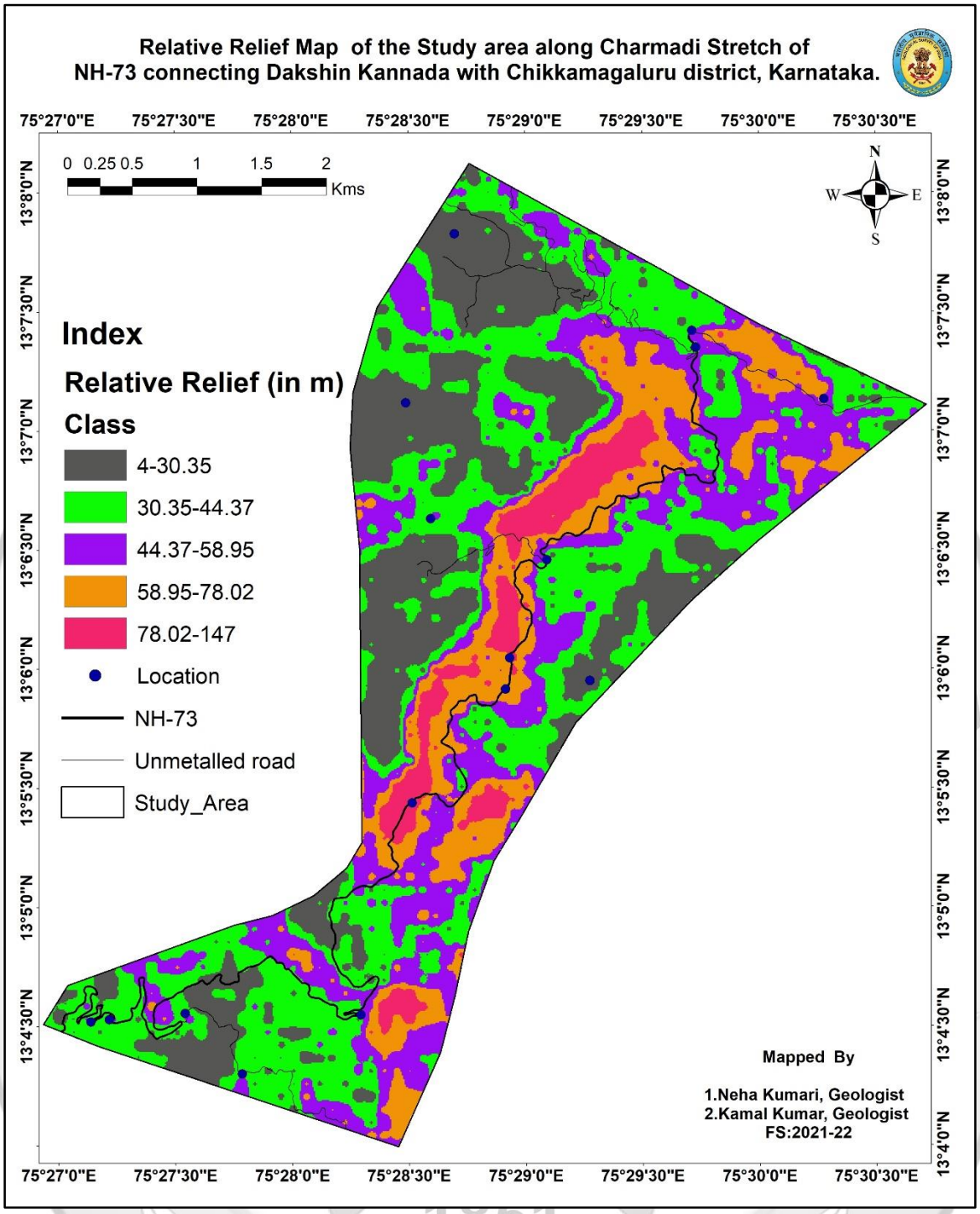


Fig 7: Relative Relief Map of the study area (1:10,000 scale).

4.1.2 Geomorphon/Landform Map (Fig 8): The Landforms are defined as specific features on the Earth's surface ranging from major types such as mountains, hills, plateaus, basins, and plains. Geomorphon/ landform units are classified into 9 landform types i.e. Summit, Ridge, Shoulder, Spur, Slope, Hollow, Footslope, Valley, and Depression. The landslides mainly occurred on the slope and Spur parts but depression and hollows play a key role in water accumulation and slope saturation in the study area. Landforms units are extracted from CartoDEM of 10m resolution using GRASS GIS software delimiting the search radius from 10m. Based on the spatial distribution of

Landform units, the frequency of landslide is more on the slope, spur, and hollow as compared to other landform units in pre-disposing terrain conditions. During mapping, the pre-field landforms extracted from CartoDEM of 10m resolution using GRASS GIS software have been validated. Landform maps are later modified in GRASS GIS by delimiting the search radius from 10m to 25m based on field inputs and observation points to prepare the best-suited landforms in existing terrain conditions. The landform is classified into 5 classes as mentioned in **Table 7**. According to the spatial distribution of landslides the landform units mainly slope, spur, and hollow are vulnerable on the moderate to steep slopes having higher relative topographic relief.

Description of the different Landform units are described below:

i) **Summit**-The topographically highest portion of a hillslope profile with a nearly level (planar or only slightly convex) surface.

ii) **Shoulder** -The hillslope profile position that forms the convex erosional surface near the top of a hill slope. It comprises the transition zone from the summit to the backslope.

iii) **Spur**-A subordinate ridge or lesser elevation that projects sharply from the crest or side of a hill mountain or other prominent range of hills or mountains.

iv) **Slope-** Slope is also called slope gradient or inclination of the land surface from horizontal.

v) **Footslope** -The hillslope profile that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope sites of deposition (toe slope).

vi) **Ridge** -A long narrow elevation of the land surface, usually sharp-crested with steep ridges and forming an extended upland between valleys.

vii) **Flat** -The area characterized by a continuous surface or stretch of land that is smooth, even or horizontal, or nearby so and that lacks any significant curvature, slope, elevation, or depressions.

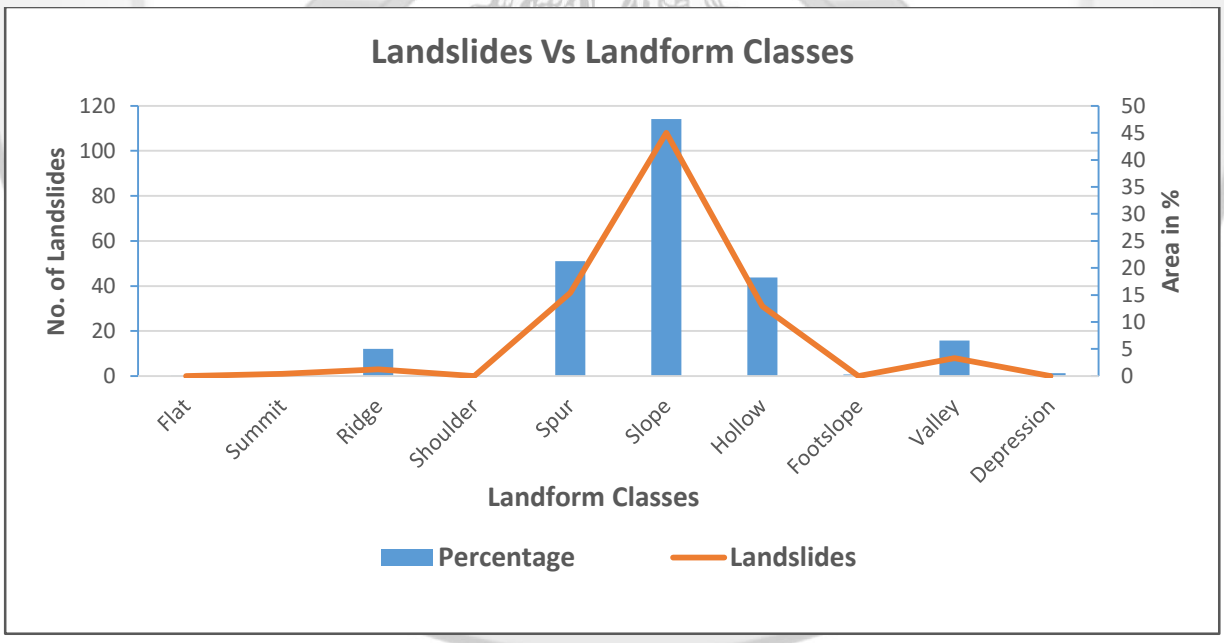
viii) **Depression**- Any relatively sunken part of the earth's surface, especially a low-lying area surrounded by higher ground.

ix) Valley- An elongated relatively large externally drained depression of the earth's surface that is primarily developed by stream erosion.

x). **Hollow-** An elongated lowland between ranges of mountains, hills, or other uplands, often having a river or stream running along the bottom or any elongated depression resembling a valley.

Table 7: Percentage distribution of Landform/Geomorphon units of the study area.

Landform Classes	Area in (sq. km.)	Percentage (%)	No. of Landslides
Flat	0.005	0.028	0
Summit	0.096	0.557	1
Ridge	0.859	5.001	3
Shoulder	0.000	0.001	0
Spur	3.646	21.230	37
Slope	8.169	47.568	108
Hollow	3.134	18.245	31
Footslope	0.047	0.274	0
Valley	1.129	6.574	8
Depression	0.090	0.521	0



Graph 4: Graph showing distribution of Landslide with respect to Landform classes.

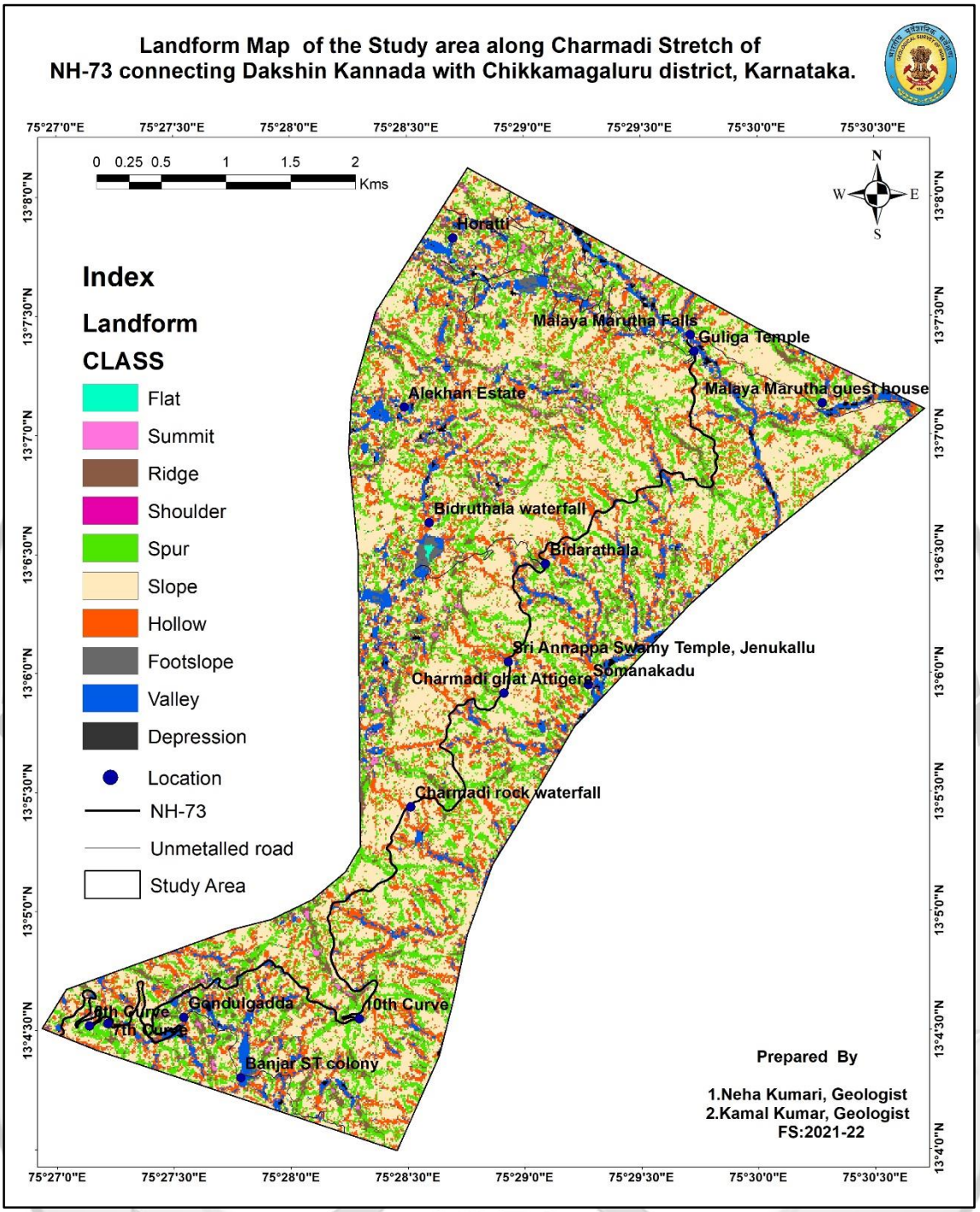


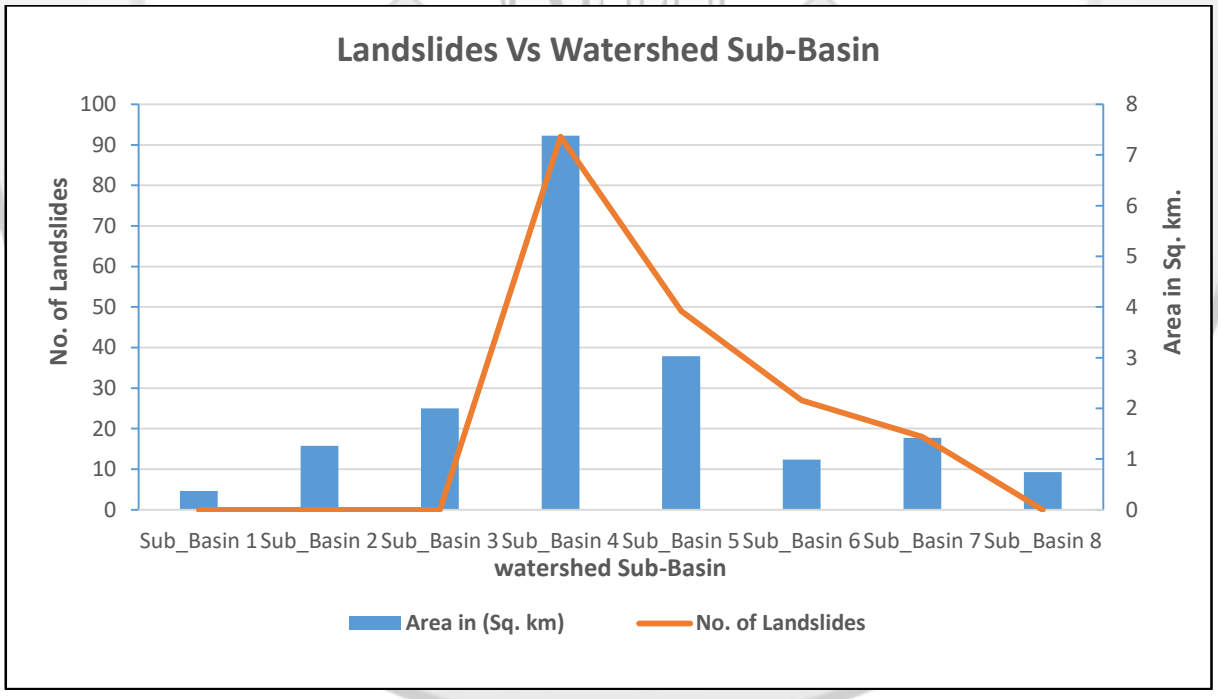
Fig 8: Landform Map of the study area on 1:10,000 scale.

4.1.3 Drainage Map (Fig 9): Considering geo-hydrological parameters, the different orders of streams are extracted and classified based on stream orders i.e. 1st Order, 2nd Order, 3rd Order, 4th Order, and 5th Order streams in the GIS platform using spatial analyst tool using Strahler's (1957) ordering system and a topographic sheet during pre-field map preparation. In general, the drainage pattern is dendritic to sub-dendritic During field-based mapping, the existing drainage and newly formed streams are updated and validated. The hydrological and erodability condition of the slope is determined by the drainage network. The drainage map is classified based on stream orders prepared in the ArcGIS platform for carrying out slope stability analysis. In a watershed, sub-basin are

delineated with the help of pour points for water discharge in the watershed. Based on the occurrence of landslides in the sub-basin within the watershed are delineated and frequency of landslide occurrences is mentioned in **Table 8**. Most of the landslides are originated in the 1st and 2nd order stream channel or at the confluence of 1st and 2nd order stream channels. The maximum no. of landslide incidences occurred in the Sub-Basin 4 and Sub-Basin 5 respectively.

Table 8: Frequency distribution of landslide incidence in the Watershed/ Sub-Basin within the study area.

Sub_Basin	Area in (Sq. km)	No. of Landslides
Sub_Basin 1	0.37	0
Sub_Basin 2	1.26	0
Sub_Basin 3	2.00	0
Sub_Basin 4	7.38	92
Sub_Basin 5	3.03	49
Sub_Basin 6	0.99	27
Sub_Basin 7	1.42	18
Sub_Basin 8	0.74	0



Graph 5: Graph showing distribution of Landslide with respect to Basin/Sub-basin.

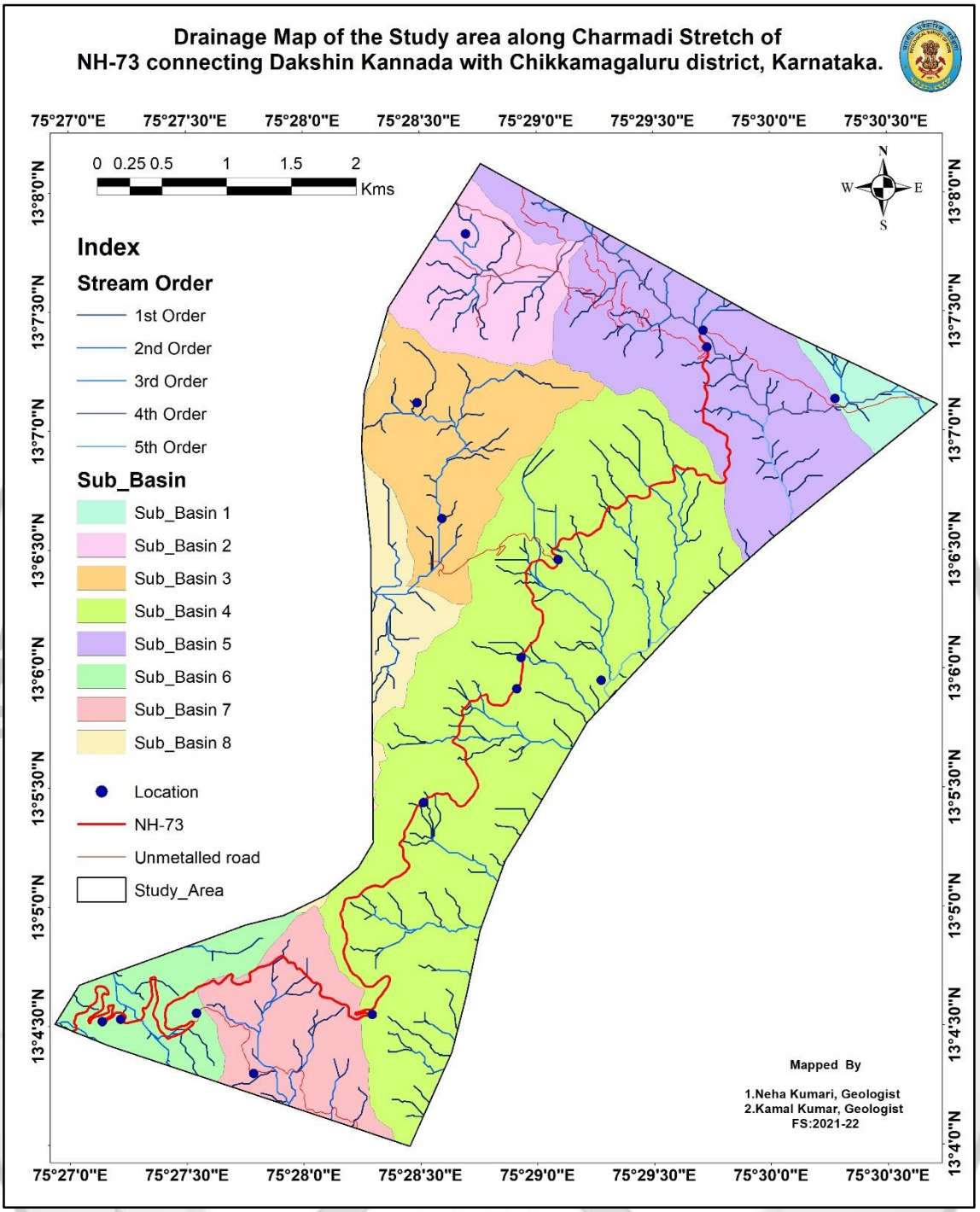


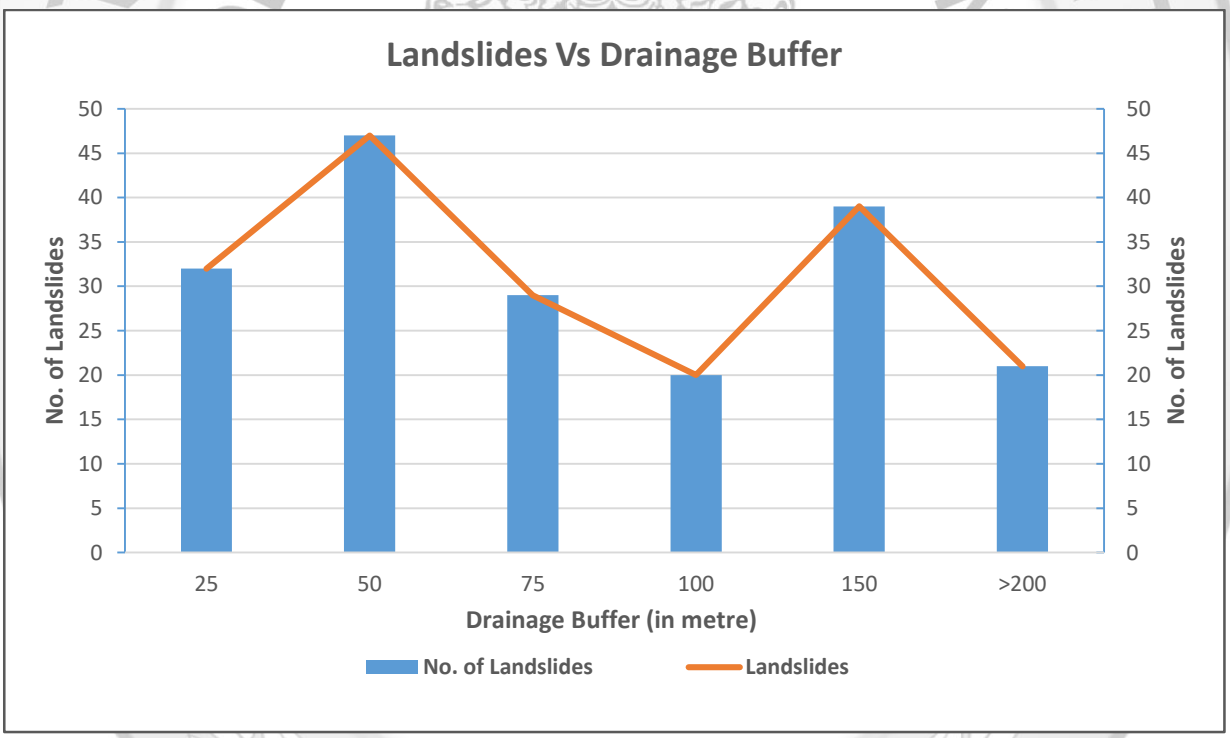
Fig 9: Drainage Map of the study area on 1:10,000 scale.

4.1.4 Distance to Drainage Buffer Map (Fig 10): Distances to the drainage buffer map are prepared to determine area of influence in the fringe of exsiting streams. The multiple buffer based spatial distribution of landslides with drainage is classified into following classes viz. (i) 0-25m, (ii) 25-50m (iii) 50-75 m (iv) 75-100 m, (iv) 100 -150m.(v) >200m in ArcGIS platform. The spatial distribution of landslides with respect to drainage buffer is shown in **Graph 6**. Based on the spatial distribution of landslide incidence about 0–150m buffer in proximity to water/stream channels or adjoining slope facet in the proximity streams shows favourable loci for slope saturation during

heavy water discharge from upper catchment area. Therefore higher weightage is given to stream buffer in close proximity to streams upto 50m stream buffer.

Table 9: Frequency distribution of landslide incidence with respect to Distance to Drainage Buffer

Drainage Buffer (in m)	No. of Landslides
25	32
50	47
75	29
100	20
150	39
>200	21



Graph 6: Graph showing distribution of Landslide with respect to Drainage Buffer.

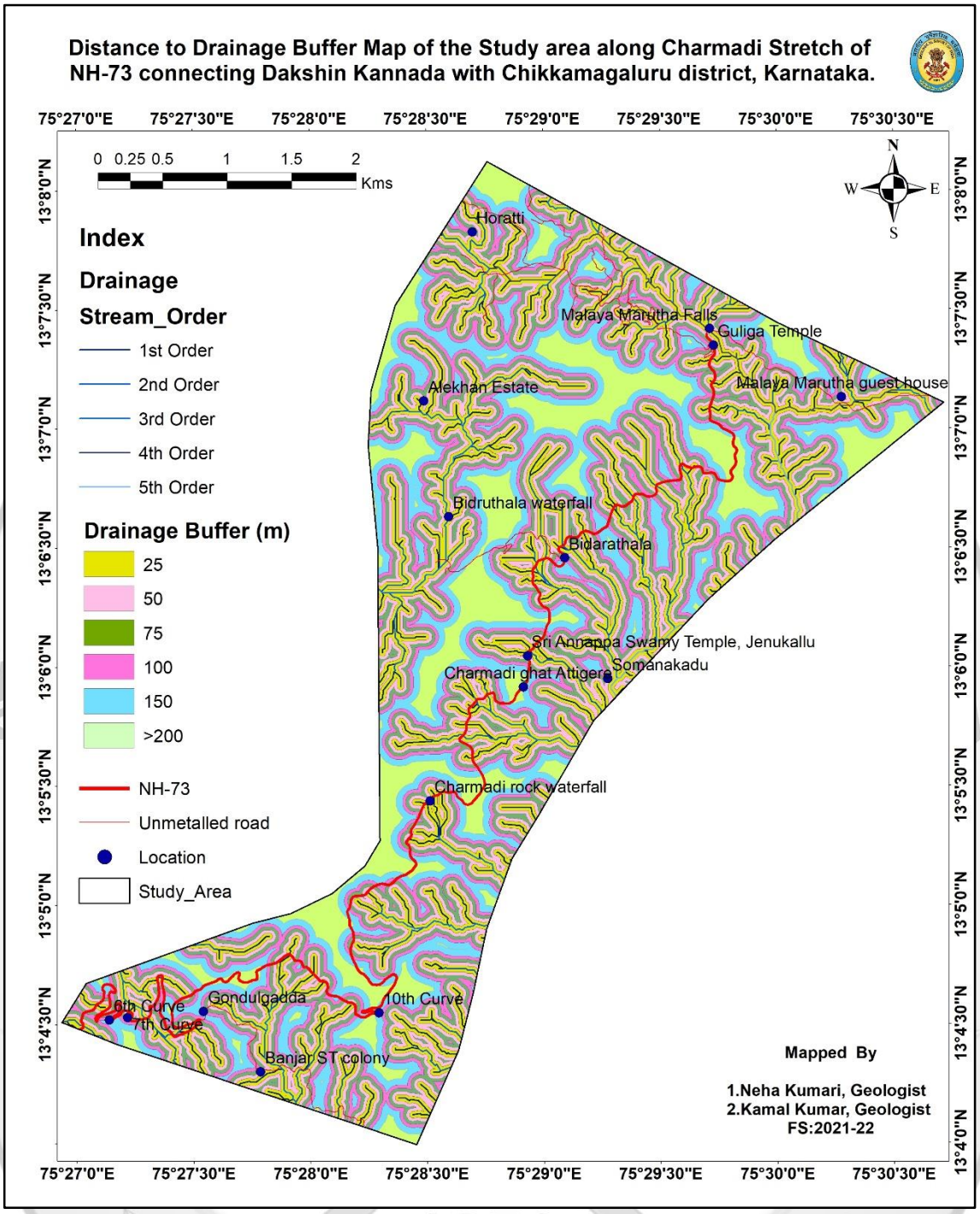


Fig 10: Distance to Drainage Buffer Map of the study area on 1:10,000 scale.

4.1.5 Stream Power Index Map (Fig 11): The stream power index map estimates the stream power as well as its variability along the mainstream and its tributaries. The sudden and more substantial variation in stream power was then related to the process acting in the fluvial system. The approach made it possible to highlight how erosion, solid transport, and sedimentation phenomenon occurring along the fluvial reaches area related to abrupt variation increase and decrease in the stream power. The stream power variability along a stream can be used as a preliminary diagnostic element to identify the most sensitive points on the stream. Stream power index (SPI) is which accounts for the

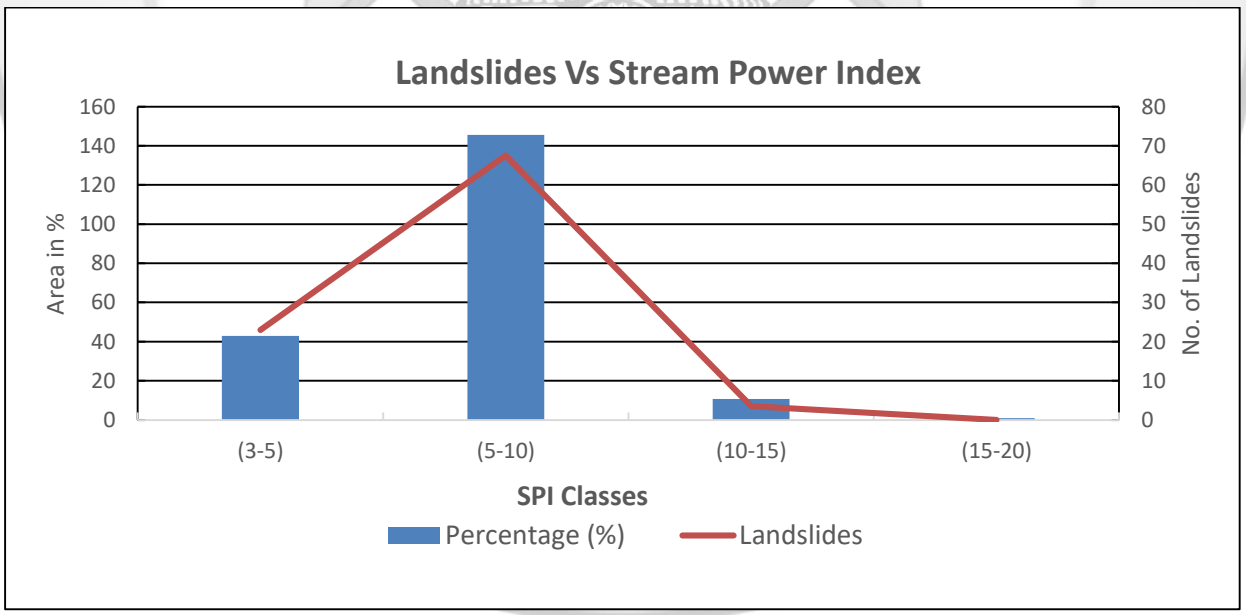
local slope gradient and catchment area and hence the proportionate discharge or erosive power of the drainage is accounted.

Stream Power Index is expressed as SPI = As $\times$ tan σ

The catchment by flow area is represented by accumulation raster **As** and σ is the slope gradient in degrees (Conforti et al., 2011, Shit et al., 2015). It is generated using the primary terrain attributes which include the slope, flow direction, and flow accumulation through the map algebra tool in ArcGIS. In the current study, the erosion condition-stream power index matrix will adequately reflect slope erosion processes along with the erosive power of running water directly influencing slope instability during incessant rainfall. DEM derivative stream power index map is reclassified into three classes viz 3-5, 5-10, 10-15, 15-20. The spatial distribution of landslides with respect to stream power erodibilty index is shown in **Graph 7**. Based on the erosion capacity of streams maximum weightage and rating are assigned to SPI Class: 10-15, 15-20. However maximum no. of

Table 10: Percentage distribution of Stream Power classes in the study area

SPI Class	Percentage (%)	No. of Landslides
3-5	21.42878	46
5-10	72.74384	135
10-15	5.339436	7
15-20	0.487944	0



Graph 7: Graph showing distribution of Landslide with repect to SPI classes.

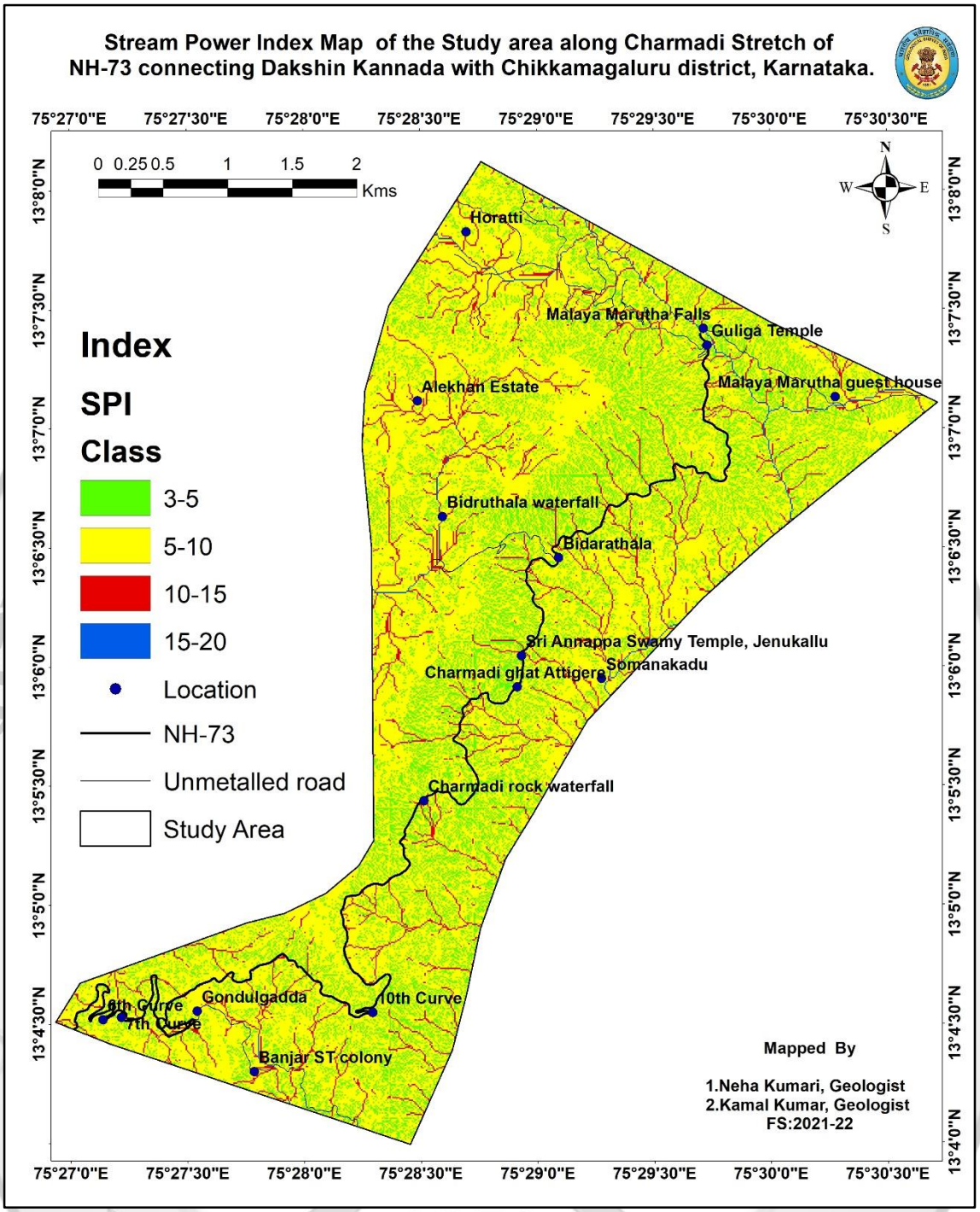


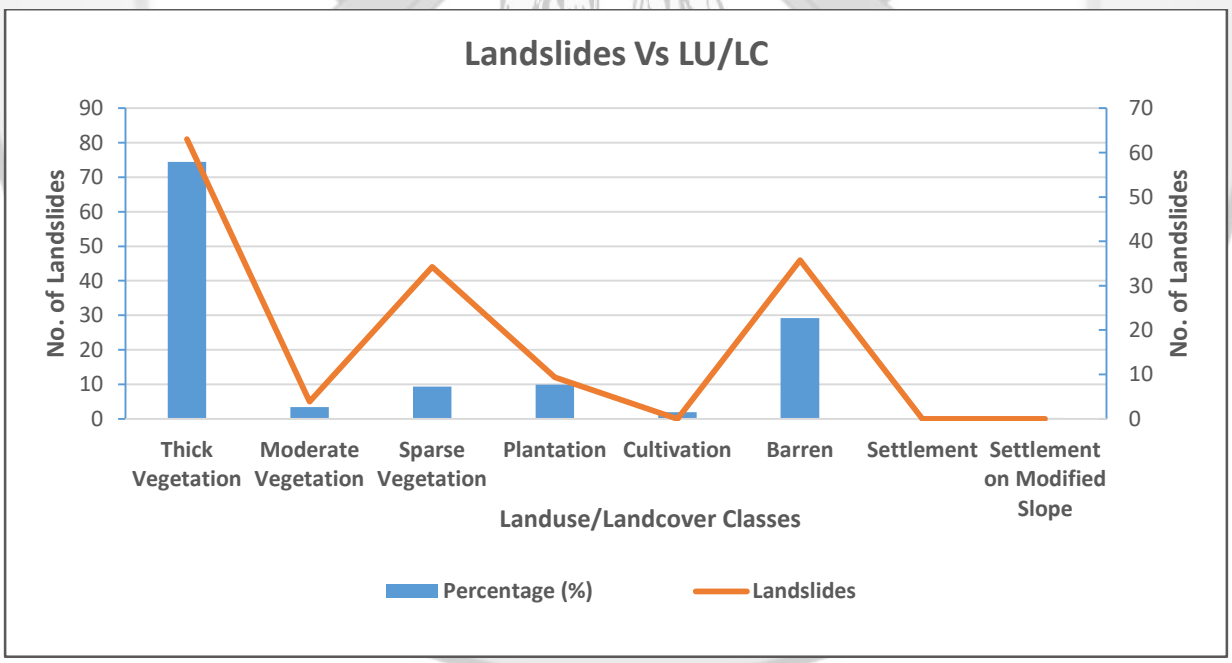
Fig 11: Stream Power Index Map of the study area on 1:10,000 scale.

4.1.6 Land use / Land cover Map (Fig 12): Pre-field Landuse/Landcover map was validated and updated and Post-field Landuse/Landcover map is prepared in the ArcGIS platform. The change in Landuse/Landcover will affect the stability of slopes which will change the hydrological condition of hillslopes, influence rainfall pattern, surface water infiltration, and runoff. All these factors contributes in determination of shear strength of the soil. The vegetastion cover on slope plays a vital role in binding the loose soil by root cohesion. About 57.91 % of the study area is covered with thick vegetation, 7.66% of the area have plantation cover. The land use/land cover categories are classified into 8 classes viz. Thick Vegetation, Moderate vegetation, Sparse vegetation, Mixed

Plantation (Coffee and Silver Oak), Cultivation, Settlement on the modified slope, Settlement, Barren. The percentage different landuse/landcover classes is illustrated in (**Table 11)**. The spatial distribution of landslides indicates that the majority of the landslides were initiated from sparsely vegetated, barren hill slope along the road cut.

Table 11: Percentage distribution of LU/LC classes vs Landslides in the study area.

LU/LC Classes	Area in (sq. km)	Percentage (%)	No. of Landslides
Thick Vegetation	9.947156	57.913	81
Moderate Vegetation	0.459297	2.674	5
Sparse Vegetation	1.248877	7.271	44
Plantation	1.3164	7.664	12
Cultivation	0.261845	1.524	0
Barren	3.899034	22.701	46
Settlement	0.009428	0.055	0
Settlement on Modified Slope	0.033623	0.196	0



Graph 7: Graph showing distribution of Landslide with repect to LU/LC classes.

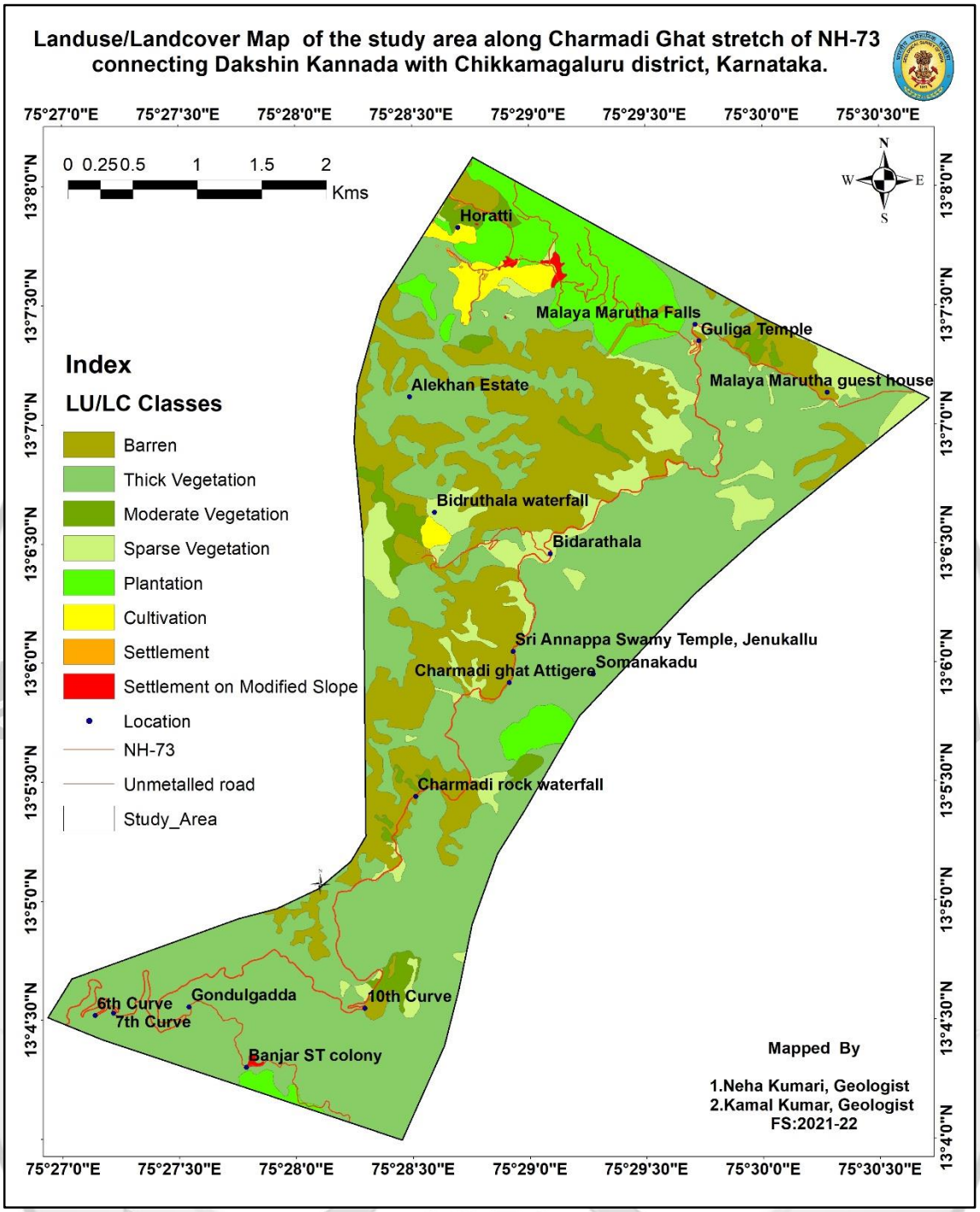


Fig 12: Landuse/Landcover Map of the study area on 1:10,000 scale.

4.2 Field-based Geo-factor Thematic Maps preparation: The geological slope forming material map, Overburden thickness map, Landslide failure domain map is prepared and 42-points geoparametric inventory database are documented during the course of field based mapping. The description of thematic geofactor maps are provided below:

4.2.1 Geological Slope Forming Material (GSFM) Map (Fig 13): Geological slope forming material is prepared during the field survey on 1:10,000 scale with the help of locations recorded with handheld GPS and topographic sheets. The landslide event has a close relationship with underlying

lithology and structural setting because lithological characteristics of different rock types have different mechanical and hydrological properties that govern the slope stability to a greater extent.

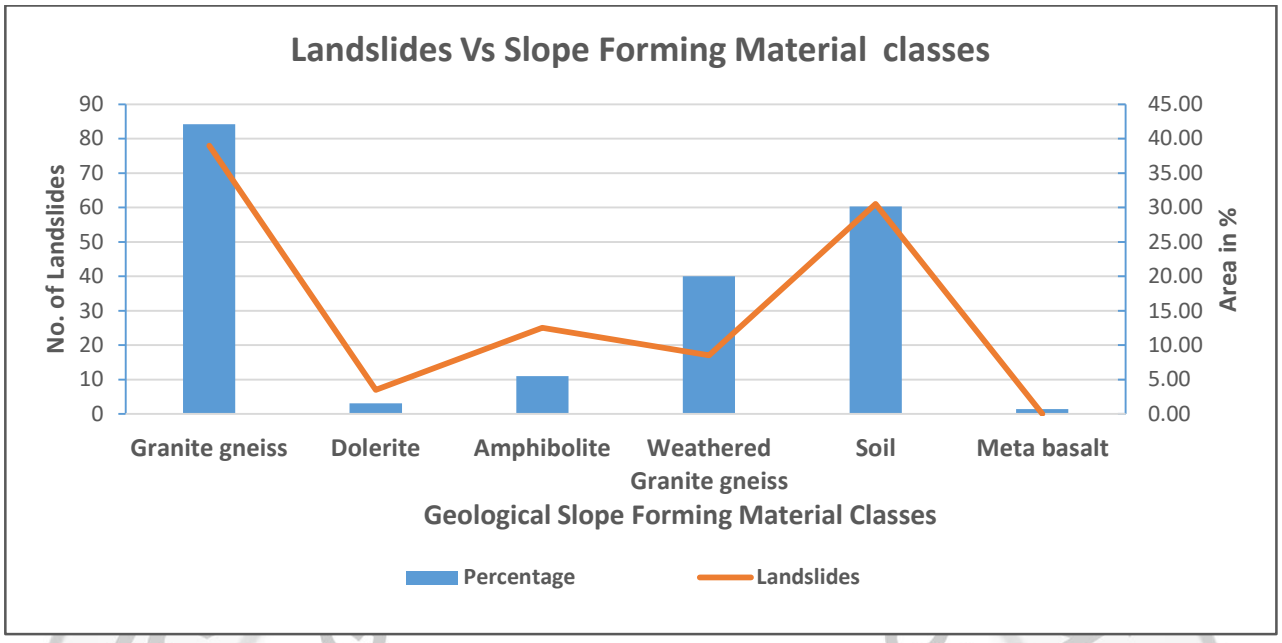
The slope forming material is classified into rock and overburden type. During mapping, the geological map was updated on a 1:10,000 scale in all accessible reaches by geological traverses. The linear bands of amphibolites, and dolerite were mapped based on the physical properties of rock. The petrographic studies of rock specimens are not done. Mostly the study area is covered with immature which shows a poorly developed soil profile mainly consisting of boulders, weathered rock, in-situ compact and loose soil and mature soil profile which shows a well-developed soil profile due to deep weathering and erosional activity. The intrusive litho-contact zone shows the strongest positive impact on the occurrence of landslides. The geological slope forming material map is classified into 6classes mentioned in **Table 12.**

Description of the Slope Forming Material Types:

i. **Soil:** The area has undergone various degree of erosion and weathering activities. So, based on the percentage distribution of silt, sand, gravel, and clay particles soil type is mature soil and as well as immature soil typewhere soil horizons are not well developed and rock mass consists of weathered rock and loose soil.
ii. **Rock:** The rock exposed in the area mapped are granite gneiss, amphibolite, dolerite and metabasalt
iii. **Weathered Rock:** The massive rocky exposures and <.5m & .5-1m overburden thickness on the slope area are classified into rock

Table 12: Percentage distribution of Geological Slope Forming Material Classes Vs Landslides in the study area.

GSFM Classes	Percentage (%)	No. of Landslides
Granite gneiss	42.09	78
Dolerite	1.56	7
Amphibolite	5.49	25
Weathered Granite gneiss	20.02	17
Soil	30.17	61
Meta basalt	0.7	0



Graph 9: Graph showing distribution of Landslide with respect Geological Slope Forming Material Classes.



Photo 3: Weathered rock fragment and soil in Debris domain.



Photo 4: Soil cover in Earth domain exposed on vertical road cut.

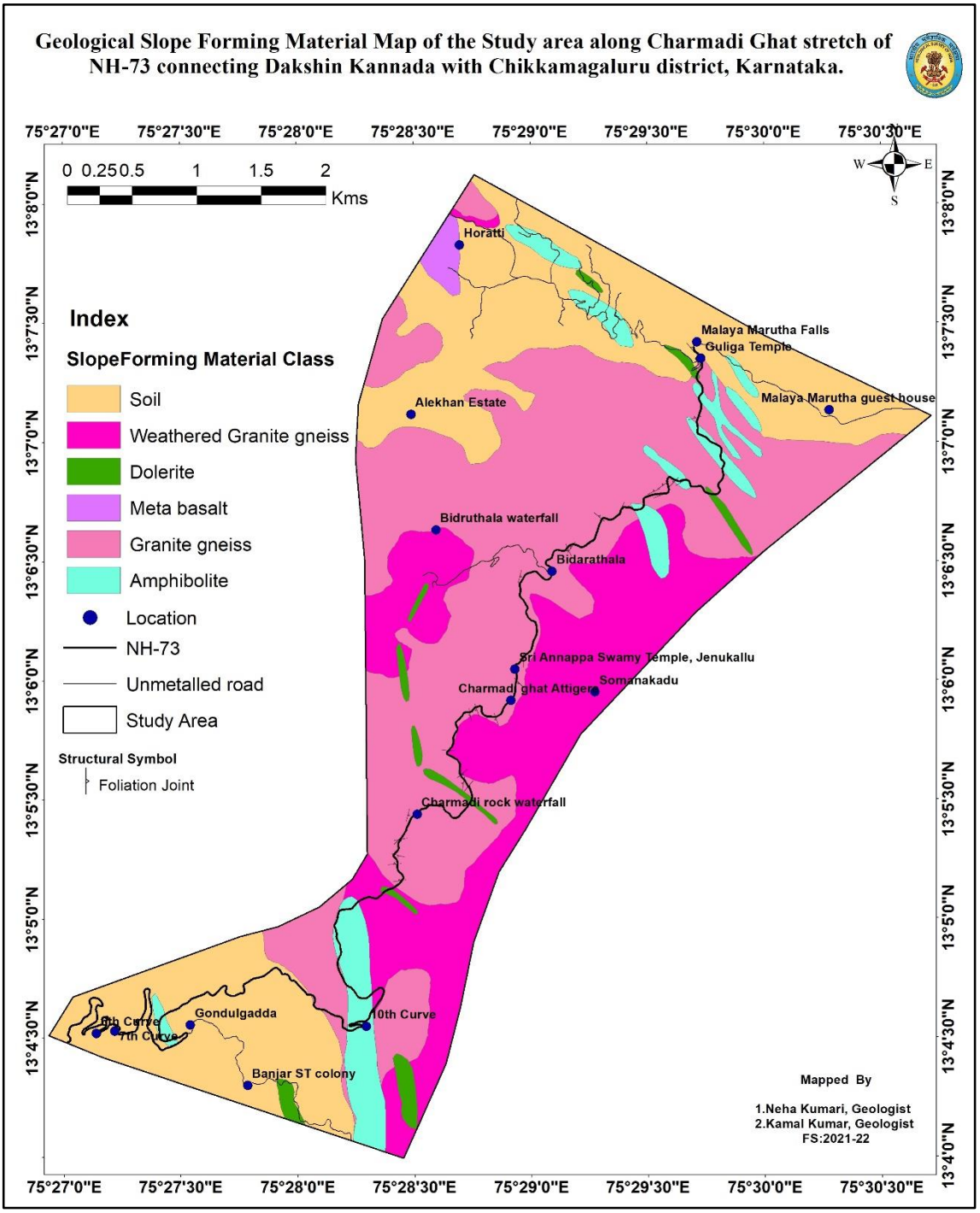
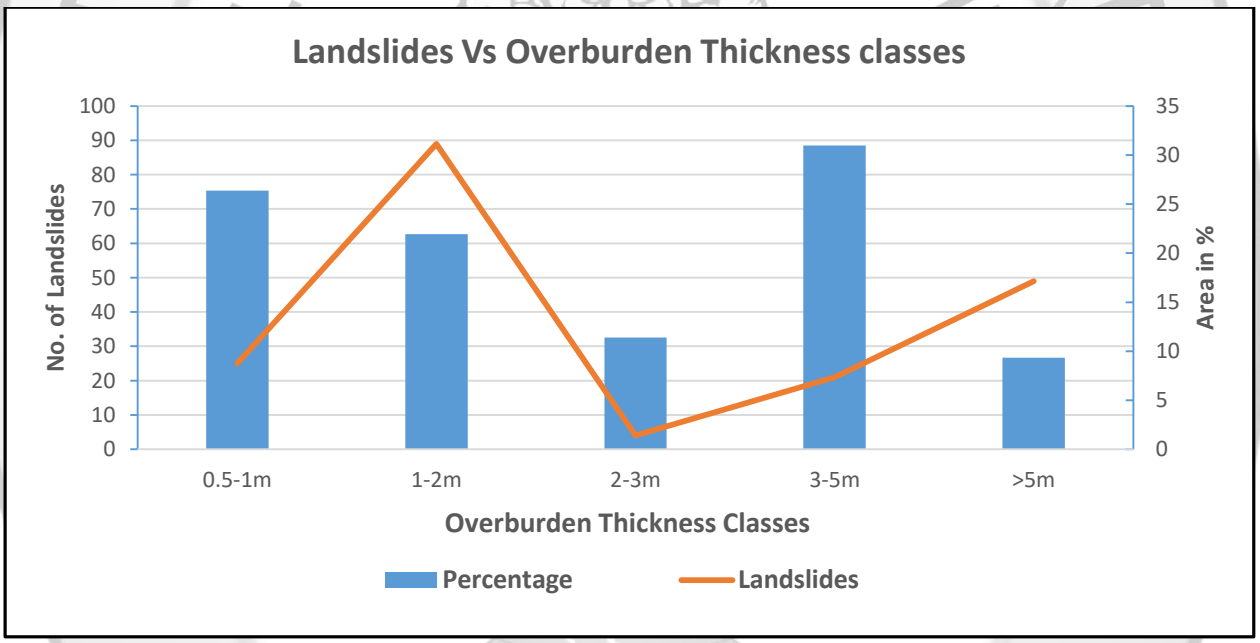


Fig 13: Geological Slope Forming Material Map of the study area (1:10,000 scale)

4.2.2 Regolith/Overburden Thickness Map (Fig 14): The regolith thickness map is prepared based on field observations. Assessment of the depth of regolith at different sites was made by studying the exposures or cut sections along the road, streams, landslide scars, and open wells. The overburden thickness of soil varies due to various degrees of weathering and erosion. The drainage and deep-seated joint and fracture in rocks provide pathways for water infiltration and weathering. The overburden thickness is classified into 5 classes: 0.5-1m , 1-2m, 2-3m, 3-5m, >5m. The percentage distribution of landslides are mentioned in **Table 13**.

Table 13: Percentage distribution of different Regolith/Overburden Thickness Classes VVs Landslide incidences.

RT Class	Area in(Sq. km)	Percentage (%)	No. of Landslides
0.5-1m	4.531274	26.39065	25
1-2m	3.766713	21.93776	89
2-3m	1.956846	11.39689	4
3-5m	5.320503	30.98721	21
>5m	1.602825	9.335031	49



Graph 10: Graph showing distribution of Landslides with respect to Overburden Thickness Classes.

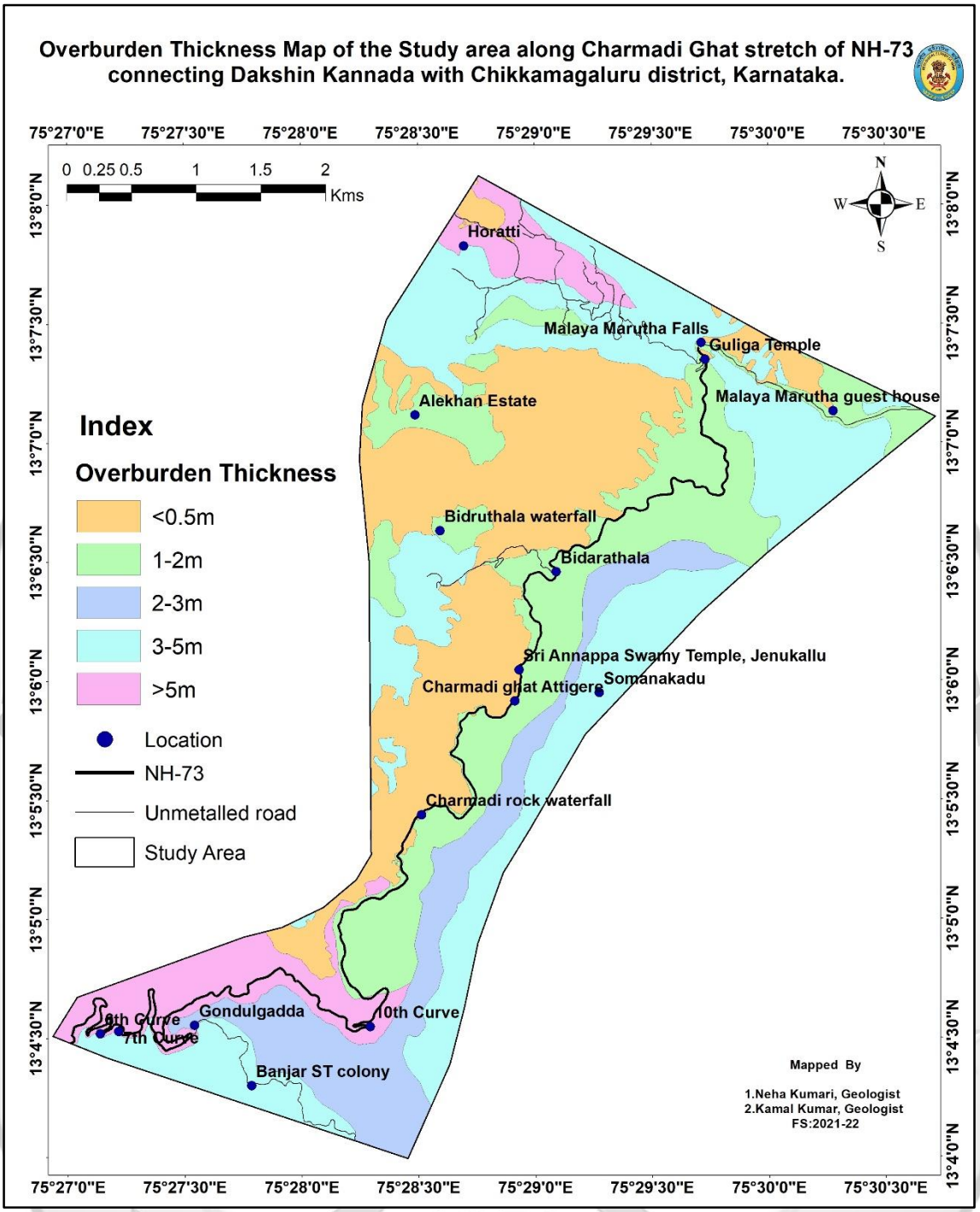


Fig 16: Regolith/Overburden Thickness Map of the Study Area (1:10,000 scale).

4.2.3 Landslide Incidences and Landslide Failure Domain Map (Fig 15 & Fig 16): During the landslide inventory mapping a total of 185 nos. of old and reactivated landslide incidences with 42-point geoparametric attributes were recorded and updated. A 42-point geoparatmetric landslide inventory database is documented in (**Annexure I**).

The landslides are classified are shallow landslides/flows of either translational or rotational in nature. The spatial distribution of landslide incidence illustrates that for slope stabilization remedial measures and mitigation measures are suggested to minimize the risk to life and property if any. The landslide failure domain is demarcated during the field-based mapping. Taking into

consideration the landslide failure mechanism and slope forming material involved in landsliding, the landslide failure domain is demarcated. The cut slope domain is demarcated along the road cut. The immature soil type consists of weathered rock and soil is classified into the Debris domain, whereas the well-developed soil is classified into the Earth slide domain, the rocky exposure is classified into the rock domain, and the rest of the area where waterbody and rivers are demarcated is classified in no landslide domain.

Total of 185 nos. of old, new, and reactivated landslides with 42-point geoparameters of landslide attributes are documented. Majority of landslides are shallow, translational, debris slide recorded along Charmadi ghat road and few are rock slide, and debris flow. Most of the old, suspended debris landslides are reactivated during heavy rainfall. The spatial correlation of geofactor thematic maps and their classes with landslide distributions are analysed to assign the weightage and rating to produce the landslide susceptibility map.

The spatial distribution of landslides indicates that the majority of the landslides are initiated on slope, spur, valley and hollow landforms. The landslide incidences and cut slope failure are mainly confined to highly dissected steep slope on highly weathered, fractured and jointed extensive vertical road cut of height >10m and slope angle >65° made at original slope angle varying between 25-35° along Charmadi Ghat road. The slope modification for road construction has disturbed the original slope geometry, gradient and relative relief. A few channel erosion along 1st and 2nd order streams are cross cutting the road and prograded as debris flow along the flow path of nala/stream breached NH-73 road section at places during heavy incessant rainfall in August-September 2019.

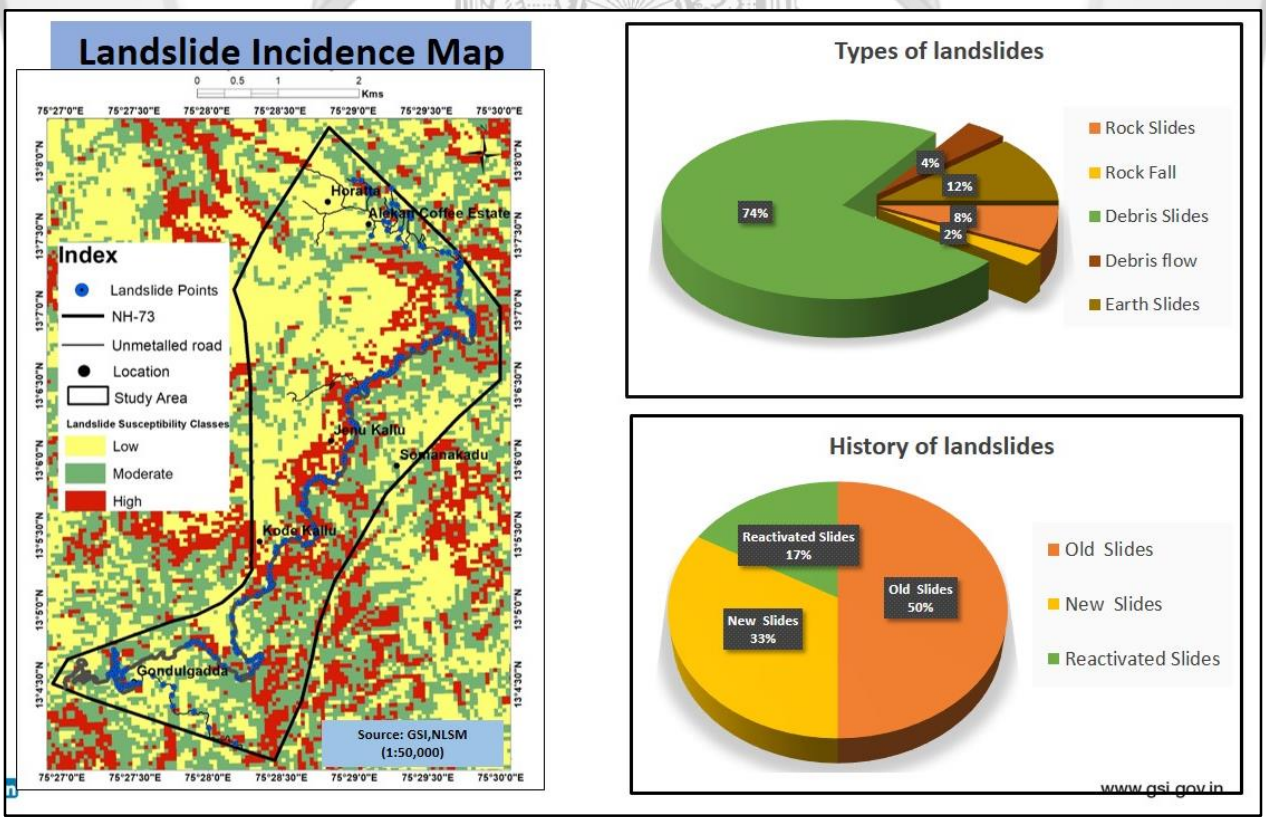
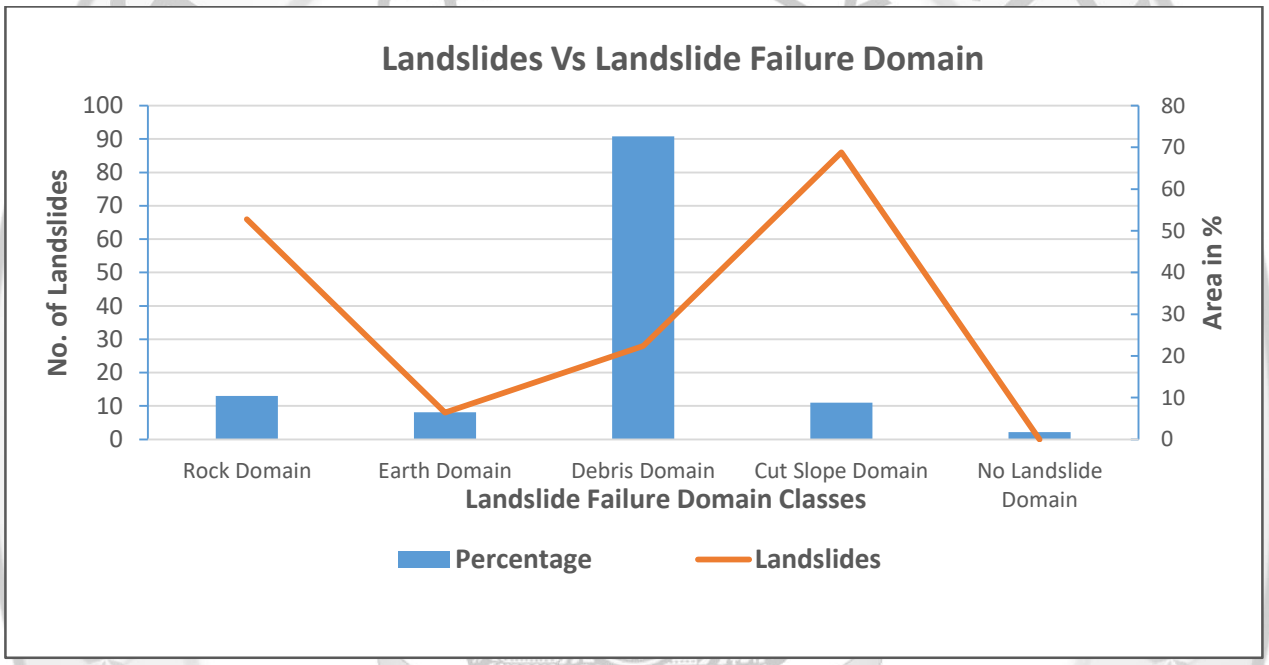


Table 14: Percentage distribution of different Landslide Failure Domain Vs Landslides

Landslide Failure Domain	Area	Percentage (%)	No. of Landslides
Rock Domain	1.788684	10.4175	66
Earth Domain	1.116181	6.500765	8
Debris Domain	12.46828	72.61665	28
Cut Slope Domain	1.511808	8.804937	86
No Landslide Domain	0.293216	1.707725	0



Graph 11: Graph showing distribution of Landslide with respect to Landslide Failure Domain classes.

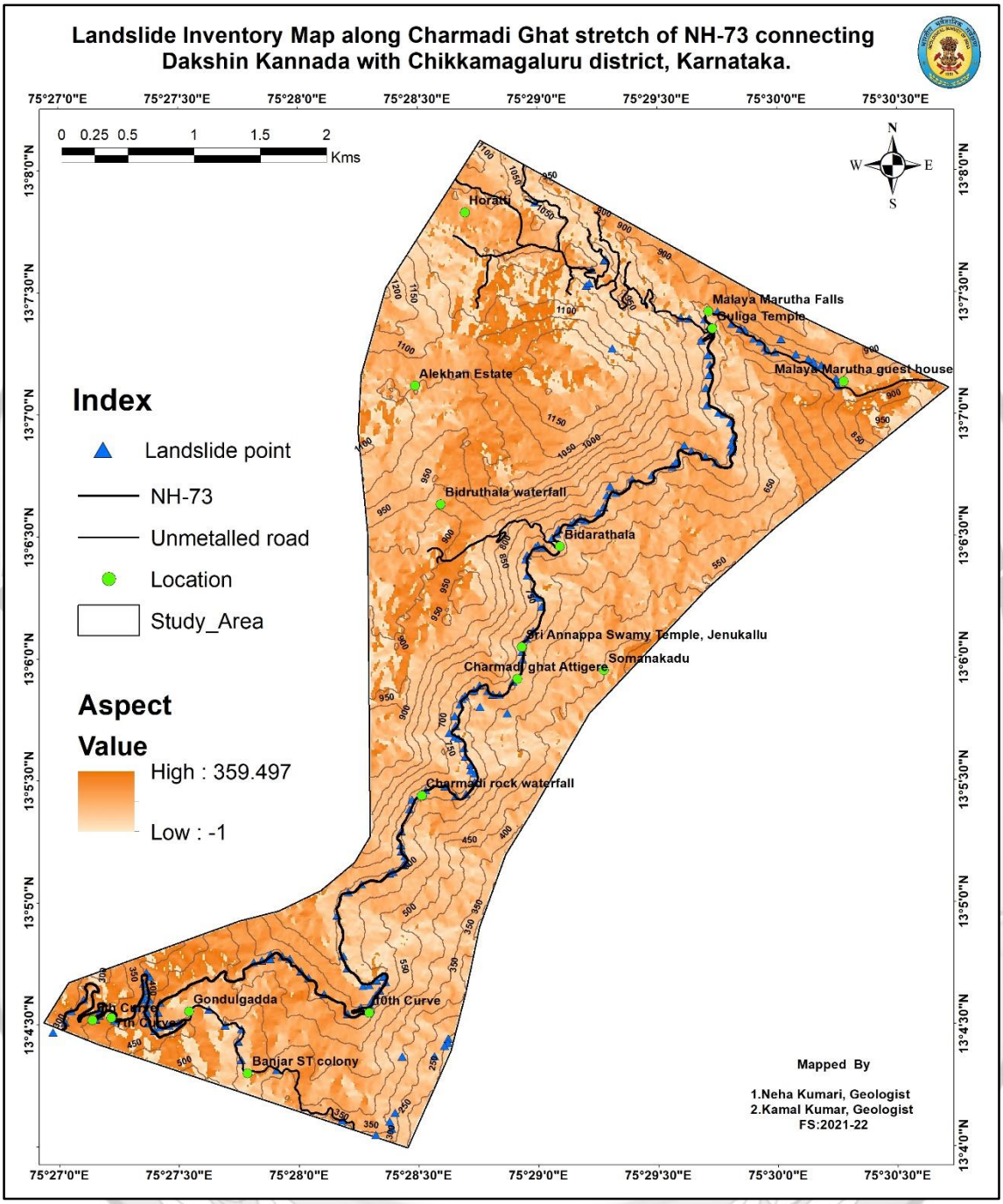


Fig 15: Landslide Incidence Map of the study area (1:10,000 scale)

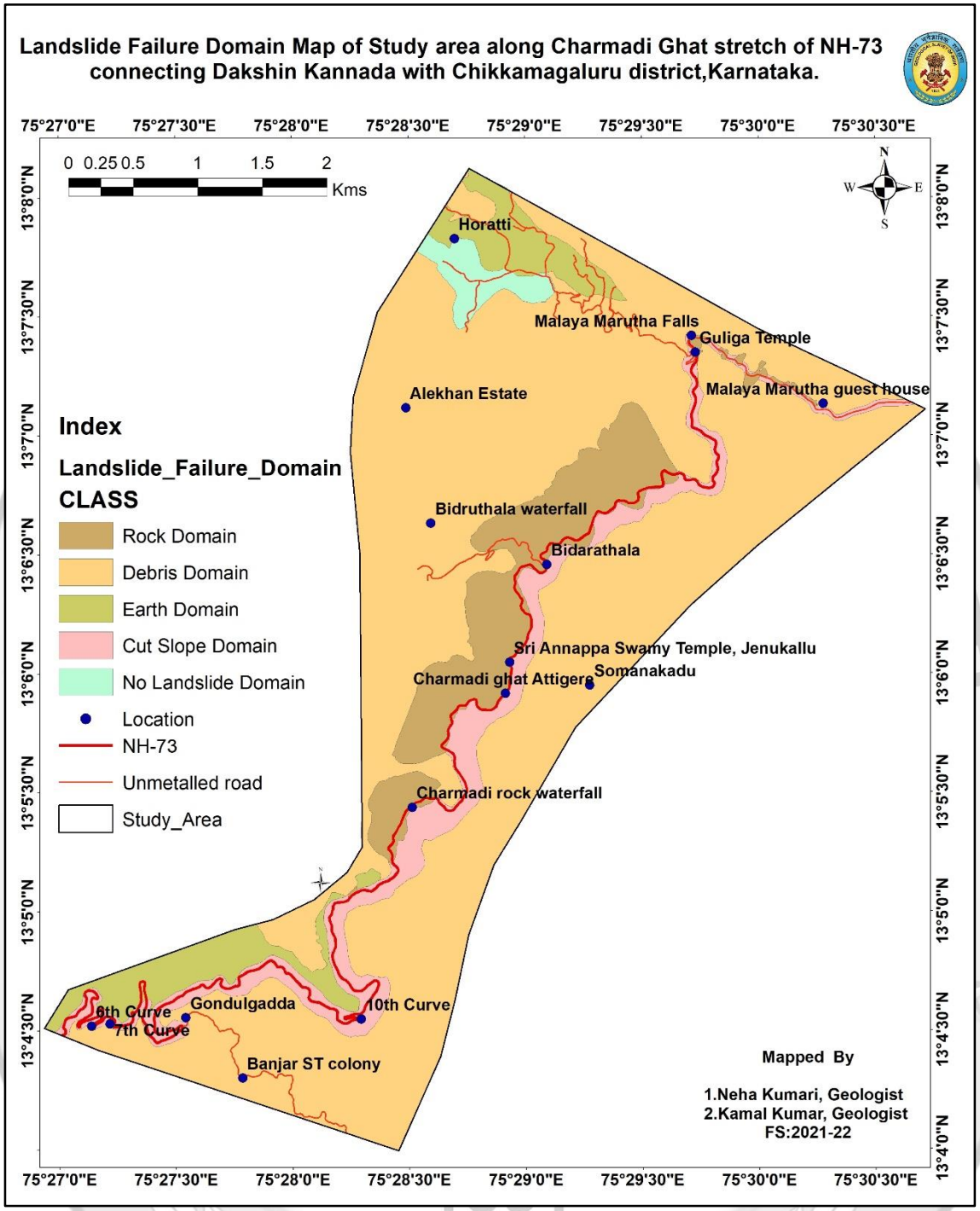


Fig 16: Landslide Failure Domain Map of the study area (1:10,000 scale)

4.3 SAMPLING AND GEOTECHNICAL TESTING:

SAMPLING: The geotechnical maps play a vital role in determining the shear parameters of the slope forming material. The spatial variability i.e. heterogeneity of soil can have a significant effect on slope stability. The geotechnical investigation includes field tests and laboratory testing of soil samples. The representative sampling is done on slope facets with similar slope morphometric parameters and similar overburden material type and at landslide

zones and vulnerable hillslopes at different elevations to study the physical and mechanical properties of slope forming material. For rock mass characterization 37 nos. of samples i.e. 30 nos. of undisturbed soil samples and 07 nos. of oriented rock samples were collected and analysed by the geotechnical laboratory, SR for sample testing. Samples are widely distributed in all the available slope-forming material classes. The geotechnical soil sample results are attached in Annexure-II. The sample location map on the Topographic Base Map is shown in **Fig 17**.

SAMPLING METHODOLOGY:

i) Sampling is done by covering the entire variants of slope forming material from varying elevations and is recorded on a base map sheet along with all observation/ field data location points. The samples are well distributed and preferably collected from undisturbed natural slopes.

ii) From debris/ soil, area, a disturbed sample weighing 5 kg is collected from the natural slope in plastic bags. The collected samples are characterized in the field itself as per the standard classification of soil and also sample type as disturbed or undisturbed samples are collected. The undisturbed soil samples are collected in standard cylindrical tubes.

iii) The samples are collected from the debris/ soil horizon at ~0.5 m depth and after removing all roots etc. from the samples. The samples were collected in sealed plastic bags to keep natural moisture content intact.

iv) The geotechnical samples are collected from the field within a maximum span of 7 days to maintain natural moisture content. A total of 30 nos. of debris/soil samples are collected and samples are widely distributed in all the available debris/ soil types in each item.

v) Samples are collected in l00 mm dia and 440 mm long steel tubes with cutting edge.

vi) After taking soil samples,both sides of the steel tube were covered with wax, and after, they were sealed in plastic to keep NMC intact.

vii) Total 07 nos. of oriented rock samples were collected representing different lithological units exposed in the study area for determing the shear strength parametres of rocks.

ii) Geotechnical testing: The geotechnical sample testing will be carried out in the Geotechnical laboratory, GSI, Hyderabad. The geotechnical tests for soil samples to be carried out are "qualitative grain size analysis", "specific gravity", "Bulk density", "Density (dry)", "Density (wet)", "Porosity", "Permeability", "UCS", "Free swell test", "NMC", "Liquid limit", "Plastic limit", "C" and "ø". Schmidt's hammer is used in the field for estimating UCS data for rock mass

characterization. The geotechnical analytical results are attached for undisturbed soil samples in **Table 15**.



Photo 5: Field photograph showing sample collection, packing, weighing, and sealing of cylinder sample tubes and plastic bags.

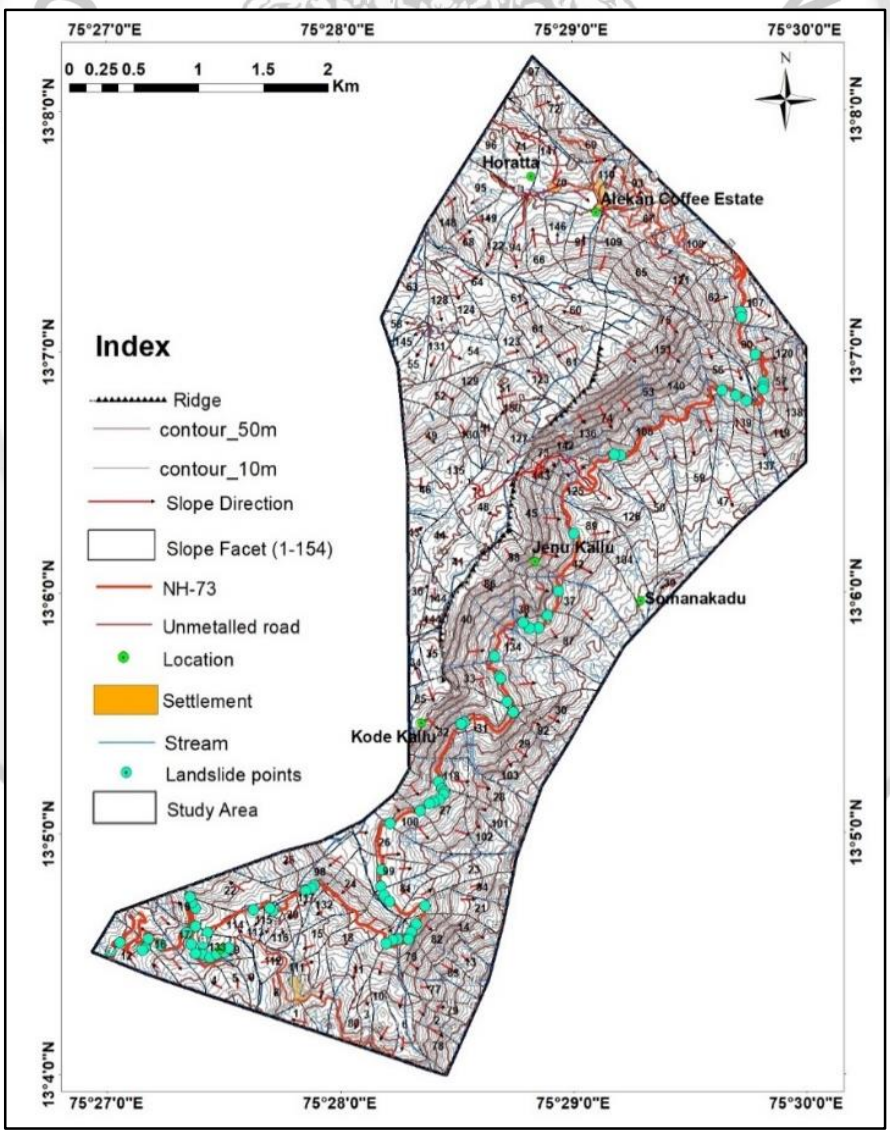


Fig 17: Topographic Base Map on 1:10,000 scale for field based mapping.

4.4 Post-field Derivative Maps: The post-field derivative maps are prepared for kinematic failure analysis in the rock domain whereas the geotechnical map is prepared for determining the shear strength of the material property. In the present study, the major part of the study area is under the rock domain. However, at places, rocky exposures are covered up to the depth of 0.5-1m thick overburden are considered under debris domain based on landslide failure mechanism as the landslide occurred at the interface of weathered rock and soil.

4.4.1 Geotechnical Map (Fig 18):

The geotechnical Map is prepared with the help of shear parameters of soil i.e. cohesion and internal friction angle obtained through soil sample testing and rock mass characterization (RMR basic) done using a Schmidt hammer in the field. All the pre-disposing terrain conditions, physical and chemical properties of overburden material are deterministic criteria to delineate the identical or similar slope facet. In order to characterize slope forming material, the RMR_{basic} in highly weathered and jointed rock mass is done, Grain size distribution, Cohesion, Internal friction angle and slope gradient of the slope facet is considered for characterizing the shear strength parameter of the overburden material.

i) RMR $_{Basic}$:

The structural data collected from the exposed rock mass along the road cut section in particular slope facet. The structural data is plotted on a rosette diagram to determine the general trend of the prominent strike and dip direction of the joint sets. Three sets of prominent joints are observed in weathered rock mass under the debris domain. The mean of all the structural joint data indicated three trends of joint sets: NE-SW, N-S, NNW-SSE directions. Major joint sets are parallel to the foliation trending in the NW-SE direction. The joint data sets are collected at exposed cut slopes along road sections and landslide zones. The joint sets are studied to determine the causes of deep weathering and the formation of the soil profile in the area.

During field based mapping geotechnical investigation Bieniawski, 1989 for rock mass rating classification is used for rock mass characterization. The uniaxial compressive strength is determined using Schimdst hammer on different vulnerable failure plane, RQD based on volumetric joint count, infilling, hyrological condition, Joint spacing and condition of joints for rock mass rating for classifying rock into poor, fair, good and very good classes for rock and cut slope landslide faiure domain by Bieniawski, 1989. Based on RMR calculated on the rocky slope the rock mass of the study area is the properties of rock mass classified into class-I : Very Good (81-100) and Class II: Good (61-80)

ii) Grain Size Analysis:

Grain size analysis is carried out for soil samples based on the classification of soil-based laboratory determination of geotechnical parameters to determine the shear parameters of soil. Different soil types are classified based on the percentage distribution of different particles i.e. silt, sand, clay, and gravel.. The cohesive strength of the soil is determined by percentage distribution in grain size as silt, sand, gravel, and clay that varies in pre-disposing terrain conditions and weathering stages. The largest volumes and highest number of landslides were triggered on the slope having silty loamy and sandy loamy soil cover.

The silt loam type of soil has the highest hydraulic conductivity and hence high water infiltration capacity that results in a rapid increase in water content and even forms perched water tables at the soil-bedrock interface (J. von Ruette et al., 2013). Loam has the lowest matric suction and hence the lowest contribution to the effective stress, and plays a vital role in triggering landslide preferentially in the steep slope areas.

iii) Cohesion and Internal Friction Angle:

The cohesion and angle of internal friction play a vital role in determining the soil properties and stability of hillslope in an overburden-covered area. Between the soil particles, there are the internal forces that the soil can offer to resist failure and sliding along any plane inside it. One of these is cohesive strength (C) and the other is the angle of internal friction (φ). Cohesion and angle of internal friction are positively correlated with shear strength. The decrease in cohesion and angle of internal friction leads to a decrease in shear strength. Equation showing shear strength equation can be written as: $S = C + \sigma \tan \varphi$, Where: Mohr-Coulomb relation, shear strength of the sliding surface is expressed in terms of the cohesion (c) and angle of internal friction (ϕ).

iv) Correlation between C and ϕ:

The final SFM map was converted into a geotechnical map by using different terrain-specific classes based on RMRbasic for rock mass characterization, C, and ϕ values for debris/earth-covered slope. The correlation matrix between the C and ϕ values of soil samples are prepared as deterministic criteria for the determination of shear parameters of slope forming material and classification of the slope into different classes. The positive and negative correlation between the C and ϕ values and slope angle is the deterministic criteria for determining the slope stability condition. So, the positive and negative correlation between slope angle and internal friction angle is considered in representative facets to categorize the hillslope into very poor, poor, good, very good, and fair categories. The unit of cohesion is converted from Kgf/cm^2 to kN/m^2. The cohesion (c) of slope forming material ranges from .18 to .44 Kgf/cm^2 and internal friction (ϕ) ranges from

22.2 to 27.6. Based on internal friction and rock mass rating relation the area falls in Poor to Fair categories.

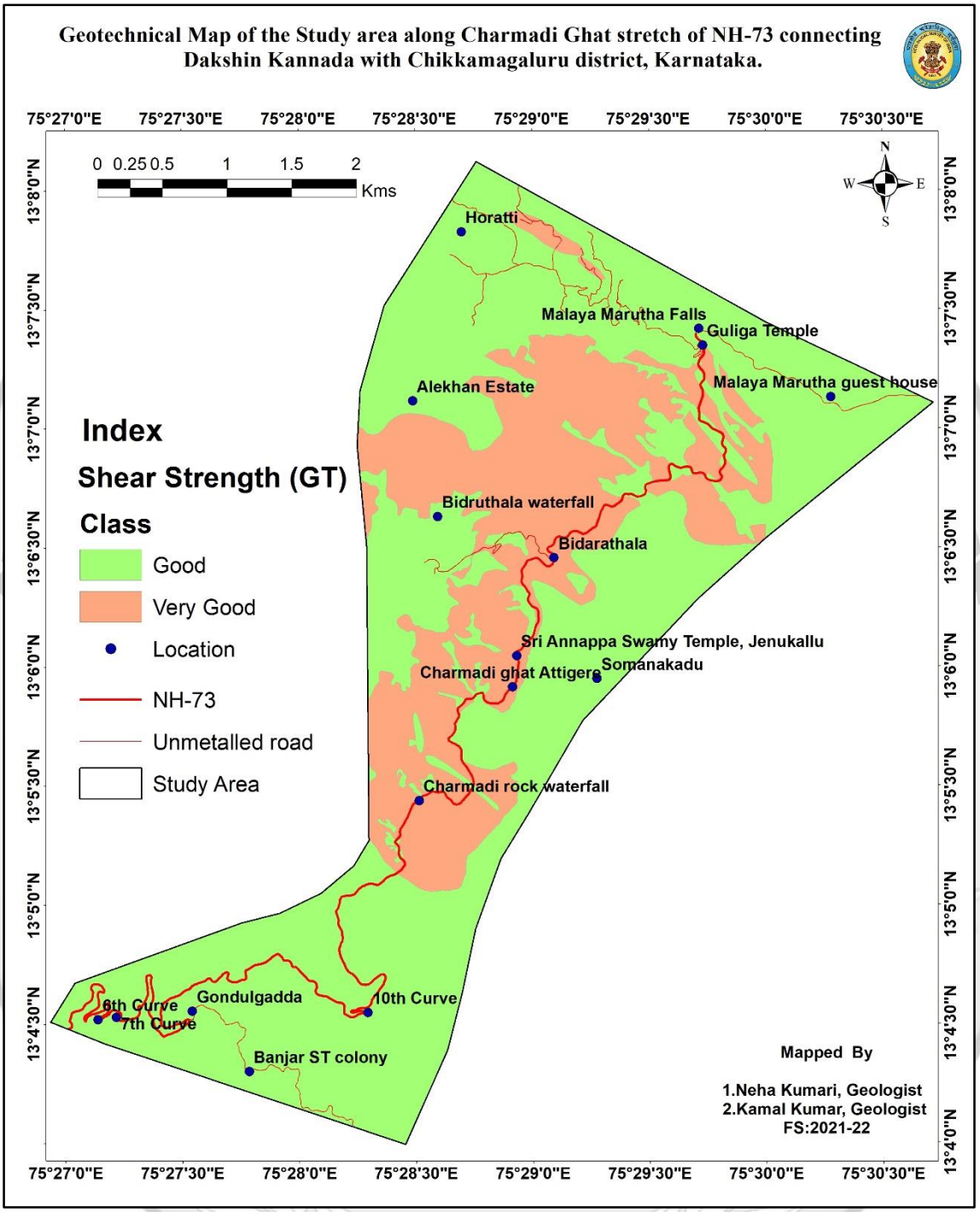


Fig 18: Geotechnical Map of the study area on 1:10,000 scale.

Table 15: Analytical results geotechnical parameters of undisturbed soil samples.

Sr. No. Undisturbed Soil samples	Sample Number	Moisture content %	Specific gravity	Density gm/cm3	Void ratio (e)	Porosity (n)	Grain Size (%)				Cohesion (Kgf/cm2)	Angle of Internal friction (Ø)
							Gravel	Sand	Silt	Clay		
1	UDS-01	13.1	2.59	1.51	0.7	0.4	32.2	34.7	22.7	10.37	0.18	25
2	UDS-02	22.03	2.92	1.33	1.2	0.5	32.3	22	41.7	4.07	0.22	26.1
3	UDS-03	10.26	2.62	1.42	0.8	0.4	5.4	55.2	34.9	4.48	0.25	25.5
4	UDS-04	12.2	2.82	1.54	0.8	0.4	34.6	33.6	27.4	4.53	0.24	24.2
5	UDS-05	15.88	2.71	1.49	0.8	0.4	24	35	36.6	4.38	0.19	23.3
6	UDS-06	10.57	2.56	1.64	0.6	0.4	18.9	39.5	36.3	5.32	0.31	22.2
7	UDS-07	14.48	2.51	1.42	0.8	0.4	18	38	40.6	3.44	0.27	27.6
8	UDS-08	16.54	2.53	1.35	0.9	0.5	11.9	37.4	46.9	3.94	0.24	24.7
9	UDS-09	19.44	2.49	1.28	0.9	0.5	73.1	13.3	9.5	4.16	0.29	26.3
10	UDS-10	13.72	2.51	1.29	0.9	0.5	19.8	47.4	27.5	5.38	0.35	25.5
11	UDS-11	11.44	2.72	1.3	1.1	0.5	32	24.1	39.7	4.3	0.4	23.8
12	UDS-12	14.55	2.53	1.38	0.8	0.4	38.6	20.6	32.6	8.3	0.38	26.5
13	UDS-13	7.92	2.54	1.61	0.6	0.4	23.1	31.3	40.6	5.07	0.32	22.8
14	UDS-14	2.18	2.54	1.64	0.5	0.3	50.2	29.2	11.5	9.22	0.28	24.5
15	UDS-15	18.87	2.57	1.39	0.8	0.4	37.8	21.3	24.2	16.76	0.29	25.5
16	UDS-16	9.36	2.6	1.62	0.6	0.4	41.5	25.9	31.2	1.44	0.24	27.4
17	UDS-17	14.2	2.64	1.45	0.8	0.4	12.2	28.1	56.5	3.21	0.25	26.5
18	UDS-18	13.06	2.5	1.4	0.8	0.4	0.5	37.9	57.3	4.35	0.27	24.7
19	UDS-19	12.89	2.5	1.46	0.7	0.4	44.8	22.6	29.4	3.23	0.22	27.2
20	UDS-20	17.09	2.68	1.45	0.8	0.4	17.4	33.9	41.1	7.61	0.26	23.7
21	UDS-21	15.01	2.61	1.45	0.8	0.4	3.5	44.9	38.9	12.8	0.23	26.3
22	UDS-22	15.88	2.58	1.6	0.6	0.4	11.5	30.9	52.9	4.75	0.19	23.6
23	UDS-23	5.6	2.48	1.71	0.5	0.3	45.1	32.3	16.4	6.28	0.3	27.4
24	UDS-24	12.45	2.51	1.4	0.8	0.4	15.6	37.8	42.8	3.84	0.37	25.5
25	UDS-25	21.49	2.62	1.25	1.1	0.5	15.1	22.7	61.2	1.04	0.41	26.2
26	UDS-26	33.55	2.59	1.37	0.9	0.5	4.2	20.8	54.6	20.4	0.44	23.1
27	UDS-27	10.24	2.6	1.42	0.8	0.4	30.7	31.2	38	0.12	0.28	25.6
28	UDS-28	13.85	2.62	1.29	1	0.5	8.6	34.8	56.2	0.37	0.29	24.9
29	UDS-29	11.86	2.6	1.41	0.8	0.4	37.3	27.6	29.5	5.59	0.24	27.2
30	UDS-30	9.38	2.53	1.41	0.8	0.4	27.9	33.7	36.2	2.27	0.25	23.3

4.4.2 Kinematic Failure Map: The kinematic failure is prepared based on the structural data collected from field based based mapping. The kinematic failure analysis is done for planar failure, wedge failure and topple failure with respect to slope angle, angle of internal friction and orientation of joints sets that determines the critical intersection between the plane of discontinuity, between slope plane and discontinuity plane with respect to slope dip direction. In the present study, the kinematic failure analysis for planar failure, wedge failure and topple failure analysis is done and classified based on their criticality for slope failure in Arc GIS platform.

4.4.2.1 Kinematic Slope Failure Incidences & their Stereoplot:

The Charmadi ghat road passes through rugged steep natural slopes during incessant rainfall. There were several cut sections of the road that failed as illustrates new failure zones were subsequently added along with erosion-induced modification of earlier-failed slopes in subsequent years. The shallow landslides occurs during peak precipitation. The orientation of plane of discontinuity and cut-slope intersection, coupled with heavy spells of rainfall during monsoon months attributed to the cause of the failure. The kinematic failure for planar, wedge and toppling condition is analysed in stereo plot along the Charmadi ghat road sector. Based on Joint sets and slope dip and dip direction kinematic failure analysis and their critical intersection along the discontinuity plane is illustrated through steronet plot. Failed slopes conform to either single or a combination of several types of failures including rock fall, plane failure, wedge failure, toppling In addition to the above, there are several locations where the road-cut slopes apparently have a possibility of failure. The field photographs of plane failure, wedge failure, and combination of planar and wedge sliding, and toppling failure is shown below.



Photo 6: Field photograph showing planar, wedge and topple failure in rock cut slope domain along Charmadi ghat road section.

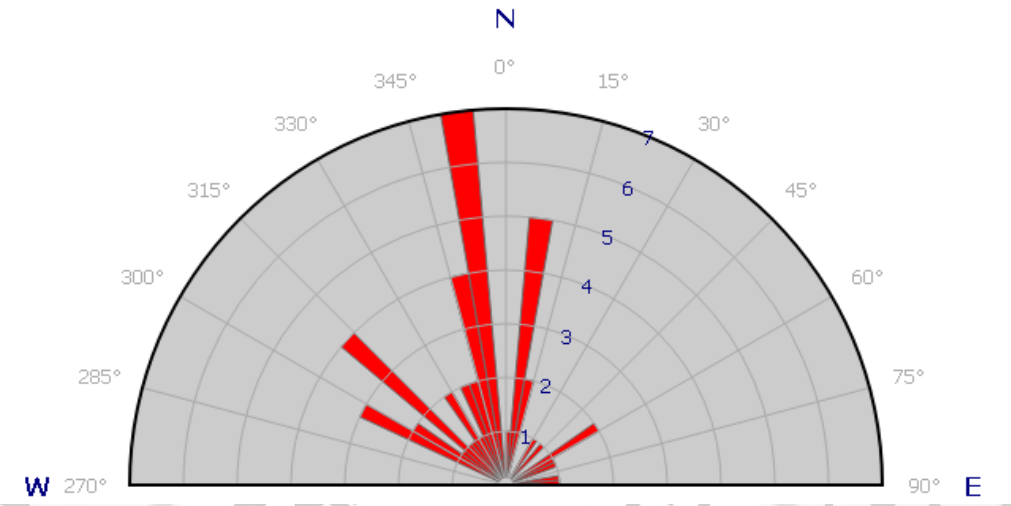


Fig 19: Rosette diagram showing the trend of the joint sets (J1) in strike direction.

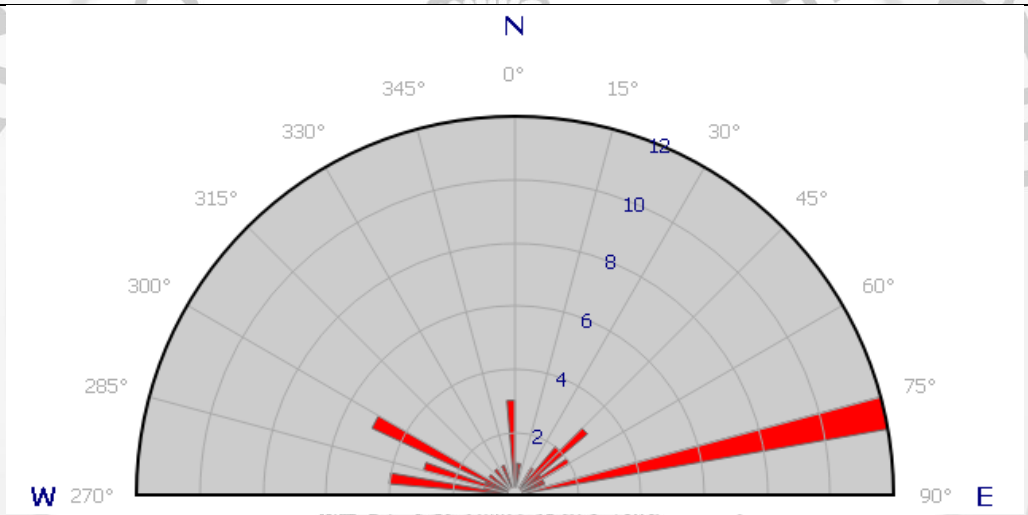


Fig 20: Rosette diagram showing the trend of the joint sets (J2) in strike direction.

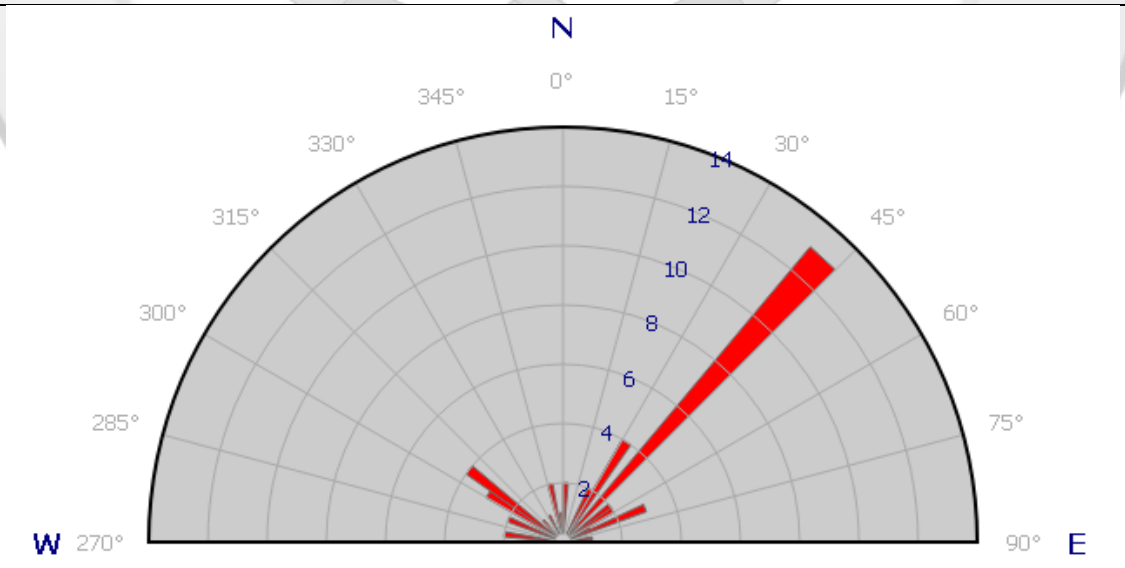


Fig 21: Rosette diagram showing the trend of the joint sets (J3) in strike direction.

Table 16: Structural data for Kinematic failure in Structural Domain.

Lat	Long	J1S	J1DA	J1DD	J2S	J2DA	J3DD	J3S	J3DA	J3DD	DIP12T	DIP12P	DIP13T	DIP13P	DIP23T	DIP23P
13.119	75.503	6.038	1.225	1.225	4.288	1.488	2.888	3.763	0.473	2.275	1.543	1.208	2.624	0.448	1.339	0.295
13.12	75.503	0.088	1.523	1.663	4.288	1.488	2.888	3.763	0.473	2.275	2.62	1.484	3.222	0.291	1.339	0.295
13.121	75.5	6.213	0.875	1.4	4.288	1.488	2.888	3.763	0.473	2.275	1.417	0.875	2.55	0.457	1.339	0.295
13.121	75.499	6.213	0.875	1.4	4.288	1.488	2.888	3.763	0.473	2.275	1.417	0.875	2.55	0.457	1.339	0.295
13.122	75.498	6.213	0.875	1.4	4.288	1.488	2.888	3.763	0.473	2.275	1.417	0.875	2.55	0.457	1.339	0.295
13.123	75.497	6.038	1.488	4.55	4.463	1.313	2.713	4.55	0.665	2.975	3.259	1.271	3.043	0.664	4.22	0.248
13.124	75.496	5.863	1.435	4.288	4.725	1.54	3.238	4.288	0.263	2.713	4.571	1.429	2.75	0.262	1.667	0.135
13.115	75.497	2.975	1.4	4.463	1.4	1.225	6.038	3.15	0.788	1.575	5.585	1.19	2.927	0.218	1.001	0.701
13.114	75.493	2.975	1.4	4.463	1.4	1.225	6.038	3.15	0.788	1.575	5.585	1.19	2.927	0.218	1.001	0.701
13.113	75.492	5.425	0.788	3.85	3.938	1.313	2.363	2.013	0.263	0.613	3.67	0.779	5.407	0.018	0.857	0.255
13.112	75.49	5.425	1.435	0.788	4.2	1.138	2.625	5.95	0.263	4.463	2.098	1.079	5.531	0.129	4.083	0.245
13.112	75.49	4.2	0.788	2.625	3.15	1.313	4.813	2.013	1.488	3.675	3.426	0.611	2.179	0.736	4.918	1.311
13.112	75.49	3.588	1.488	0.7	4.375	0.613	2.888	4.113	1.4	3.938	2.226	0.507	5.454	0.32	2.476	0.572
13.111	75.489	5.425	0.963	3.763	4.025	1.313	5.425	4.2	0.788	2.713	4.204	0.914	2.94	0.774	3.941	0.327
13.111	75.488	5.425	1.4	0.525	4.725	0.315	5.513	4.988	1.488	3.5	5.306	0.309	1.983	0.585	5.049	0.284
13.109	75.487	4.463	1.05	3.063	5.688	1.488	0.875	0.7	0.438	2.013	5.843	0.248	2.515	0.389	3.271	0.144
13.109	75.486	5.425	1.313	2.1	5.95	1.313	4.725	4.9	0.7	2.275	3.412	0.77	3.625	0.185	3.273	0.43
13.109	75.485	5.25	1.4	0.438	6.213	1.54	4.638	5.163	0.56	3.763	6.057	1.352	5.18	0.098	3.079	0.453
13.107	75.483	3.85	1.015	5.425	5.163	1.138	0.438	4.025	0.595	2.45	5.894	0.963	3.902	0.083	1.765	0.483
13.1	75.482	2.538	1.488	0.875	1.4	1.365	5.25	2.538	0.438	1.05	5.928	1.308	2.443	0.084	0.443	0.367
13.099	75.482	5.688	1.4	0.963	4.113	1.225	2.275	3.938	0.56	2.275	2.045	1.216	2.428	0.555	0.7	0
13.09	75.475	6.038	1.488	4.463	4.813	1.488	3.238	3.938	0.56	2.275	3.85	1.468	2.931	0.462	1.709	0.487
13.091	75.475	3.238	1.488	4.9	5.163	1.54	3.5	3.938	0.613	2.275	4.674	1.485	3.354	0.322	1.948	0.587
13.098	75.48	5.338	1.488	3.85	4.113	1.47	5.688	4.813	0.613	3.238	4.674	1.485	3.354	0.322	1.948	0.587
13.098	75.479	4.638	0.613	2.713	4.988	1.4	3.413	0.088	1.435	2.013	1.925	0.461	3.519	0.453	2.847	1.369
13.098	75.478	6.038	1.05	4.813	4.988	1.4	0.438	3.815	0.613	2.1	5.417	0.962	3.362	0.212	1.891	0.602
13.095	75.477	6.038	1.05	4.813	4.988	1.4	0.438	3.815	0.613	2.1	5.417	0.962	3.362	0.212	1.891	0.602
13.095	75.477	3.203	1.26	4.55	1.925	0.963	3.588	3.238	0.438	1.313	3.454	0.958	6.113	0.035	2.217	0.282
13.089	75.474	3.413	1.05	4.9	5.25	0.963	0.263	2.1	0.788	0.525	5.819	0.814	6.048	0.622	1.326	0.611
13.088	75.474	3.063	1.313	4.463	5.25	0.963	0.263	2.1	0.788	0.525	5.819	0.814	6.048	0.622	1.326	0.611
13.085	75.471	3.238	1.33	4.76	4.813	1.348	3.238	4.025	0.788	2.45	5.819	0.814	6.048	0.622	1.326	0.611

Fig 22: Sector wise kinematic failure map (Malaya Marutha Guest house to Guliga Temple) of the Charmadi ghat road section on 1:10,000 scale.

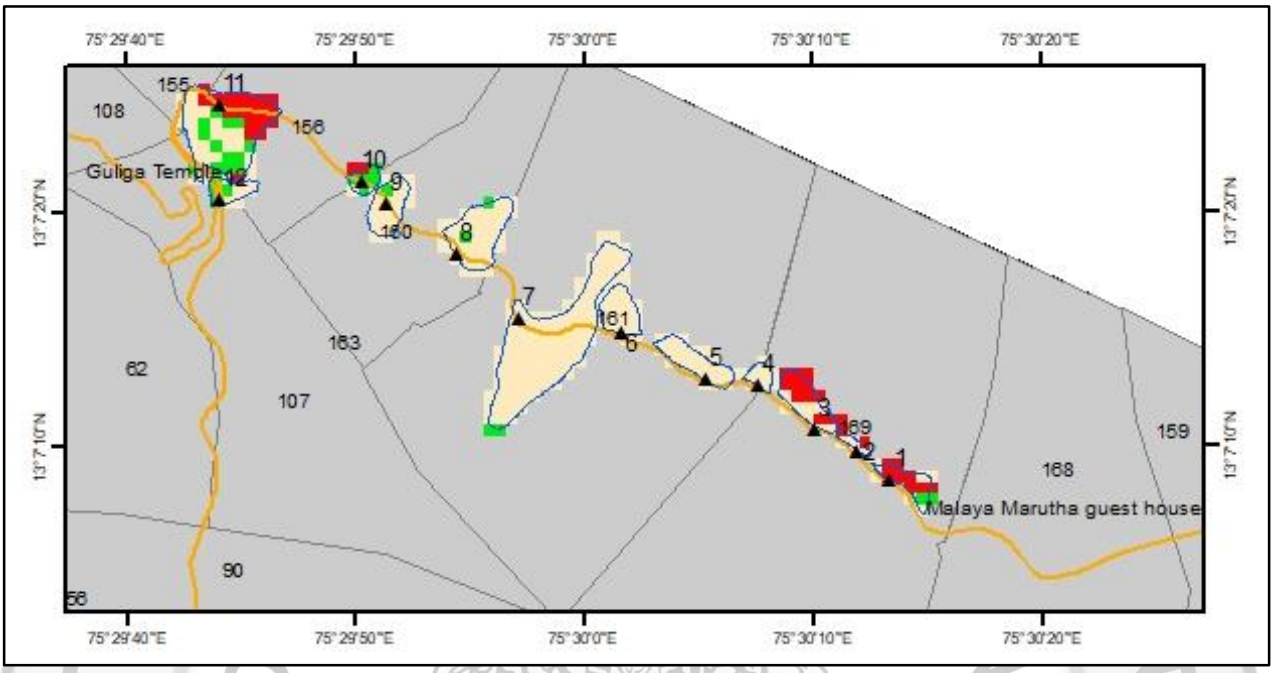
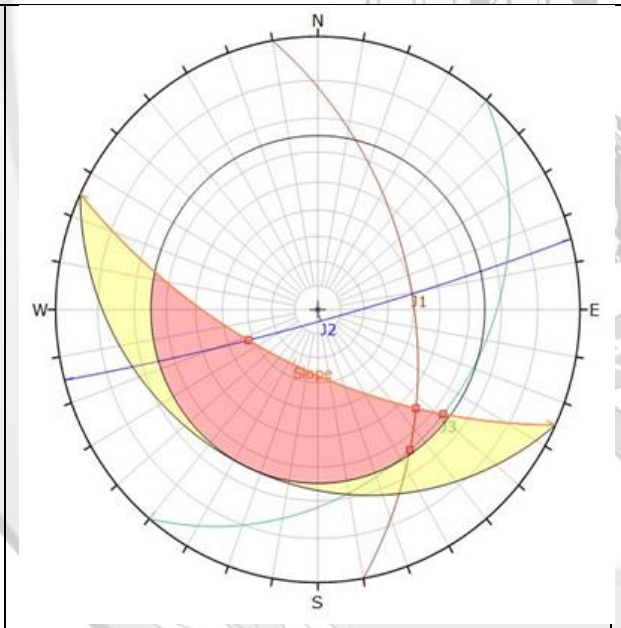


Fig 23: Stereo plot for Sector wise Kinematic Failure analysis (Malaya Marutha Guest house to Guliga Temple)

Loc1



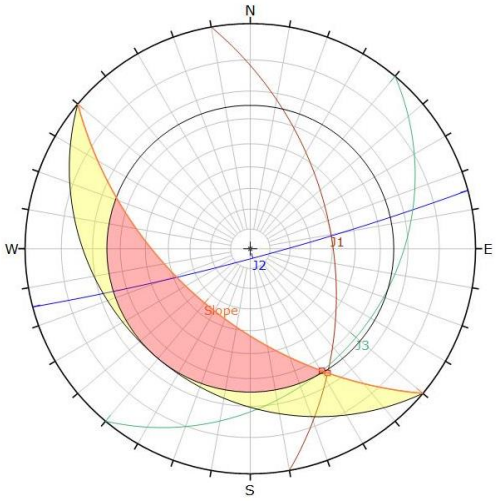
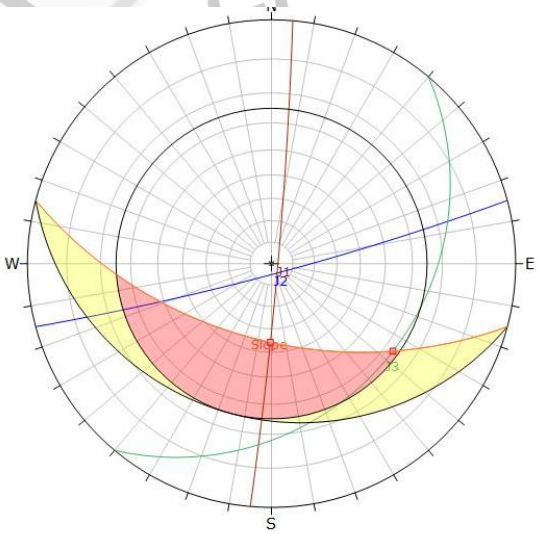
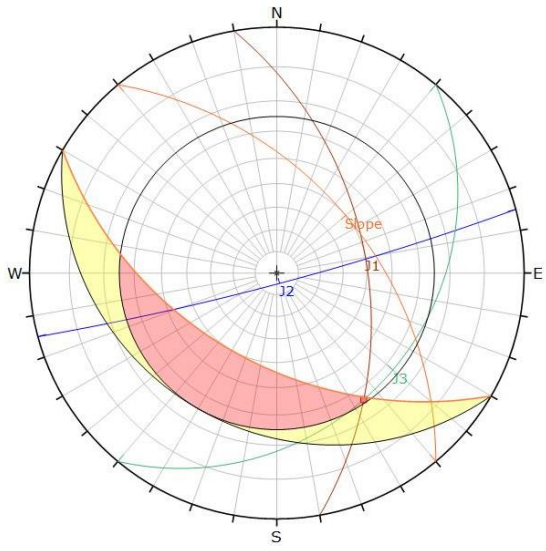
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	65
Slope Dip Direction	205
Friction Angle	25°

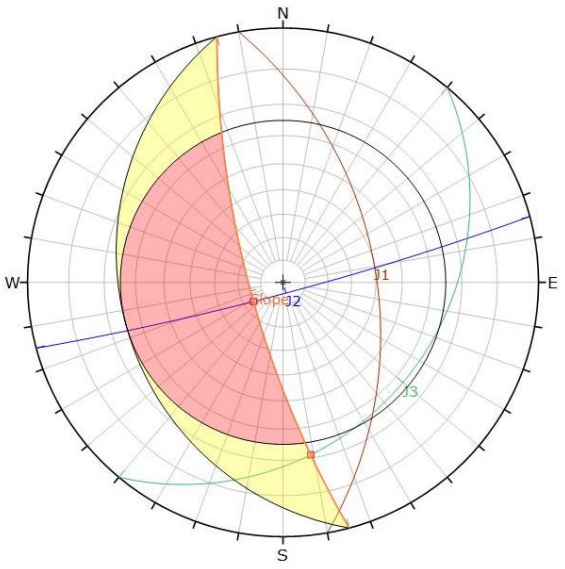
	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		65	205	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc2		**Symbol** **Feature** Critical Intersection **Kinematic Analysis** Wedge Sliding **Slope Dip** 55 **Slope Dip Direction** 220 **Friction Angle** 25° **Critical** **Total** **%** Wedge Sliding 2 6 33.33% **Color** **Dip** **Dip Direction** **Label** **User Planes** 1 50 80 J1 2 85 165 J2 3 27 130 J3 4 55 220 Slope **Plot Mode** Pole Vectors **Vector Count** 3 (3 Entries) **Intersection Mode** User Planes **Intersections Count** 6 **Hemisphere** Lower **Projection** Equal Angle
Loc3 & Loc4		**Symbol** **Feature** Critical Intersection **Kinematic Analysis** Wedge Sliding **Slope Dip** 55 **Slope Dip Direction** 195 **Friction Angle** 25° **Critical** **Total** **%** Wedge Sliding 2 6 33.33% **Color** **Dip** **Dip Direction** **Label** **User Planes** 1 87 95 J1 2 85 165 J2 3 27 130 J3 4 55 195 Slope **Plot Mode** Pole Vectors **Vector Count** 3 (3 Entries) **Intersection Mode** User Planes **Intersections Count** 6 **Hemisphere** Lower **Projection** Equal Angle
Loc5 & Loc6		**Symbol** **Feature** Critical Intersection **Kinematic Analysis** Wedge Sliding **Slope Dip** 50 **Slope Dip Direction** 210 **Friction Angle** 25° **Critical** **Total** **%** Wedge Sliding 1 6 16.67% **Color** **Dip** **Dip Direction** **Label** **User Planes** 1 50 80 J1 2 85 165 J2 3 27 130 J3 4 50 50 Slope **Plot Mode** Dip Vectors **Vector Count** 3 (3 Entries) **Intersection Mode** User Planes **Intersections Count** 6 **Hemisphere** Lower **Projection** Equal Angle

Loc7



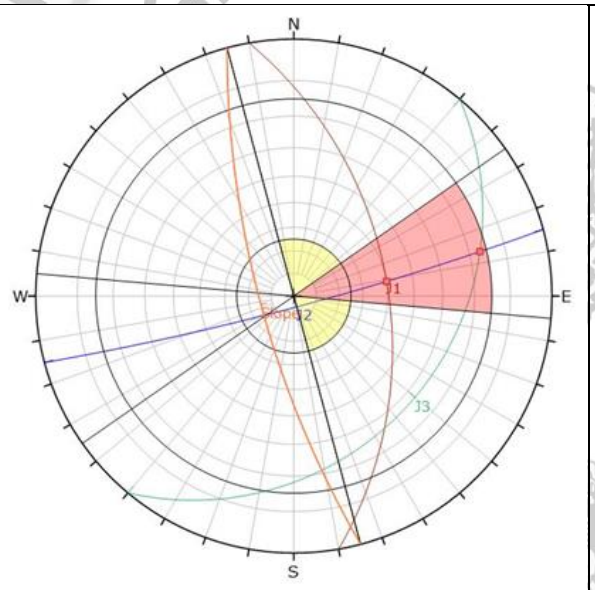
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	75
Slope Dip Direction	255
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		75	255	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



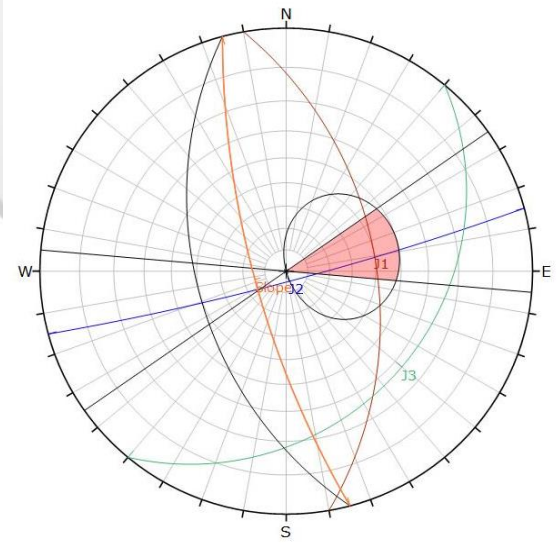
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	75
Slope Dip Direction	255
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	2	6	33.33%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		75	255	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



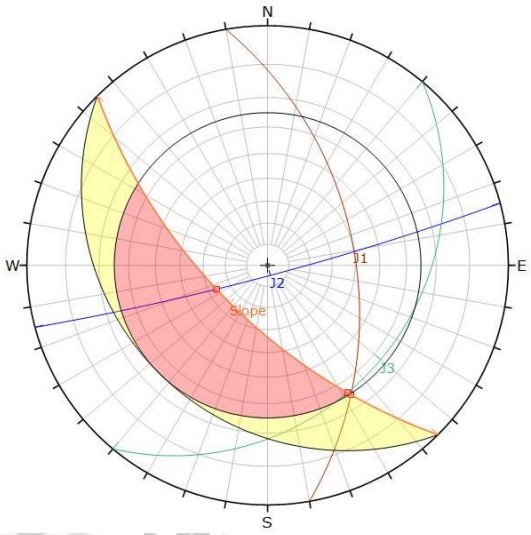
Kinematic Analysis	Flexural Toppling
Slope Dip	75
Slope Dip Direction	255
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		75	255	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle

Loc8



Symbol	Feature
	Critical Intersection

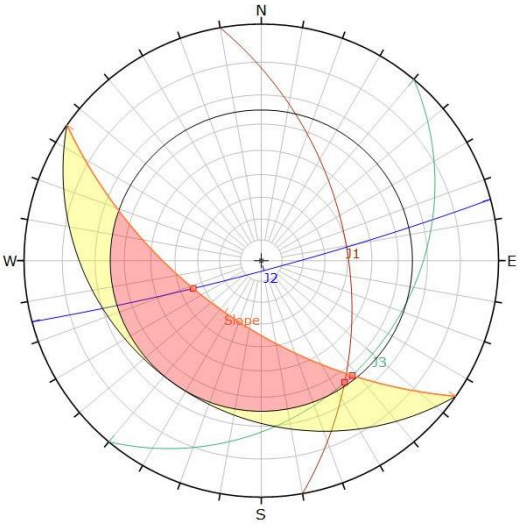
Kinematic Analysis	Wedge Sliding
Slope Dip	65
Slope Dip Direction	225
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		65	225	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 9



Symbol	Feature
	Critical Intersection

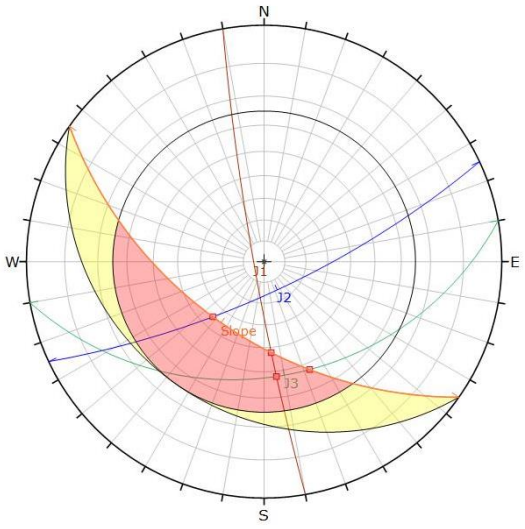
Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	215
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		50	80	J1
2		85	165	J2
3		27	130	J3
4		60	215	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc10



Symbol	Feature
	Critical Intersection

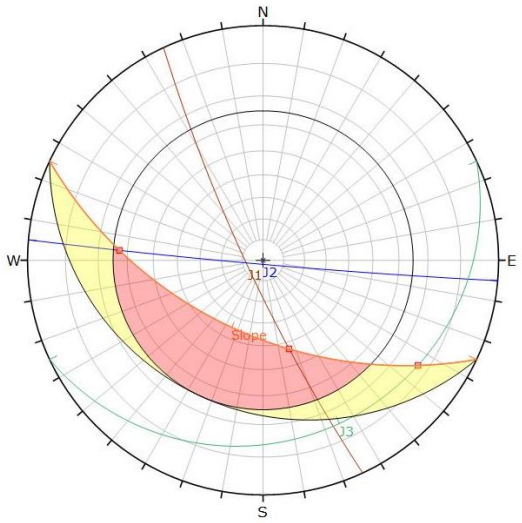
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	215
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	260	J1
2		75	155	J2
3		38	170	J3
4		55	215	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc11



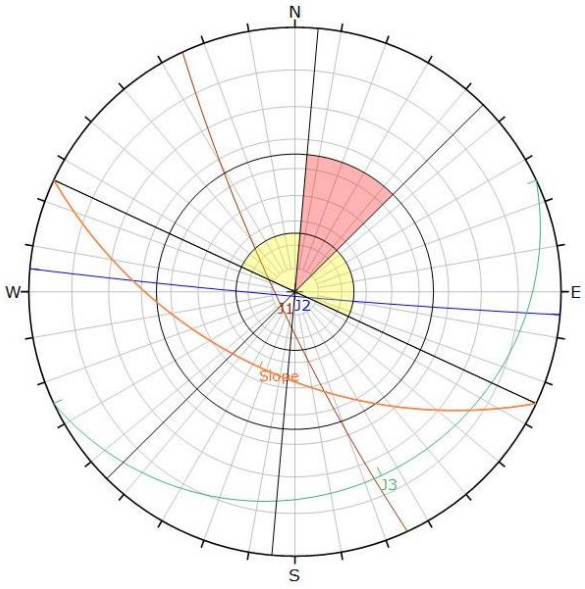
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	205
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	245	J1
2		88	185	J2
3		15	155	J3
4		55	205	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

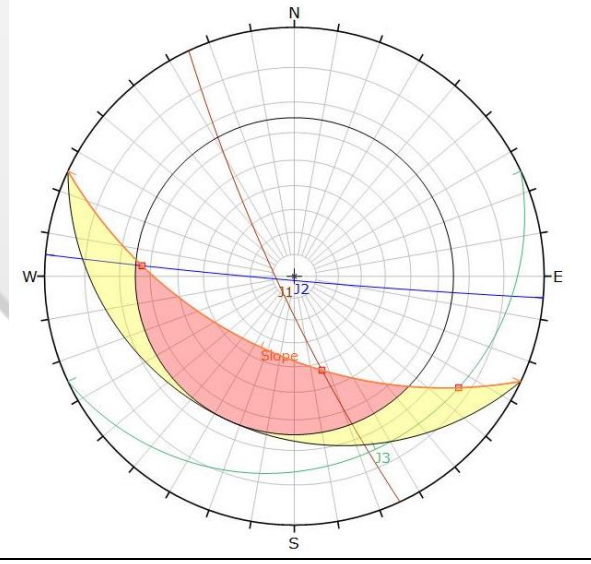
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	205
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	245	J1
2		88	185	J2
3		15	155	J3
4		55	205	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc12



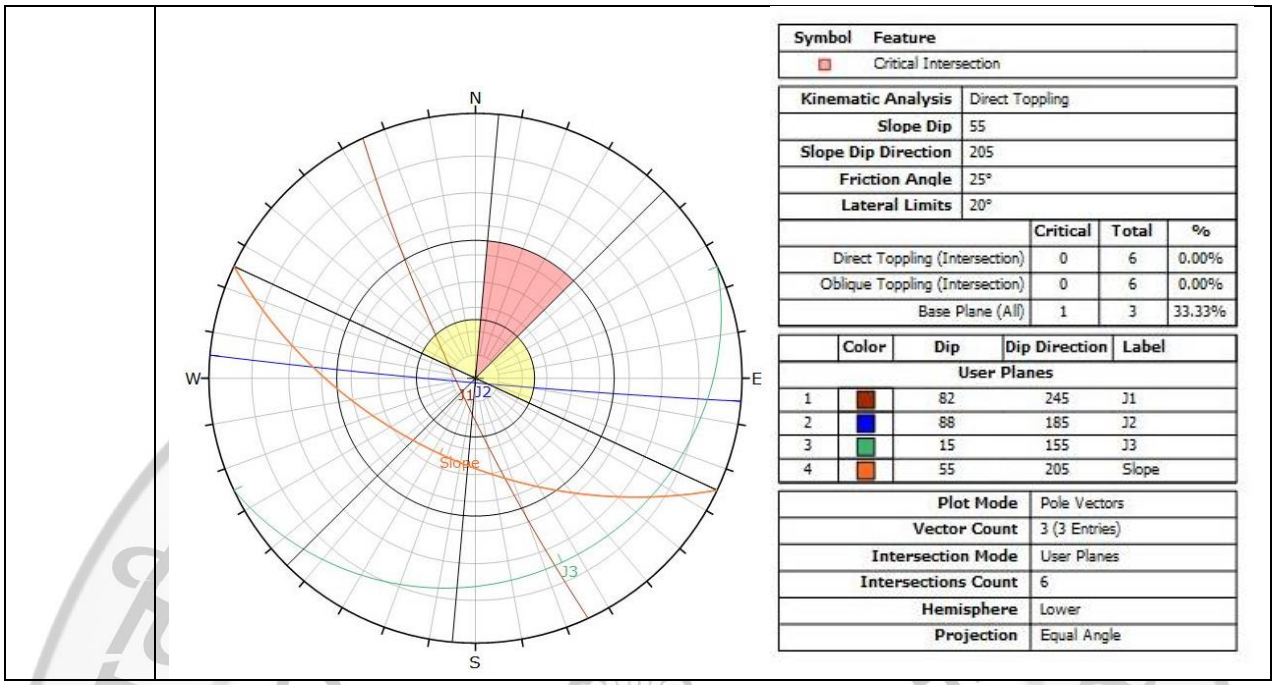
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	205
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	245	J1
2		88	185	J2
3		15	155	J3
4		55	205	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	205
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	245	J1
2		88	185	J2
3		15	155	J3
4		55	205	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Fig 24: Sector wise kinematic failure map (Guliga Temple to Attigere) along charmadi ghat road section on 1:10,000 scale.

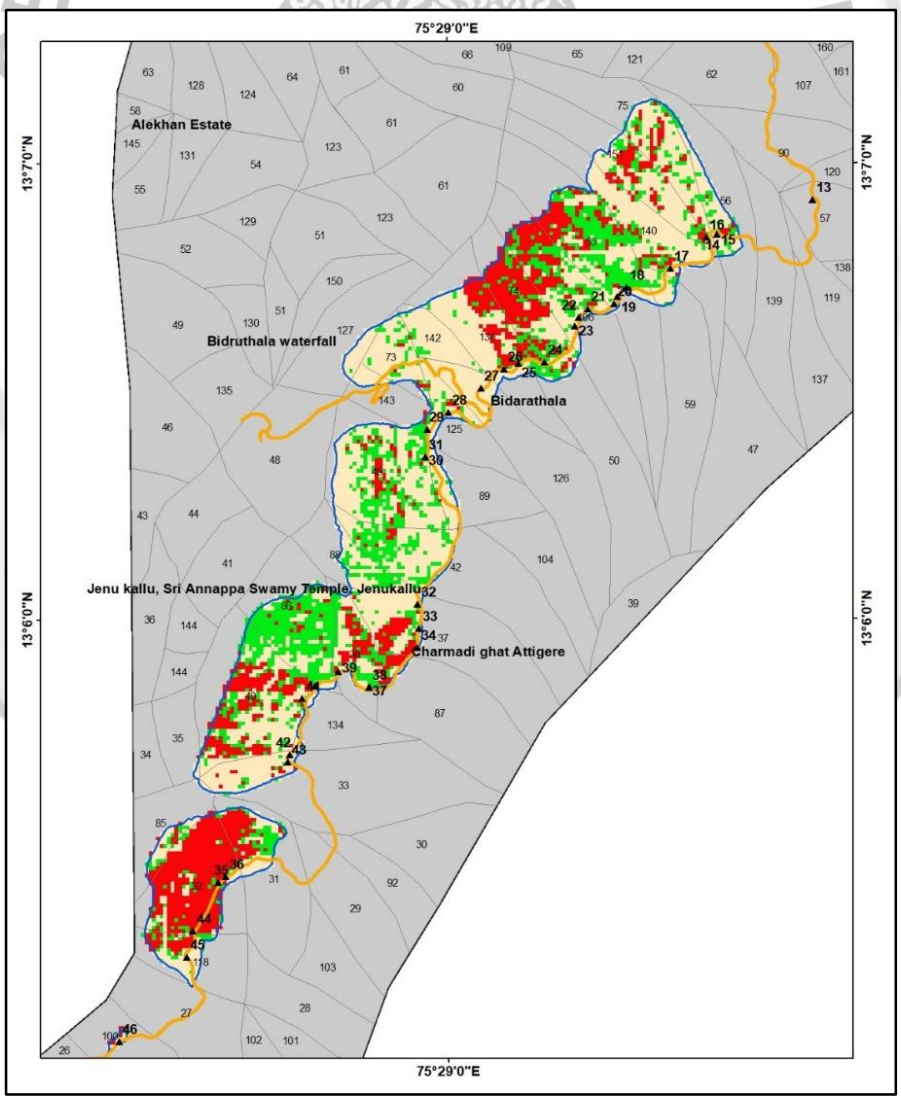
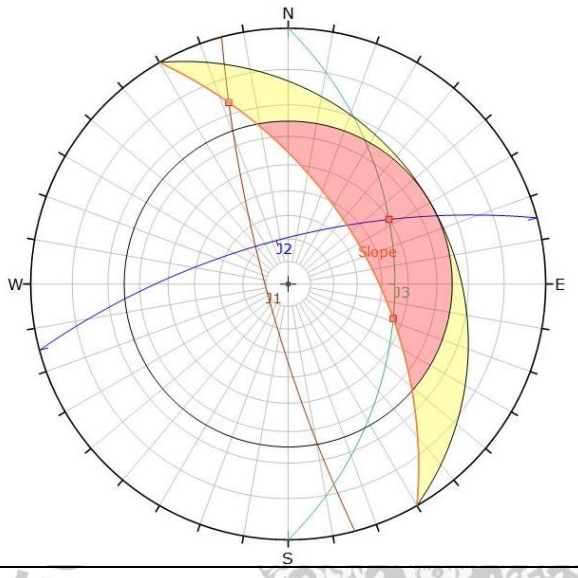


Fig 25: Stereo plot for Sector wise kinematic failure map of Guliga Temple to Attigere charmadi ghat road) on 1:10,000 scale.

Loc13



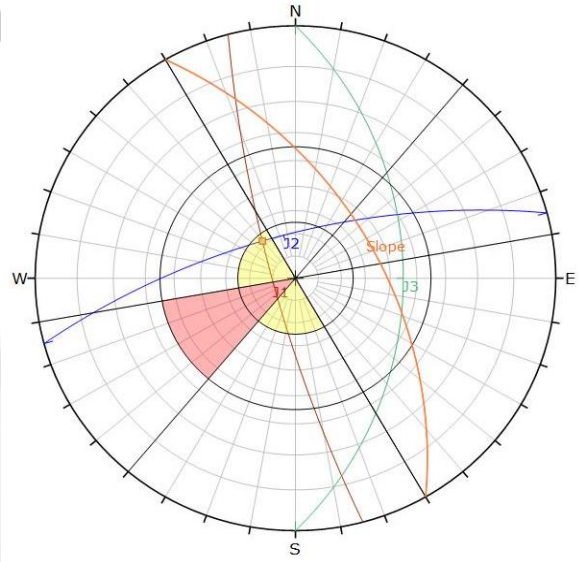
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



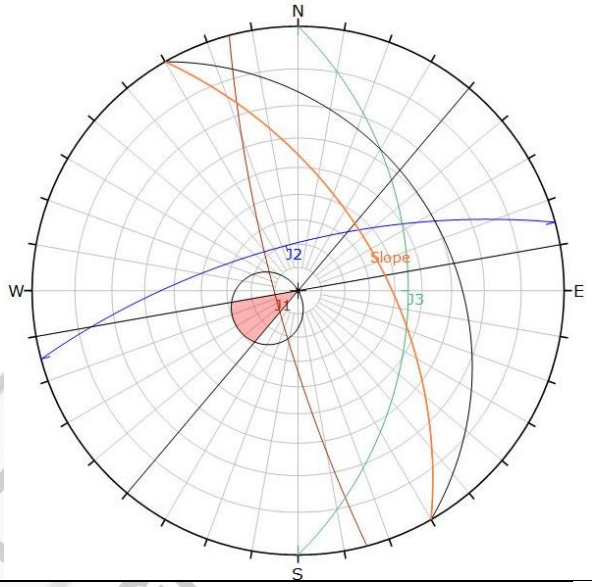
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



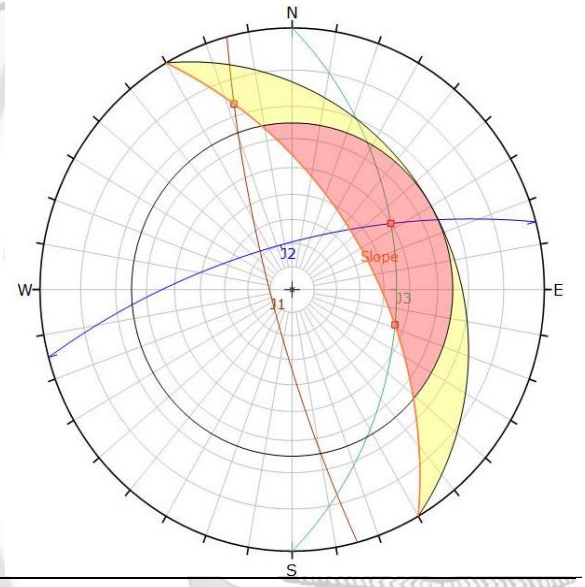
Kinematic Analysis	Flexural Toppling
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle

Loc14



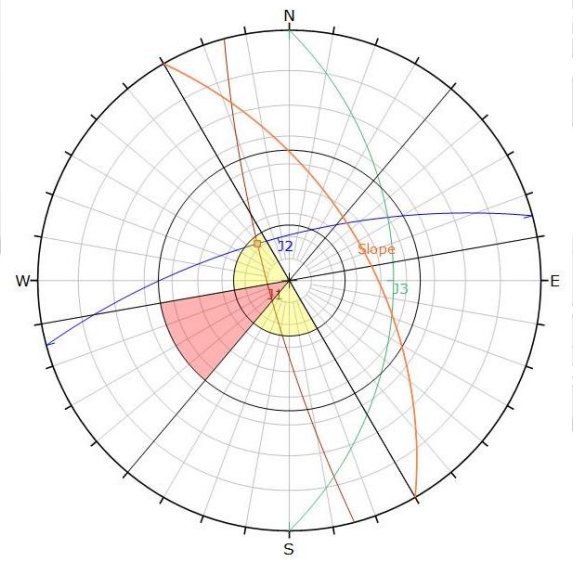
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



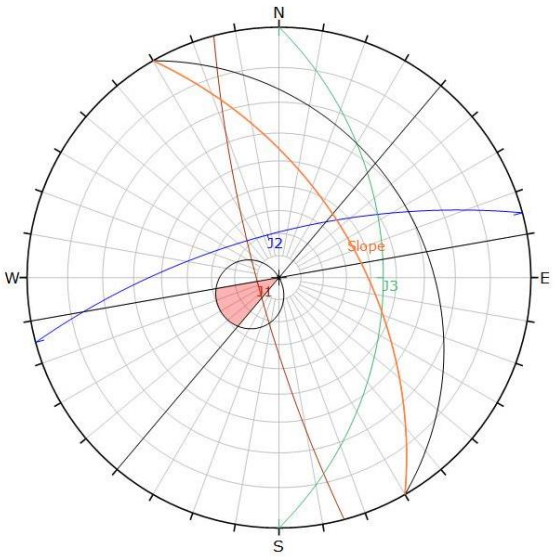
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



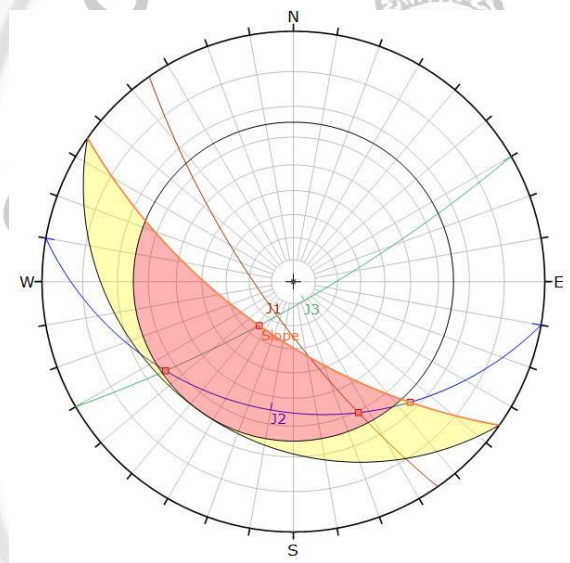
Kinematic Analysis	Flexural Toppling
Slope Dip	55
Slope Dip Direction	60
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	255	J1
2		70	345	J2
3		45	90	J3
4		55	60	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle

Loc15



Symbol	Feature
	Critical Intersection

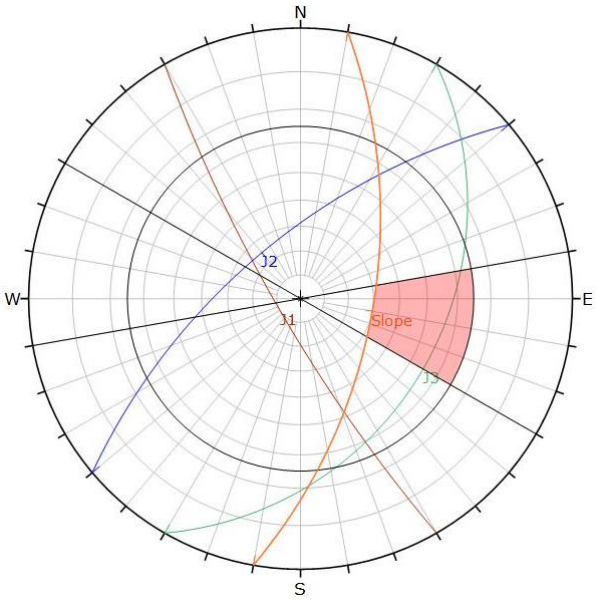
Kinematic Analysis	Wedge Sliding
Slope Dip	65
Slope Dip Direction	215
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		75	235	J1
2		35	190	J2
3		80	150	J3
4		65	215	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc16

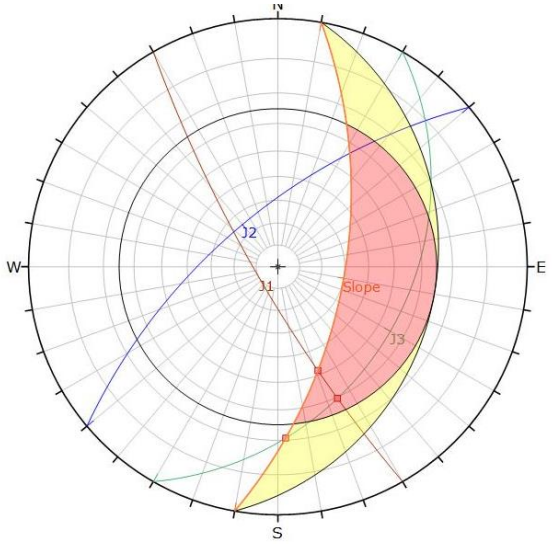


Kinematic Analysis	Planar Sliding
Slope Dip	60
Slope Dip Direction	100
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	240	J1
2		65	320	J2
3		35	120	J3
4		60	100	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



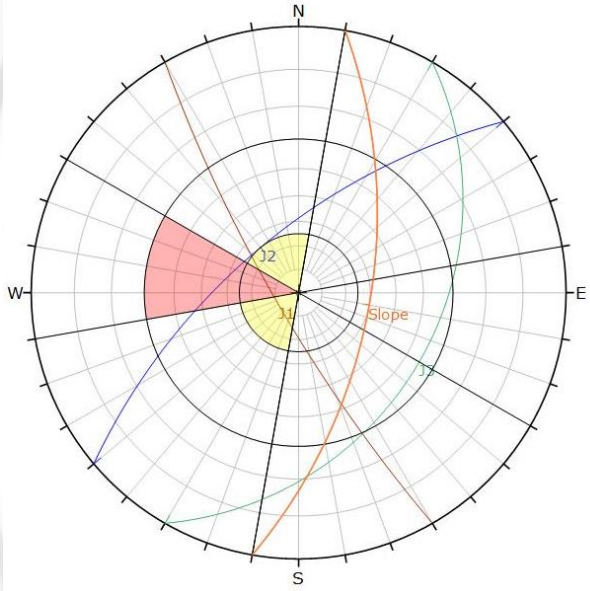
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	100
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	240	J1
2		65	320	J2
3		35	120	J3
4		60	100	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

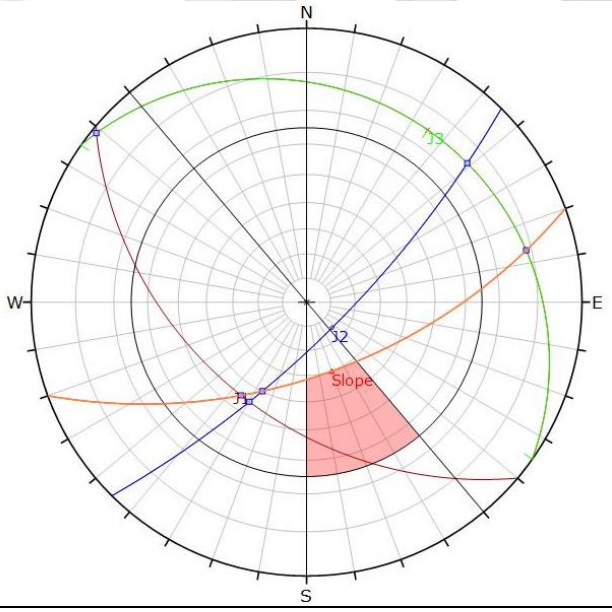
Kinematic Analysis	Direct Toppling
Slope Dip	60
Slope Dip Direction	100
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	240	J1
2		65	320	J2
3		35	120	J3
4		60	100	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc17



Symbol	ID	Quantity
	2	1
	3	1
	Others	1

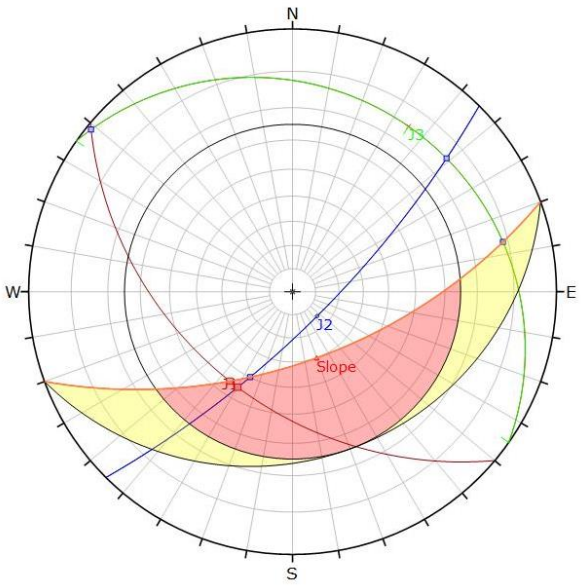
Symbol	Feature
	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	60
Slope Dip Direction	160
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	220	J1
2		75	135	J2
3		15	35	J3
4		60	160	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	2	1
×	3	1
	Others	1

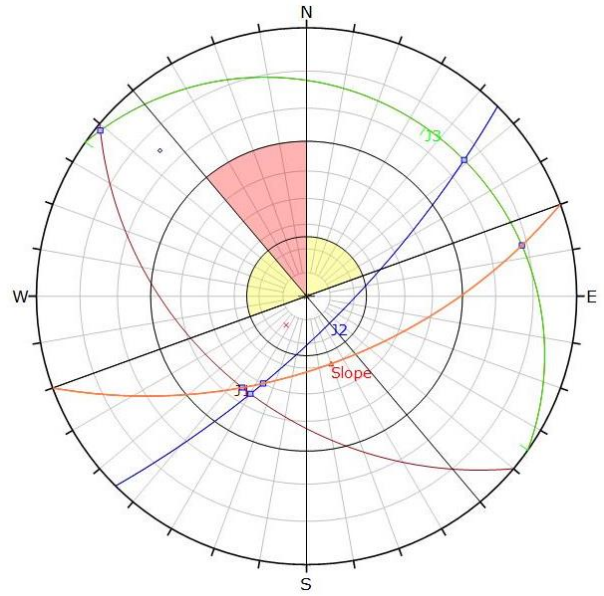
Symbol	Feature
	Critical Intersection
	Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	160
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	220	J1
2		75	135	J2
3		15	35	J3
4		60	160	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	2	1
×	3	1
	Others	1

Symbol	Feature
	Critical Intersection
	Intersection

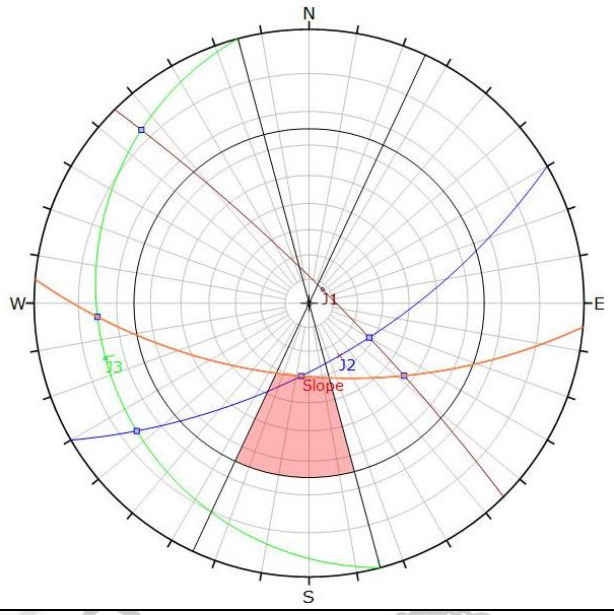
Kinematic Analysis	Direct Toppling
Slope Dip	60
Slope Dip Direction	160
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	220	J1
2		75	135	J2
3		15	35	J3
4		60	160	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc18



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

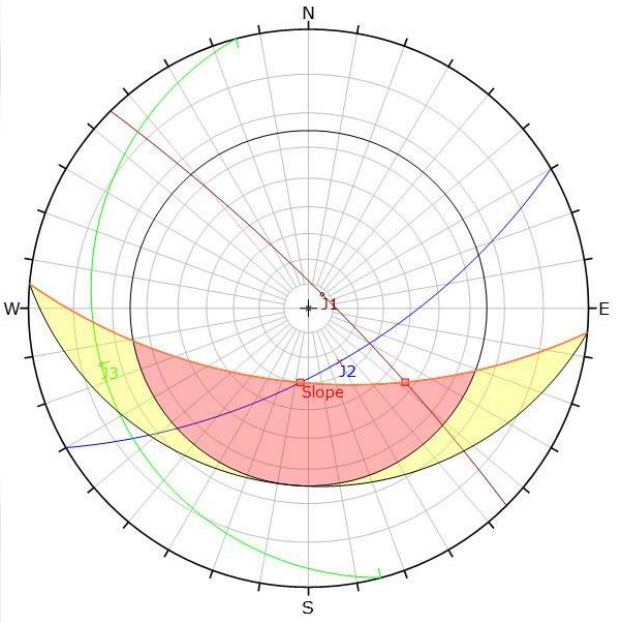
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	60
Slope Dip Direction	185
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	45	J1
2		65	150	J2
3		15	255	J3
4		60	185	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

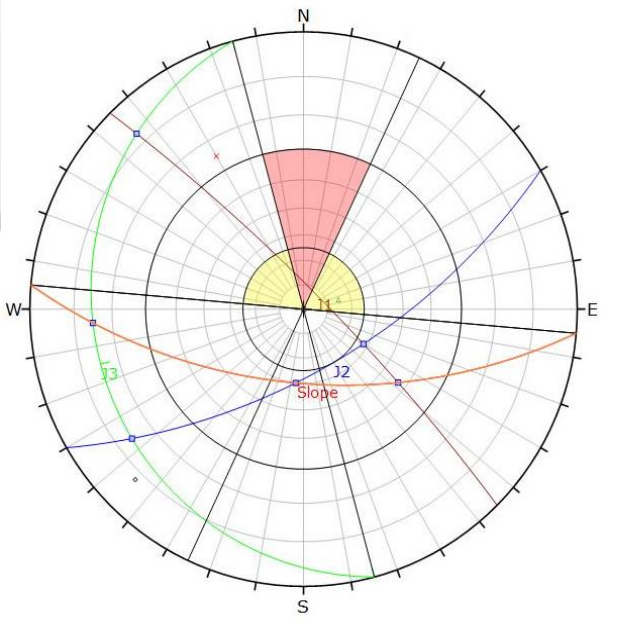
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	185
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	45	J1
2		65	150	J2
3		15	255	J3
4		60	185	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection
□	Intersection

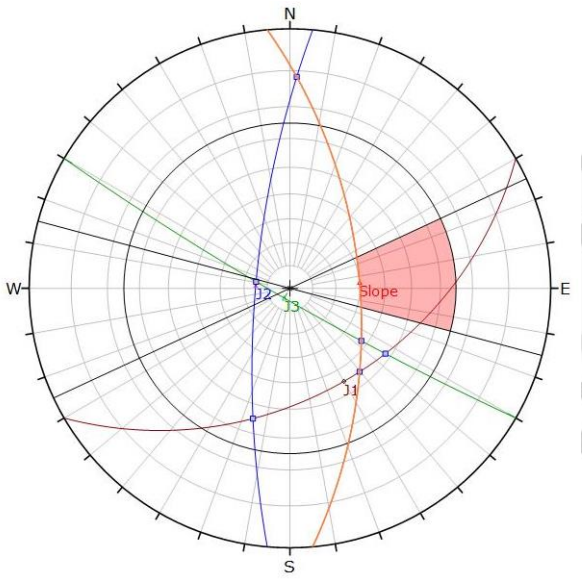
Kinematic Analysis	Direct Toppling
Slope Dip	60
Slope Dip Direction	185
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		82	45	J1
2		65	150	J2
3		15	255	J3
4		60	185	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc19



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

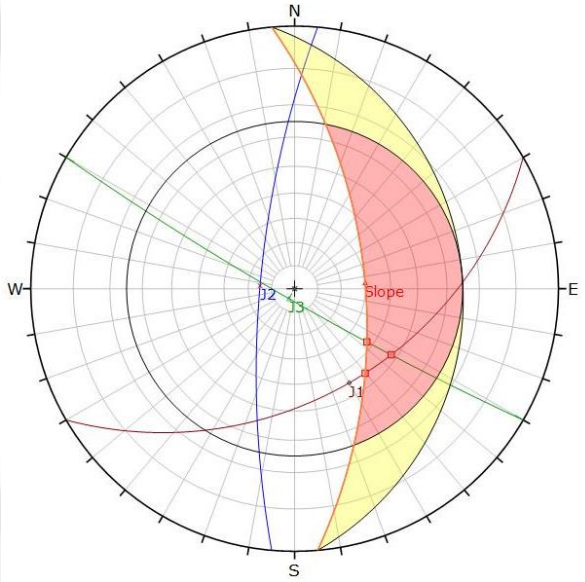
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	60
Slope Dip Direction	85
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	150	J1
2		75	275	J2
3		85	210	J3
4		60	85	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

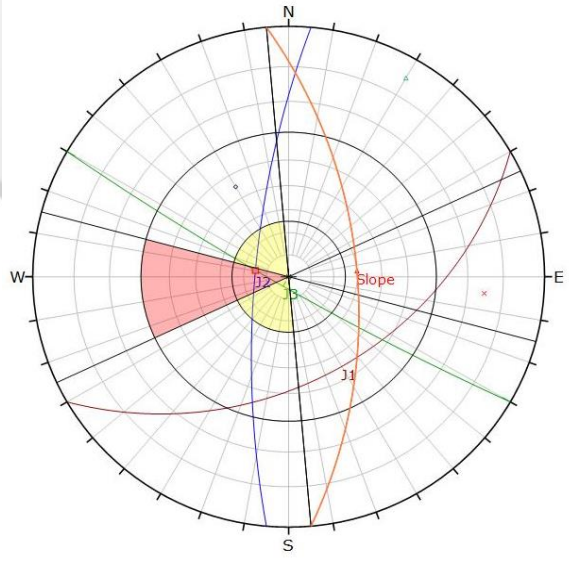
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	85
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	150	J1
2		75	275	J2
3		85	210	J3
4		60	85	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

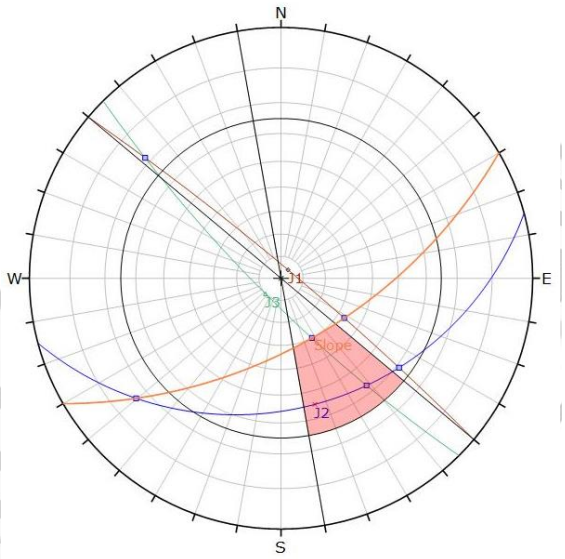
Kinematic Analysis	Direct Toppling
Slope Dip	60
Slope Dip Direction	85
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	1	6	16.67%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	150	J1
2		75	275	J2
3		85	210	J3
4		60	85	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc20



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

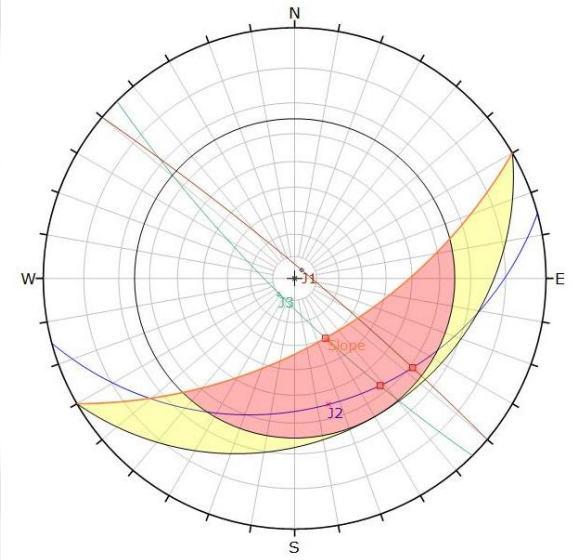
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	60
Slope Dip Direction	150
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
2		35	165	J2
3		80	225	J3
1		85	40	J1
4		60	150	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

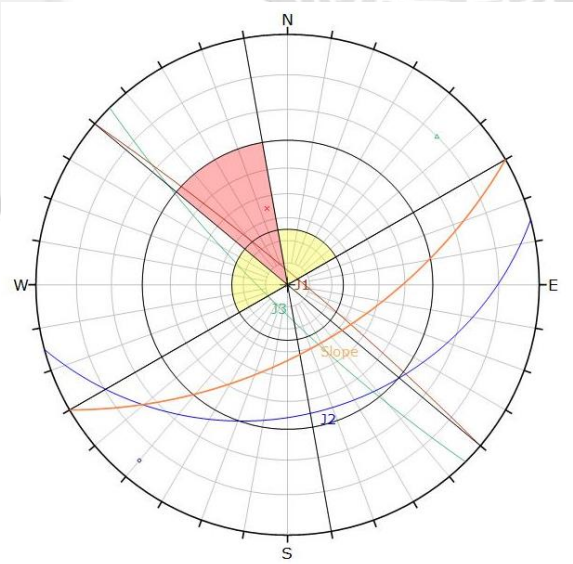
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	60
Slope Dip Direction	150
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
2		35	165	J2
3		80	225	J3
1		85	40	J1
4		60	150	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

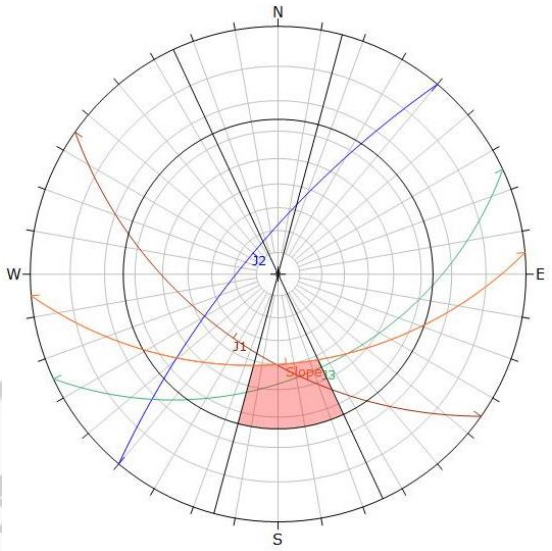
Kinematic Analysis	Direct Toppling
Slope Dip	60
Slope Dip Direction	150
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
2		35	165	J2
3		80	225	J3
1		85	40	J1
4		60	150	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc21

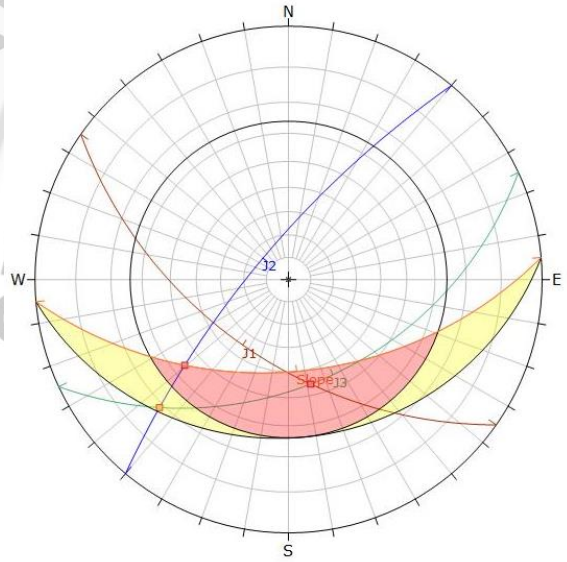


Kinematic Analysis	Planar Sliding
Slope Dip	50
Slope Dip Direction	175
Friction Angle	26°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		55	215	J1
2		75	310	J2
3		45	155	J3
4		50	175	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



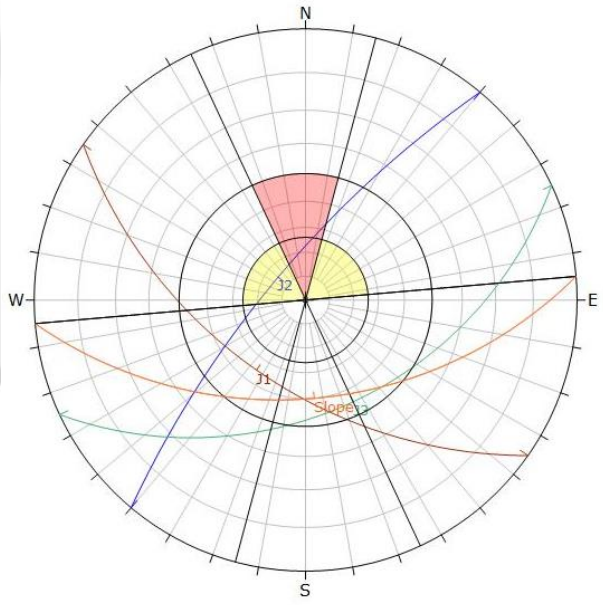
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	50
Slope Dip Direction	175
Friction Angle	26°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		55	215	J1
2		75	310	J2
3		45	155	J3
4		50	175	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

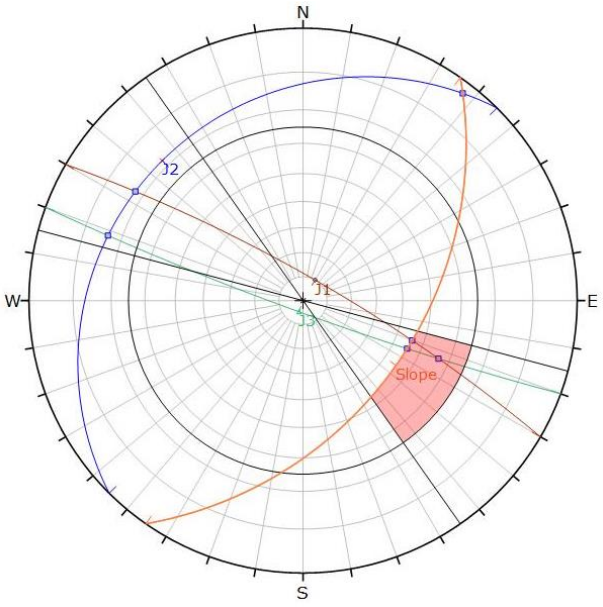
Kinematic Analysis	Direct Toppling
Slope Dip	50
Slope Dip Direction	175
Friction Angle	26°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		55	215	J1
2		75	310	J2
3		45	155	J3
4		50	175	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc22 and Loc23



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

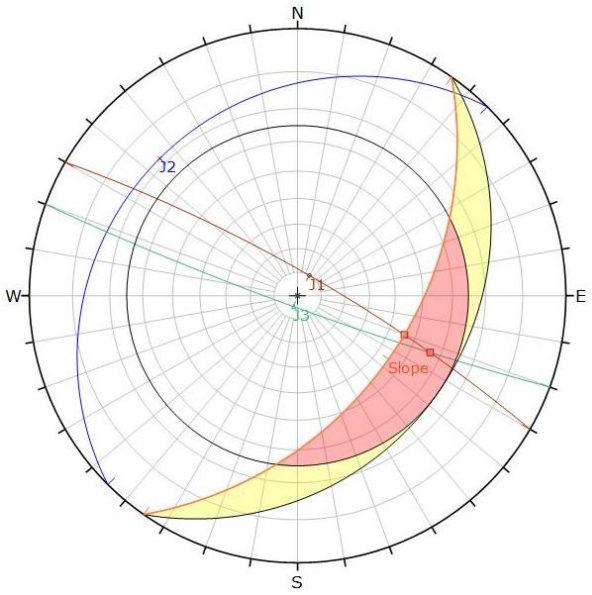
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	125
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	30	J1
2		18	315	J2
3		85	200	J3
4		45	125	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

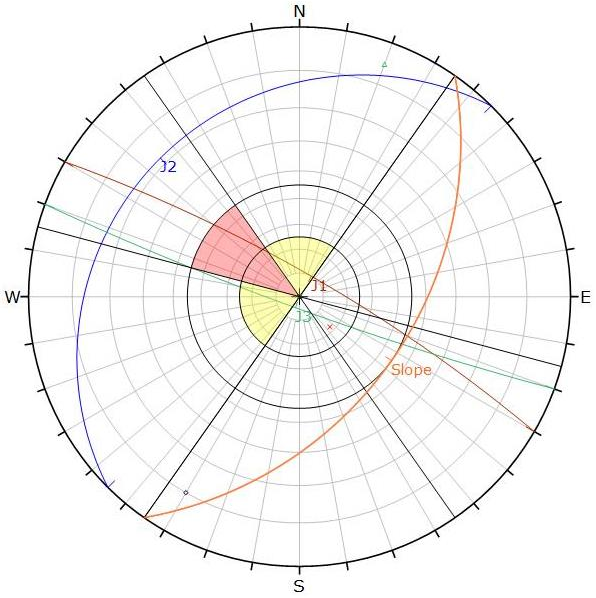
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	125
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	30	J1
2		18	315	J2
3		85	200	J3
4		45	125	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

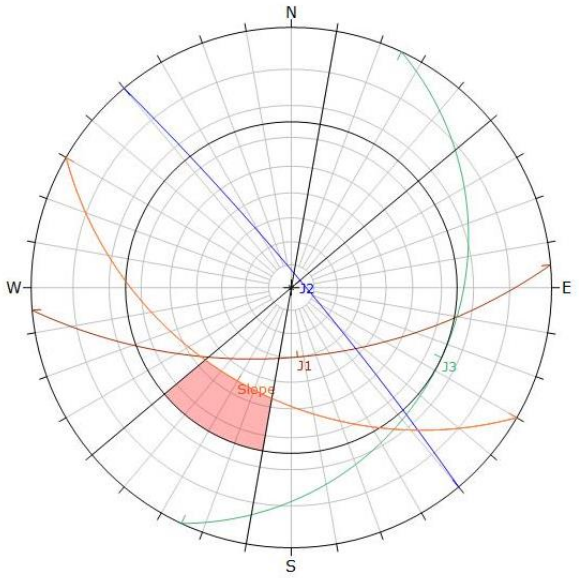
Kinematic Analysis	Direct Toppling
Slope Dip	45
Slope Dip Direction	125
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	30	J1
2		18	315	J2
3		85	200	J3
4		45	125	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc24

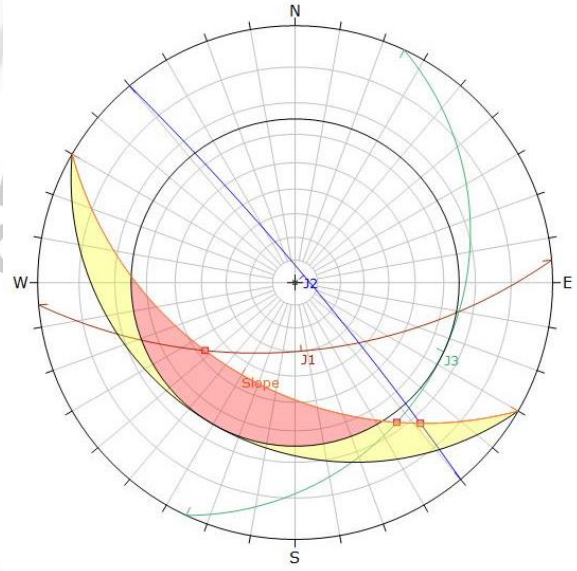


Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	210
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	175	J1
2		85	50	J2
3		25	115	J3
4		45	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

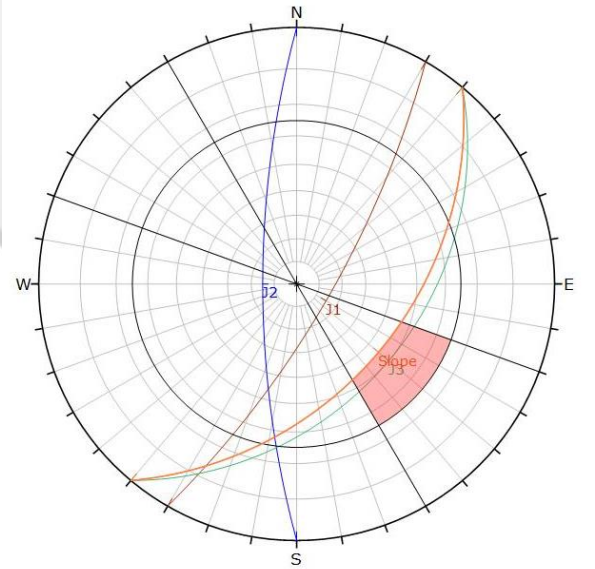
Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	210
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	175	J1
2		85	50	J2
3		25	115	J3
4		45	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc25

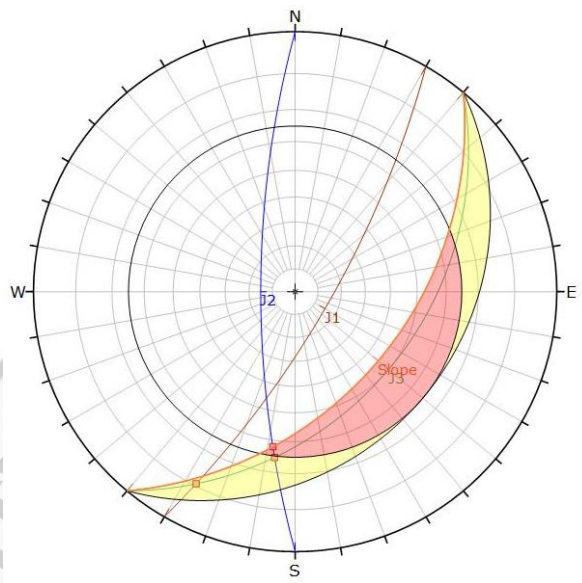


Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	130
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		75	120	J1
2		75	270	J2
3		40	130	J3
4		45	130	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



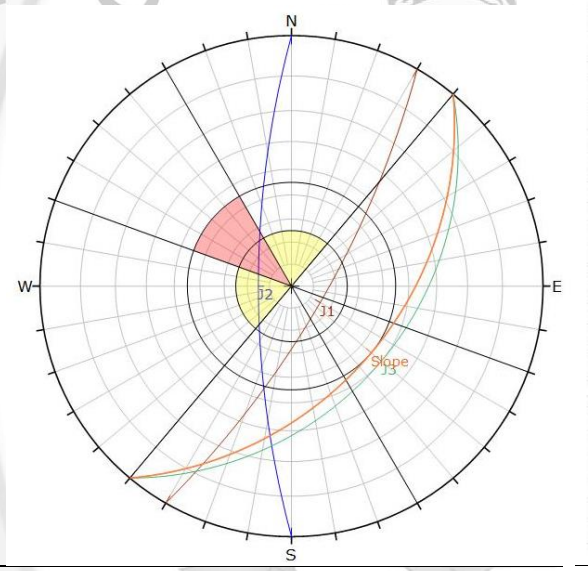
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	130
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		75	120	J1
2		75	270	J2
3		40	130	J3
4		45	130	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	Feature
	Critical Intersection

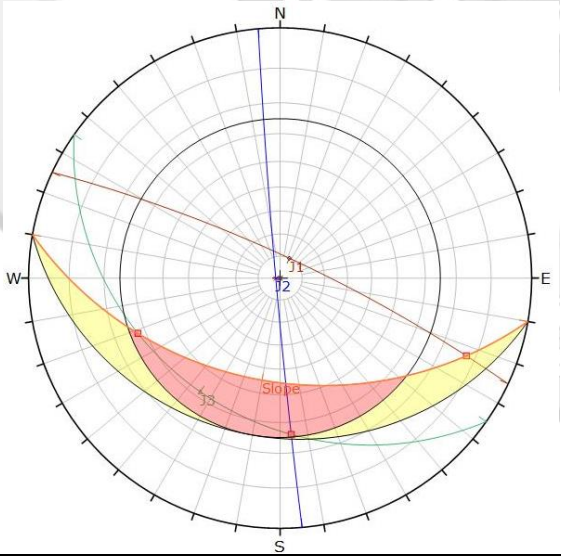
Kinematic Analysis	Direct Toppling
Slope Dip	45
Slope Dip Direction	130
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		75	120	J1
2		75	270	J2
3		40	130	J3
4		45	130	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc26 and Loc27



Symbol	ID	Quantity
	1	1
	2	1
	3	1

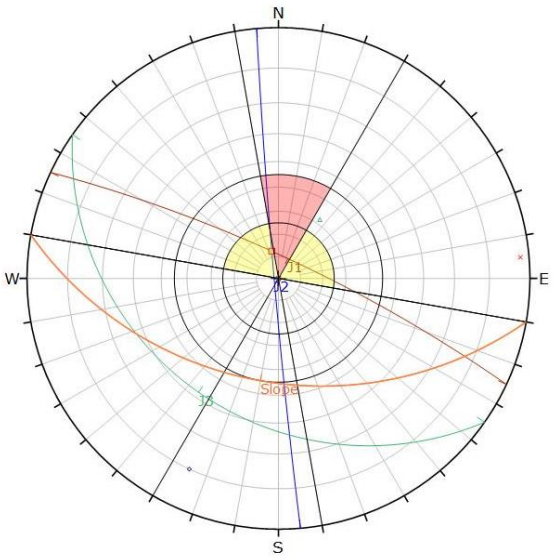
Symbol	Feature
	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	190
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	190	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

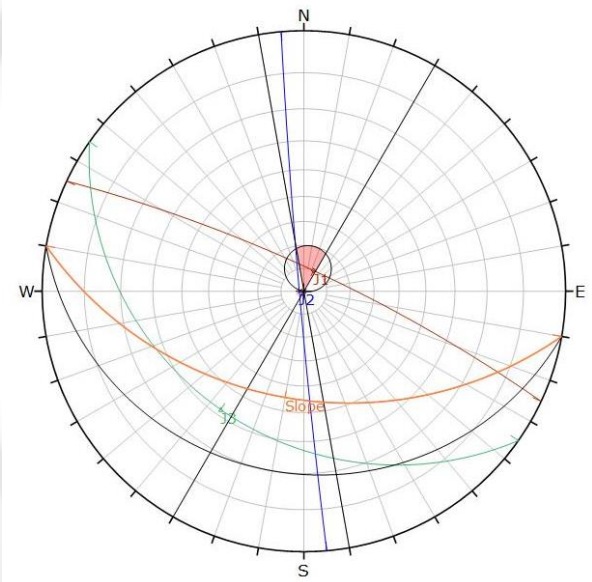
Symbol	Feature
▭	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	45
Slope Dip Direction	190
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	190	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

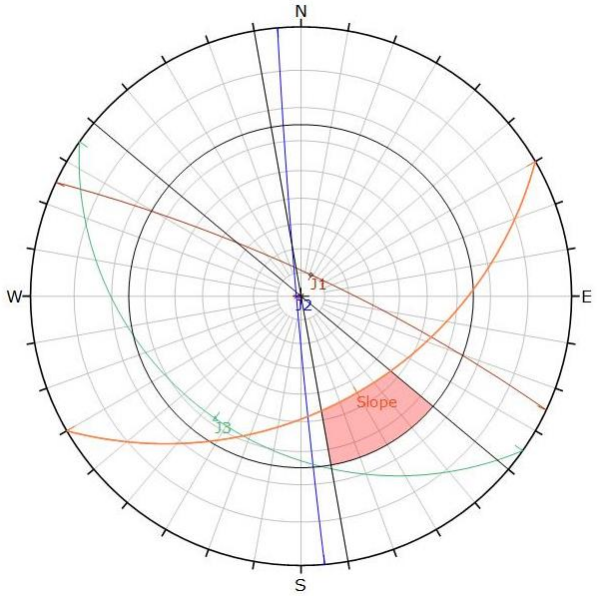
Kinematic Analysis	Flexural Toppling
Slope Dip	45
Slope Dip Direction	190
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	190	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle

Loc28



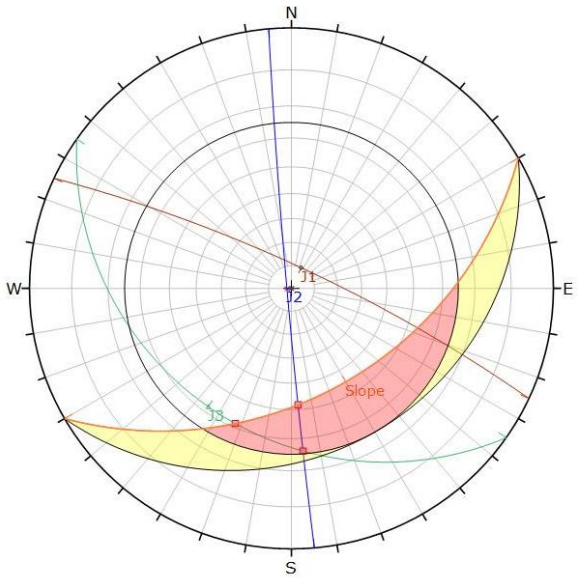
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	150
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	150	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

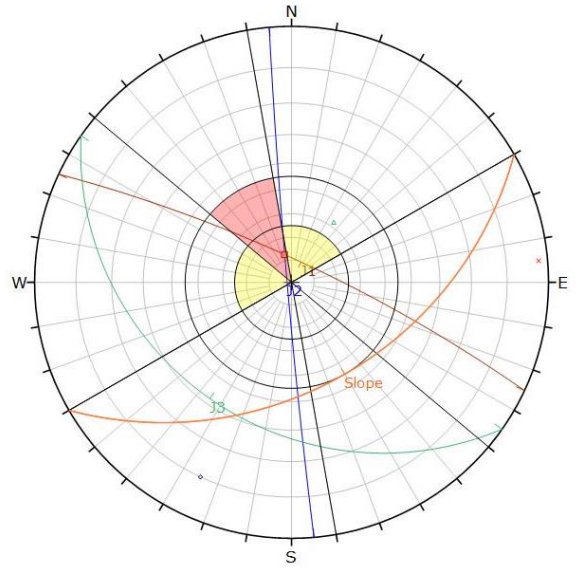
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	150
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	150	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

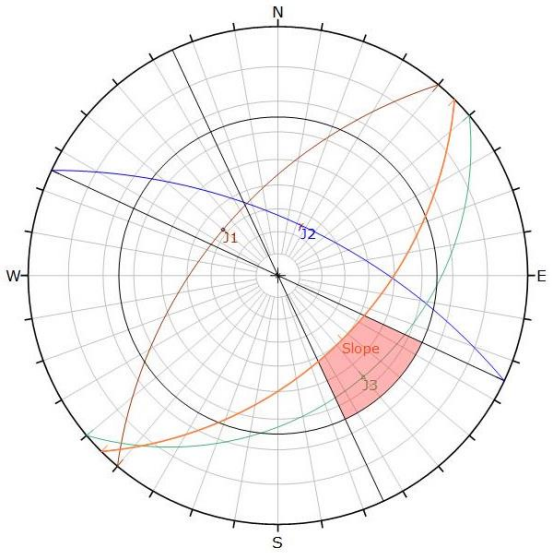
Kinematic Analysis	Direct Toppling
Slope Dip	45
Slope Dip Direction	150
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	1	6	16.67%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	25	J1
2		88	265	J2
3		32	215	J3
4		45	150	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc29



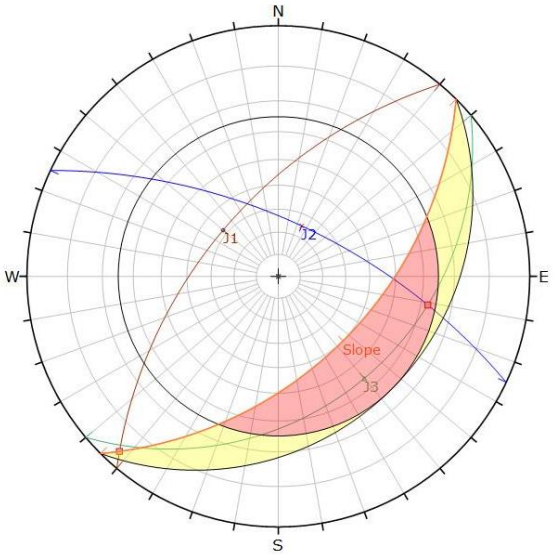
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Kinematic Analysis	Planar Sliding
Slope Dip	50
Slope Dip Direction	135
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		58	310	J1
2		65	25	J2
3		34	140	J3
4		50	135	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

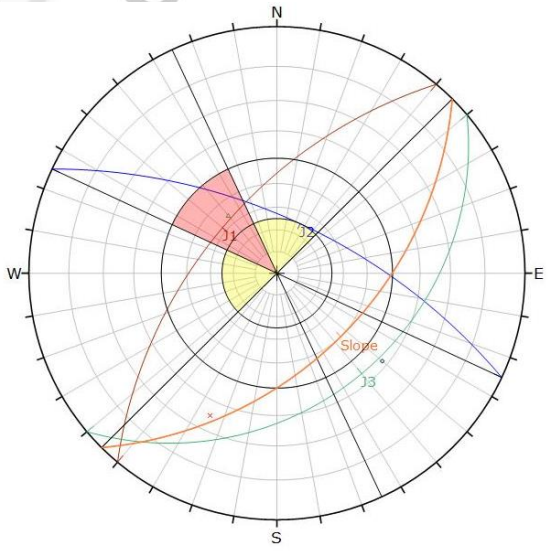
Symbol	Feature
▭	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	50
Slope Dip Direction	135
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		58	310	J1
2		65	25	J2
3		34	140	J3
4		50	135	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
▭	Critical Intersection

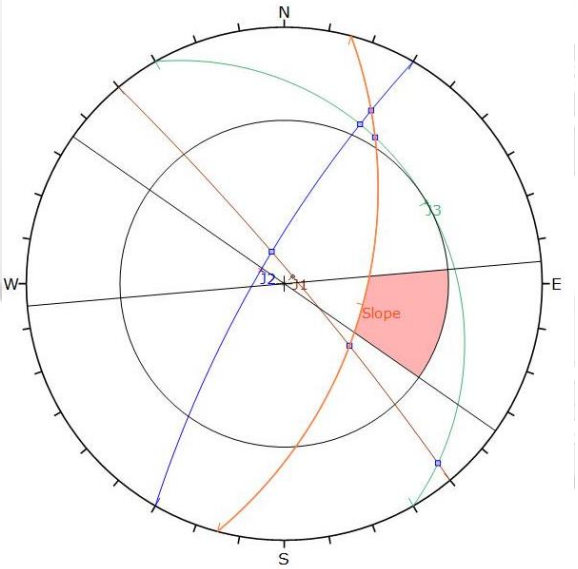
Kinematic Analysis	Direct Toppling
Slope Dip	50
Slope Dip Direction	135
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		58	310	J1
2		65	25	J2
3		34	140	J3
4		50	135	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc33



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

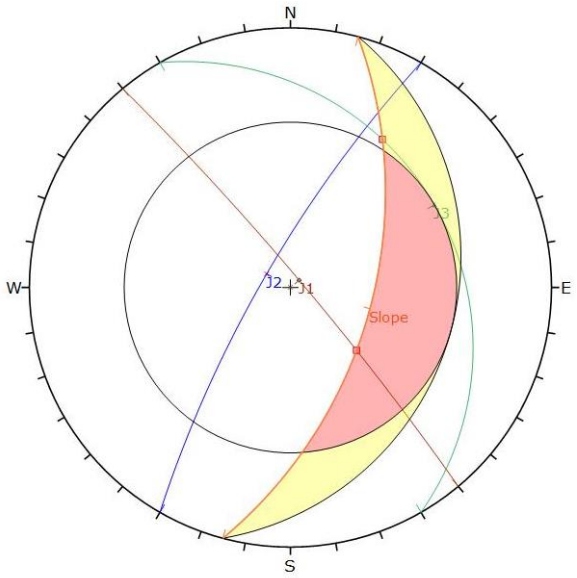
Symbol	Feature
▭	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	105
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	50	J1
2		78	300	J2
3		25	60	J3
4		55	105	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

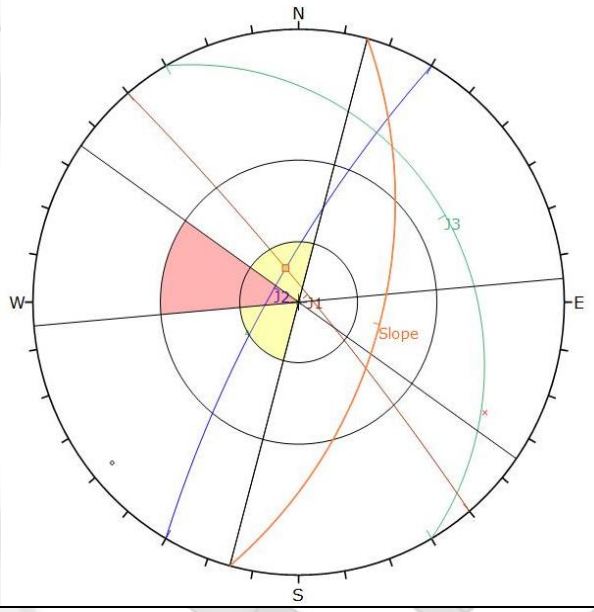
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	105
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	50	J1
2		78	300	J2
3		25	60	J3
4		55	105	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

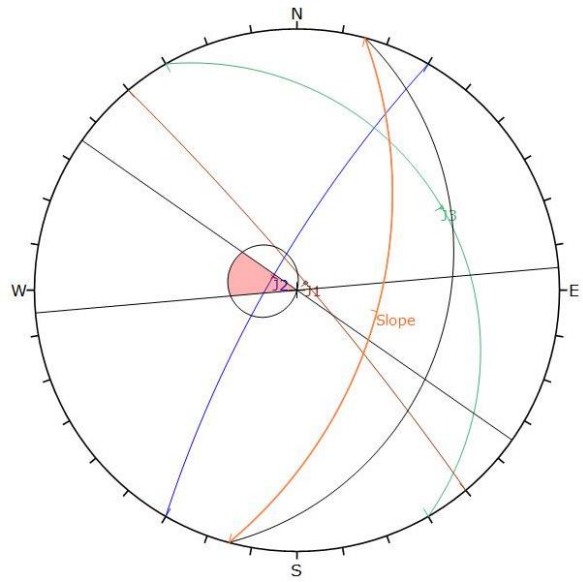
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	105
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	50	J1
2		78	300	J2
3		25	60	J3
4		55	105	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

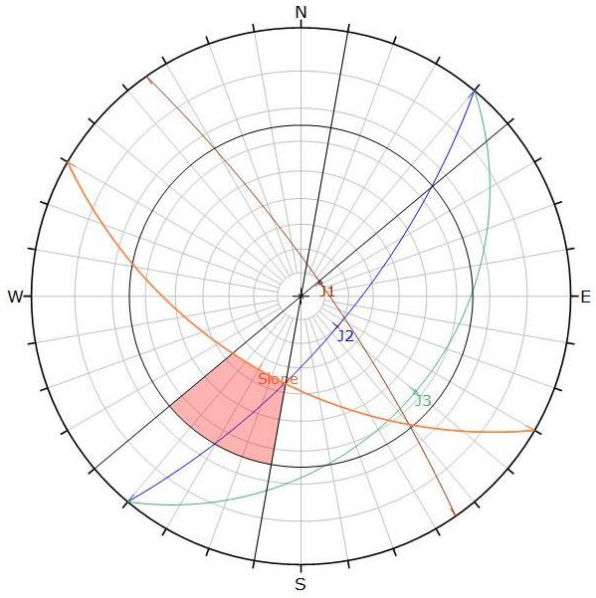
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	105
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	50	J1
2		78	300	J2
3		25	60	J3
4		55	105	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc34



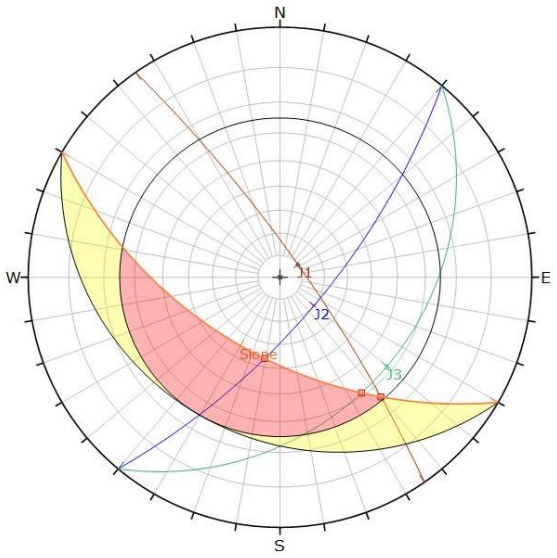
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	210
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	55	J1
2		70	130	J2
3		32	130	J3
4		55	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



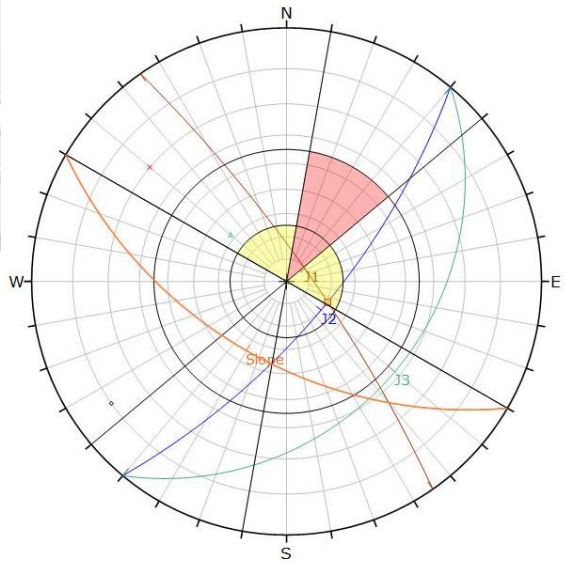
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1
Symbol	Feature	
▭	Critical Intersection	

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	210
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	55	J1
2		70	130	J2
3		32	130	J3
4		55	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1
Symbol	Feature	
▭	Critical Intersection	

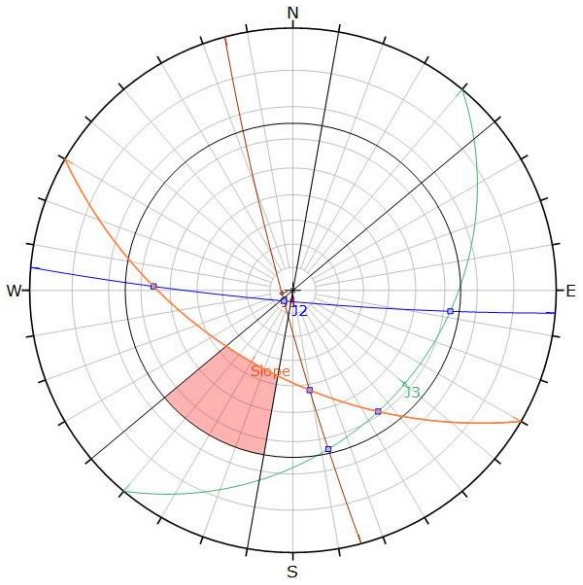
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	210
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		80	55	J1
2		70	130	J2
3		32	130	J3
4		55	210	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc35



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

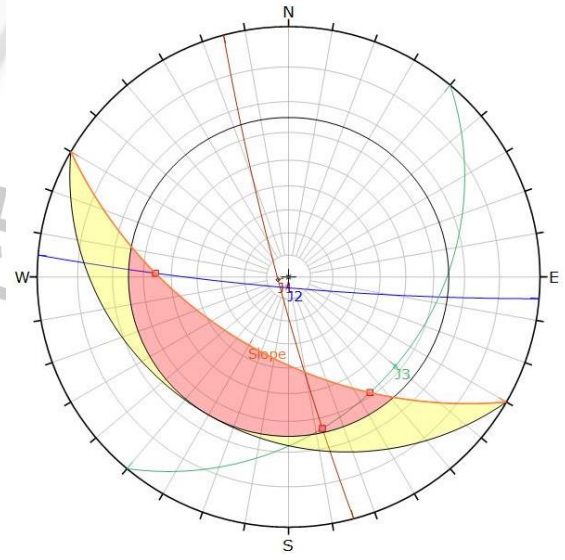
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	210
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	255	J1
2		85	185	J2
3		32	130	J3
4		55	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

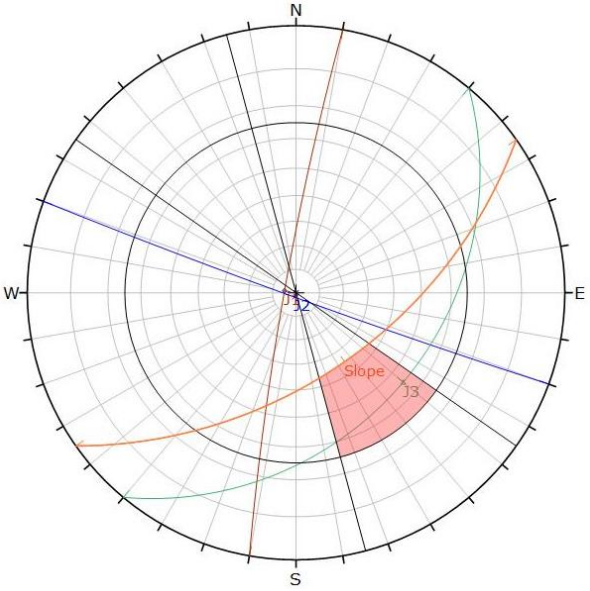
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	210
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	255	J1
2		85	185	J2
3		32	130	J3
4		55	210	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc36



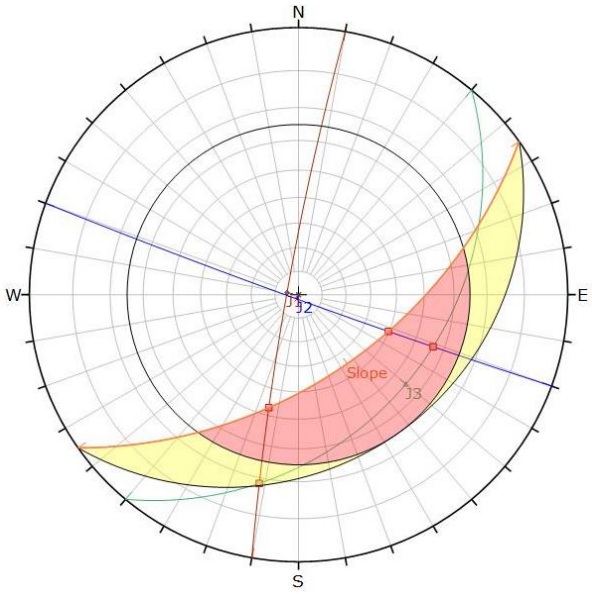
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	145
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	280	J1
2		88	200	J2
3		35	130	J3
4		55	145	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

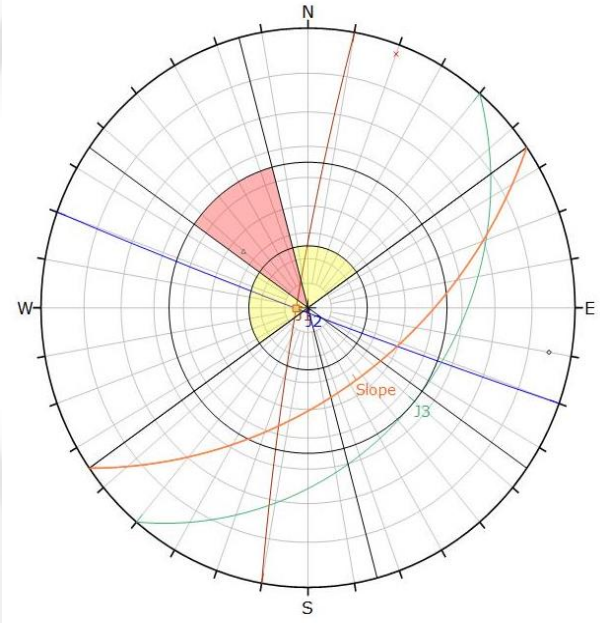
Symbol	Feature
▢	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	145
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	280	J1
2		88	200	J2
3		35	130	J3
4		55	145	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
▢	Critical Intersection

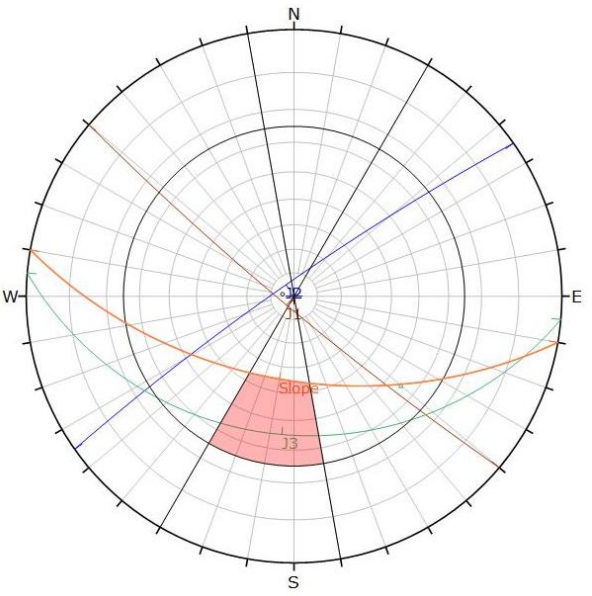
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	145
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	1	6	16.67%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	280	J1
2		88	200	J2
3		35	130	J3
4		55	145	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc37 and Loc 38



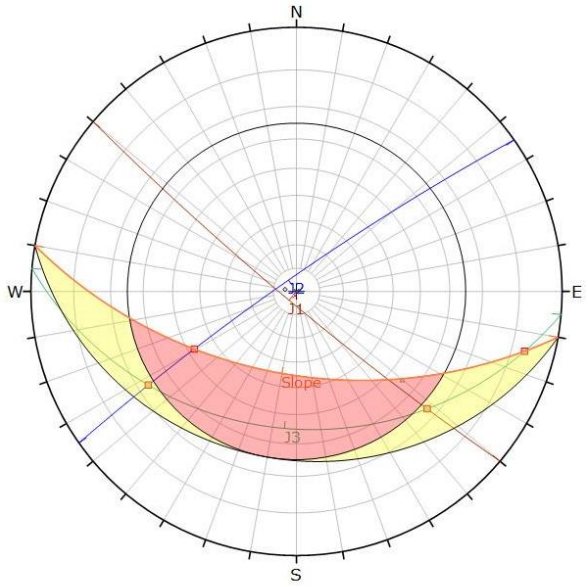
Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	190
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	220	J1
2		84	325	J2
3		35	185	J3
4		55	190	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

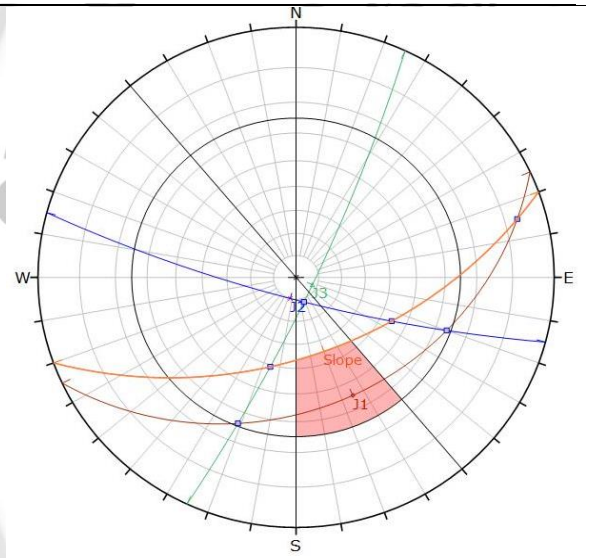
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	190
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		85	220	J1
2		84	325	J2
3		35	185	J3
4		55	190	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 39



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

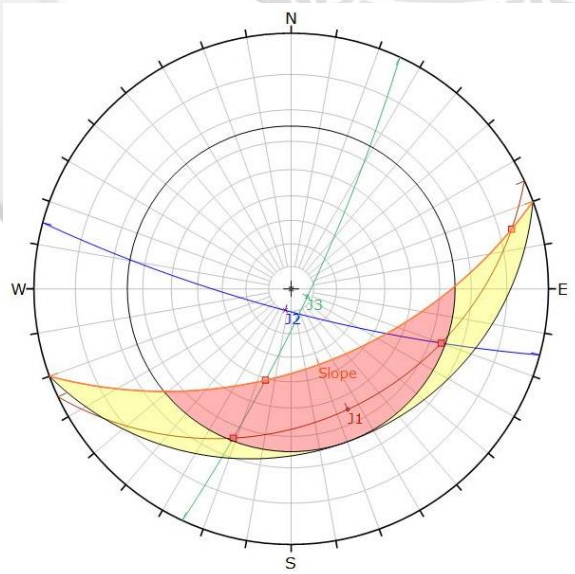
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	160
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		35	155	J1
2		80	195	J2
3		82	115	J3
4		55	160	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

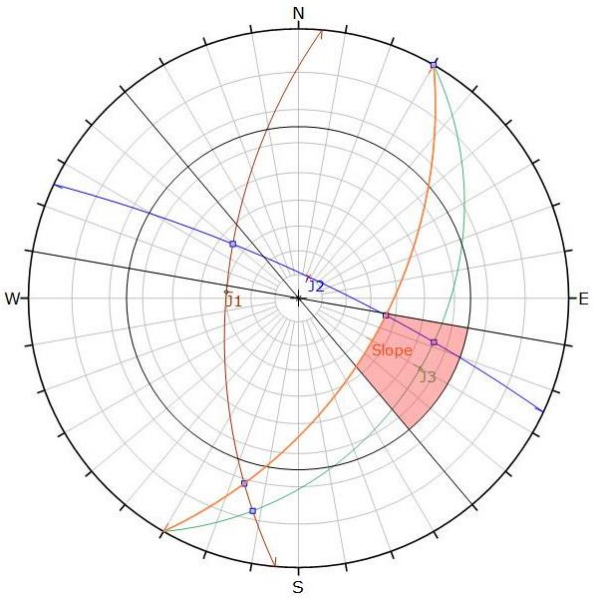
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	160
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	4	6	66.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		35	155	J1
2		80	195	J2
3		82	115	J3
4		55	160	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 40



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

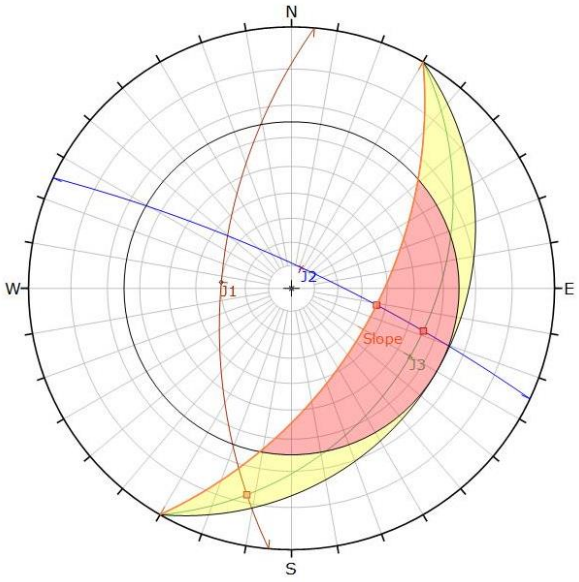
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	120
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	275	J1
2		80	25	J2
3		35	120	J3
4		55	120	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

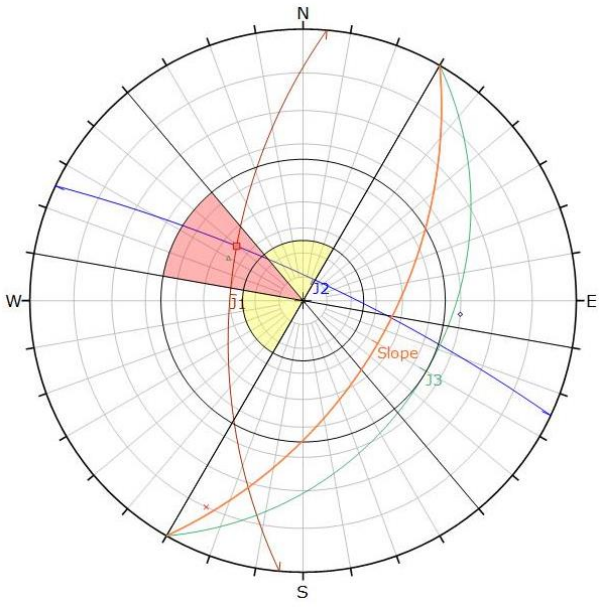
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	120
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	275	J1
2		80	25	J2
3		35	120	J3
4		55	120	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

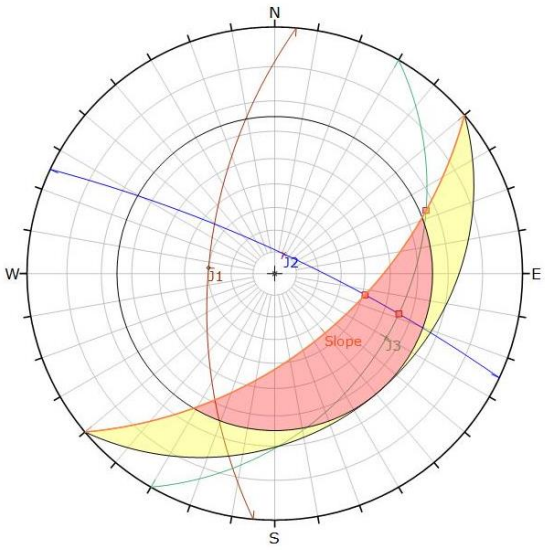
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	120
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	1	6	16.67%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	275	J1
2		80	25	J2
3		35	120	J3
4		55	120	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

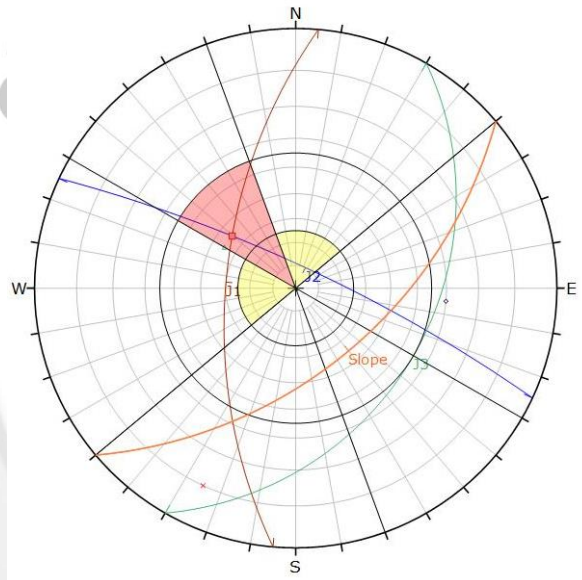
Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	140
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	275	J1
2		80	25	J2
3		35	120	J3
4		55	140	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

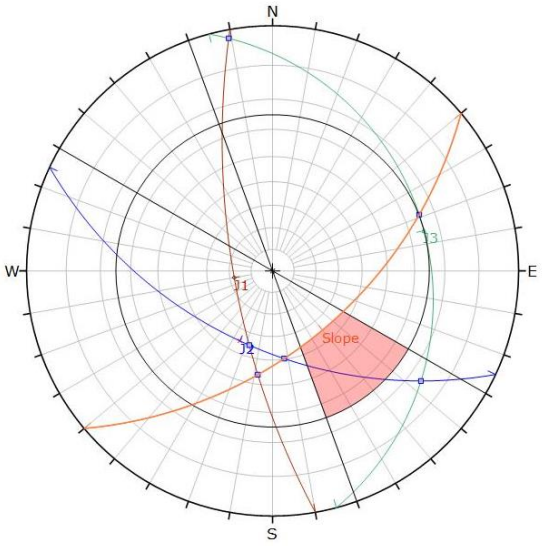
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	140
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	1	6	16.67%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		60	275	J1
2		80	25	J2
3		35	120	J3
4		55	140	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 43



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

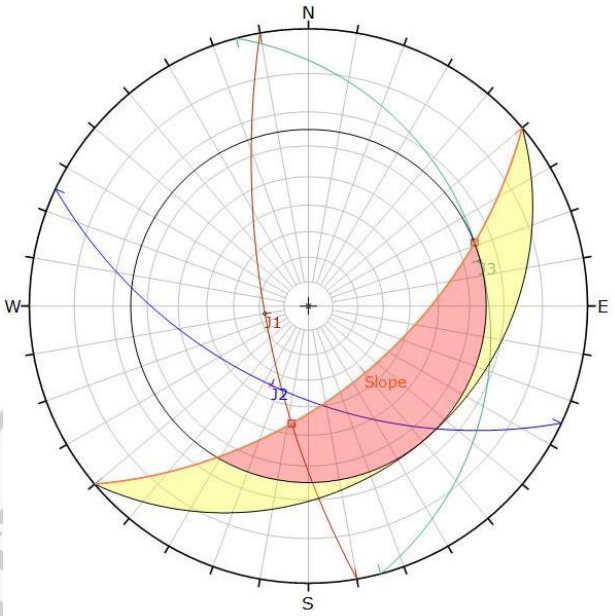
Symbol	Feature
□	Intersection

Kinematic Analysis	Planar Sliding
Slope Dip	55
Slope Dip Direction	140
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	3	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		72	260	J1
2		55	205	J2
3		25	75	J3
4		55	140	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

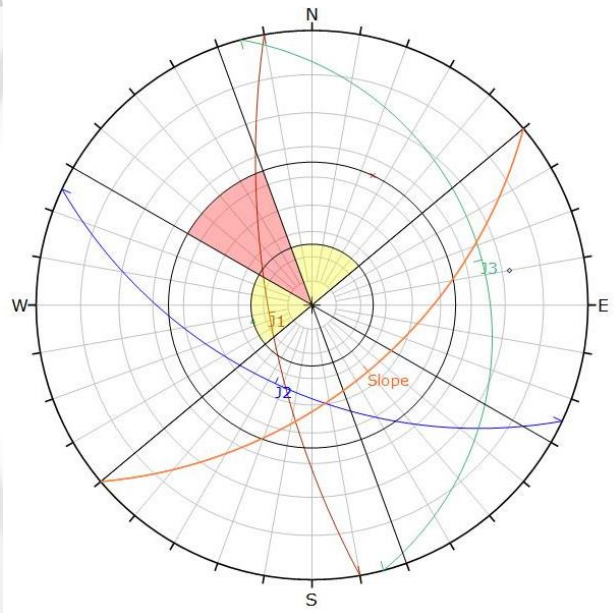
Symbol	Feature
▭	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	140
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	2	6	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		72	260	J1
2		55	205	J2
3		25	75	J3
4		55	140	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
▭	Critical Intersection

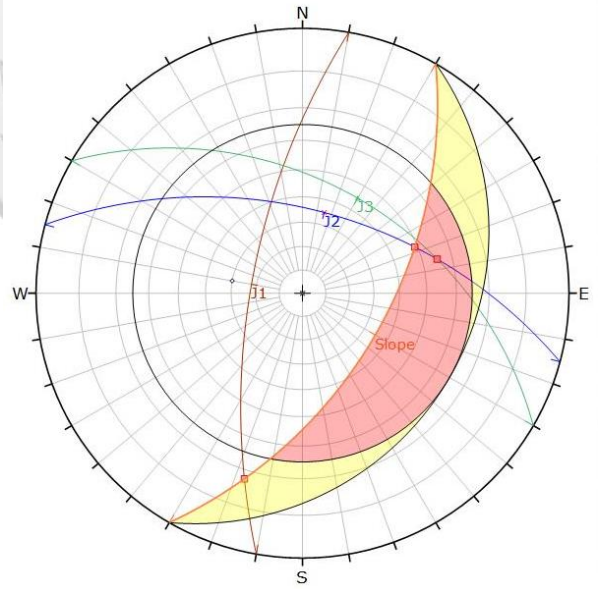
Kinematic Analysis	Direct Toppling
Slope Dip	55
Slope Dip Direction	140
Friction Angle	25°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	0	6	0.00%
Oblique Toppling (Intersection)	0	6	0.00%
Base Plane (All)	1	3	33.33%

	Color	Dip	Dip Direction	Label
User Planes				
1		72	260	J1
2		55	205	J2
3		25	75	J3
4		55	140	Slope

Plot Mode	Pole Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 44



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
▭	Critical Intersection

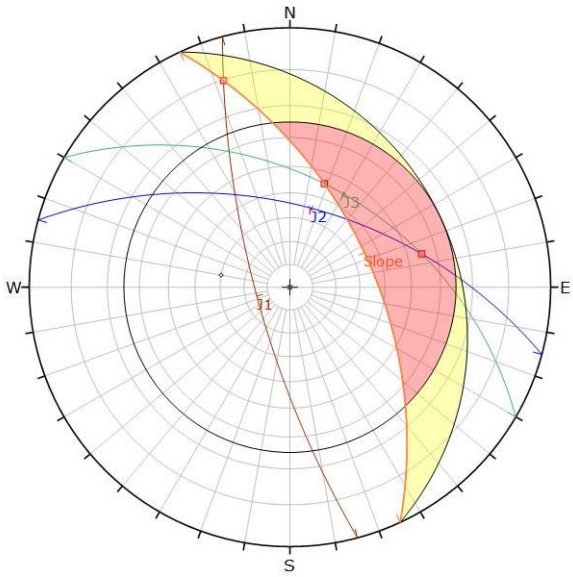
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	120
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		68	280	J1
2		55	15	J2
3		45	30	J3
4		55	120	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 45



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

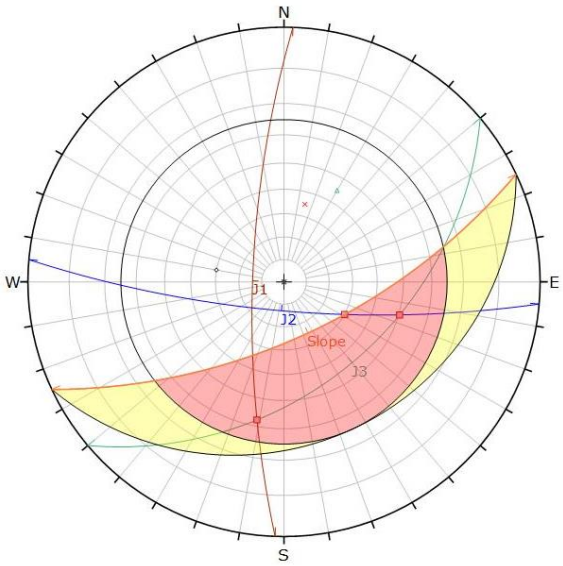
Kinematic Analysis	Wedge Sliding
Slope Dip	55
Slope Dip Direction	65
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		75	255	J1
2		55	15	J2
3		45	30	J3
4		55	65	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

Loc 46



Symbol	ID	Quantity
◇	1	1
×	2	1
△	3	1

Symbol	Feature
□	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	65
Slope Dip Direction	155
Friction Angle	25°

	Critical	Total	%
Wedge Sliding	3	6	50.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		76	272	J1
2		77	185	J2
3		45	140	J3
4		65	155	Slope

Plot Mode	Dip Vectors
Vector Count	3 (3 Entries)
Intersection Mode	User Planes
Intersections Count	6
Hemisphere	Lower
Projection	Equal Angle

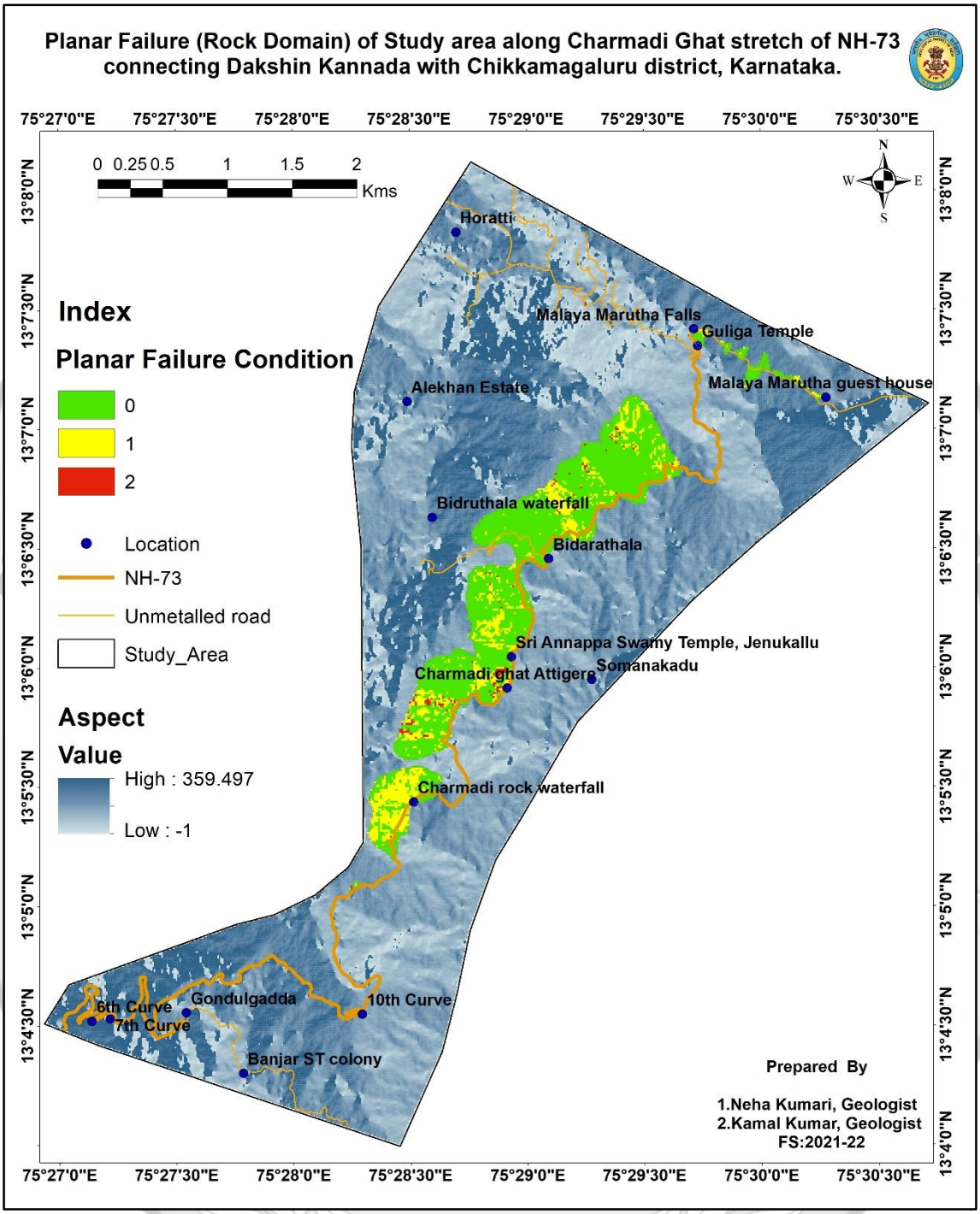


Fig 26: Planar Failure Map in Rock domain of the study area on 1:10,000 scale.

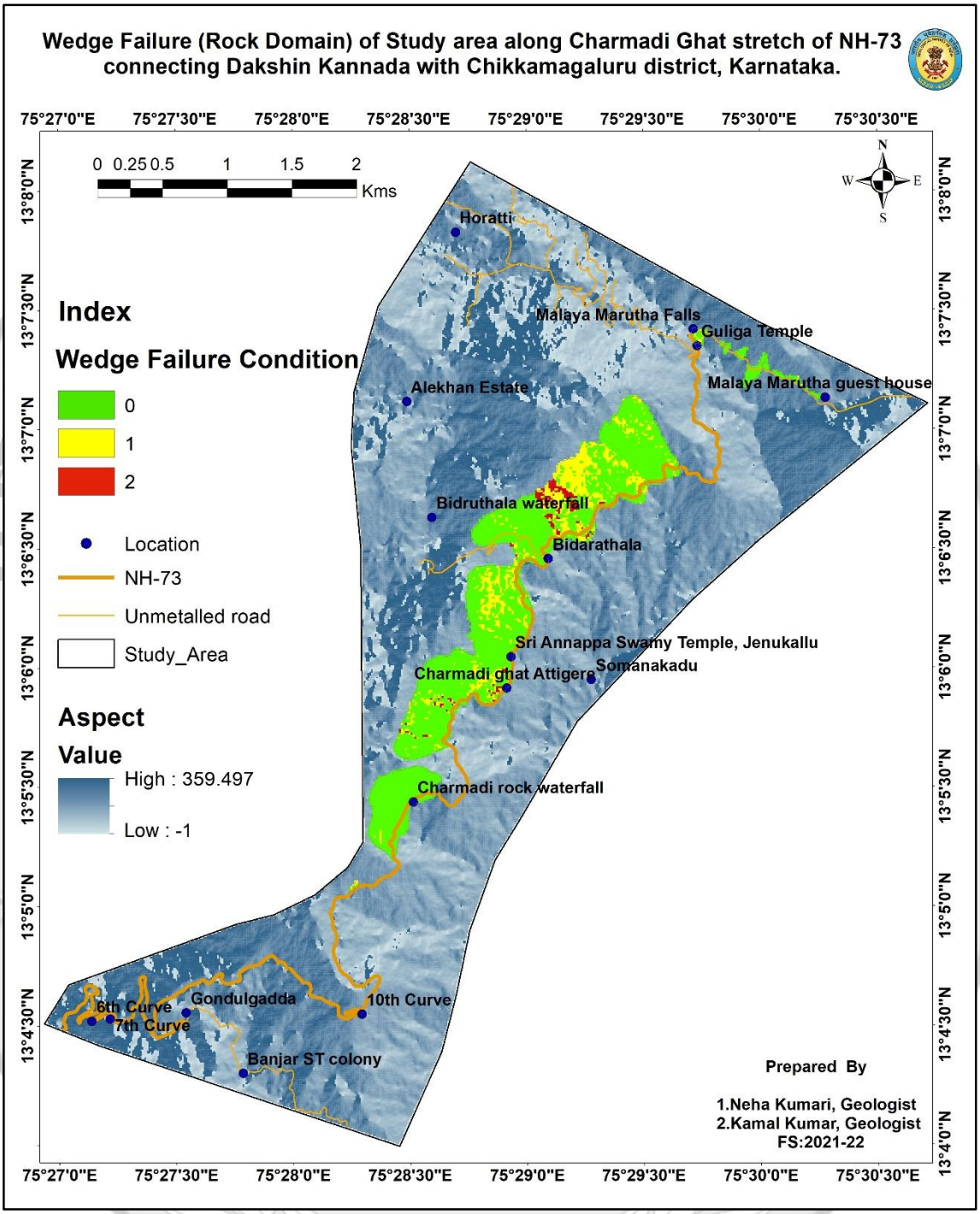


Fig 27: Wedge Failure Map in Rock domain of the study area on 1:10,000 scale.

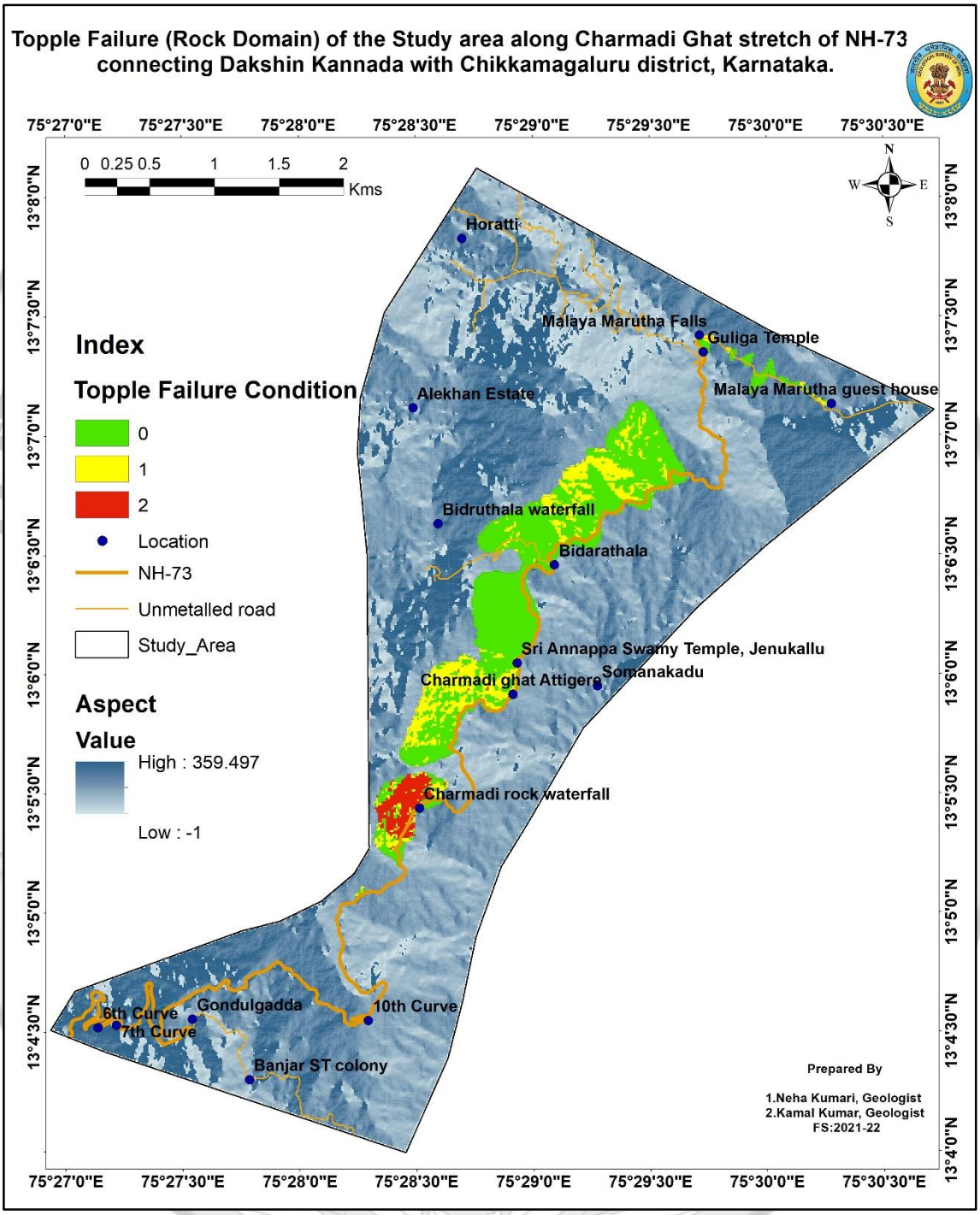


Fig 28: Topple Failure Map in Rock domain of the study area on 1:10,000 scale.

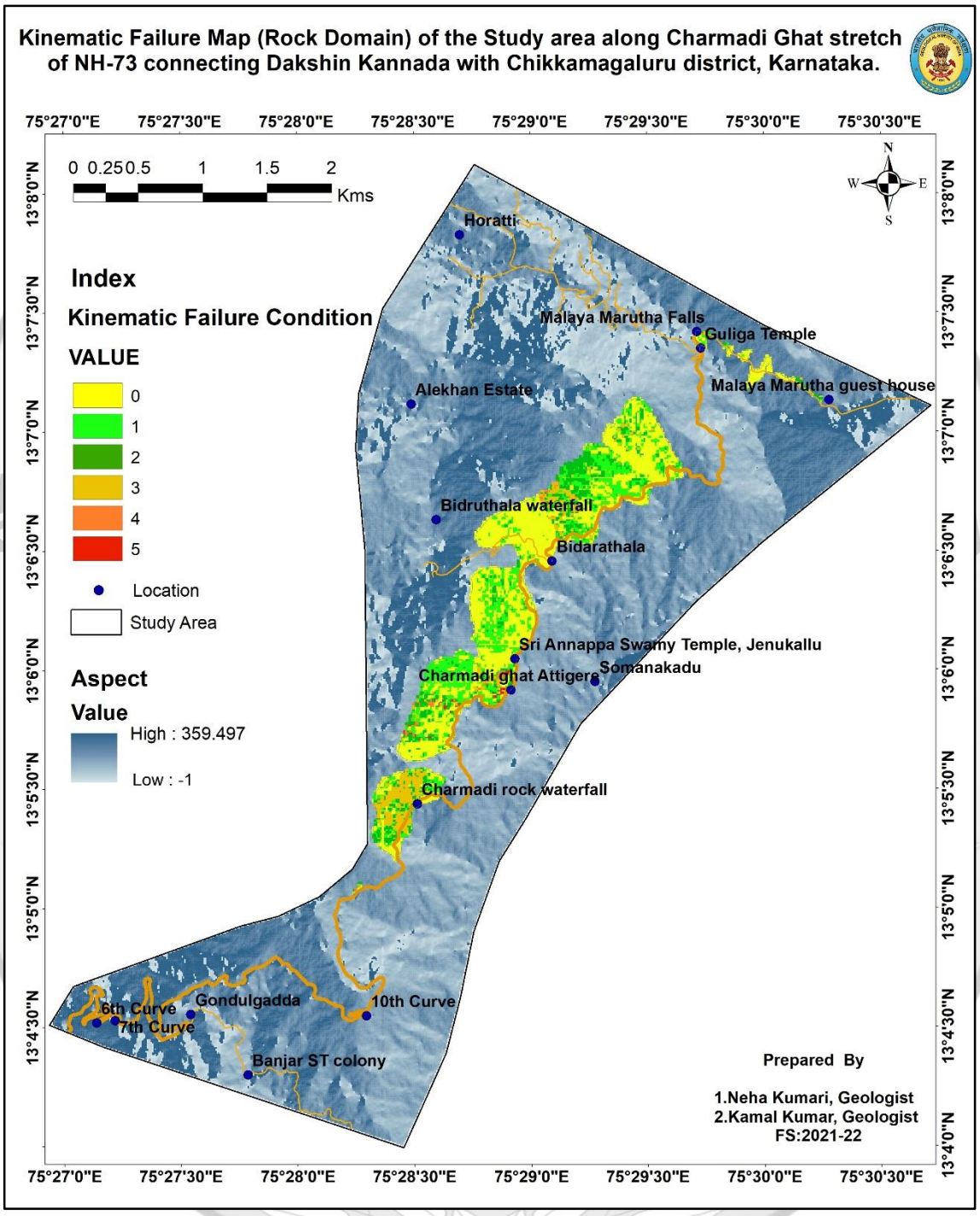
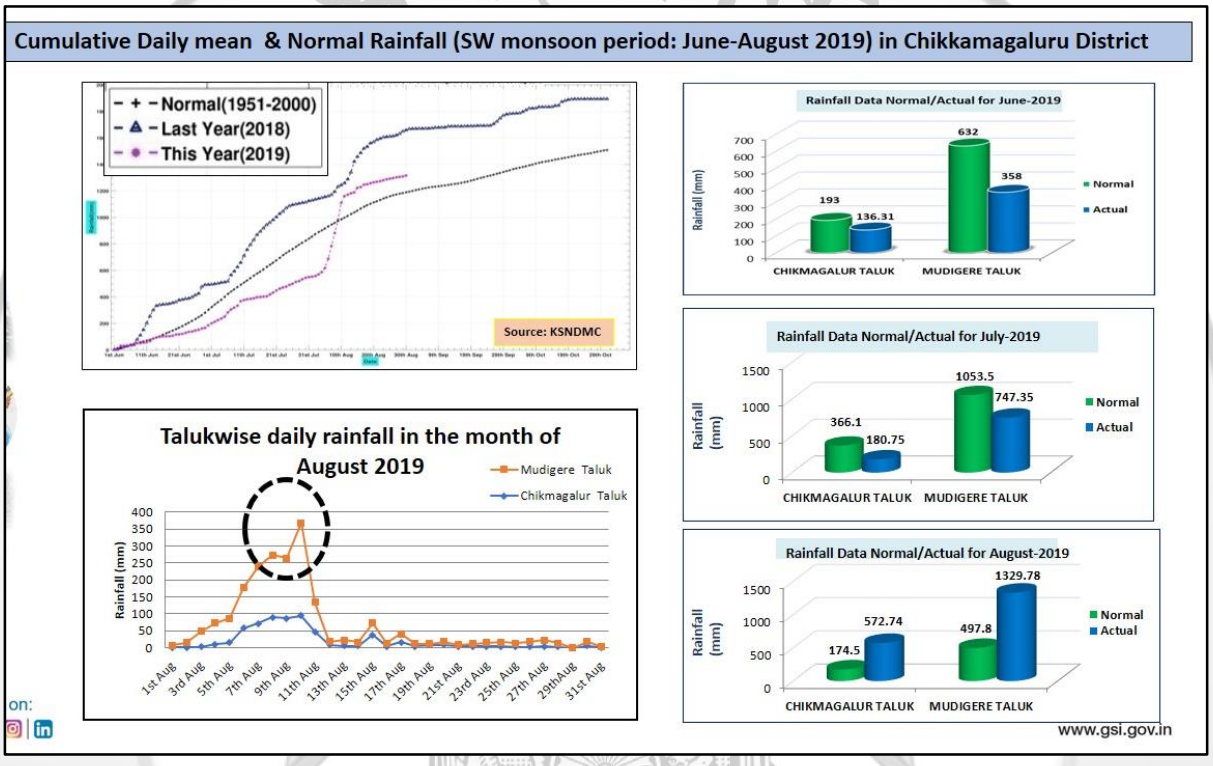
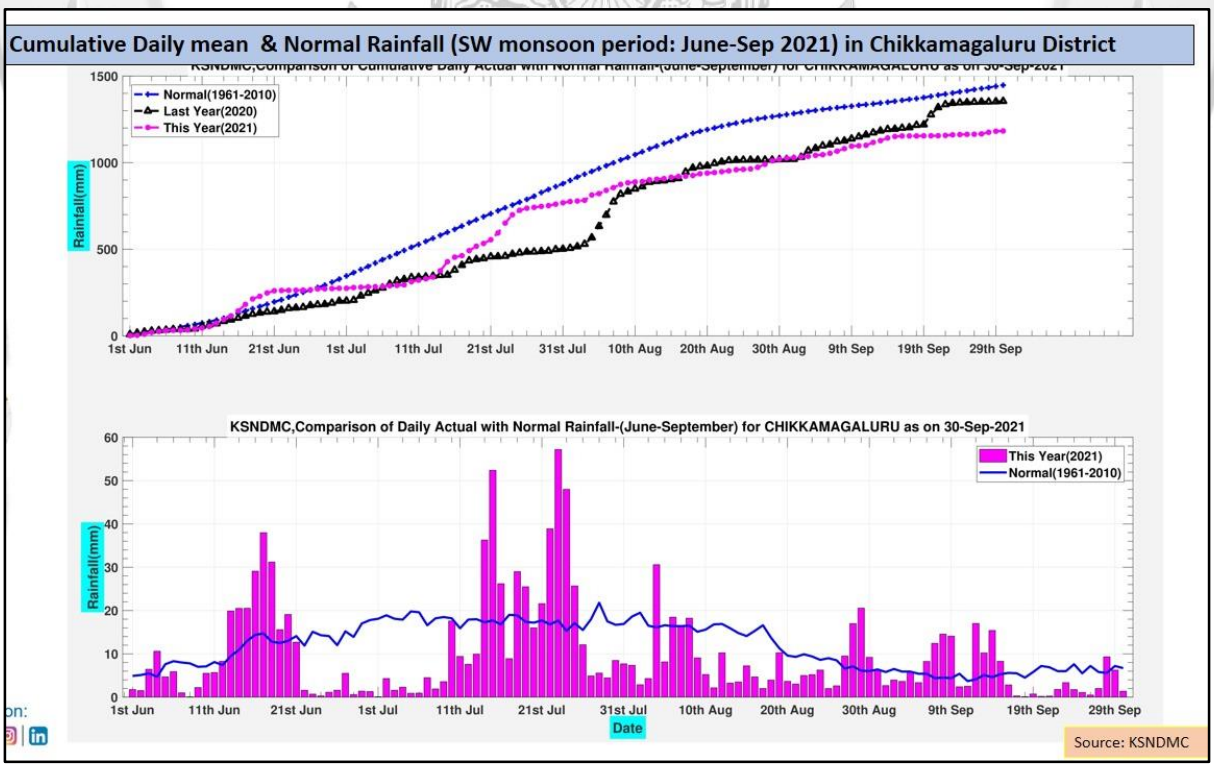


Fig 29: Kinematic Failure Map in Rock domain of the study area on 1:10,000 scale.

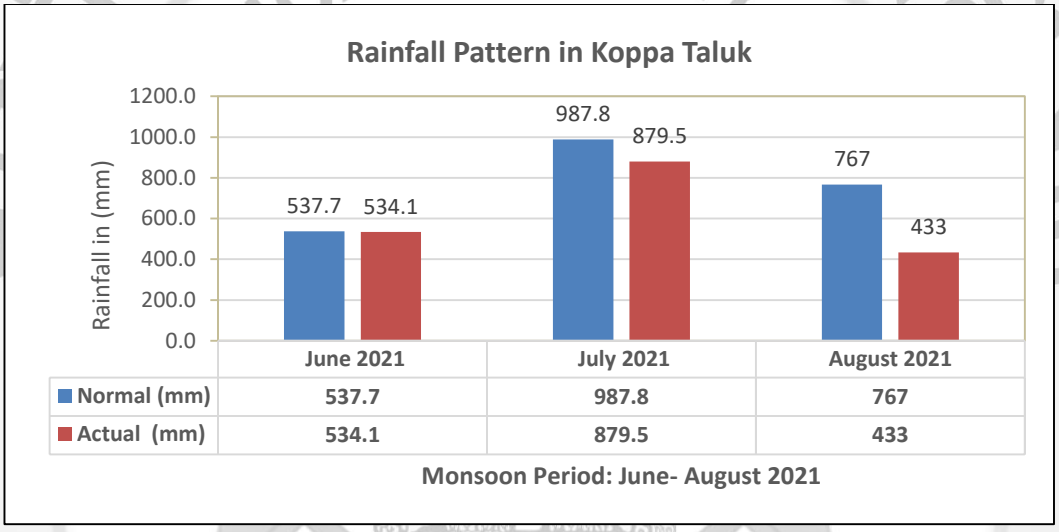
4.5 Rainfall Condition:

The rainfall data of available from rain gauge stations of different taluks in the Chikkamagaluru district were analyzed. Based on daily rainfall recorded during the southwest monsoon season for the period between June to August 2021, the departure between the normal and actual rainfall conditions was studied. The antecedent rainfall events for the peak monsoon period are also analyzed for determining the triggering factor for landslide initiation.

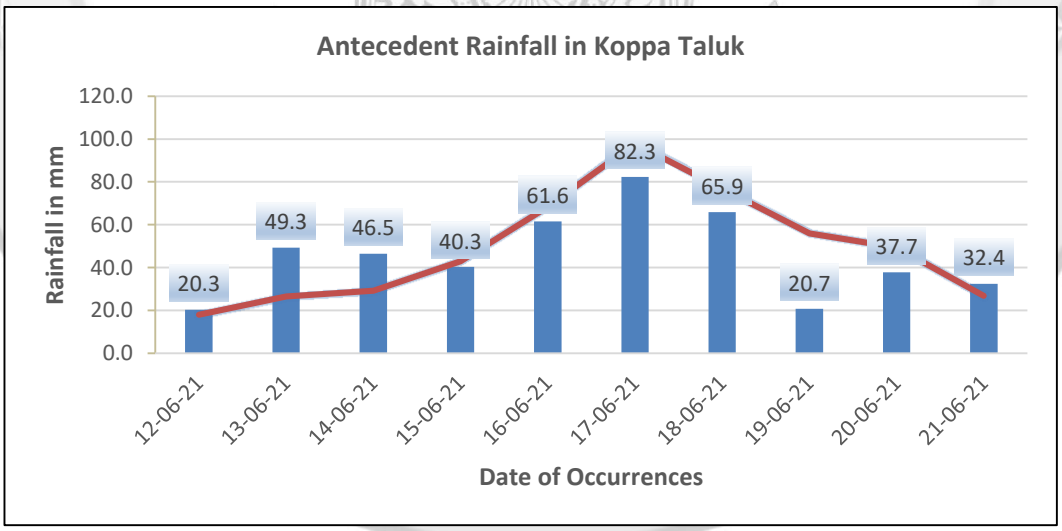




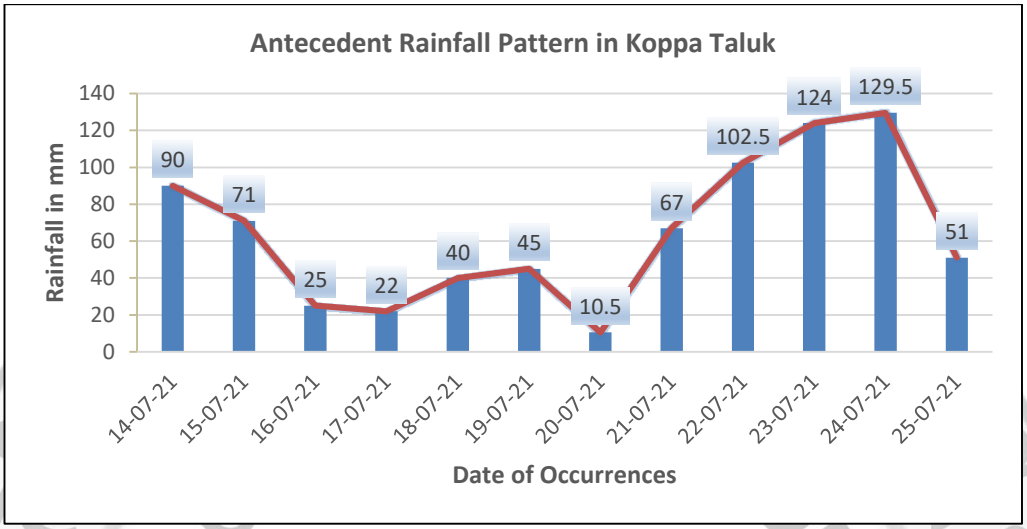
(a). Koppa taluk: In Koppa taluk, the departure between the normal and actual rainfall shows that actual rainfall received is lower than the normal rainfall recorded during the period between June to August 2021. However, the rainfall-induced new and reactivated old landslides, landslips, and surface cracks were recorded during the peak monsoon season in July 2021. The antecedent rainfall distribution curve (11 days) in July 2021 indicates maximum rainfall in 3 consecutive days from 22nd July to 24th July 2021 that triggered shallow debris slide (<5m) at various places in Koppa taluk. The effect of a low-intensity antecedent rainfall event of a longer duration played a vital role in causing landslips and landslides.



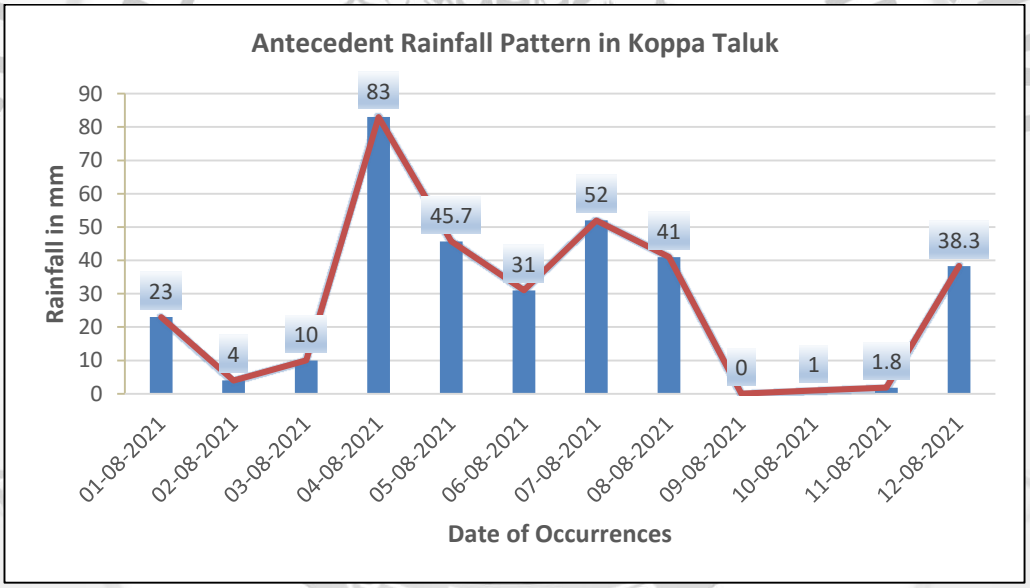
Graph 12: Graph showing Departure between Normal and Actual Rainfall 2021(Koppa Taluk)



Graph 13: Graph showing Antecedent rainfall distribution curve during June 2021(Koppa Taluk)

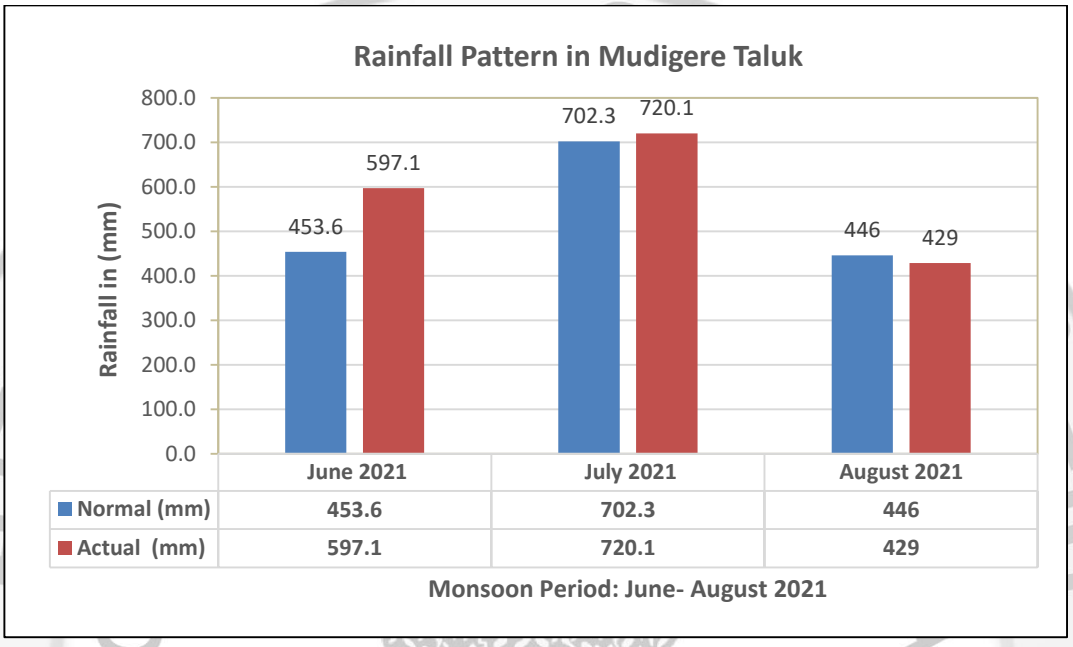


Graph 14: Graph showing Antecedent rainfall distribution curve during July 2021(Koppa Taluk)

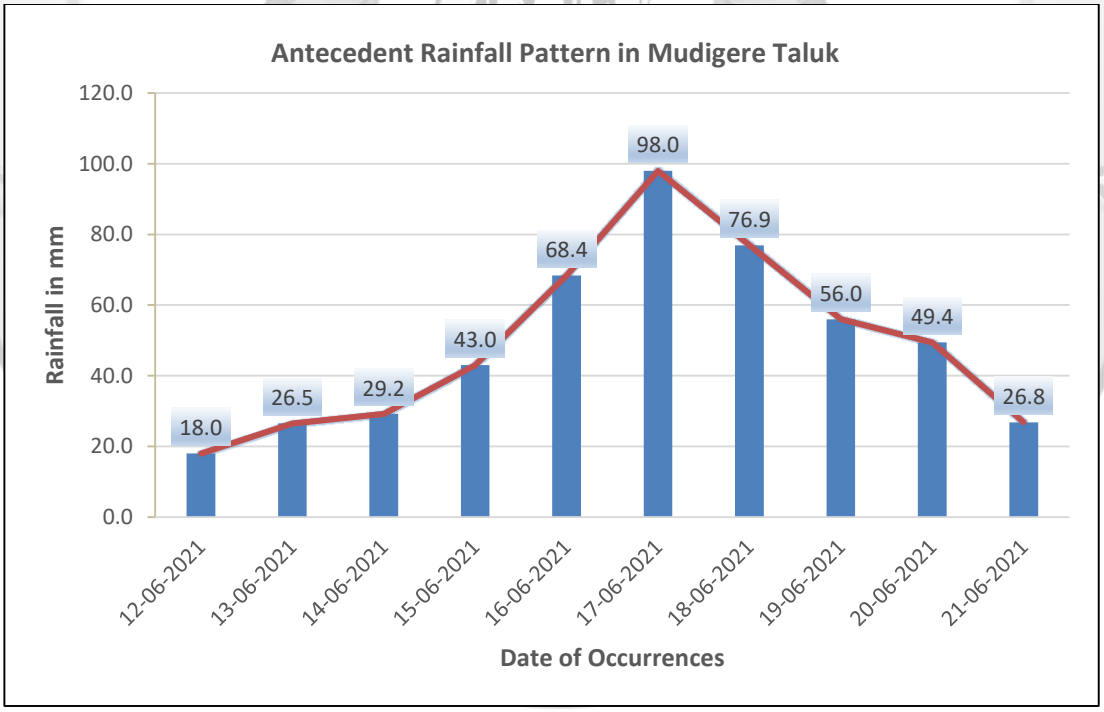


Graph 15: Graph showing Antecedent rainfall distribution curve during August 2021(Koppa Taluk)

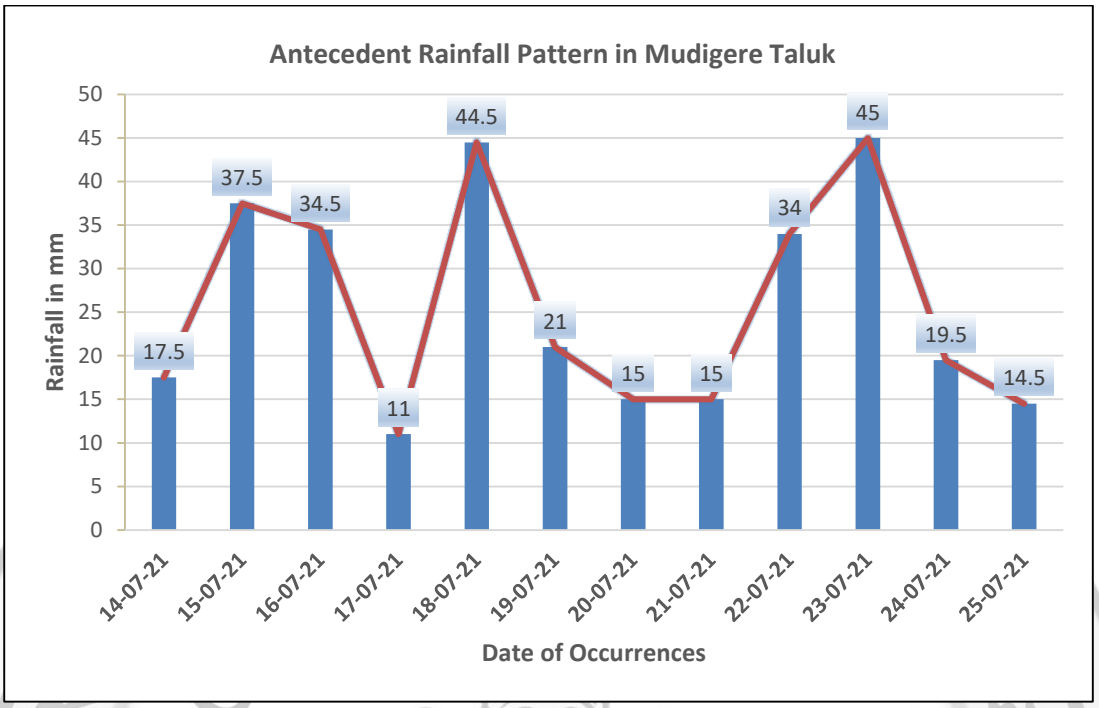
(b). Mudigere taluk: The actual and normal rainfall distribution in Mudigere taluk indicates a slight departure from normal rainfall received. Based on short-duration rainfall events on 18th July and 23rd July 2021, the low-intensity antecedent rainfall events triggered shallow landslides at places Kalasa- Hirebellu -Hornadu (SH-106) road section and short-duration rainfall events on 16th June and 18th June 2021 in Charmadi ghat road (NH-73).



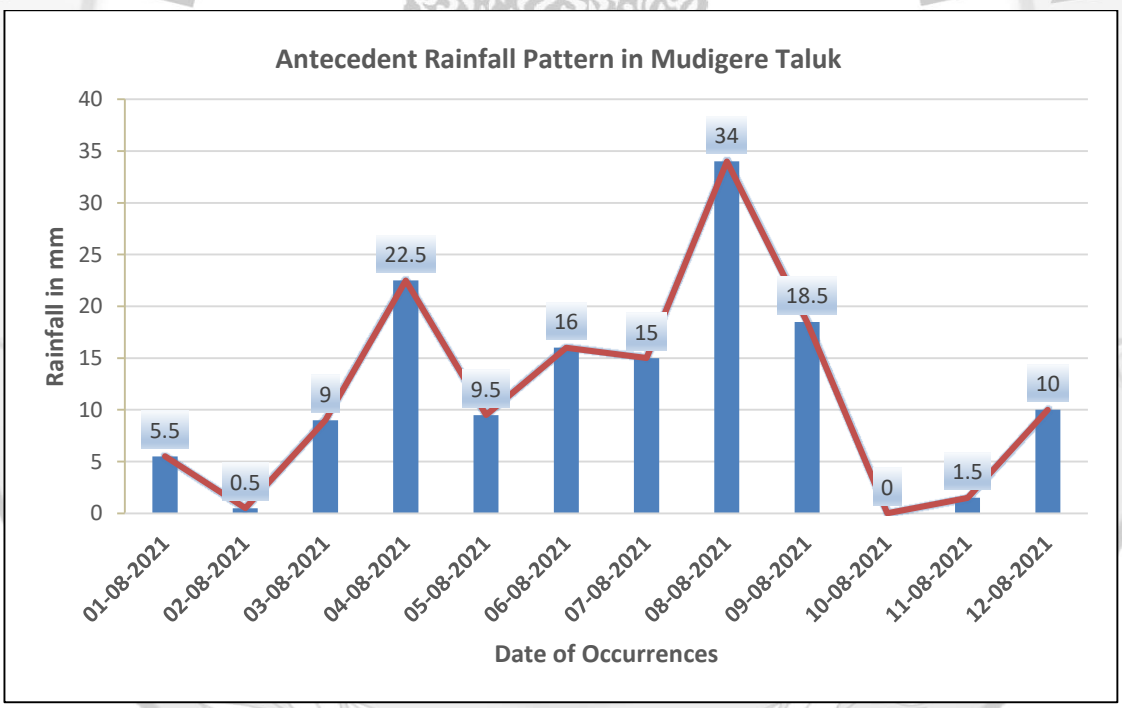
Graph 16: Graph showing Departure between Normal and Actual Rainfall (MudigereTaluk)



Graph 17: Graph showing Antecedent rainfall distribution curve during June 2021 (Mudigere Taluk)

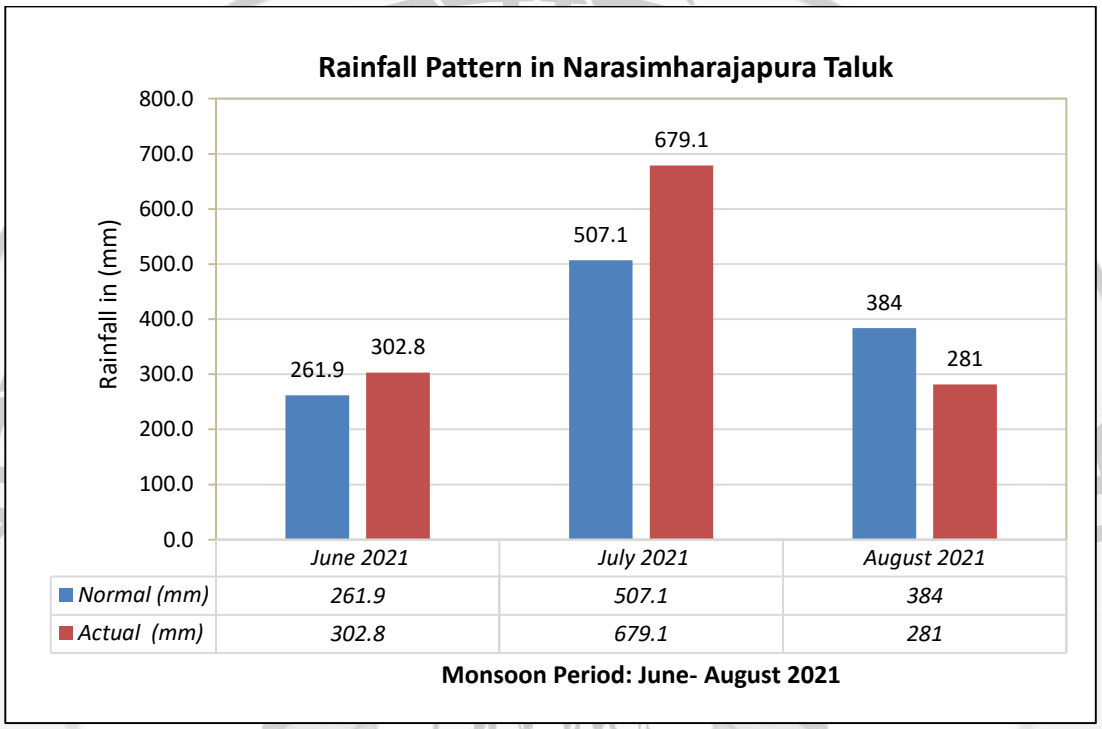


Graph 18: Graph showing Antecedent rainfall distribution curve during July 2021 (Mudigere Taluk)

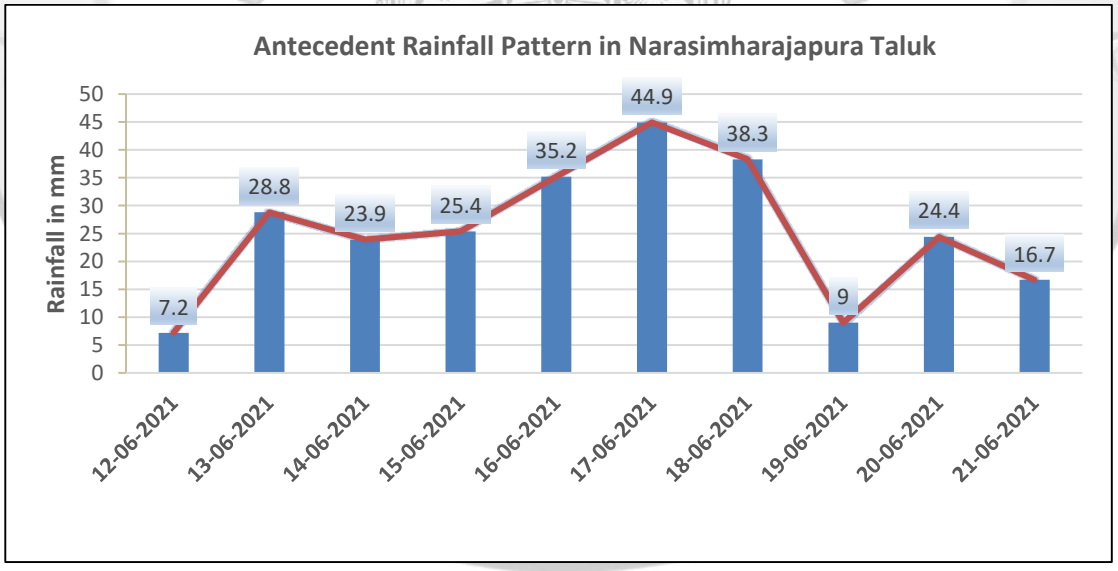


Graph 19: Graph showing Antecedent rainfall distribution curve during August 2021 (Mudigere Taluk)

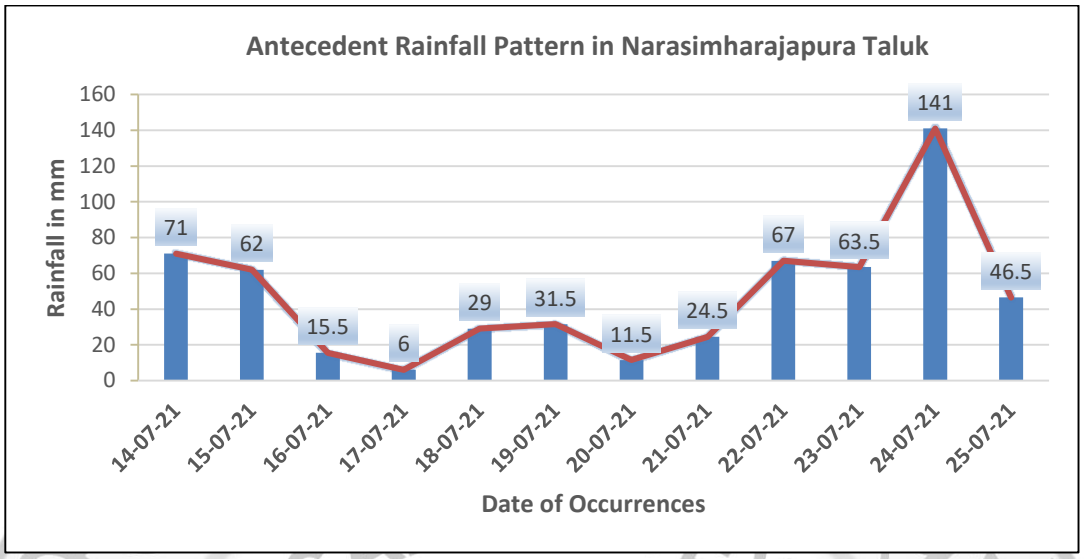
(c). Narasimharajapura taluk: In Narasimharajapura taluk, the actual and normal rainfall distribution indicates that the actual rainfall is higher than the normal rainfall condition in June and July 2021. Based on rainfall events incessant rainfall which is higher than the normal rainfall condition on 24th July 2021 (141mm rainfall) triggered shallow landslides at places.



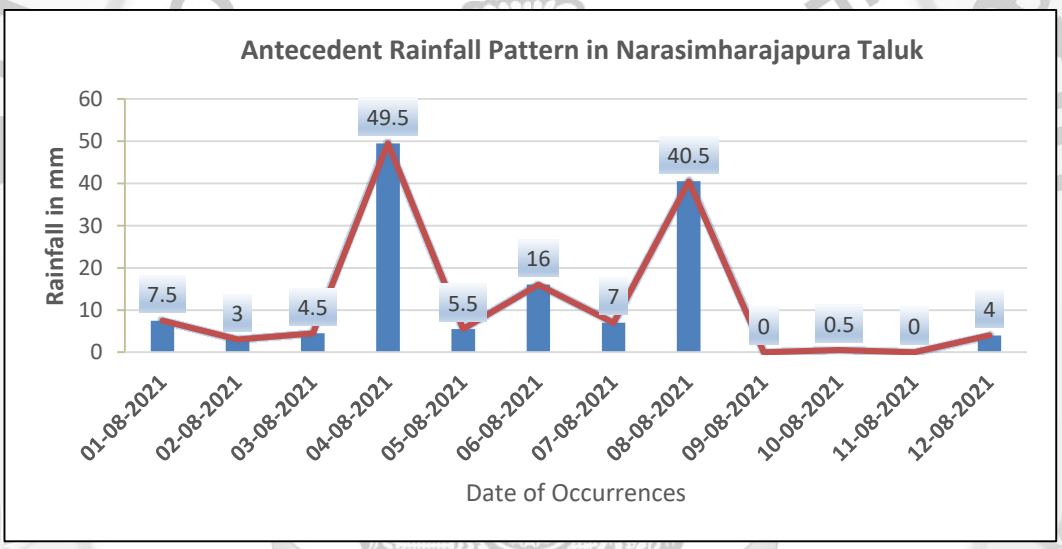
Graph 20: Graph showing Departure between Normal and Actual Rainfall (Narasimharajapura Taluk)



Graph 21: Graph showing Antecedent rainfall distribution curve during June 2021 (NarasimharajapuraTaluk)

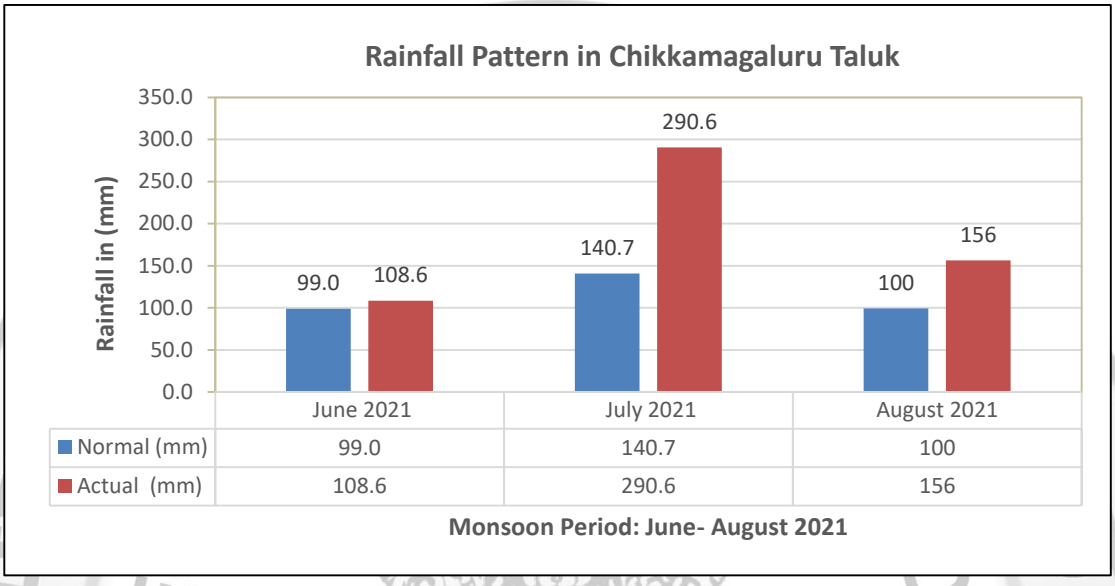


Graph 22: Graph showing Antecedent rainfall distribution curve during July 2021 (NarasimharajapuraTaluk)

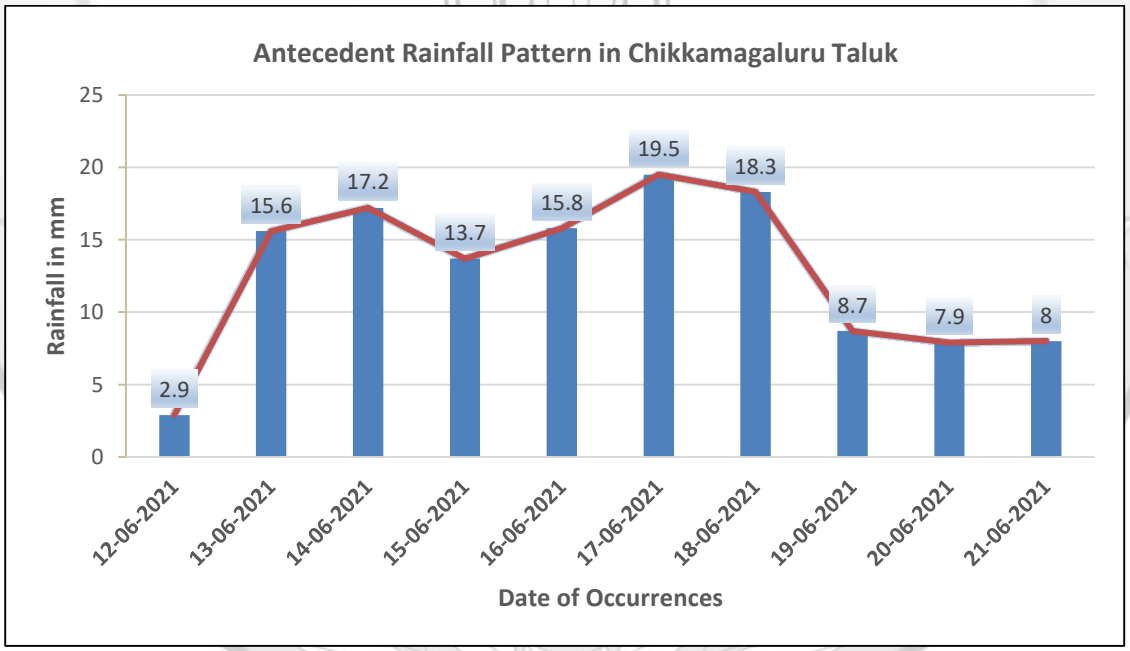


Graph 23: Graph showing Antecedent rainfall distribution curve during July 2021 (NarasimharajapuraTaluk)

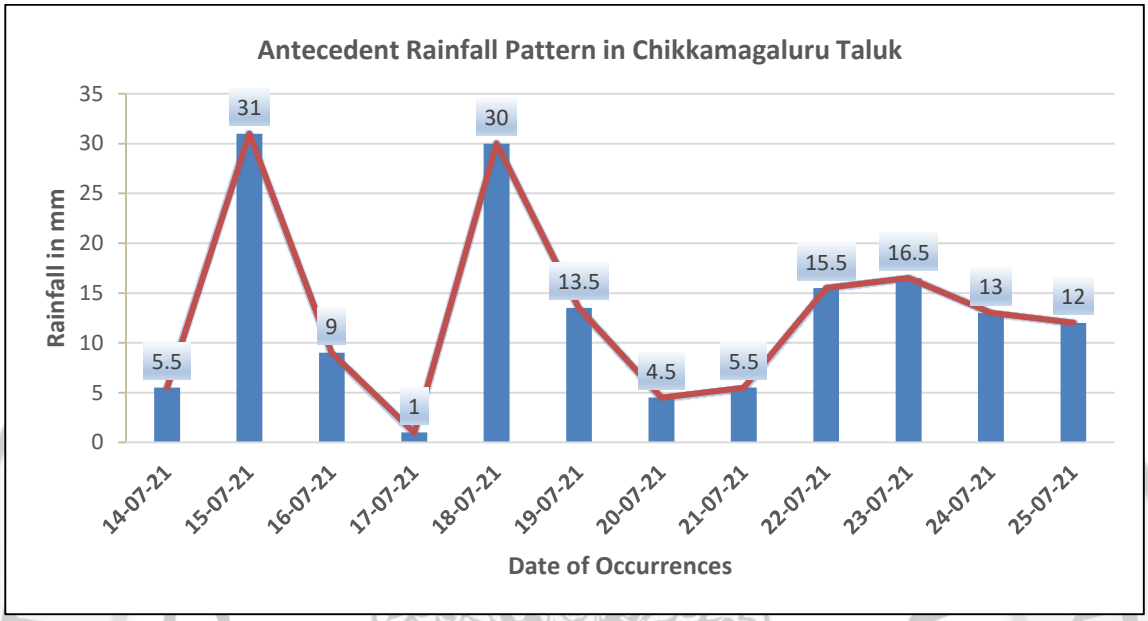
(d). Chikkamagaluru Taluk: Chikkamagaluru taluk receives comparatively low rainfall compared to other taluks. However, the actual rainfall received during June to August Monsoon period is higher than the normal rainfall in the year 2021. The low-intensity incessant rainfall higher than the normal rainfall condition in the area influenced the slope stability condition along the vulnerable stretches of the Mulliyangiri-Bababudan hill road section.



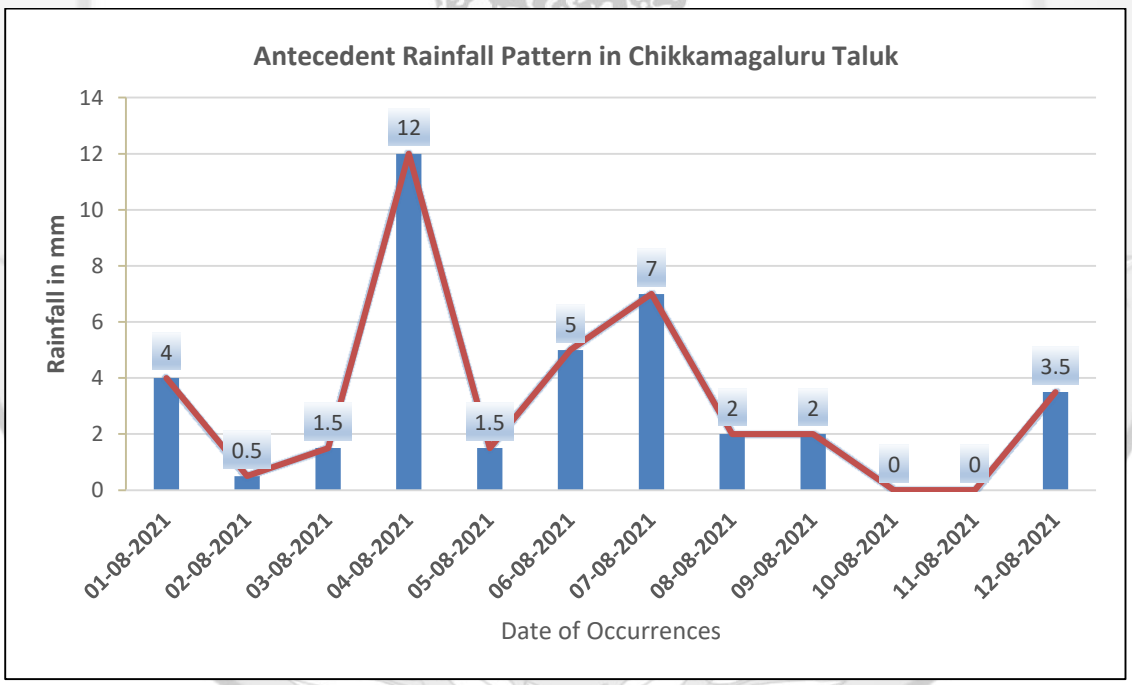
Graph 24: Graph showing Departure between Normal and Actual Rainfall Year 2021 (ChikkamagaluruTaluk)



Graph 25: Graph showing Antecedent rainfall distribution curve during June 2021 (ChikkamagaluruTaluk)



Graph 26: Graph showing Antecedent rainfall distribution curve during July 2021 (ChikkamagaluruTaluk)



Graph 27: Graph showing Antecedent rainfall distribution curve during August 2021 (ChikkamagaluruTaluk)

CHAPTER 5

LANDSLIDE SUSCEPTIBILITY MAP

5.1 Domain Based Landslide Susceptibility Map:

Landslide Susceptibility Map is generated on a priority basis using a terrain-specific heuristic knowledge-driven mathematical modelling method using a multi-class overlay index method in the GIS platform. The hill slopes are categorized as high, moderate, and low susceptible zones based on weightage and rating assigned to causative geofactors for each landslide failure domain through assigning and integrating Landslide susceptibility evaluation rating (TSER) to get final classified "Total estimated susceptibility values (TESV) to generate domain based landslide susceptibility map for delineating the probability of spatial occurrence of landslides and landslide susceptible zones.

In each failure domain, terrain-specific geofactors are identified and inter-predictor weights are assigned, and then selected predictors with their weights in a suitable susceptibility model like Weighted Multiclass Index Overlay are combined in the GIS platform. GIS-based modeling and integration of selected and weighted geofactor maps are generated separately for each landslide failure domain by assigning and integrating landslide susceptibility evaluation values to get the total estimated landslide susceptibility value for preparation of landslide susceptibility maps showing the varying degree of landslide susceptibility and validated with landslide inventory, and ground cracks.

The weighted summation of the thematic geofactor is carried out using the map algebra calculation tool in the ArcGIS platform. Since the geofactor assemblages are failure domain-specific, initially different susceptibility maps specific to different failure domains are prepared and finally are combined as a "Combined Landslide Susceptibility" map and classified into three susceptibility classes (High, Moderate and Low) for easy comprehension and taking quick decision by stakeholders.

5.1.1 Landslide Susceptibility in Debris/Earth Domain: The domain-specific susceptibility map of the terrain is prepared by semi-heuristic data modelling technique, inter-predictor weights for geofactor themes, and classes are assigned based on terrain conditions.

a). Debris/Earth Domain: The Debris domain is demarcated on the basis of slope forming material type in the overburden of soil and failure mechanism. The rock fragment and weathered rock with loose soil, 0.5m to 1m overburden on the rock are considered in the debris domain and earth domain constitutes mature soil with a low percentage of debris The debris domain susceptibility map is prepared after taking into consideration landform units, Stream power index, Relative relief, and slope gradient as predisposing inherent geofactor that contribute to slope instability.

The debris/earth domain susceptibility map of the terrain is prepared by semi-heuristic data modelling technique, and inter-predictor weights for geofactor themes and classes are assigned based on terrain conditions (Table 12 & Table 13). In the Debris failure domain, 74.05% of the area falls in Low susceptibile Zone, 17.04% in Moderate susceptible and 8.91 % of the area falls in low susceptible zone.

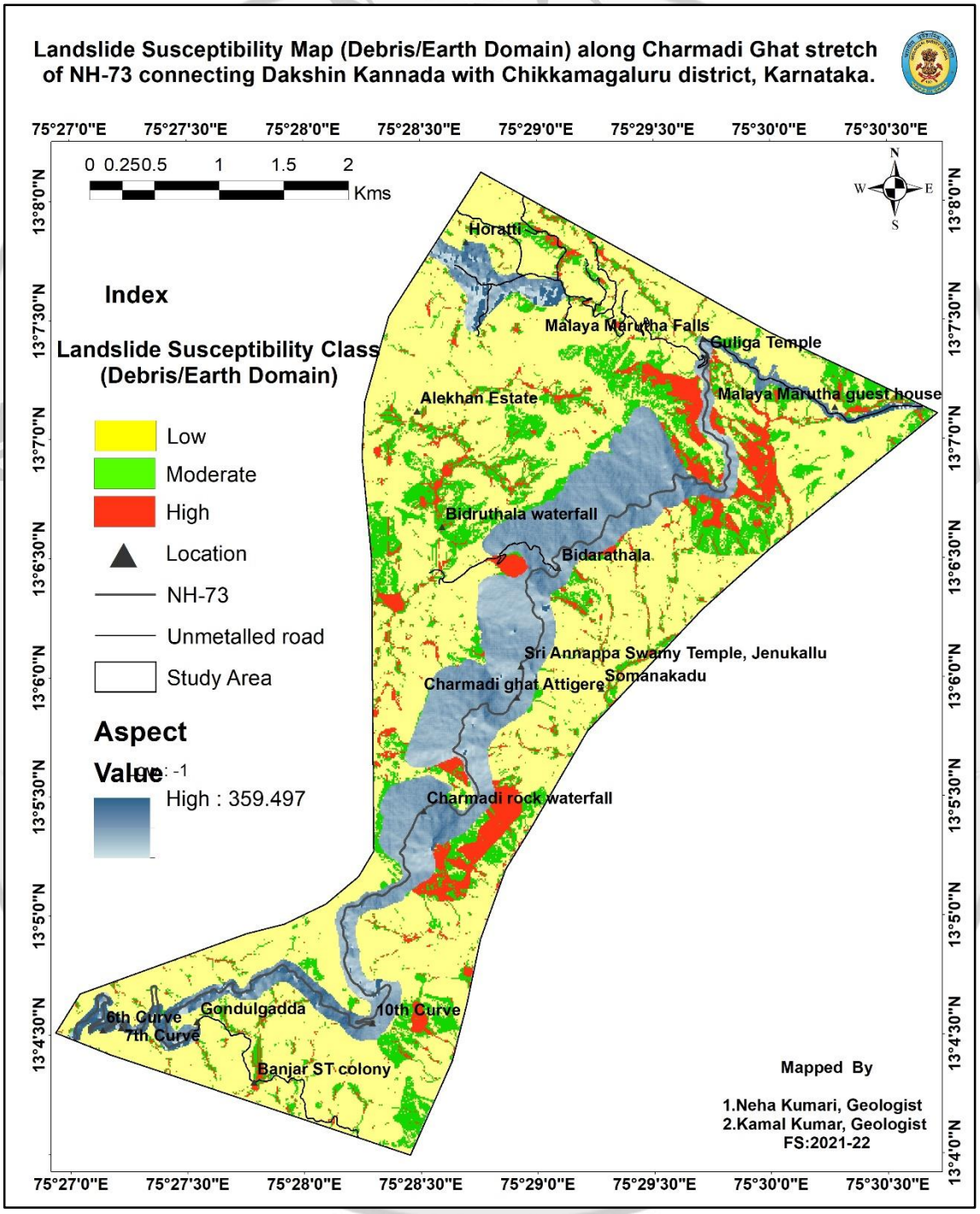
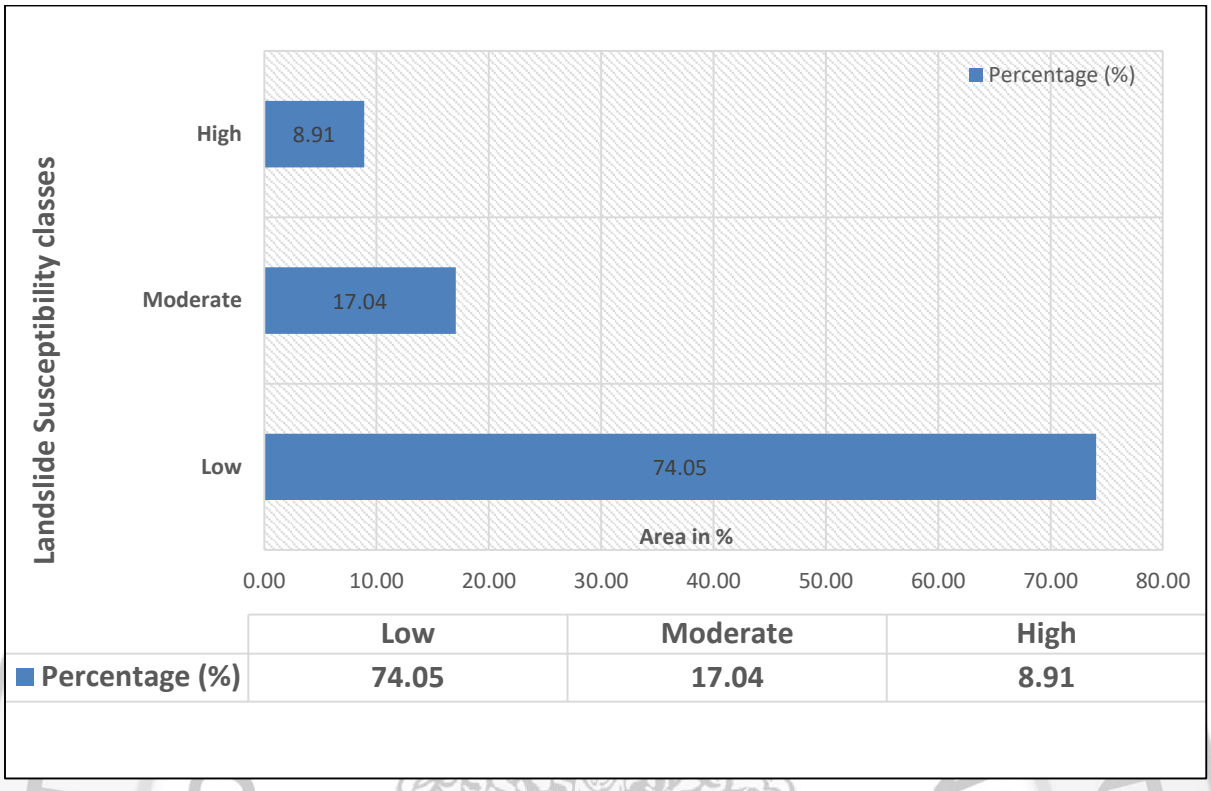


Fig 30: Landslide Susceptibility Map in of the study area on 1:10,000 scale in Debris/Earth domain.



Graph 28: Graph showing percentage distribution of area under landslide susceptibility classes in Debris Domain.

c). Landslide Susceptibility Evaluation Rating (LSER): Semi-quantitative heuristic method is used for the determination of domain-specific Landslide Susceptibility Map preparation. The Landslide Susceptibility Evaluation Rating and weights are assigned to geofactor classes and geofactor themes in each failure domain based on causative geofactors influencing landslides and slope stability.

5.1.2 Landslide Susceptibility in Rock Domain:

The cut slope domain is demarcated along the road cut along NH-73, with the help of contour-based field mapping. In the cut slope domain, a buffer of 25m is kept in the upslope and downslope direction of the road. The landside susceptibility analysis is carried out by taking into consideration the relative relief, slope gradient, and geotechnical parameters in the cut slope domain to determine the stability condition of the slope. According to the cut slope susceptibility map prepared by the semi-heuristic data modelling technique, the inter predictor weights for geofactor themes and classes are assigned based on the terrain condition. The landslide susceptibility map indicates that 54.02% of the area falls in Low susceptibile Zone, 23.51% in Moderate susceptible and 22.46% of the area falls in low susceptible zone.

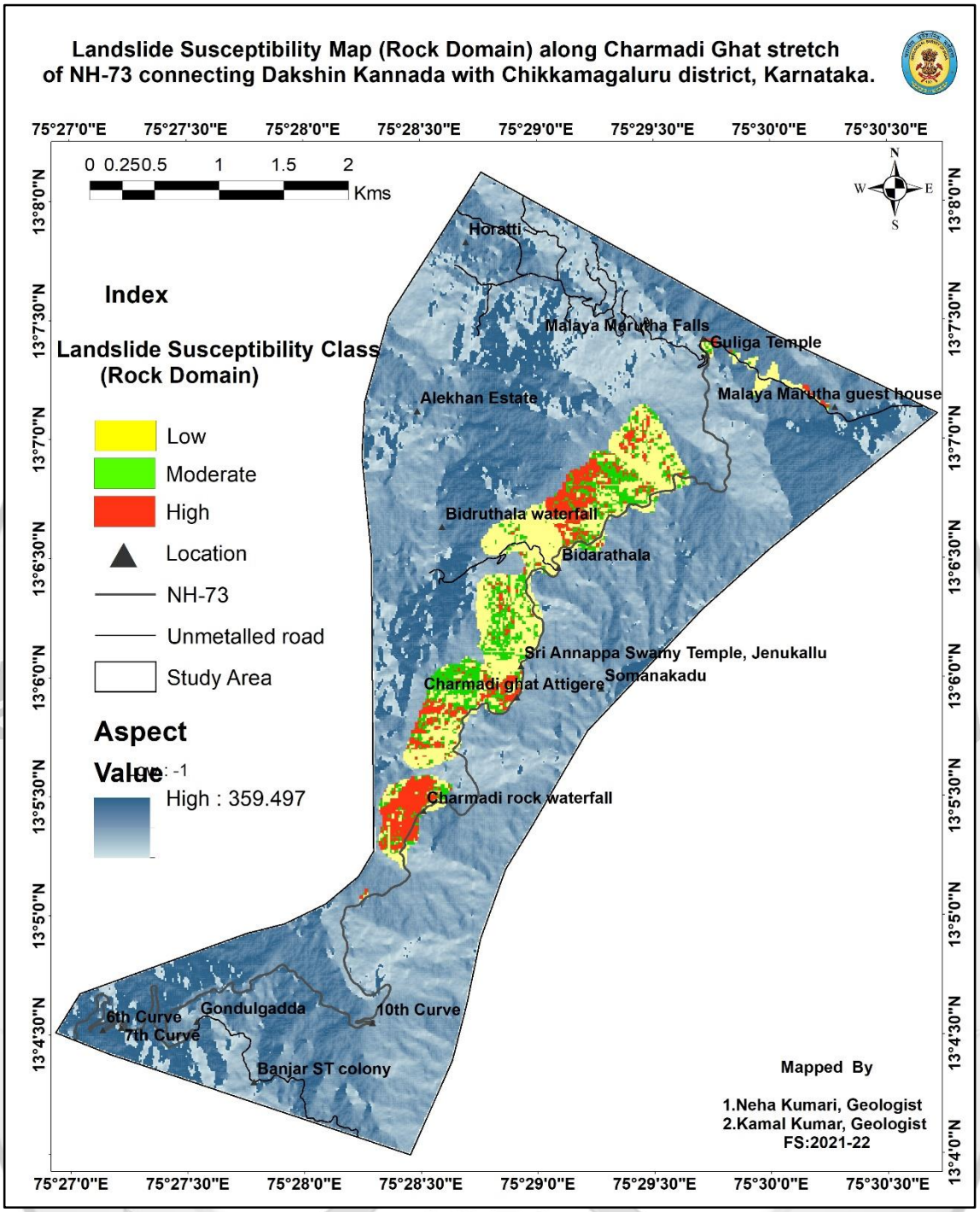
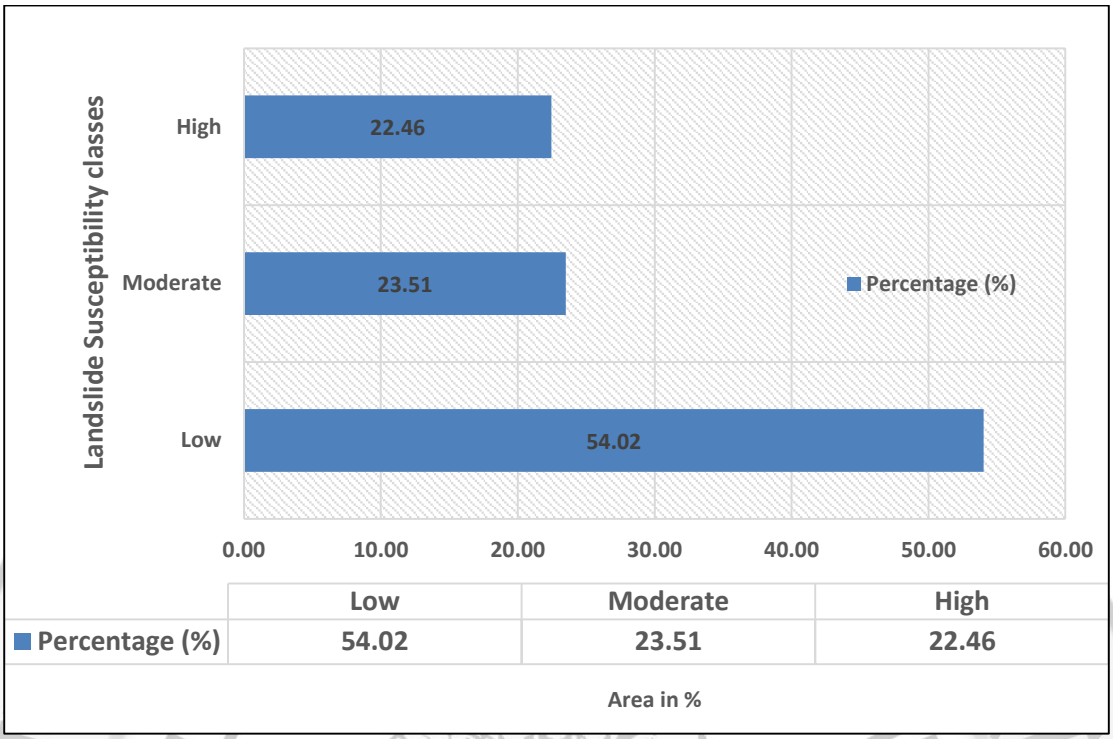


Fig 31: Landslide Susceptibilty Map in of the study area on 1:10,000 scale in Rock domain.



Graph 29: Graph showing percentage distribution of area under landslide susceptibility classes in Rock Domain.

5.1.3 Landslide Susceptibility in Cut slope Domain:

The cut slope domain is demarcated along the road cut along NH-73, with the help of contour-based field mapping. In the cut slope domain, a buffer of 50m is kept in the upslope and downslope direction of the road. The landside susceptibility analysis is carried out by taking into consideration the relative relief, slope gradient, and geotechnical parameters in the cut slope domain to determine the stability condition of the slope. According to the cut slope susceptibility map prepared by the semi-heuristic data modelling technique, the inter predictor weights for geofactor themes and classes are assigned based on the terrain condition. The landslide susceptibility map indicates that 45.25% of the area falls in Low susceptibile Zone, 31.34% in Moderate susceptible and 23.40% of the area falls in high susceptible zone.

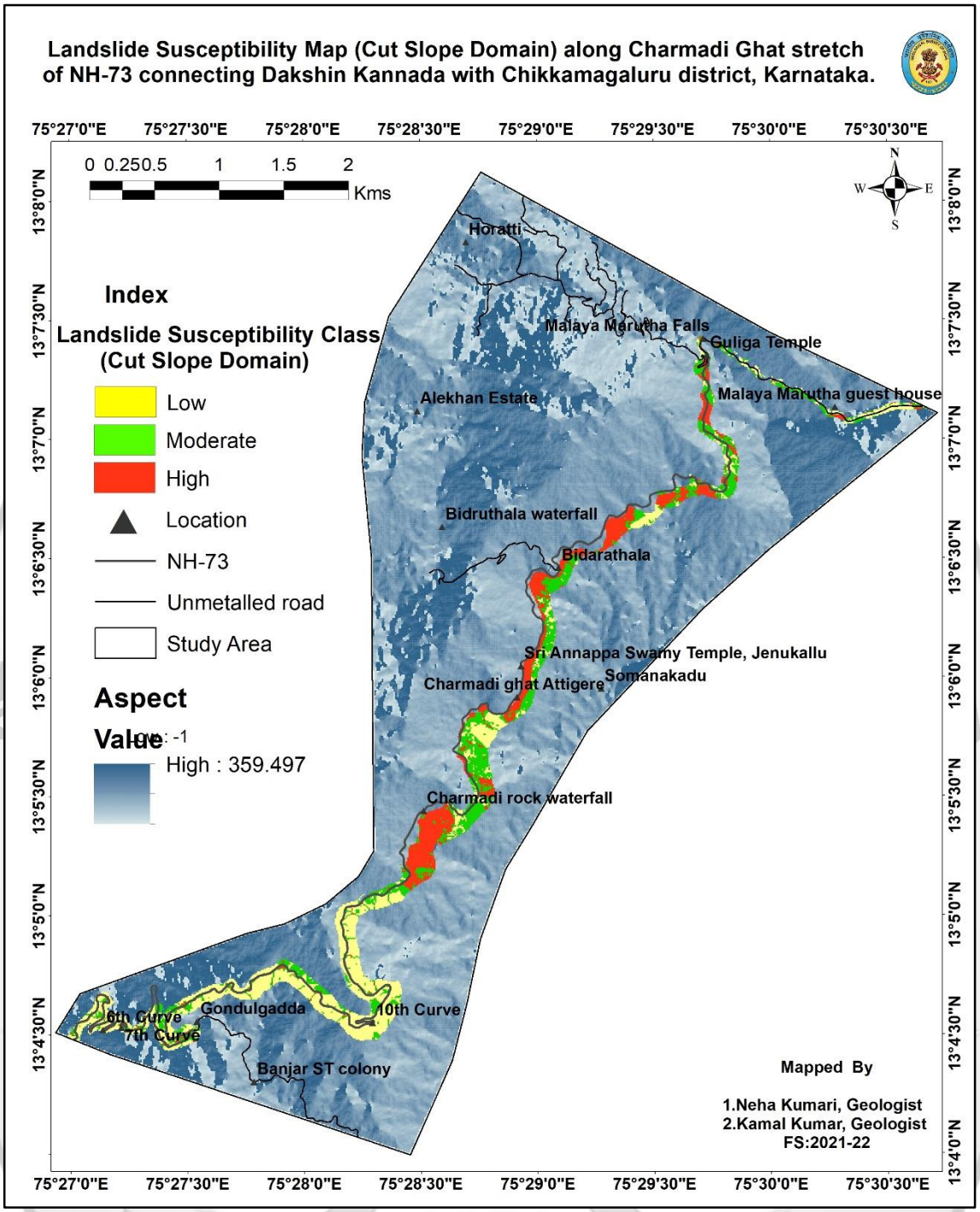
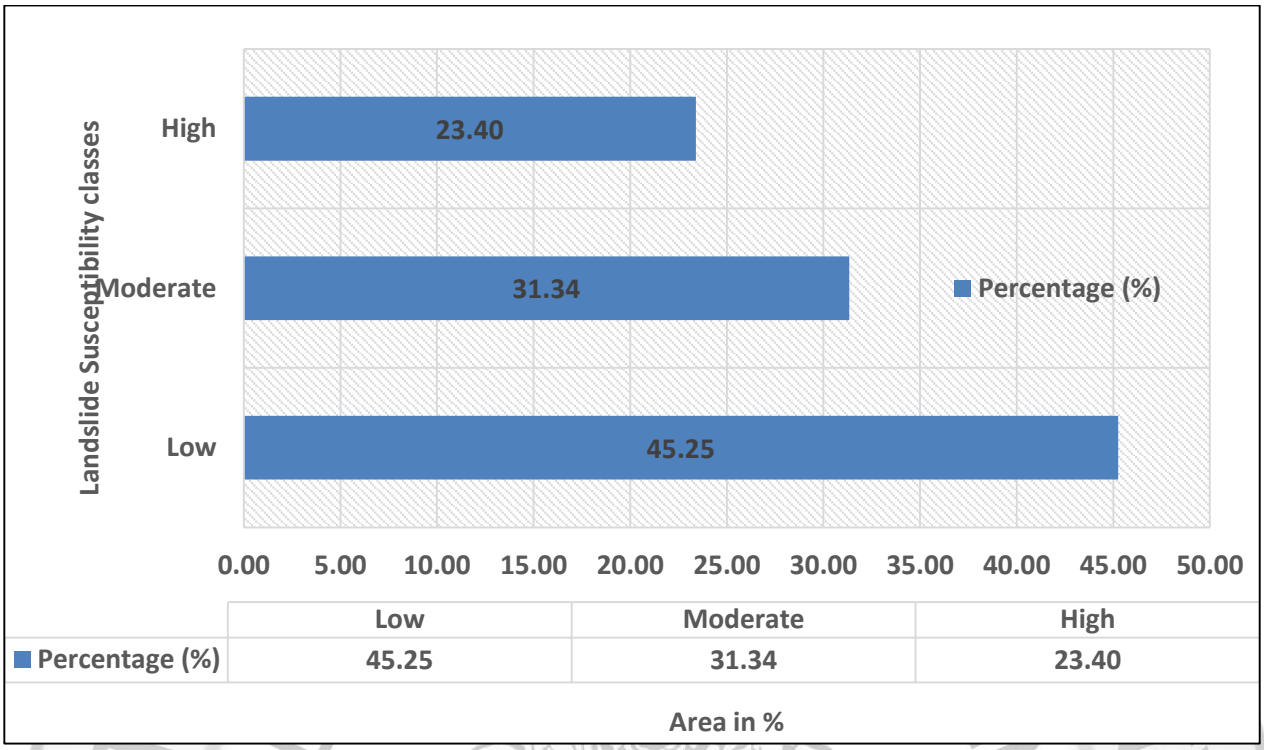


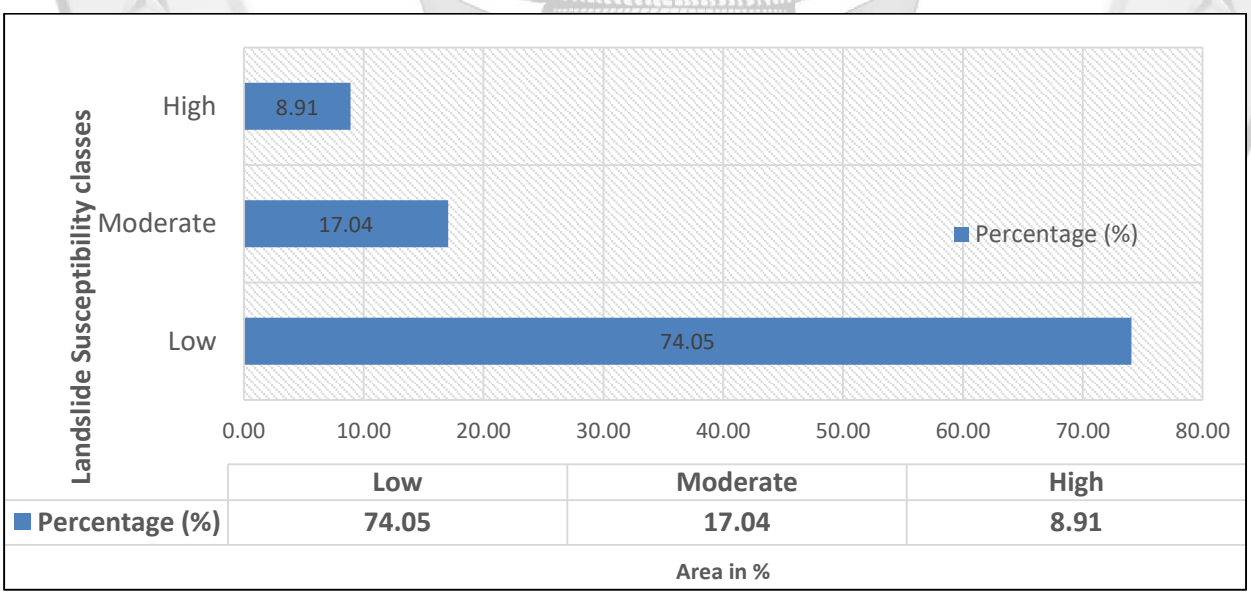
Fig 32: Landslide Susceptibilty Map in of the study area on 1:10,000 scale in Cut Slope domain.



Graph 30: Graph showing percentage distribution of area under landslide susceptibility classes in Cut Slope Domain.

5.1.4 Combined Landslide Susceptibility Map:

The landside susceptibility in debris/earth domain, Rock and cutslope domain is integrated or combined in ArcGIS platform to prepare the combined landslide susceptibility map. In combined susceptibity map about 74.05% of the area falls in Low susceptibile Zone, 17.04% in Moderate susceptible and 8.91 % of the area falls in high susceptible zone.



Graph 31: Graph showing percentage distribution of area under landslide susceptibility classes in combined landslide domain.

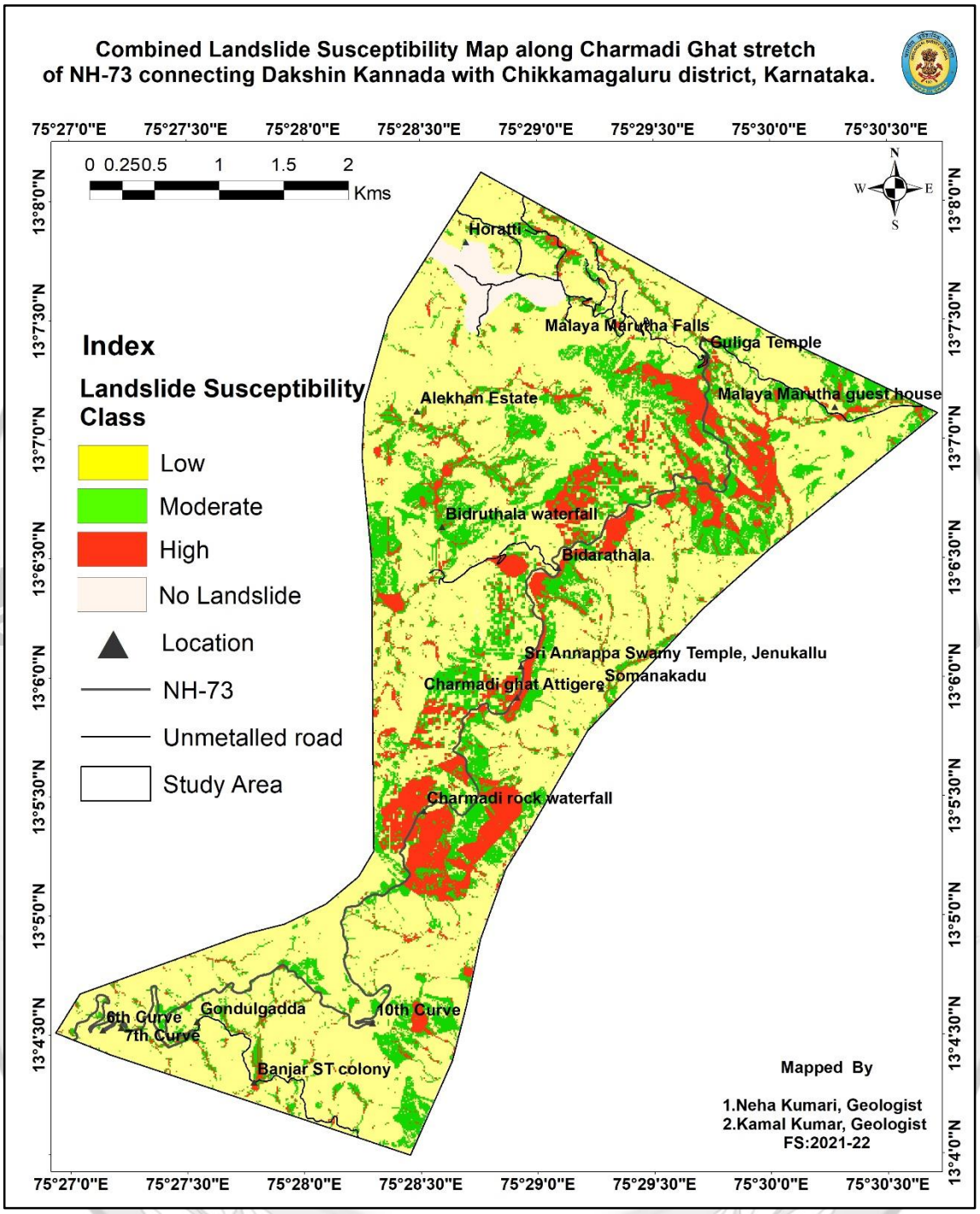


Fig 33: Combined Landslide Susceptibilty Map in of the study area on 1:10,000 scale.

CHAPTER 6

LANDSLIDE SUSCEPTIBILITY ANALYSIS

6.1 LANDSLIDE INCIDENCES IN THE STUDY AREA

The landslide inventory mapping plays a vital role in landslide susceptibility analysis of the terrain. The slope failure mechanism helps to understand the inherent causative factors responsible for landslide initiation. The landslide inventory is prepared using landslide inventories documented in GSI reports and literature, satellite data, multi-temporal google earth imageries, and field inputs. During landslide mapping, a detailed field assessment is carried out for all the past and present landslide locations. During the investigation, 56 nos. of landslides were recorded and documented with 42-point geoparametric attributes and the landslide inventory database is generated (Annexure–I). The causative factors and triggering factors responsible for landslide initiation, failure mechanism, damage, risk assessment, and remedial/mitigation measures were suggested as per the site conditions.

Total of 185 nos. of old, new, and reactivated landslides with 42-point geoparameters of landslide attributes are documented. Majority of landslides are shallow translational, of either translational or rotational in nature recorded along Charmadi ghat road and few are rock slide, and debris flow. Most of the old, suspended debris landslides are reactivated. The spatial correlation of geofactor thematic maps and their classes with landslide distribution are analysed to assign the weightage and rating to produce susceptibility map. The spatial distribution of landslides indicates that the majority of the landslides are initiated on slope, spur and hollow part of hill. The landslide incidences and cut slope failure are mainly confined to highly dissected steep slope on highly weathered, fractured and jointed extensive vertical road cut of height >10m and slope angle >65° made at original slope angle varying between 25-35° along Charmadi Ghat road. The slope modification for road construction has disturbed the original slope geometry, gradient and relative relief. A few channel erosion along 1st and 2nd order streams are cross cutting the road and prograded as debris flow along the flow path of nala/stream breached NH-73 road section at places during heavy incessant rainfall events in September 2019. The Bidartale, Alekhan estate, Horrati village area are at high risk during monsoon.

6.2 CAUSATIVE GEOFACTORS & TRIGGERING FACTORS: All inherent & external causative factors influencing slope stability are determined through detailed field observations and assessment. Based on the net effect of predisposing inherent & external causative geofactors associated with landsliding, the factors governing slope stability are mainly pre-disposing terrain conditions i.e. landform units, slope morphometric parameters i.e. slope gradient, relative relief,

land use/land cover, drainage morphometric parameters; influx of water and steam power erodibility index, hydro-geological setting: water condition of slope, lithology and structural discontinuity, shear parameters (cohesion and frictional resistance) and grain size of the slope forming material. The external factors responsible for slope instability in prevailing terrain condition is excessive periodic heavy incessant rainfall events that triggered a large number of landslides.

6.3 HYDRO-GEOLOGICAL SETTING: The deep-seated joints and fracture system, lithological discontinuity, i.e. intrusive litho-contact zones (dykes), and interface of weathered rock and loose soil provides a new pathway for water infiltration and slope saturation and are identified as potential failure/slip for mass failure during a periodic incessant rainfall event. The intrusive litho-contact zones at places acted as a natural barrier for surface water infiltration and sub-surface water flow. In high artesian pressure conditions, hydrological stress was built in sub-surface strata due to excessive water infiltration that increases sub-surface water flow to a greater extent. The high pore water pressure was developed due to an increase in surface infiltration and sub-surface water flow in drainage basins during incessant rainfall events that significantly reduced the cohesive strength and shear/frictional resistance of slope forming material causing shear failure of the hillslope. The headward and lateral erosion of the valley caused basin failure in the water catchment area due to heavy water recharge during incessant rainfall.

Geologically, granite gneiss of archean age are the predominant litho-unit, which is are highly foliated, jointed, fracture, sheared, folded and shows gneissic banding, amphiboilite is occurring as enclave/xenolith with granite gneiss oriented in NW-SE, N-S, NE-SW. Basic intrusives are represented by dolerite dyke criss crossing Peninsular Gneiss-I with varying trends i.e. NE-SW, N-S, NNW-SSE directions. The planar structures are represented by bedding, gneissosity, fracture, cleavage and joints. The regional foliation trends NW-SE to NNW-SSE with a westerly dip of 50°-60°. The folding and flexure slips are observed in granite gneiss at few landslide locations, the orthogonal relationship between the foliation or foliation joint with other joint sets in granite gneiss is playing a vital role in causing the slope failure. The orientation of joint sets with slope angle caused planar, wedge and toppling at vulnerable jointed rocky slope faces dipping towards the road at places along the Charmadi ghat road. The highly weathered, jointed and deformed rock along the road stretches is found vulnerable to slope failure. At places the plunge of the fold is dipping towards road are vulnerable slip plane. The water seepage and water saturation of the slope build high hydrostatic/pore water pressure that leads to decrease in the cohesive and shear strength of slope forming material. The widening of joint sets due to excessive water infiltration into the deep pervasive joint sets during the peak monsoon period induces slope instability. Along the road cut section, sector wise kinematic analysis is carried out to identify the vulnerable joint sets

representative slope facet where probability of slope failure is maximum for demarcating high risk zones. For rock mass characterization total 30 nos. of undisturbed and 7 nos. of oriented rock samples were collected from landslide zones and vulnerable slope facets representing different rock/overburden material for geotechnical investigation. Due to landslide incidence cracks are developed and retaining structures at places were damaged along the ghat road. The slope stability condition is mainly influenced by pre-disposing terrain condition mainly governed by slope morphometry and hydro-geological setting of the terrain. The buffer of 25-30m on either side of drainage, intrusive litho-contact zones at places acted as favourable loci/potential zone for landslide initiation during heavy incessant rainfall event.

6.4 SUSCEPTIBILITY CONDITION OF THE SLOPE: According to the Macro-scale (1:50000) landslide susceptibility map, 57.28% fall in Low, 24.39% in High, and 18.33% in Moderate landslide susceptible zone. The pre-disposing terrain condition i.e. landform units, slope morphometric parameters i.e. slope gradient, relative relief, land use/land cover, drainage morphometric parameters; influx of water and steam power erodibility index, hydro-geological setting, shear parameters (cohesion and frictional resistance), and orientation of structural discontinuity and elation with slope idp and direction resulted in critical slope failure . So, rock kinematics in rocky slope in charmadi ghat plays vital role in governing the slope stability condition. If slope geometry is disturbed without any supporting structure may trigger landslides during heavy incessant rainfall event of Monsoon. The final susceptibility map of the area illustares that in combined susceptibity map about 74.05% of the area falls in Low susceptibile, 17.04% in Moderate susceptible and 8.91 % of the area falls in high susceptible zones.

CHAPTER 7

RISK MANAGEMENT IN PROBABLE HIGH-RISK AREAS

7.1 PROBABLE HIGH-RISK AREAS & MITIGATION MEASURES:

A total of twenty one areas are delineated as probable high-risk areas considering the hazard and associated risk elements on high landslide susceptible zones as well as the areas where the likelihood of recurrence of past landslide incidence is possible during heavy incessant rainfall events. The spatial distributions of high-risk zones are mentioned in detail and related site-specific scientific observations are discussed in detail for effective disaster prevention, preparedness, and planning by the policy maker.

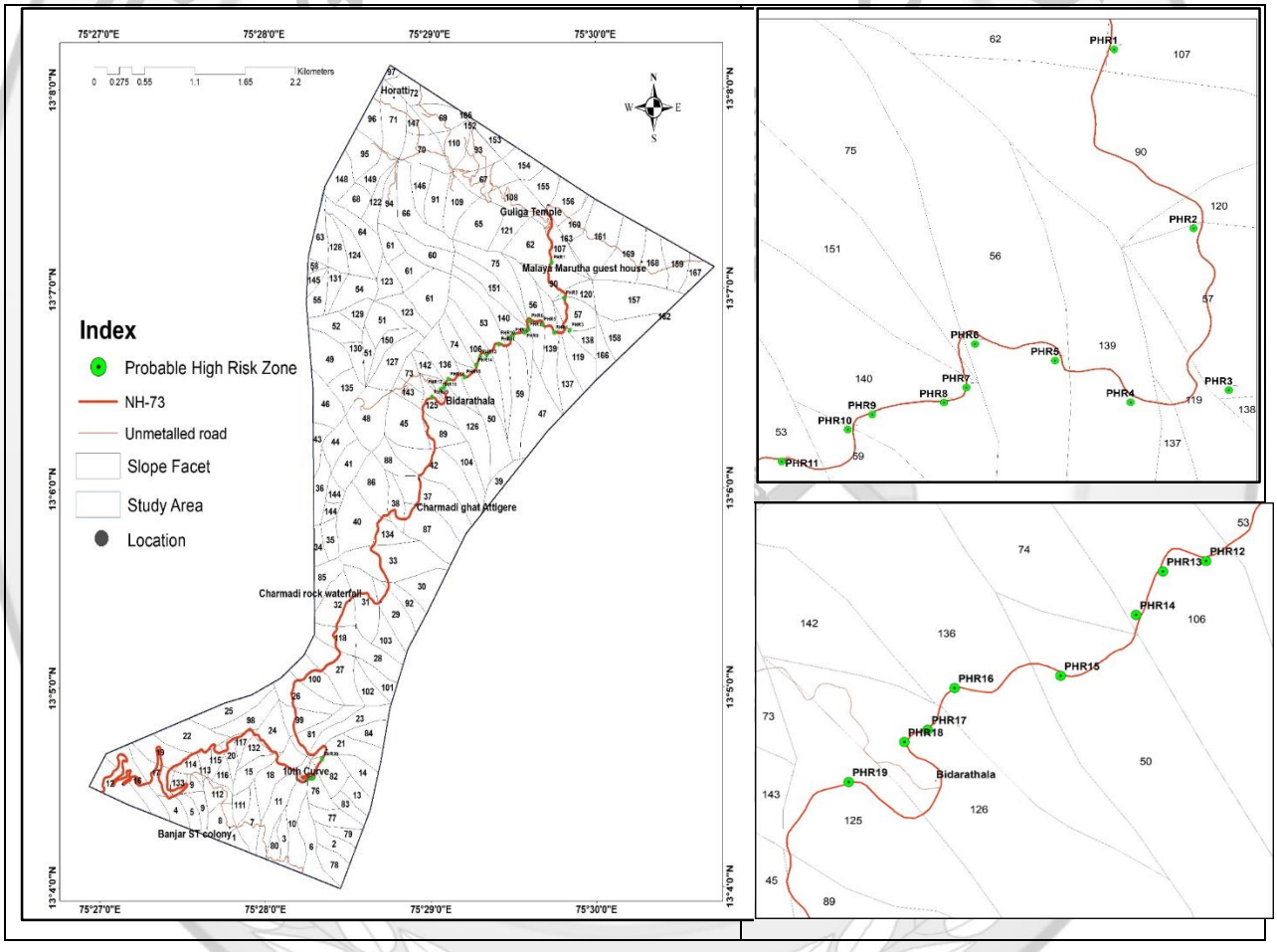


Fig 34: Probable high risk zones/vulnerable road stretches along Charmadi ghat road (NH-73)

CHIKKAMAGALURU DISTRICT

1. PHR1: Facet no. 107: 120 m stretch

Location: The hillslope is dissected by 1st order stream channel and landslide initiated in adjacent faces of hill slope lying in the buffer of 45m in the proximity of 1st order drainage at road bench level on the upslope and downslope direction during incessant rainfall events in the month of Aug-Sep 2019. The slope face has a 3-5m overburden of soil and highly weathered rock (granite gneiss) as slope-forming material on the vertical cut slope. The original slope geometry is disturbed for road construction. At 13°07'8.60"N/ 75°29'44.00"E, new stream channels are originating at road bench level in a downslope direction. At large dimension debris slide lat/long: 13° 7'6.41"N/ 75°29'42.23"E.

Geoscientific Causes:

Decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.

Remedial Measures:

1. The upslope slope angle should be eased or the Ditch width can be increased to retain the slope geometry and back filling of the slope can be done.
2. The lined drainage with weep should be constructed to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
3. At large dimension debris slide lat/long: 13°7'6.41"N/ 75°29'42.23"E ditch width can be increased. Strong reinforced retaining structure to be constructed. A new stream channel is originating at 13° 07'6.6"N/75°29'43.3" E

Damage Assessment:

1. Damaged steel pier at 13°7'7.90" N/75°29'44.00"E and Gabion wall broken at 13° 7'4.90"N/ 75°29'42.30"E.

2. PHR2: Facet no. 57 (110 m strech)

Location: Landslide incidence at 13°06'56.15"N/ 75°29'47.65"E at opposide side of road retaining wall/ gabion wall damaged. The slope face has a 3-5m overburden of soil and highly weathered rock

(granite gneiss) as slope-forming material on the vertical cut slope. The original slope geometry is disturbed for road construction. New stream channels are originating at road bench level in a downslope direction.

Geoscientific causes:

Decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.

Remedial Measures:

1. The upslope slope angle should be eased or the Ditch width can be increased to retain the slope geometry and back filling of the slope can be done.
2. The suitable dimension culvert should be constructed and lined drainage with weep should be constructed to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.

Damage Assessment:

1. Retaining structure i.e. Gabion wall broken at 13°6'56.10"N/75°29'48.70" E to 13°6'53.20"N / 75°29'49.10"E (115m road stretch) need to be repaired.

3. PHR3: Facet no. 119(139m stretch)

Location: Landslide incidence (old, scar) at 13°6'50.58"N/ 75°29'46.84"E of dimension: Length: 62m, Width: 45m, Height: 52m, Depth: 5m are disturbed zone. The multiple landslide scars are observed along a 139m stretch along the road section. At 13°6'45.28"N/ 75°29'49.55"E landslide scars are observed on the slope in the downslope direction. The slope is dissected and sub-surface drainage.

Geoscientific causes:

Decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.

Remedial Measures:

1. The upslope slope angle should be eased or the Ditch width can be increased to retain the slope geometry and back filling of the slope can be done.
2. The suitable dimension culvert should be constructed and lined drainage with weep should be constructed to avoid slope saturation and toe erosion and to drain excess water through the culvert.

Damage Assessment:

1.Culvert clogged at 13°6'49.20"N/75°29'48.20"E and steel pier damaged at 13°6'48.50"N/ 75°29'48.40"E need to be repaired.

4. PHR4: Facet no. 139 (75m stretch)

Location: Multiple Landslide incidence (old, scar) observed on upslope and downslope direction along 75m vulnerable stretch along road section. The hanging boulders (dolerite dyke body) on slope should be removed. The old landslide scars in downslope direction is observed. The sub-surface drainage is originating at road bench level initiated the landslide during incessant rainfall condition.

Remedial Measures:

1. Ditch width can be increased and Reinforced retaining structure with weep holes should be constructed at road bench level in downslope direction.
2. Slope should be eased and lined drainage with weep should be constructed to avoid slope saturation and toe erosion and to drain excess water through the culvert.
3. The precarious hanging boulders (dolerite dyke body) on slope should be removed.

5. PHR5: Facet no. 56(75m stretch)

Location : Landslide initated at 13° 6'50.18"N/ 75°29'40.49"E on upslope at vertical cut.

Remedial Measures:

1. At 13° 6'49.30"N/ 75°29'40.58"E reinforced retaining wall with culvert required and culvert is constructed along stream flow path.

Damage assessment:

1. Gabion wall damaged 13° 6'49.30"N/ 75°29'40.58"E need to be repaired.

6. PHR6: Facet no. 75

Location: At 13°6'50.30"N/ 75°29'36.00"E high hydrological stress prevails on upslope and retaining structure/breast wall with weep holes should be constructed.

7. PHR7: Facet no. 140: 75 m strech

Location: At 13° 6'47.70"N/ 75°29'35.50"E landslide/ slope failure observed in upslope on highly wetherd felsic granite gneiss (0.5-1m overburden thickness) and slope got failed in downslope direction with overburden of 5m at road bench level at convex curve of the road section. The vulnerable stretches extending about 75m along the road section.

Geoscientific causes:

Decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.

Damage assessment: Road damaged at road bench level.

8. PHR8: Facet no. 140: 55 m stretch

Location: At 13° 6'47.13"N/ 75°29'33.79"E landslide/ slope failure observed in upslope on highly wetherd felsic granite gneiss (0.5-1m overburden thickness) and slope got failed in downslope direction with overburden of 5m at road bench level at convex curve on vertical cut slope road section. The vulnerable stretches extending about 55m along the road section.

Geoscientific causes:

Decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
3. Reinforced retaining structure with weep holes of suitable dimension should be constructed at road bench level in downslope direction.

Damage assessment:

1.Road damaged at road bench level.

9. PHR9: Facet no. 140: 40 m stretch

Location: At 13° 6'46.10"N/ 75°29'30.10"E, highly jointed rock upslope faces high hydrological stress on the slope and delineated as highly strained area.

Geoscientific causes:

The sub-surface drainage in topographic depression may initiated change in topographic relief on slope during hydrological stress condition, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.

Damage assessment: Retaining structure on other side of slope is partly damaged.

10. PHR10: Facet no. 140: 40 m stretch

Location: At 13° 6'45.20"N/ 75°29'28.70"E, highly jointed rock upslope faces high hydrological stress on the slope and delineated as highly strained area and unstable zone.

Geoscientific causes: hydrological stress condition/pore pressure, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed

2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
3. Culvert at stream course should be constructed.

Damage assessment:

1. Retaining structure on other side of slope is partly damaged.

11. PHR11: Facet no. 53: 40 m stretch

Location: At 13° 6'43.30"N/ 75°29'24.90"E, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone.

Geoscientific causes:

Hydrological stress condition/pore pressure which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
3. Culvert of suitable dimension at stream course at road bench level should be constructed.
4. Retaining structure can be extended upto 60m.

12. PHR12: Facet no. 106: 45 m stretch

Location: At 13° 6'40.10"N/ 75°29'20.50"E, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone.

Geoscientific Causes:

Hydrological stress condition/pore pressure which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
3. Culvert of suitable dimension at stream course at road bench level should be constructed.
4. Vertiver grass can be grown on slope.
5. Culvert at lat/long;13°06'40.60"N/ 75°29'19.20"E is clogged.

13. PHR13: Facet no. 106: 45 m stretch

Location: At 13°06'39.1"N/ 75°29'17.5"E, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone.

Geoscientific causes:

Hydrological stress condition/pore pressure which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across NH-73 road.
3. Concrete gabion wall should be constructed.

Damage Assessment:

1. Gabion wall broken, culvert is required.

14. PHR14: Facet no. 106: 91 m stretch

Location: At 13° 6'36.68"N/ 75°29'16.85"E, landslide occurred at downslope, and 13° 6'36.70"N/ 75°29'16.60"E landslide occurred at upslope at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone.

Geoscientific Causes:

Hydrological stress condition/pore pressure which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across NH-73 ghat road.

15.PHR15: Facet no. 105: 91 m stretch

Location: At 13°6'33.50"N/75°29'12.40"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. At 13°06'33.80"N/ 75°29'10.50"E major landslide recorded. Due to change in relative relief slope disturbance on upslope is recorded.

Geoscientific Causes:

Hydrological stress condition/pore pressure which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites.

3. Perforated weep holes can be installed on upslope.

16. PHR16: Facet no. 105: 30 m stretch

Location: At 13° 6'32.80"N/ 75°29'6.50"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. At 13°06'33.80"N/ 75°29'10.50"E major landslide recorded. Due to change in relative relief slope disturbance on upslope is recorded. Water dripping along adjacent joint faces

Geoscientific Causes:

Hydrological stress condition/pore pressure, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh (10m) 13° 6'31.81"N/ 75°29'5.66"E by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites.
3. Perforated weep holes can be installed on upslope.

17. PHR17: Facet no. 126: 30 m stretch

Location: At 13° 6'30.78"N/ 75°29'4.52"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone.. Due to change in relative relief slope disturbance on upslope is recorded.

Geoscientific Causes:

Hydrological stress condition, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh (by back filling of slope need to be constructed

2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites.

18. PHR18: Facet no. 126: 30 m stretch

Location: At 13° 6'29.70"N/ 75°29'3.70"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. Due to change in relative relief slope disturbance on upslope is recorded.

Geoscientific Causes:

Hydrological stress condition/pore pressure, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh (by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites
3. Steel pier installed at road bench level is damaged.

19. **PHR19: Facet no. 125: 30 m stretch**

Location: At 13° 6'27.4"N/ 75°29'00.6"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. Due to change in relative relief slope disturbance on upslope is recorded. Topographic depression along nala.

Geoscientific Causes:

Hydrological stress condition, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width 13° 6'25.60"N / 75°28'58.00"E can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh (by back filling of slope need to be constructed

2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites.

Damage assessment: Road is damaged.

20. PHR20: Facet no. 112 : 30m stretch

Location: At 13°4'38.6"N/75°28'20.5"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. Due to change in relative relief slope disturbance on upslope is recorded. Topographic depression along nala.

Geoscientific Causes:

The hydrological stress condition/pore pressure , which may ultimately lead to slope failure during incessant rainfall

Remedial Measures:

1. The upslope slope angle should be eased or Ditch width 13° 6'25.60"N / 75°28'58.00"E can be increased to retain the slope geometry and reinforced retaining wall/gabion wall with wire mesh (by back filling of slope need to be constructed
2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain out excess water through the culvert constructed at suitable sites.

DAKSHIN KANNADA

21. PHR21: Facet no. 76 (10th curve of Charmadi Ghat)

Location: At 13°4'32.9"N/ 75°28'17.5"E, landslide occurred at road bench level, high hydrological stress on the slope and delineated as highly dissected, strained area and unstable zone. Due to change in relative relief slope disturbance on upslope is recorded. Topographic depression along nala.

Geoscientific Causes:

Hydrological stress condition, which may ultimately lead to slope failure during incessant rainfall.

Remedial Measures:

1. Lined drainage is required on upslope, drain chute/trench should be designed.
2. Stabilization: cement grouting done on slope to strengthen the slope tensile strength.

Damage Assessment:

1. Steel pier constructed on upslope broken.

CONCLUSION & RECOMMENDATIONS

i) The final susceptibility map illustrates that in combined susceptibility map about 74.05% of the area falls in Low Susceptible Zone, 17.04% in Moderate Susceptible and 8.91% of the area falls in high susceptible zone.

ii) Landslide incidences in the area are mainly triggered by heavy incessant rainfall events in the peak monsoon period.

iii) The hydro-dynamic stress built due to heavy water recharge in the basin increased sub-surface water flow and hydraulic head. The intrusive litho-contact zones that acted as a natural barrier to the free flow of water, water gushes out with high hydrostatic pressure at favourable weaker zone causing massive landslides.

iv) Due to excessive water recharge/prolonged water infiltration in the water catchment area/sub-basin, sub-surface streams i.e. 1st order and 2nd order non-perennial stream channels get reactivated due to excessive sub-surface water flow beyond the carrying capacity of the sub-basin that caused headward and lateral erosion of the hilllslope along the valley portion due to a rise in water level/hydraulic head.

v) The slope disturbance of natural steep hillslope with high relative relief should be prohibited because it may disturb the natural pathway of sub-surface water flow.

vi) The effective drainage management and maintenance are recommended all along hillslope at road bench level all along ghat road, and culverts of suitable dimensions should be constructed at suitable sites to prevent seepage, water saturation toe erosion, and divert surface runoff to safer places by providing contour and chute drains.

vii) The horizontal perforated pipes/seepage holes should be installed for drainage management on the slope at seepage zones/points

viii) The landslides are mainly triggered by anthropogenic activities i.e. human interference with the natural slope. The main causes of landslides and slope failure in the study area are pediment cutting, toe cutting of hill slope for the construction of roads, modification of slope for human settlement, removal of soil, and stripping of vegetation destabilizes the slope.

ix) The triggering factors for slope failures are weathering and increased pore water pressure in highly weathered rock mass, jointed and fractured rocks that greatly reduce shearing resistance of underlying rock units during heavy rainfall.

x) The cut slope angle and height play a major role in all the slides. Cut slope height was included as a factor as this is found to be a major cause of the slides. Prograding of the slide is more towards both the flanks rather than towards the back of the crown. The sliding is more in convex turns of the road than concave sections.

xi) The anthropogenic activities are the causative factors that lead to instability and slope failure. Toe cutting or slope cutting, excavation, land use change, vibration, water leakage, barren & sparsely vegetated areas. The probable physical causes are intense rainfall, prolonged precipitation, soil pore water pressure, surface runoff, etc. The geological causes are the weaker plane, weathered, jointed and fissured materials, permeability contrasts, and material contrast.

xii) The morphological parameters governing the slope failure are slope angle, erosional activity i.e. erosion of lateral margins and sub-terrain erosions, and overburden.

xiii) The vertical cut of slope angle 55° to >65° made on the slope covered with sparse vegetation, weathered rock, and loose material with an original slope angle of 25°- 35° are found more susceptible to failure.

xiv) The litho-units mapped are amphibolite, granite gneiss of Archaean age, and bands of younger intrusives Dolerite. The degree of weathering is pronounced and rainfall is the landslide triggering factor during heavy rainfall in Monsoon.

RECOMMENDATIONS:

i). The remedial measures required to stabilize the disturbed zones are retaining wall, lined drainage with weep holes in the toe portion of hill slope including chute drains, stone pitching, gabion wall, and slope re-gradation as per the site conditions are suggested.

ii). Proper Management of drainage is required on roads in the hills. Weep holes with perforated pipes are to be provided where water seepage is observed on the slopes.

iii). The vertical cut slopes should be modified to stabilize the slope geometry by providing benching on the slope at a specific interval to reduce the risk of sliding in the future.

iv). The unscientific way of removal of material and slope modifications for construction purposes must be avoided, if required proper scientific way of slope treatment should be adopted for the long-term stability of disturbed slopes.

v). During the cutting/modifications of the slope, nearby Engineering Geology Division may be consulted for attending better slope protective measures.

vi). Regulations on slope cutting i.e. Indiscriminate slope cuttings have to be strictly regulated and engineering solutions such as protective walls/embankments to be made where ever required.

vii). Based on the landslide Susceptibility map it is suggested that the areas delineated under high and moderate susceptible zones, disturbance of natural slope due to landuse/landcover change, and slope modification should be taken due caution before undergoing any development activity to avoid casualties due to landslips/landslides incidences.

viii). In heavy incessant rainfall conditions, an early warning should be done to alert residents residing in Bidarthale, Alekhan, and Horati coffee estate to shift to safer places.

ix). In future landsliding, the elements at risk are NH-73 road under debris flow path and private land and settlements under coffee plantation in Alekhan coffee estate.

x). The land conversion in a high landslide susceptible zone should be well regulated and planned by policymakers and administrative authorities. The recommendation may be sent to State Government authorities may prepare land use ordinance/zoning ordinance by categorization land use in hilly areas within the legal framework of the state.

xi). As per the Bureau of Indian Standards (BIS code) toe support, low-height concrete retaining walls with weep holes can be constructed at road bench level for effective drainage management on slopes.

xii). Based on probable high-risk zones identified during mapping, safe shelter and rehabilitation location in topographically stable areas in and around the Javanahalli village area is suggested.

xiii). The highly weathered, jointed, and deformed rock along the road stretches is found vulnerable to slope failure.

xiv). In the rock fall areas, it is suggested to provide wire mess followed by shotcreting and in the vulnerable areas of planar failure, it is suggested to provide rock boltting with wire mess followed by shotcreting.

LOCALITY INDEX

Locality	Latitude	Longitude	TS No.
Bidruthala waterfall	13° 6' 37.903" N	75° 28' 35.643" E	48 O/08
Bidarathala	13° 6' 27.460" N	75° 29' 5.439" E	48 O/08
Malaya Marutha guest house	13° 7' 7.985" N	75° 30' 16.673" E	48 O/12
Guliga Temple	13° 7' 20.978" N	75° 29' 43.755" E	48 O/08
Charmadi ghat Attigere	13° 5' 54.983" N	75° 28' 54.792" E	48 O/08
Charmadi ghat view point	13° 5' 25.819" N	75° 28' 41.999" E	48 O/08
Banjar ST colony	13° 4' 18.104" N	75° 27' 47.019" E	48 O/08
Horatti	13° 8' 6.060" N	75° 28' 23.812" E	48 O/08
Alekhan Estate	13° 7' 5.784" N	75° 28' 17.413" E	48 O/08
Jenu kallu, Sri Annappa Swamy Temple, Jenukallu	13° 6' 2.803" N	75° 28' 55.840" E	48 O/08
Malaya Marutha Falls	13° 7' 25.186" N	75° 29' 42.749" E	48 O/08
Charmadi rock waterfall	13° 5' 26.301" N	75° 28' 30.723" E	48 O/08
10th Curve of Charmadi Ghat	13° 4' 32.900" N	75° 28' 17.500" E	48 O/08
7th Curve of Charmadi Ghat	13° 4' 31.804" N	75° 27' 12.924" E	48 O/08
6th Curve of Charmadi Ghat	13° 4' 31.200" N	75° 27' 8.200" E	48 O/08
2nd Curve of Charmadi Ghat	13° 3' 58.900" N	75° 26' 17.600" E	48 O/08
1st Curve of Charmadi Ghat	13° 4' 9.600" N	75° 26' 18.500" E	48 O/08

REFERENCES

1. Maruthi, K.V. et al. (2010): "Landslide inventory along NH & SH of Ghat roads in in chikmagalur, coorg, dakshina kannada, udupi and shimoga districts Karnataka. (Unpublished GSI report, FS: 2009-10).

2. Maruthi, K.V. et al. (2012):"Landslide inventory along NH & SH of ghat roads in Uttar Kannada and Chikmagalur Districts, Karnataka" (Unpublished GSI report, FS: 2010-12).

3. Maruthi, K.V. et al. (2013):"Landslide inventory along national highway &state highway of Ghat roads in Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur Districts, Karnataka (Unpublished GSI report, FS: 2012-13).

4. Mishra, A. K. et al (2010): "A report on landslide inventory along NH & SH of ghat roads in Karnataka" (Unpublished GSI report, FS: 2007-2008). Mishra, A. K. et al. (2011):"A report on Landslide hazard zonation on Macro scale of Charmudi ghat section from Charmudi to kotigehara, kotigehara to kalasa and Sakleshpur to Uppinangadi in Dakshin Kannada and Chikmagalur districts, Karnataka"(Unpublished GSI report, FS:2008-09 & FS:2009-2010).

5. Saaty, T. L. (1980): The analytic hierarchy process. McGraw-Hill, New York. Strahler, A.N. (1957):"Quantitative analysis of watershed geomorphology", Trans. American. Geophysical Union, 38, No.6, 913-920**.**

6. SOP on Meso-scale (1:10,000 scale) Landslide Susceptibility Mapping, 2021.

7. J. von Ruette et al, (2013), Rainfall-triggered shallow landslides at catchment scale: Threshold mechanics-based modeling for abruptness and localization. *Water resources research, vol. 49, 6266–6285, doi:10.1002/wrcr.20418, 2013.*

`

SYNOPSIS OF WORK DONE

1.	**Title of the report**	Mesoscale (1:10,000) landslide susceptibility mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.	
2.	**FSP Code No**	M4LSSM/NC/SR/SU-KG/2021/36786	
3.	**Field Season**	2021– 2022	
4.	**Date of Commencement**	1st April 2021	
5.	**Date of Completion**	31st March 2022	
6.	**Officers associated with the investigation and no. of days spent in the field**	Ms. Neha Kumari, Geologist (114 days) & Shri. Kamal Kumar, Geologist (113 days)	
7.	**Quantum of work done**		
	1. Detailed pre-field landslide inventory map including ground deformation, creeps, etc., and identification of failure domains	15.75 sq. km	
	2. Preparation of pre-field thematic geofactor maps on 10k based on failure domains	15.75 sq. km	
	a. Land Use/ Land Cover Map	15.75 sq. km	
	b. Drainage Map	15.75 sq. km	
	c. Geomorphology Map / Landform Map	15.75 sq. km	
	d. Slope Morphometry (Slope Angle, Slope Aspect, Slope Curvature, and Relative Relief)	15.75 sq. km	
	e. Slope forming material Map (Geological)	15.75 sq. km	
	f. Stream Power Index Map	15.75 sq. km	
	g. Landslide Domain Map	15.75 sq. km	
	h. Overburden Thickness map	15.75 sq. km (185 nos. Landslides)	
	i. Slope Facet Map	15.75 sq. km	
	3. Field-based studies		
	a. Validation and updation of all thematic maps and landslide inventory in the field.	15.75 sq. km	
	b. Data collection for preparation of Geotechnical map	15.75 sq. km	
	c. Geotechnical field sample collection for determination of geotechnical parameters*	15.75 sq. km	
	4. Post-field studies and modelling	15.75 sq. km	
	a. Updation and finalization of thematic maps and landslide inventory in GIS platform.	15.75 sq. km	
	b. Preparation of Geotechnical map #	15.75 sq. km	
	5. Preparation of landslide susceptibility map in GIS platform.	15.75 sq. km	
	6. Collection of Rainfall data	**Collected**	
	*** Geotechnical properties will be determined by Geotechnical Laboratory, GSI, SR**		
8.	**Expenditure amount in Rupees**	**Wages (Rs.)**	**Rs 1,16,880/-**
		OC (Rs.)	**Rs 1,07,982/-**
		Total (Rs.)	**Rs 2,24,862/-**

`

FIVE POINT PROFORMA

Title of the report	Mesoscale (1:10,000) landslide susceptibility mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.
Names of the Authors	Ms. Neha Kumari, Geologist & Shri Kamal Kumar, Geologist
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/2021/36786 with an objective to prepare a Landslide Susceptibility Map on a 1:10,000 scale.
2. Whether the item of the investigation was included in the approved programme for the year concerned. If so, particulars, such as item No. page reference etc. may be given.	Yes M4LSSM/NC/SR/SU-KG/2021/36786
3. Date of commencement of the investigation with month and year, and the exact number of days spent by the officers in the field in connection with the investigation.	Field Initiation: 28th September 2020 1. Ms.Neha Kumari, Geologist- 114days 2. Shri. Kamal Kumar, Geologist- 113days
4. Brief comments by Director/ Supervisory officer on the conclusion and recommendation by the author(s) with a 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	
Date: 31-10-2022 **Place:** Bengaluru **Project/Division:** LSM/Engineering and Landslide Division **Operation/Region:** SU:K&G/Southern Region	**Signature:** **Name:** Shri R. Sajeev **Designation:** Director (G)

`

GEOLOGICAL SURVEY OF INDIA

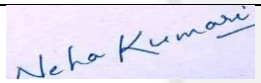
Certificate of Quality of the Report

Project/ Division: Landslide Division **FSP Code.:** M4LSSM/NC/SR/SU-KG/2020/36786 **Mission**: IVA

Title of the Report: **Mesoscale (1:10,000) landslide susceptibility mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, 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 with date
1. Ms. Neha Kumari, Geologist	**114 days**	
2. Shri .Kamal Kumar, Geologist	**113 days**	

Part-B:

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

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: **NA**

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		-	

`

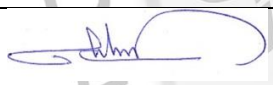
Part-D

This is to certify that the chemical analysis of the geological samples has been carried out as per the table given below - **NA**

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 R. Sajeev, Director	02	07	

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:	MLSM/EG	**FSP No:**	M4LSSM/NC/SR/SU-KG/2020/36786	**Mission:**	IV
Title of the Project:	Mesoscale (1:10,000) landslide susceptibility mapping along Charmadi Ghat stretch of NH-73 connecting Dakshin Kannada with Chikkamagaluru district, Karnataka.				

Name of author(s) 1. Neha Kumari, Geologist 2. Kamal Kumar, Geologist	Date of submission of report to the Supervisory Officer:	30/05/2022
	Signature of the senior most officer	Neha Kumari
Name of Supervisory Officer 1. Shri. R.Sajeev, Director(G)	Date of receipt of report	30/05/2022
	Date of completion of scrutiny	16/06/2022
	Date of handing over report to the author after scrutiny Signature :	16/06/2022
Name of author(s) To whom the report has been handed over by the Supervisory officer 1. Neha Kumari, Geologist 2. Kamal Kumar, Geologist	Date of receipt after scrutiny Signature :	16/06/2022 Komal Kumar
	Date of resubmission Signature :	23/10/2022 Komal Kumar
Supervisory officer 1. Shri. R.Sajeev, Director(G)	Date of receipt after modification	23/10/2022
	Date of handing over the report to the Regional Mission Head Signature:	27/10/2022
Name of the Regional Mission Head/ Internal peer reviewer Shri. S.K. Tripathi, DDG & RMH-IV	Date of receipt of report	27/10/2022
	Date of handing over the report after peer review to the Project Director Signature:	30/10/2022 Sh. Tripathi

Name of Supervisory Officer 1. Shri. R.Sajeev, Director(G)	Date of receipt from the Regional Mission Head after peer review:	30/10/2022
	Date of handing over to author(s) Signature:	30/10/2022
Name of author(s) 1. Neha Kumari, Geologist 2. Kamal Kumar, Geologist	Date of receipt of report from Supervisory Officer	30/10/2022
	Date of handing over report after modification to Supervisory Officer: Signature:	31/10/2022 Kamal Kumar
Name of Supervisory Officer 1. Shri. R.Sajeev, Director(G)	Date of receipt of report after modification from the author(s)	31/10/2022
	Date of handing over report to Regional Mission Head Signature:	31/10/2022
Name of Regional Mission Head Shri. S.K. Tripathi; DDG & RMH-IV.	Date of receipt of the report from the Project Director after modification	31/10/2022
	Date of handing over the report to the HOD of the region for approval Signature:	S.K. Tripathi
Name of the HOD of the Region Sri. S.K. Tripathi, DDG & RMH-IV (Addl. Charge of HOD, SR)	Date of receipt of report for approval	31/10/2022
	Date of approval:	31/10/2022
	Date of sending back to Project Director Signature of the HOD:	S.K. Tripathi
Name of the Project Director	Date of receipt of report after approval of HOD	
	Date of circulation of report Signature:	

`

ANNEXURE-I

42-point detailed geoparametric attributes of landslide incidences

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O12/2021/01
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/12
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'06.68"N
8	Longitude	75°30'15.31"E
9	Length	~15m
10	Width	~35m
11	Height	~12m
12	Area	~1088m^2
13	Depth	~2.5m
14	Volume	~2720m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Successive
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Foliated and Jointed (Fo‖J1:345°/70°/140°)-Seepage plane
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated on the extensive vertical cut slope of slope angle varying between 65-75°. The modification of slope by toe cutting for road construction have disturbed the original slope geometry and relative relief of highly weathered, jointed and deformed granite gneiss on hillslope triggered during heavy incessant rainfall. The orientation of joints sets and foliation with respect to slope angle and slope direction (NW-SE) resulted in translational failure along the joint sets dipping towards road widening of joints and foliation planes during heavy water inflow into deep seated pervasive joint sets during incessant rainfall condition will lead to slope instability.

`

37	Remedial measures	1.The lined drainage and weep holes should be constructed along hill at road bench level to prevent water seepage and slope saturation and to avoid/minimize toe cutting and erosion by flowing water during monsoon. The excessive water on slope is drained out through the culvert constructed at suitable location. 2. As engineering measures slope gradation i.e. reducing the slope angle to 25-35° can be done to stabilize the slope. 3. As biotechnical measure vetiver grass can be grown on slopes to stabilize soil to prevent excessive erosion. 4. Lined Contour drains/trenches on slope can be made.to intercept rain water.
38	Remarks, if any	The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational debris slide got reactivated on the extensive vertical cut slope of slope angle varying between 65-75°. The modification of slope by toe cutting for road construction have disturbed the original slope geometry and relative relief that triggered landslide on highly weathered, jointed and deformed granite gneiss on hillslope during heavy incessant rainfall. The orientation of joints sets and foliation with respect to slope angle and slope direction (NW-SE) resulted in translational planar failure along the joint sets dipping towards road further widening of joints and foliation planes during heavy water inflow into deep seated pervasive joint sets during incessant rainfall condition incorporate slope instability. The lined drainage and weep holes should be constructed along hill at road bench level to prevent water seepage and slope saturation and to avoid/minimize toe cutting and erosion by flowing water during monsoon. The excessive water on slope is drained out through the culvert constructed at suitable location. As engineering measures slope gradation of 25-35° slope angle can be done to stabilize the slope and veriber grass as biotechnical measure can be grown on slopes. Lined Contour drains on slope can be made at places after slope gradation.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O12/2021/02
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/12
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'08.51"N
8	Longitude	75°30'14.91"E
9	Length	~30m
10	Width	~105m
11	Height	~25m
12	Area	~3150m^2
13	Depth	~2.5m
14	Volume	~7875m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered and Sheared Granite gneiss
26	Structure	Foliated and Jointed Fol‖J1:345°/70°/140° J2:35°/25°/125° J3:70°/85°/165°
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall, the vertical cut slope (75°) failure occurred on hillslope at road bench level on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle may cause planar translational failure along the joint sets dipping towards road. The joints and foliation planes got widened during excessive water inflow into deep seated pervasive joint sets.
37	Remedial measures	The drainage management i.e. lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the

`

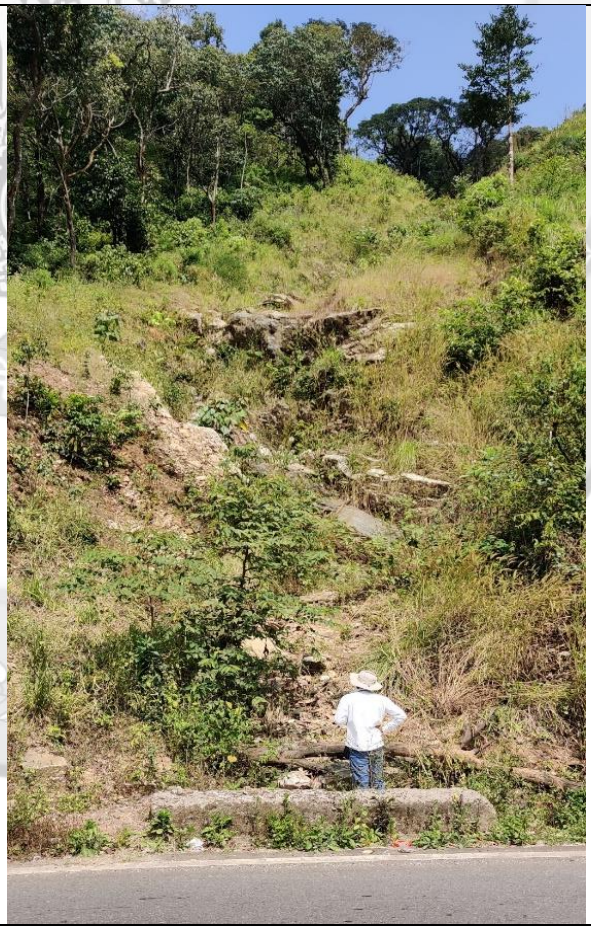
		downslope direction and to avoid toe erosion by flowing water during rainfall. The excessive water on slope will get discharged through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. Downslope sub-surface drainage or valley can destabilized the upslope. Reinforced retaining wall required at steep downslope.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall. Highly strained area (Boudinage and mica fish indicator of shearing) 13°07'9.44"N/ 75°30'12.39"E vulnerable location. 13°07'10.03"N/ 75°30'12.00"E dissection in valley portion
39	Photos. Sketch of Plan & section of the slide	  

`

40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered,jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/03
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/12
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'11.86"N
8	Longitude	75°30'11.19"E
9	Length	~45m
10	Width	~8m
11	Height	~41m
12	Area	~360m2
13	Depth	~2.5m
14	Volume	~900m3
15	Run out distance	~118m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Weathered)
26	Structure	Foliated, Jointed and Sheared

`

27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred due to headward erosion and widening of narrow valley along the stream pathway along stream channel due to heavy water discharge during heavy incessant rainfall into the water catchment area, the debris material prograded as debris flow in downslope direction.
37	Remedial measures	1. For slope stabilization at road bench level the reinforced culvert and reinforced retaining wall towards downslope direction is constructed for slope support. 2. The check dams along course of nala is recommended to restrict heavy water discharge during heavy down pour.
38	Remarks, if any	The relief/slope gradient and hydrological condition in existing terrain condition is identified as landslide susceptible zones during heavy incessant rainfall. The slope facet adjoining to nala/drainage is vulnerable for slope failure.
39	Photos. Sketch of Plan & section of the slide	

`

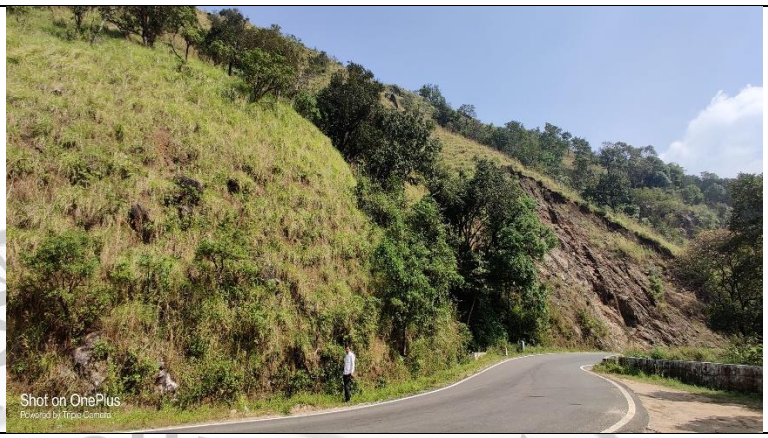
40	Summary/Abstract	Shallow translational debris slide occurred due to headward erosion and widening of narrow valley along stream channel due to heavy water discharge during heavy incessant rainfall into the water catchment area, the debris material further prograded as flow in downslope direction. For the slope stabilization at road bench level, the reinforced culvert and reinforced retaining wall towards downslope direction is constructed for slope support. The check dams along course of nala is recommended to restrict heavy water discharge during heavy down pour. The relief/slope gradient and hydrological condition in existing terrain condition is identified as landslide susceptible areas during heavy incessant rainfall. The slope facet adjoining to nala/drainage is vulnerable for slope failure.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/04 (Most vulnerable facet)
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'11.50"N
8	Longitude	75°30'9.68"E
9	Length	~22m
10	Width	~35m
11	Height	~15m
12	Area	~660m2
13	Depth	~.5m
14	Volume	~330m3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss, micaceous felspathic granite gneiss and pegmatite vein.
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping

`

29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall, the vertical cut slope (75°) failure occurred on hillslope at road bench level on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle may cause planar translational failure along the joint sets dipping towards road. The joints and foliation planes got widened during excessive water inflow into deep seated pervasive joint sets. Mica sheet/micaceous sheet acted as slip plane.
37	Remedial measures	The drainage management i.e. lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe erosion during rainfall. The excessive water on slope will get discharged through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. Downslope sub-surface drainage or valley can destabilized the upslope. The reinforced retaining wall required at steep downslope.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall. At lat/long:13°07'11.40"N/75°30'9.20"E retaining wall is damaged.
39	Photos. Sketch of Plan & section of the slide	 

`

		
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/05
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'12.76"N
8	Longitude	75°30'9.12"E
9	Length	~30m
10	Width	~12m
11	Height	~26m
12	Area	~1950m^2
13	Depth	~2.5m
14	Volume	~4875m^3
15	Run out distance	~40m

`

16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Fast
19	Activity	Suspended
20	Distribution	Confined
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream.
37	Remedial measures	The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/06
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'13.41"N
8	Longitude	75°30'7.91"E
9	Length	~33m
10	Width	~28m
11	Height	~25m
12	Area	~924m^2
13	Depth	~1.5m
14	Volume	~1386m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Reactivated in July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Weathered Granite gneiss
26	Structure	Foliated, Deformed, Sheared and Jointed Plunge of fold axis : 40° towards 220° facing road

`

		Fo‖J1:55°/62°/140° J2:N-S /75°/260°
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets. Flexure slip along joints observed, granite is mylonised, fold is plunging towards road
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable. At lat/long: 13°07'12.15"N/ 75°30'7.89"E, retaining wall is damaged and crack is observed. Ditch width is increased on other side of road.

`

39	Photos. Sketch of Plan & section of the slide	   
40	Summary/Abstract	Shallow translational rock slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss The slide has been occurred adjacent to the first order streams. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The plunge of the fold axis and the axial plane is dipping towards the slope. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the

`

		downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry in order to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O12/2021/07
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/12
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'14.59"N
8	Longitude	75°30'4.76"E
9	Length	~60m
10	Width	~10m
11	Height	~35m
12	Area	~600m^2
13	Depth	~2.5m
14	Volume	~1500m^3
15	Run out distance	~107m
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Moderate
19	Activity	Suspended
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Reactivated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest

`

36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream.
37	Remedial measures	1.The reinforced culvert at road bench level constructed and reinforced retaining wall with weep holes at road bench level towards downslope direction is constructed for slope support and slope stabilization. 2. Lined drainage with weep holes suggested at road bench level.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/08
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'18.32"N
8	Longitude	75°30'1.06"E
9	Length	~100m
10	Width	~16m
11	Height	~15m
12	Area	~1600m^2
13	Depth	~2m
14	Volume	~3200m^3
15	Run out distance	~350m
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. Intrusive litho-contact zone behave as a potential saturation zone.
37	Remedial measures	The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and

`

		slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.Lined drainage with weep holes suggested. Culvert clogged.Adjacent facet affected.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/09
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'15.20"N
8	Longitude	75°29'59.50"E
9	Length	~63m
10	Width	~46m
11	Height	~15m

`

12	Area	~2898m^2
13	Depth	~5m
14	Volume	~14490m^3
15	Run out distance	~298m
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Moderate
19	Activity	Suspended
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream.
37	Remedial measures	The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization.
38	Remarks, if any	The adjacent area in buffer zone of 60 m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone vulnerable to failure during heavy incessant rainfall.Lined drainage with weep holes is suggested in upslope at road bench level.

`

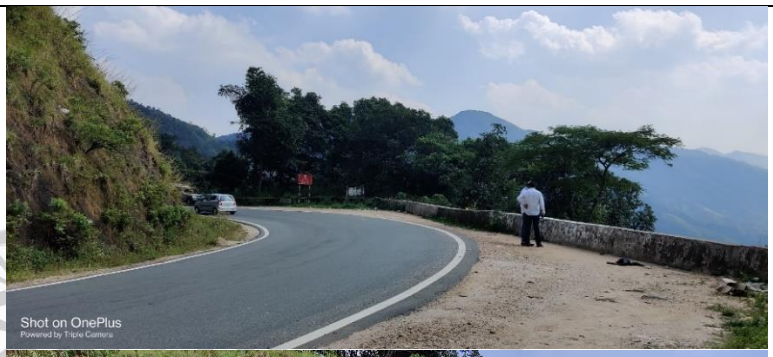
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O12/2021/10
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/12
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'15.40"N
8	Longitude	75°29'57.72"E
9	Length	~56m
10	Width	~26m
11	Height	~12m
12	Area	~1456m^2
13	Depth	~5m
14	Volume	~7280m^3
15	Run out distance	~170m

`

16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Fast
19	Activity	Suspended
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on the extensive vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss. The debris slide originated at road bench level due to disturbance in slope geometry in upslope.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

		 
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss. The debris slide originated at road bench level due to disturbance in slope geometry in upslope. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall. Old landslide at downslope direction. Reinforced retaining wall constructed. Upward rising slope, highly weathered zone. Upslope extensive cut slope, failure occurred on downslope direction at road bench level.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/11
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08

`

5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'16.20"N
8	Longitude	75°29'57.07"E
9	Length	~20m
10	Width	~30m
11	Height	~18m
12	Area	~600m^2
13	Depth	~1m
14	Volume	~600m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Granite gneiss
26	Structure	Weathered, foliated and jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/12
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'17.70"N
8	Longitude	75°29'55.84"E
9	Length	~38m
10	Width	~20m
11	Height	~32m
12	Area	~760m^2
13	Depth	~1m
14	Volume	~760m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur

`

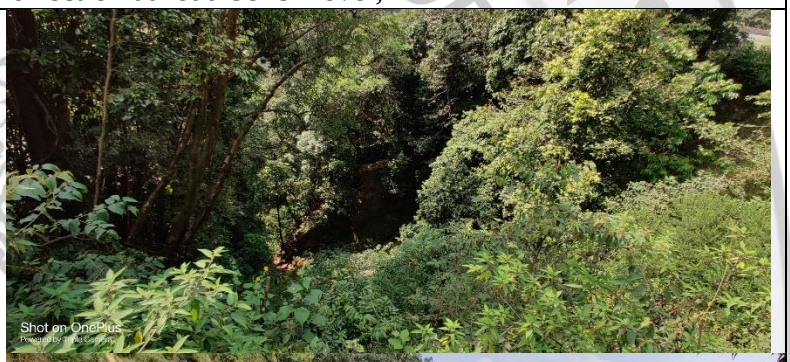
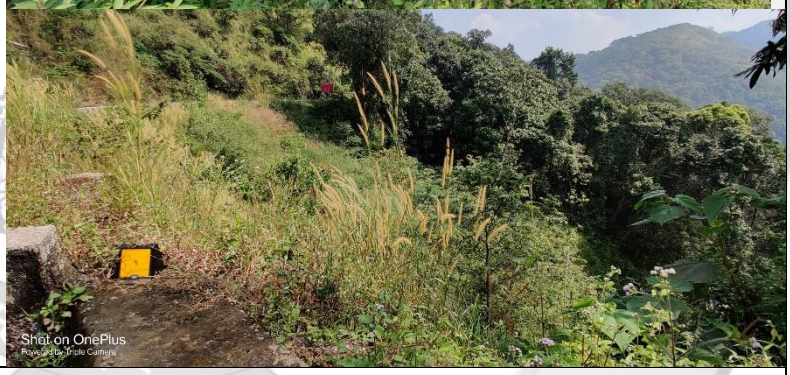
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed and Sheared
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road partly affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road.
37	Remedial measures	Lined drainage with weep holes suggested on upslope direction.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall. The extensive cut slope at adjacent facet at lat/long: 13°07'17.8"N/75°29'55.0"E are prone to failure.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road. Lined drainage with weep holes suggested on upslope direction.

`

		The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall. The extensive cut slope at adjacent facet at lat/long: 13°07'17.8"N/75°29'55.0"E are prone to failure.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/13
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'18.42"N
8	Longitude	75°29'54.22"E
9	Length	~20m
10	Width	~35m
11	Height	~18m
12	Area	~700m^2
13	Depth	~.5m
14	Volume	~350m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Granite gneiss
26	Structure	Foliated, Jointed (
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest

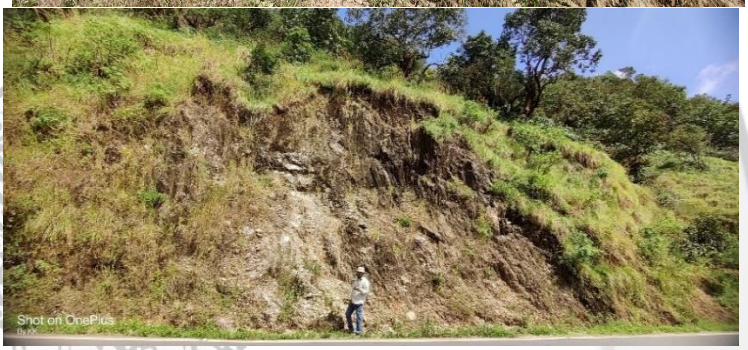
`

36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	At 13°07'18.90"N/75°29'53.68"E stream flowing in downslope direction. The reinforced retaining wall constructed. Upward rising slope, highly weathered zone. Upslope extensive cut slope, failure occurred on downslope direction at road bench level,
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/14
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'20.61"N
8	Longitude	75°29'51.97"E
9	Length	~35m
10	Width	~15m
11	Height	~33m
12	Area	~525m^2
13	Depth	~2.5m
14	Volume	~1312.5m^3
15	Run out distance	~45m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and pegmatite vein
26	Structure	Foliated, Jointed and deformed (sheared) Fol‖J1:340°/78°/260° J2:350°/5°/80° J3:70°/76°/155° Slope direction:N220°
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during

`

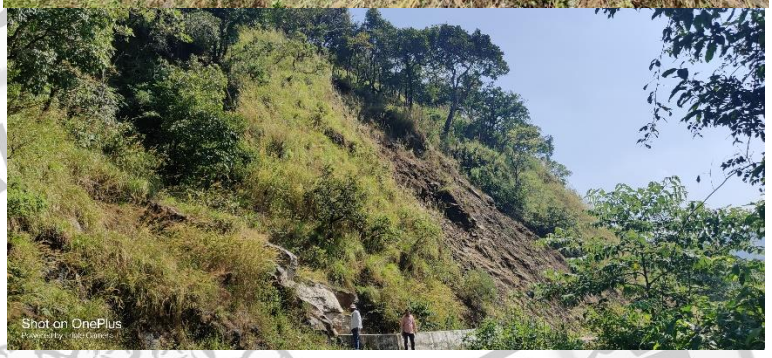
		monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	The upward rising slope, highly weathered zone on upward rising slope occurred on extensive cut slope, debris slide occurred all along the slope .
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level that prograde towards downslope direction during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/15
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'20.98"N
8	Longitude	75°29'50.84"E
9	Length	~20m

`

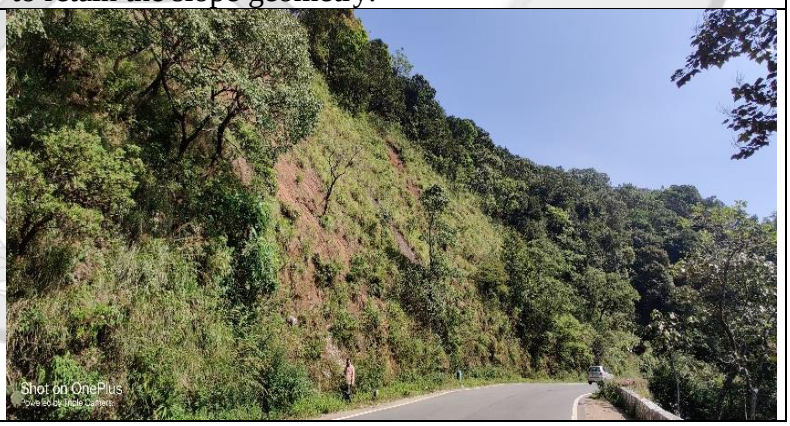
10	Width	~15m
11	Height	~15m
12	Area	~300m^2
13	Depth	~2m
14	Volume	~600m^3
15	Run out distance	~100m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Amphibolite and pegmatite vein
26	Structure	Foliated, Jointed and deformed (sheared) Fo‖J1:350°/65°/265° J2:350°/5°/80° J3:70°/76°/155° Slope direction:N220°
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	Upward rising slope, highly weathered zone on upward rising slope occurred on extensive cut slope, debris slide occurred all along the slope.

`

39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level that prograde towards downslope direction during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss and amphibolite contact zone.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/16
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'22.15"N
8	Longitude	75°29'48.73"E
9	Length	~20m
10	Width	~45m
11	Height	~15m
12	Area	~900m^2
13	Depth	~2m
14	Volume	~1800m^3
15	Run out distance	~25m

`

16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, reactivated
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Highly weathered amphibolite
26	Structure	Foliated
27	Land use/ Land cover	Moderate vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and foliated granite gneiss. The deep weathering along pervasive foliation joints in amphibolite are observed.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	The highly weathered zone on vertical cut slope can be failed and highly strained area. The ditch width is enlarged to retain the slope geometry.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational debris slide occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and foliated granite gneiss. The deep weathering along pervasive foliation joints in amphibolte are observed. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/17
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'25.14"N
8	Longitude	75°29'45.15"E
9	Length	~20m
10	Width	~75m
11	Height	~15m
12	Area	~1500m^2
13	Depth	~2m
14	Volume	~3000m^3
15	Run out distance	~100m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Stabilized
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Initiated on July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Spur
25	Geology	Amphibolite and pegmatite vein
26	Structure	Foliated, Jointed and deformed (sheared) Fo‖J1:335°/82°/245° J2:270°/88°/185° J3:245°/15°/155°

`

		Slope direction:N205°
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on vertical cut slope (85°) at steep upward rising slope at road bench level during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
38	Remarks, if any	Upward rising slope, highly weathered zone on upward rising slope occurred on extensive cut slope, debris slide occurred all along the slope .
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational debris slide occurred on the extensive vertical cut slope (75°) at steep upward rising slope at road bench level that prograde towards downslope direction during heavy incessant rainfall on highly weathered, folded, jointed and deformed granite gneiss.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/18
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'23.14"N
8	Longitude	75°29'41.90"E
9	Length	~15m
10	Width	~45m
11	Height	~12m
12	Area	~675m2
13	Depth	~.5m
14	Volume	~337.5m3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Moderately weathered)
26	Structure	Foliated and Jointed (J1: 245°/70°/320°, J2: 235°/62°/255°, J3: 105°/32°/5°), Slope direction: 45°
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert

`

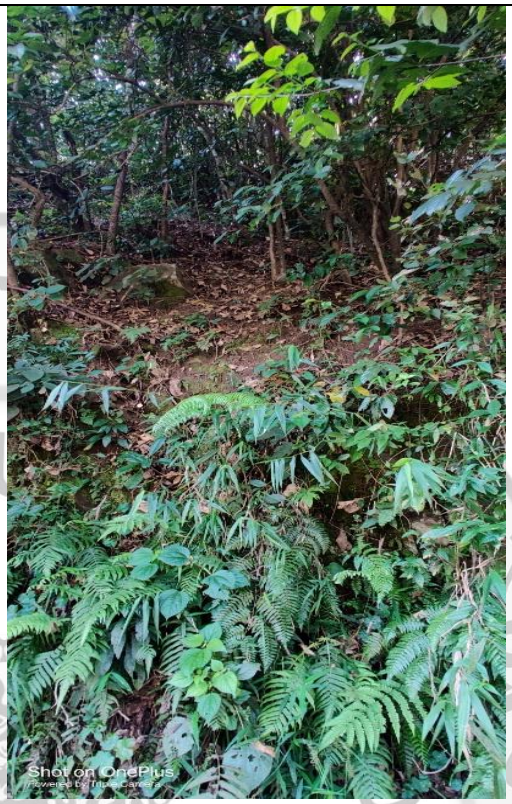
		constructed in proximity. As engineering measures slope gradation of 25-35° can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The orientation of joints sets with respect to slope angle relation favours plannar failure along the joint sets dipping towards road. The joints and weaker foliation planes got widened during water inflow into deep seated pervasive joint sets. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/19
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'14.43"N

`

8	Longitude	75°29'42.72"E
9	Length	~15m
10	Width	~22m
11	Height	~12m
12	Area	~330m^2
13	Depth	~2m
14	Volume	~660m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Amphibolite (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall.

`

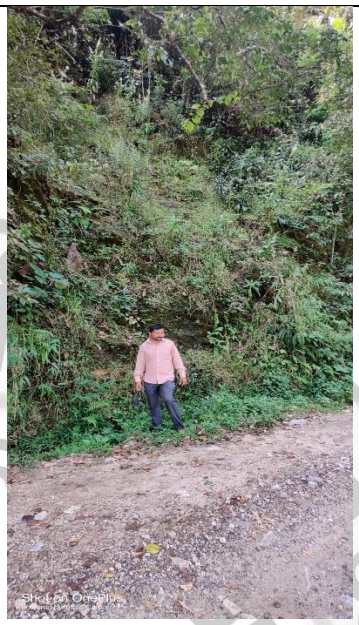
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational debris failure occurred during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/20
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'12.11"N

`

8	Longitude	75°29'43.21"E
9	Length	~25m
10	Width	~38m
11	Height	~17m
12	Area	~950m^2
13	Depth	~2m
14	Volume	~1900m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Amphibolite (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/21
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'9.55"N
8	Longitude	75°29'42.99"E
9	Length	~12m

`

10	Width	~55m
11	Height	~10m
12	Area	~660m^2
13	Depth	~2m
14	Volume	~1320m^3
15	Run out distance	~35m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall.

`

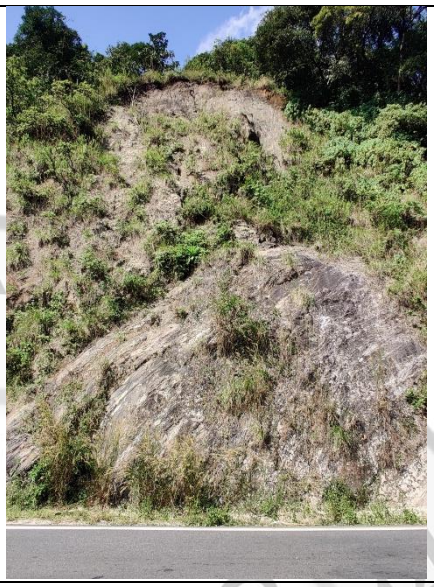
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/22
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 7'6.39"N
8	Longitude	75°29'42.25"E

`

9	Length	~28m
10	Width	~45m
11	Height	~23m
12	Area	~1260m^2
13	Depth	~3m
14	Volume	~3780m^3
15	Run out distance	~35m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1: 343°/75°/255°)
27	Land use/ Land cover	Sparse Vegetation/Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and likely to fail in heavy incessant rainfall. The gabion wall on other side of road should be repaired.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The intrusive litho-contact zones are favorable zones that paves new pathway for water seepage and infiltration. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/23
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'02.10"N
8	Longitude	75°29'42.50"E
9	Length	~15m
10	Width	~18m
11	Height	~10m

`

12	Area	~270m^2
13	Depth	~1.5m
14	Volume	~405m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite in facet adjoining to nala/stream course.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/24
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°07'0.26"N
8	Longitude	75°29'45.44"E
9	Length	~8m
10	Width	~60m
11	Height	~6m
12	Area	~480m^2
13	Depth	~1.5m
14	Volume	~720m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow Translational Failure
23	History	Old, reactivated
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered) and amphibolite
26	Structure	Jointed
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp

`

29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/25
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'59.81"N
8	Longitude	75°29'46.78"E
9	Length	~9m
10	Width	~18m
11	Height	~8m
12	Area	~162m^2
13	Depth	~1.5m
14	Volume	~243m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1: 343°/75°/255°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.

`

38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/26
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'57.80"N
8	Longitude	75°29'48.40"E
9	Length	~12m
10	Width	~28m
11	Height	~10m
12	Area	~336m^2
13	Depth	~1.5m
14	Volume	~504m^3
15	Run out distance	~15m
16	Type of Material	Debris

`

17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road washed off.
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The retaining wall or embankment need to be constructed at lat/long: 13°6'56.38"N /75°29'48.66"E.
38	Remarks, if any	The area is unstable and highly vulnerable slope.
39	Photos. Sketch of Plan & section of the slide	

`

		
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/27
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'54.01"N
8	Longitude	75°29'49.12"E
9	Length	~10m
10	Width	~15m
11	Height	~8m
12	Area	~150m^2
13	Depth	~1.5m
14	Volume	~225m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active

`

20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Dolerite (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and highly vulnerable slope.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be

`

		done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/28
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'52.39"N
8	Longitude	75°29'48.55"E
9	Length	~20m
10	Width	~22m
11	Height	~18m
12	Area	~440m2
13	Depth	~1.5m
14	Volume	~660m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest

`

36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and highly vulnerable slope.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/29
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)

`

6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'51.21"N
8	Longitude	75°29'48.79"E
9	Length	~18m
10	Width	~20m
11	Height	~15m
12	Area	~360m2
13	Depth	~1.5m
14	Volume	~540m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and highly vulnerable slope.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/30
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'50.62"N
8	Longitude	75°29'48.65"E
9	Length	~20m
10	Width	~25m
11	Height	~18m
12	Area	~500m2
13	Depth	~1.5m
14	Volume	~750m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and highly vulnerable slope.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench

`

		level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/31
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'48.03"N
8	Longitude	75°29'44.68"E
9	Length	~18m
10	Width	~28m
11	Height	~15m
12	Area	~504m^2
13	Depth	~1m
14	Volume	~504m^3
15	Run out distance	~45m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivated (September 2021) Date of initiation: August 2019 & subsequent reactivations: 25th July 2021
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Dolerite (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities

`

31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational debris slide occurred on extensive steep cut slope covered with overburden material along road section at during heavy rainfall. The shear failure of rock boulders (intrusive dolerite) intercalated with soil occurred at road cut. The prolonged weathering along vulnerable joints faces dipping towards road during heavy incessant rainfall reduced the effective cohesion of slope forming material during excessive water saturation during rainfall. The interface between loose material and dolerite boulders is identified as potential slip plane.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. 2. The wire mesh should be installed on slope to prevent loose precarious boulders from falling down. 3.The breast wall of suitable dimension should be constructed. The precarious hanging boulders emplaced with loose material should be removed to reduce risk and Retaining wall at road bench level in downslope direction should be constructed. 4. The slope gradation required for slope stability and slope forming material should be backfilled for road embankment.
38	Remarks, if any	The area is unstable and highly vulnerable slope. Landslide recorded on upslope and downslope at road bench level.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational debris slide occurred on extensive steep cut slope covered with overburden material along road section at during heavy rainfall. The shear failure of rock boulders (intrusive dolerite) intercalated with soil occurred at road cut. The prolonged weathering along vulnerable joints faces dipping towards road during heavy incessant rainfall reduced the effective cohesion of slope forming material during excessive water saturation during rainfall. The interface between loose material and dolerite boulders is identified as potential slip plane.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/32
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'49.39"N
8	Longitude	75°29'42.12"E
9	Length	~12m
10	Width	~15m
11	Height	~8m
12	Area	~180m^2
13	Depth	~1m
14	Volume	~180m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure

`

23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Dolerite (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/33
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'50.85"N
8	Longitude	75°29'38.60"E
9	Length	~18m
10	Width	~25m
11	Height	~15m
12	Area	~450m2
13	Depth	~1m
14	Volume	~450m3
15	Run out distance	~30m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1:N320°/85°/240°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The slope failure initiated from competent and incompetent rock strata.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/34
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'52.23"N
8	Longitude	75°29'36.83"E
9	Length	~75m
10	Width	~100m

`

11	Height	~62m
12	Area	~750m^2
13	Depth	~1m
14	Volume	~750m^3
15	Run out distance	~125m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1:N315°/80°/225°, J2:N60°/88°/140°, J3:N70°/37°/165°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level on jointed and foliated rocky slope during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable. High hydrological stress prevails on upslope and retaining structure/breast wall with weep holes should be constructed.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/35
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'48.13"N
8	Longitude	75°29'34.70"E
9	Length	~18m
10	Width	~35m
11	Height	~14m
12	Area	~630m^2
13	Depth	~1.5m

`

14	Volume	~945m^3
15	Run out distance	~50m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered Felsic composition)
26	Structure	Foliated and Jointed (F0‖J1:N325°/80°/245°, J2:N45°/68°/330°, J3:N60°/52°/150°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked and damaged.
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.
37	Remedial measures	1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed 2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the ghat road.
38	Remarks, if any	The area is unstable. The ditch width is enlarged for slope stability.

`

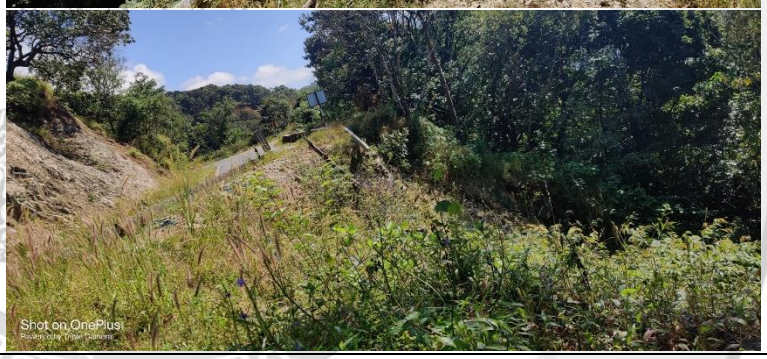
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At 13°6'47.70"N/75°29'35.50"E landslide/slope failure is observed in upslope on highly weathered felsic granite gneiss (0.5-1m overburden thickness) and slope failed in downslope direction with overburden of 5m at road bench level at convex curve of the road strech. The vulnerable stretches extending about 75m along the road section. The decrease in effective cohesion and frictional resistance of the slope during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope. The upslope slope angle should be eased or ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/36
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'47.08"N
8	Longitude	75°29'33.79"E

`

9	Length	~17m
10	Width	~45m
11	Height	~12m
12	Area	~765m^2
13	Depth	~2m
14	Volume	~1530m^3
15	Run out distance	~65m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered Felsic granite gneiss)
26	Structure	Foliated and Jointed (F0‖J1:N325°/85°/250°, J2:N35°/13°/150°, J3:N50°/85°/340°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road breached.
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The effective cohesion and frictional resistance of the slope decreases during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope.
37	Remedial measures	1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed 2. The lined drainage with weep should be constructed at at the upslope direction at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites to avoid toe cutting and erosion by flowing water during monsoon. 3. The slope gradation can be done to maintain slope geometry to stabilize the slope.

`

		4. The horizontal drain pipes on seepage point should be installed to drain excess water built on slope through culvert. 5. The reinforced retaining structure with weep holes of suitable dimension should be constructed at road bench level in downslope direction.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	  
40	Summary/Abstract	Shallow translational debris failure occurred on the extensive vertical cut slope (80°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The effective cohesion and frictional resistance of the slope decreases during excessive water infiltration and slope saturation during incessant rainfall events. The change in relative relief of the slope due to the vertical slope cut modified the original slope geometry and disturbed the stability condition of the slope. The upslope slope angle should be eased or ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed.The lined drainage with weep should be constructed at at the upslope direction at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites to avoid toe cutting and erosion by flowing water during

`

		monsoon.The slope gradation can be done to maintain slope geometry to stabilize the slope. Reinforced retaining structure with weep holes of suitable dimension should be constructed at road bench level in downslope direction.The horizontal drain pipes on seepage point should be installed to drain excess water built on slope through culvert.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/37
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'45.02"N
8	Longitude	75°29'28.65"E
9	Length	~10m
10	Width	~18m
11	Height	~8m
12	Area	~180m^2
13	Depth	~2m
14	Volume	~360m^3
15	Run out distance	~8m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Active
20	Distribution	Suspended
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered Felsic composition)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level on highly weathered, jointed and deformed rock, failed due to hydrological stress condition, which ultimately lead to slope failure during incessant rainfall.
37	Remedial measures	1. The upslope slope angle should be eased or ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed 2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73. 3. Culvert at stream course should be constructed.
38	Remarks, if any	At 13°06'45.20"N/75°29'28.70"E, highly jointed rock upslope faces high hydrological stress on the slope and delineated as highly strained area and unstable zone. The retaining structure on other side of slope is partly damaged.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level on highly weathered, jointed and deformed rock, failed due to hydrological stress condition, which ultimately lead to slope failure during incessant rainfall. 1. The upslope slope angle should be eased or ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73.Culvert at stream course should be constructed. At 13° 6'45.20"N/ 75°29'28.70"E, highly jointed rock upslope faces high hydrological stress on the slope and delineated as highly strained area and unstable zone.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/38
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'43.90"N
8	Longitude	75°29'23.72"E
9	Length	~22m
10	Width	~45m
11	Height	~18m
12	Area	~990m^2
13	Depth	~2m
14	Volume	~1980m^3
15	Run out distance	~60m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level on highly weathered, jointed and deformed rock during heavy incessant rainfall.

`

37	Remedial measures	1. The upslope slope angle should be eased and reinforced retaining wall by back filling of slope need to be constructed 2. The lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across the NH-73. 3. Culvert of suitable dimension at stream course at road bench level should be constructed.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/39
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'40.54"N

`

8	Longitude	75°29'19.68"E
9	Length	~13m
10	Width	~25m
11	Height	~9m
12	Area	~325m^2
13	Depth	~.5m
14	Volume	~162.5m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Very slow
19	Activity	Active
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1:N300°/85°/25°, J2:N38°/32°/135°, J3:N170°/72°/275°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed rock, failure along the compositional variation of granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable and few precarious hanging boulders are observed on extensive vertical cut slope.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/40
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'42.21"N
8	Longitude	75°29'18.15"E
9	Length	~62m
10	Width	~45m
11	Height	~30m
12	Area	~2790m^2
13	Depth	~2.5m
14	Volume	~6975m^3
15	Run out distance	~55m
16	Type of Material	Rock

`

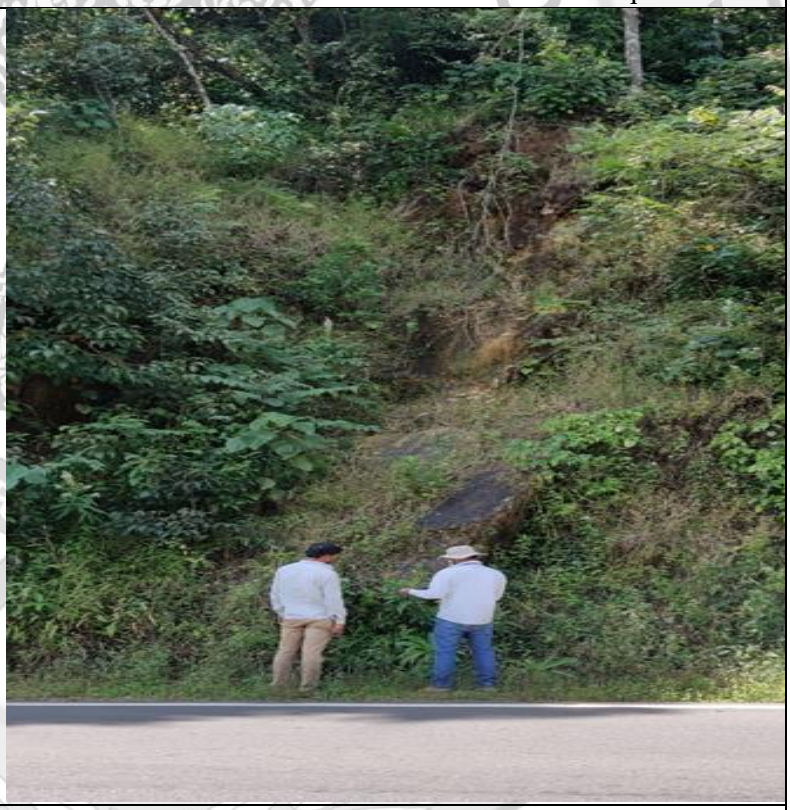
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded,Foliated and Jointed (F0‖J1:N52°/55°/135°, J2:N40°/80°/310°, J3:N312°/88°/45°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road blocked
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed and folded rock due to rise in hydrostatic head due to saturation that lead to headward erosion.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed and folded rock due to rise in hydrostatic head due to saturation that lead to headward erosion. The lined

`

		drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/41
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'39.96"N
8	Longitude	75°29'17.34"E
9	Length	~12m
10	Width	~22m
11	Height	~10m
12	Area	~264m^2
13	Depth	~1m
14	Volume	~264m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities

`

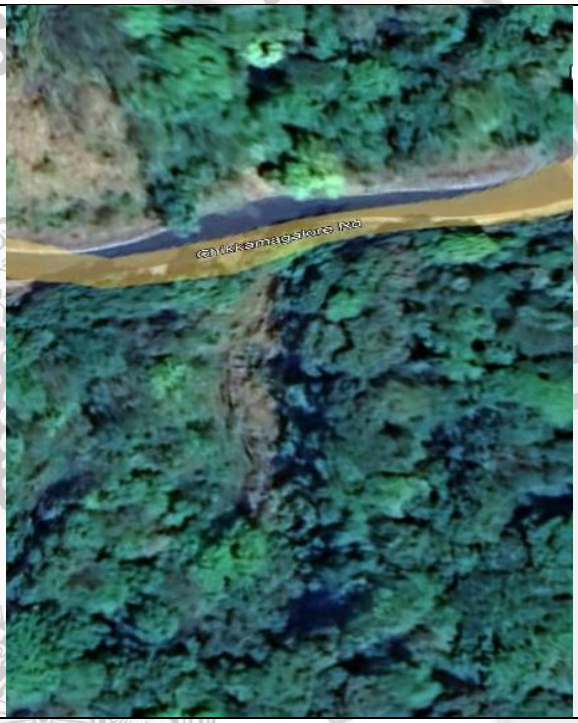
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (80°) at road bench level, hydrological stress condition, which may ultimately lead to slope failure during incessant rainfall.
37	Remedial measures	1. The upslope slope angle should be eased or Ditch width can be increased to retain the slope geometry and reinforced retaining wall by back filling of slope need to be constructed 2. The culvert of suitable dimension and lined drainage with weep should be constructed at road bench level to avoid slope saturation and toe erosion and to drain excess water through the culvert constructed at suitable sites along the stream channel cutting across NH-73 road. 3. Concrete gabion wall should be constructed.
38	Remarks, if any	The area is unstable. On other side of the road gabion wall is broken and culvert of suitable dimension is required.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench on highly weathered, jointed and deformed rock during heavy rainfall. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction in order to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain

`

		slope geometry to stabilize the slope.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/42
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'37.07"N
8	Longitude	75°29'16.60"E
9	Length	~50m
10	Width	~15m
11	Height	~35m
12	Area	~750m2
13	Depth	~1.5m
14	Volume	~1125m3
15	Run out distance	~60m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Slow
19	Activity	Stabilized
20	Distribution	Progressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Not distinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The change in relative relief due to road construction and modification of slope geometry supported by water

`

		saturation on slope lead to slope failure during incessant rainfall condition.
37	Remedial measures	The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/43
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'35.70"N
8	Longitude	75°29'15.23"E
9	Length	~12m
10	Width	~22m
11	Height	~10m
12	Area	~264m^2
13	Depth	~1m
14	Volume	~264m^3
15	Run out distance	~60m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (65°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed rock, failure along the compositional variation of granite gneiss.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent toe erosion, water seepage and saturation in the downslope direction during monsoon. 2.To maintain the slope geometry slope gradation can be done.

`

38	Remarks, if any	The area is unstable. The precarious hanging boulders on slope. The extensive vertical cut slope on same facet.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/44
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'35.70"N
8	Longitude	75°29'15.23"E
9	Length	~14m
10	Width	~18m
11	Height	~12m
12	Area	~252m2
13	Depth	~.5m
14	Volume	~126m3

`

15	Run out distance	~60m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (65°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed rock, failure along the compositional variation of granite gneiss.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable. The precarious hanging boulders on slope. The extensive vertical cut slope on same facet.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/45
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'33.80"N
8	Longitude	75°29'11.91"E
9	Length	~28m
10	Width	~75m
11	Height	~18m
12	Area	~2100m2
13	Depth	~.5m
14	Volume	~1050m3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp

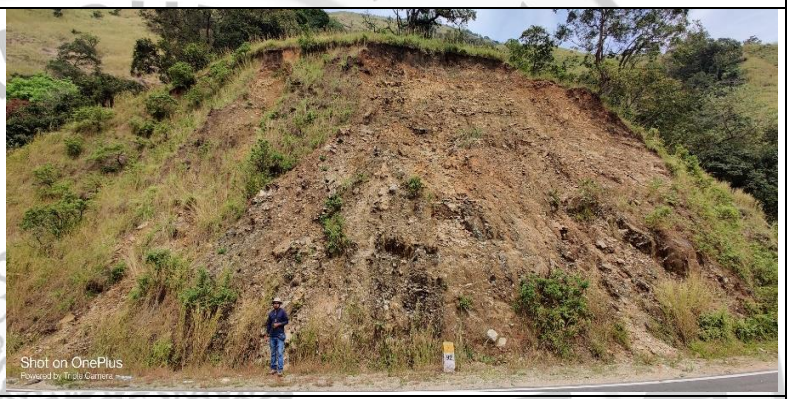
`

29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure along the compositional variation of granite gneiss causes differential weathering on competent and incompetent bed.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/46
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'34.28"N
8	Longitude	75°29'10.66"E
9	Length	~50m
10	Width	~20m
11	Height	~15m
12	Area	~1000m^2
13	Depth	~.5m
14	Volume	~500m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed (F0‖J1:N305°/85°/215°, J2:N215°/60°/305°, J3:N255°/30°/160°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.

`

37	Remedial measures	1. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. 2. The retaining wall to be constructed at road bench level in downslope direction along the course of flowing river.
38	Remarks, if any	The area is unstable. The dislodged boulders on slope should be removed.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/47
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'33.44"N

`

8	Longitude	75°29'9.14"E
9	Length	~20m
10	Width	~28m
11	Height	~16m
12	Area	~560m^2
13	Depth	~1m
14	Volume	~560m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed (F0‖J1:N305°/85°/215°, J2:N215°/60°/305°, J3:N255°/30°/160°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/48
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'32.72"N
8	Longitude	75°29'8.24"E
9	Length	~25m
10	Width	~55m
11	Height	~22m
12	Area	~1375m^2
13	Depth	~1m
14	Volume	~1375m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed, Fractured
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be

`

		done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/49
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'31.66"N
8	Longitude	75°29'5.28"E
9	Length	~12m
10	Width	~20m
11	Height	~10m
12	Area	~240m2
13	Depth	~1m
14	Volume	~240m3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Not distinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy

`

		incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/50
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'30.58"N
8	Longitude	75°29'4.77"E

`

9	Length	~12m
10	Width	~25m
11	Height	~8m
12	Area	~300m2
13	Depth	~1m
14	Volume	~300m3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed, Fractured
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/51
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'29.54"N
8	Longitude	75°29'3.72"E
9	Length	~50m
10	Width	~35m
11	Height	~25m
12	Area	~1750m^2
13	Depth	~1.5m
14	Volume	~2625m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed, Fractured
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope. The culvert is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be

`

		done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/52
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'28.06"N
8	Longitude	75°29'5.21"E
9	Length	~50m
10	Width	~15m
11	Height	~7m
12	Area	~750m2
13	Depth	~1.5m
14	Volume	~1125m3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed, Fractured
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest

`

36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/53
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 6'27.20"N
8	Longitude	75°29'1.48"E
9	Length	~45m
10	Width	~55m
11	Height	~30m
12	Area	~2475m^2
13	Depth	~2m
14	Volume	~4950m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed
27	Land use/ Land cover	SparseVegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The retaining wall and culvert is required.

`

38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/54
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'27.77"N
8	Longitude	75°29'0.03"E
9	Length	~45m
10	Width	~55m
11	Height	~30m
12	Area	~2475m^2
13	Depth	~2m
14	Volume	~4950m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Flow

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed
27	Land use/ Land cover	SparseVegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream.
37	Remedial measures	The reinforced culvert and reinforced retaining wall at road bench level should be towards downslope direction is constructed for slope support and slope stabilization.
38	Remarks, if any	The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall. The cracksare developed on road.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	During heavy incessant rainfall the heavy water discharge into the catchment area resulted in stream erosion resulted in shallow translational debris flow along stream channel. The excessive water in stream channel resulted in headward erosion and widening of valley along the stream pathway and prograded into downslope damaged the road and support structures along stream. The reinforced culvert at road bench level constructed and reinforced retaining wall at road bench level towards downslope direction is constructed for slope support and slope stabilization. The adjacent area in buffer zone of 60m on either side is vulnerable stretch as per the hydrological condition and slope morphometry in existing terrain condition is identified as landslide prone zone during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/55
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'27.21"N
8	Longitude	75°28'59.42"E

`

9	Length	~22m
10	Width	~25m
11	Height	~16m
12	Area	~550m^2
13	Depth	~1m
14	Volume	~550m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Folded, Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. Stone masonry can be constructed.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable during heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/56
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'25.29"N
8	Longitude	75°28'57.33"E
9	Length	~30m
10	Width	~45m
11	Height	~25m
12	Area	~1350m^2
13	Depth	~1m
14	Volume	~1350m^3
15	Run out distance	~70m
16	Type of Material	Rock

`

17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1:N290°/64°/15°,J2:N245°/40°/155°, J3:N230°/70°/300°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes

`

		should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/57
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'24.20"N
8	Longitude	75°28'56.98"E
9	Length	~30m
10	Width	~45m
11	Height	~25m
12	Area	~1350m^2
13	Depth	~.5m
14	Volume	~675m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil

`

33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/58
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'20.30"N
8	Longitude	75°28'57.44"E
9	Length	~45m
10	Width	~50m
11	Height	~35m
12	Area	~1350m^2
13	Depth	~1.5m
14	Volume	~2025m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.

`

38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/59
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'15.88"N
8	Longitude	75°28'58.87"E
9	Length	~18m
10	Width	~50m
11	Height	~15m
12	Area	~900m^2
13	Depth	~.5m
14	Volume	~450m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by

`

		flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/60
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'14.84"N
8	Longitude	75°29'00.00"E
9	Length	~10m
10	Width	~18m
11	Height	~8m
12	Area	~180m^2
13	Depth	~.5m
14	Volume	~90m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded

`

35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/61
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)

`

6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'12.60"N
8	Longitude	75°29'0.96"E
9	Length	~15m
10	Width	~55m
11	Height	~12m
12	Area	~825m^2
13	Depth	~1.5m
14	Volume	~1237.5m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/62
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'6.70"N
8	Longitude	75°28'58.83"E
9	Length	~18m
10	Width	~20m
11	Height	~15m
12	Area	~360m^2
13	Depth	~1.5m
14	Volume	~540m^3
15	Run out distance	~70m
16	Type of Material	Debris

`

17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	New, Reactivated (2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Highly weathered)
26	Structure	Foliated and Jointed (F0‖J1:N270°/80°/180°,J2:N200°/10°/125°, J3:N205°/86°/290°)
27	Land use/Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes

`

		should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/63
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'4.67"N
8	Longitude	75°28'57.12"E
9	Length	~35m
10	Width	~28m
11	Height	~30m
12	Area	~980m^2
13	Depth	~1m
14	Volume	~980m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	New (2019)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities

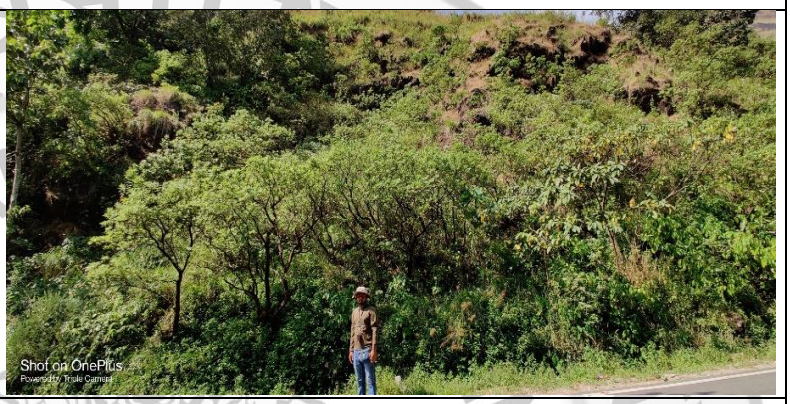
`

31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope to reduce the chances of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/64
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°06'1.54"N
8	Longitude	75°28'56.05"E
9	Length	~65m
10	Width	~45m
11	Height	~55m
12	Area	~2925m^2
13	Depth	~1m
14	Volume	~2925m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/65
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'59.62"N
8	Longitude	75°28'56.16"E
9	Length	~45m

`

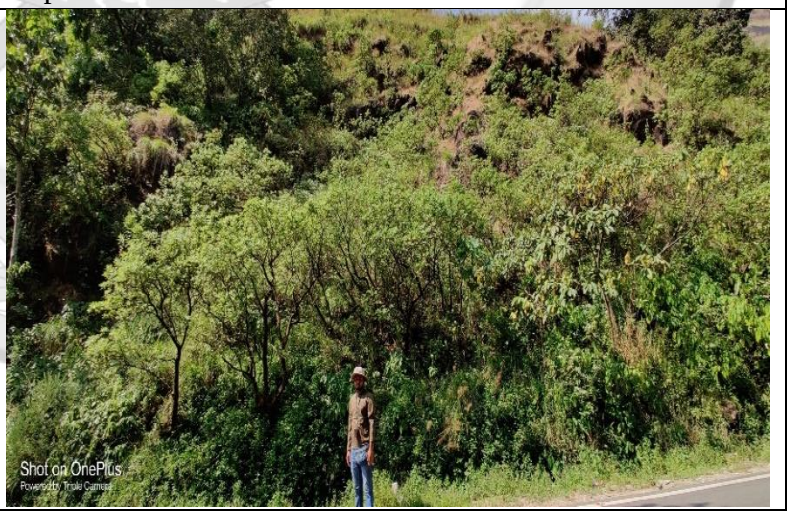
10	Width	~55m
11	Height	~32m
12	Area	~2475m^2
13	Depth	~1m
14	Volume	~2475m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (F0‖J1:N318°/80°/45°, J2:N240°/30°/45°, J3:N255°/75°/360°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/66
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'54.18"N
8	Longitude	75°28'53.78"E
9	Length	~45m
10	Width	~55m
11	Height	~32m
12	Area	~2475m^2
13	Depth	~1m
14	Volume	~2475m3
15	Run out distance	~70m
16	Type of Material	Rock

`

17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (F0‖J1:N318°/80°/45°, J2:N240°/30°/45°, J3:N255°/75°/360°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road damaged
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable. The precarious hanging boulders on slope.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/67
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73), Jenukallu, Annapaswamy Temple
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'51.02"N
8	Longitude	75°28'50.38"E
9	Length	~12m
10	Width	~35m
11	Height	~8m
12	Area	~420m^2
13	Depth	~.5m
14	Volume	~210m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss

`

26	Structure	Foliated and Jointed (F0‖J1:N245°/82°/160°, J2:N50°/48°/335°, J3:N50°/48°/335°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by

`

		flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/68
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'51.07"N
8	Longitude	75°28'48.65"E
9	Length	~10m
10	Width	~22m
11	Height	~7m
12	Area	~220m^2
13	Depth	~.5m
14	Volume	~110m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (F0‖J1:N245°/82°/160°,J2:N50°/48°/335°, J3:N50°/48°/335°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil

`

33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/69
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'51.94"N
8	Longitude	75°28'47.42"E
9	Length	~18m
10	Width	~45m
11	Height	~15m
12	Area	~810m^2
13	Depth	~.5m
14	Volume	~405m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/70
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'53.27"N
8	Longitude	75°28'45.44"E
9	Length	~18m
10	Width	~45m

`

11	Height	~15m
12	Area	~810m^2
13	Depth	~.5m
14	Volume	~405m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old (1984)
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (J1:N65°/40°/160°, J2:N335°/88°/65°)
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/71
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'52.10"N
8	Longitude	75°28'43.94"E
9	Length	~25m
10	Width	~35m
11	Height	~20m
12	Area	~875m^2
13	Depth	~.5m
14	Volume	~437.5m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Planar Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (J1:N310°/75°/220°, J2:N63°/70°/325°, J3: N63°/75°/220°)
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp

`

29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure due to slope saturation during incessant rainfall condition.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is meta stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/72
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'50.77"N
8	Longitude	75°28'41.73"E
9	Length	~20m
10	Width	~22m
11	Height	~18m
12	Area	~440m^2
13	Depth	~.5m
14	Volume	~220m^3
15	Run out distance	~70m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (65°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/73
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'50.00"N
8	Longitude	75°28'41.05"E
9	Length	~18m

`

10	Width	~28m
11	Height	~15m
12	Area	~504m^2
13	Depth	~1m
14	Volume	~504m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/74
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 5'48.70"N
8	Longitude	75°28'40.50"E
9	Length	~10m
10	Width	~28m
11	Height	~8m
12	Area	~280m^2
13	Depth	~1m
14	Volume	~280m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed

`

27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/75
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'45.83"N
8	Longitude	75°28'39.14"E
9	Length	~25m
10	Width	~35m
11	Height	~15m
12	Area	~875m^2
13	Depth	~2m
14	Volume	~1750m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	ModerateVegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/76
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 5'43.44"N
8	Longitude	75°28'39.37"E
9	Length	~55m
10	Width	~18m

`

11	Height	~45m
12	Area	~990m^2
13	Depth	~4m
14	Volume	~3960m^3
15	Run out distance	~70m
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed
27	Land use/ Land cover	ModerateVegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered, jointed and folded rock, failure at slip plane weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed amphibolite. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/77
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'41.70"N
8	Longitude	75°28'37.76"E
9	Length	~22m
10	Width	~35m
11	Height	~18m
12	Area	~770m^2
13	Depth	~.5m
14	Volume	~385m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Foliated and Jointed (J1:0/35 (95), J2:275/88(350), J3:355/80 (75)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along joints at interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure.
38	Remarks, if any	The area is unstable. The retaining structure (~15m) at road bench level in downslope direction are damaged. So, need to be repaired.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The slope gradation can be done to maintain slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/78
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'40.71"N
8	Longitude	75°28'39.10"E
9	Length	~22m
10	Width	~45m
11	Height	~20m
12	Area	~990m^2
13	Depth	~.5m
14	Volume	~495m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured weathered and Jointed
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp

`

29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on the extensive vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.The culvert of suitable dimension should be constructed to divert excess water to safer sites.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. Culvert of suitable dimension should be constructed to divert excess water to safer sites.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/79
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'40.31"N
8	Longitude	75°28'40.17"E
9	Length	~15m
10	Width	~40m
11	Height	~12m
12	Area	~600m^2
13	Depth	~1.5m
14	Volume	~900m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	weathered and Jointed
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is meta-stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/80
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'37.88"N
8	Longitude	75°28'41.46"E
9	Length	~9m
10	Width	~55m
11	Height	~8m
12	Area	~495m^2
13	Depth	~.5m
14	Volume	~247.5m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	Weathered and Jointed
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/81
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'35.83"N
8	Longitude	75°28'41.85"E
9	Length	~9m

`

10	Width	~55m
11	Height	~8m
12	Area	~495m^2
13	Depth	~.5m
14	Volume	~247.5m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	weathered and Jointed (J0‖J1:N325/65(50)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/82
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'33.77"N
8	Longitude	75°28'43.21"E
9	Length	~22m
10	Width	~22m
11	Height	~18m
12	Area	~484m2
13	Depth	~1.5m
14	Volume	~726m3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	weathered and Jointed (J0‖J1:N325/65(50)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil. 2. Vertiver grass on slope will increase the effective cohesion of the soil.

`

37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/83
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'32.37"N
8	Longitude	75°28'43.17"E
9	Length	~40m
10	Width	~28m
11	Height	~38m
12	Area	~1120m^2
13	Depth	~1.5m
14	Volume	~1680m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure

`

23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	Weathered, folded and Jointed (F0‖J1:N308/35(40) , Cleavage‖J2:N285/86 (195), J3:N215/43(320)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable flexure slip plane along interface of weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/84
2	State	Karnataka
3	District	Chikkamagaluru

`

4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'31.68"N
8	Longitude	75°28'44.16"E
9	Length	~15m
10	Width	~18m
11	Height	~12m
12	Area	~270m^2
13	Depth	~.5m
14	Volume	~135m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (weathered rock+soil)
26	Structure	Weathered, folded and Jointed (F0‖J1:N308/35(40) , Cleavage‖J2:N285/86 (195), J3:N215/43(320)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil. Flexure slip, folded ***
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/85
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'29.51"N
8	Longitude	75°28'44.08"E
9	Length	~15m
10	Width	~18m
11	Height	~12m
12	Area	~270m^2
13	Depth	~.5m
14	Volume	~135m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Weathered, folded and Jointed (F0‖J1:N308/35(40) , Cleavage‖J2:N285/86 (195), J3:N215/43(320)
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred due to lossin effective cohesion of slope forming material during heavy incessant rainfall.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/86
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'26.64"N
8	Longitude	75°28'42.01"E
9	Length	~40m
10	Width	~55m
11	Height	~38m
12	Area	~2200m^2
13	Depth	~1m
14	Volume	~2200m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured and jointed
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Culvert should be made to divert water in downslope

`

		direction.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°)at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/87
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'26.08"N
8	Longitude	75°28'39.40"E
9	Length	~8m
10	Width	~22m
11	Height	~7m
12	Area	~176m^2
13	Depth	~.5m
14	Volume	~88m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active

`

20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured and jointed
27	Land use/ Land cover	Dense vegetation on upslope, Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	1. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Culvert should be made to divert water in downslope direction.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/88
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'28.54"N
8	Longitude	75°28'36.69"E
9	Length	~55m
10	Width	~28m
11	Height	~7m
12	Area	~1540m^2
13	Depth	~.5m
14	Volume	~770m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Widening and enlarging (retrogressive)
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured and jointed J1: 340/75(60) J2:30/25(125), J3: 15/60(280)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil. 2. The vulnerable plane is dipping towards road.

`

37	Remedial measures	1. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Culvert should be made to divert water in downslope direction. 3. Vertiver grass should be grown on slope.
38	Remarks, if any	1. The area is unstable. 2. Retaining wall broken on left side of road.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/89
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'27.58"N
8	Longitude	75°28'31.82"E
9	Length	~10m
10	Width	~15m
11	Height	~8m
12	Area	~150m2

`

13	Depth	~.5m
14	Volume	~75m3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Widening and enlarging (retrogressive)
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured and jointed
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	1. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Culvert should be made to divert water in downslope direction. 3. Vertiver grass should be grown on slope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/90
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'26.76"N
8	Longitude	75°28'31.00"E
9	Length	~15m
10	Width	~28m
11	Height	~12m
12	Area	~420m^2
13	Depth	~.5m
14	Volume	~210m3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Fractured and jointed
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities

`

31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock, failure at vulnerable slip plane along interface of weathered rock and soil.
37	Remedial measures	1. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Culvert should be made to divert water in downslope direction. 3. Vertiver grass should be grown on slope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall on highly weathered and jointed rock. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/91
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall

`

6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'25.2"N
8	Longitude	75°28'28.4"E
9	Length	~85m
10	Width	~100m
11	Height	~58m
12	Area	~8500m^2
13	Depth	~.5m
14	Volume	~4250m^3
15	Run out distance	~110m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Folded, Fractured and jointed J1: 10/63(15) J2:260/85(166), J3: 350/28(75)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly jointed rock, failure at vulnerable slip plane. 2. Deep seated joint sets facing towards road. 3. Foliation is folded to form joint.
37	Remedial measures	1.The retaining wall constructed on upslope and at downslope direction at road bench level. 2. Slope geometry (slope angle) is retained at 40 degree. 3. Drainage management on slope is done.
38	Remarks, if any	The area is stabilized .

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Rock failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall along the water fall and breached the road. The slope failure initiated from upslope.
41	Pdf	Attached
42	Alert	I

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/92
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 5'22.85"N
8	Longitude	75°28'27.77"E
9	Length	~55m
10	Width	~38m
11	Height	~50m
12	Area	~2090m^2
13	Depth	~.5m
14	Volume	~1045m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope

`

25	Geology	Granite gneiss
26	Structure	Folded, Fractured and jointed J1: 10/63(15) J2:260/85(166), J3: 350/28(75)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1. Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly jointed weathered rock, failure is initiated at deep pervasive joints parallel to foliation are the vulnerable slip plane. 2. Deep seated pervasive joint sets parallel to foliation is dripping and is most vulnerable set facing towards road and water pressure on slope has widened the joints.
37	Remedial measures	1. Drainage management on slope is required. 2. Slope gradation is required to maintain the slope geometry.
38	Remarks, if any	The area at approx. 90m away from this location is highly vulnerable area at stretch of ~45m wide zone is highly susceptible to failure at 13°5'20.13"N/ 75°28'26.26"E: J1:315/60(45) J2:290/22(25), J3: 15/75(285)
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Rock failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of jointed rock due to high hyrological stress build on the slope.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/93
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'17.45"N
8	Longitude	75°28'25.70"E
9	Length	~40m
10	Width	~38m
11	Height	~35m
12	Area	~1520m2
13	Depth	~.5m
14	Volume	~760m3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Folded, Fractured and jointed J1: 10/63(15) J2:260/85(166), J3: 350/28(75)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Dripping
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1. Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly jointed weathered rock, failure is initiated at deep pervasive joints parallel to foliation are the vulnerable slip plane. 2. Deep seated pervasive joint sets parallel to foliation is dripping and is most vulnerable set facing towards road and water pressure on slope has widened the joints.

`

37	Remedial measures	1. Drainage management on slope is required. 2. Slope gradation is required to maintain the slope geometry.
38	Remarks, if any	The area at approx. 60m away from this location is highly vulnerable and susceptible to failure at 13°05'15.77"N/ 75°28'24.93"E: J1: 355/72(270) J2:283/86(10), J3: 10/38(105)
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Rock failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of jointed rock due to high hyrological stress build on the slope.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/94
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'14.1"N

`

8	Longitude	75°28'25.6"E
9	Length	~10m
10	Width	~28m
11	Height	~8m
12	Area	~280m^2
13	Depth	~1m
14	Volume	~280m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Folded, Fractured and jointed J1|F0: 10/180(60) J2: 10/35(85)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1. Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly jointed weathered rock, failure is initiated at deep pervasive joints parallel to foliation are the vulnerable slip plane. 2. Highly fractured, weathered and jointed rock. 3. Contact between granite gneiss and felspathic granite gneiss.
37	Remedial measures	1. Drainage management on slope is required. 2.Slope gradation is required to maintain the slope geometry.
38	Remarks, if any	The area is meta stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Rock failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of jointed rock due to high hyrological stress build on the slope.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/95
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'12.56"N
8	Longitude	75°28'25.79"E
9	Length	~18m
10	Width	~25m
11	Height	~13m
12	Area	~450m^2
13	Depth	~1.5m
14	Volume	~675m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite

`

26	Structure	Highly weathered (Joint set not distinct)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered rock,
37	Remedial measures	1. Drainage management on slope is required. 2. Slope gradation is required to maintain the original slope geometry.
38	Remarks, if any	The area is meta stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock between granite gneiss and amphibolite due to high hydrological stress build on the slope.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/96
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73) waterfall

`

6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'11.32"N
8	Longitude	75°28'26.56"E
9	Length	~30m
10	Width	~55m
11	Height	~28m
12	Area	~1650m^2
13	Depth	~1.5m
14	Volume	~2475m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Qurtzo-felspathic)
26	Structure	Highly weathered (Joint set not distinct)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered rock. 2. Progressive Upward rising slope
37	Remedial measures	1. Drainage management on slope is required. 2. Slope gradation is required to maintain the original slope geometry. 3. The ditch width can be increased. 4. Vertiver grass on slope with increase cohesion.
38	Remarks, if any	Shifting of retaining wall observed.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock between granite gneiss and amphibolite due to high hydrological stress build on the slope.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/97
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'09.81"N
8	Longitude	75°28'26.81"E
9	Length	~15m
10	Width	~35m
11	Height	~12m
12	Area	~525m2
13	Depth	~1m
14	Volume	~525m3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Qurtzo-felspathic)
26	Structure	Jointed and Fractured (J1:355/60(262), J2:215/40(125)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	1.Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock. 2. The vulnerable slip plane is dipping towards road.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered and jointed rock..
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/98
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'09.20"N
8	Longitude	75°28'26.16"E
9	Length	~18m

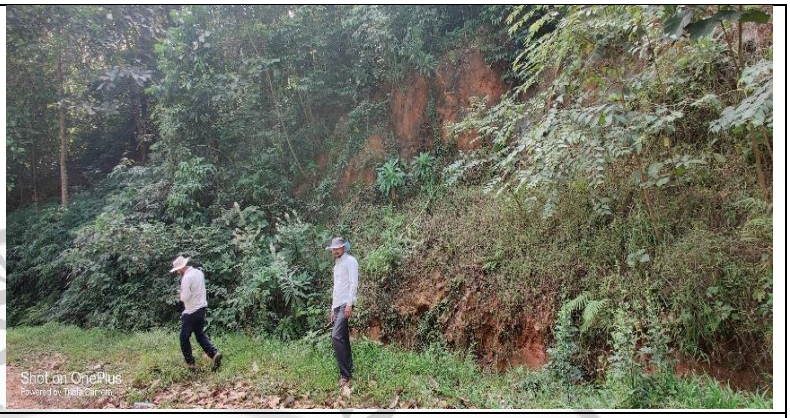
`

10	Width	~55m
11	Height	~14m
12	Area	~990m^2
13	Depth	~1m
14	Volume	~990m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss (Qurtzo-felspathic)
26	Structure	(J1:355/60(262), J2:215/40(125)
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes and culvert of suitable dimension required on upslope.
38	Remarks, if any	The area is unstable and highly strained.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered and jointed rock..
41	Pdf	Attached
42	Alert	III

`

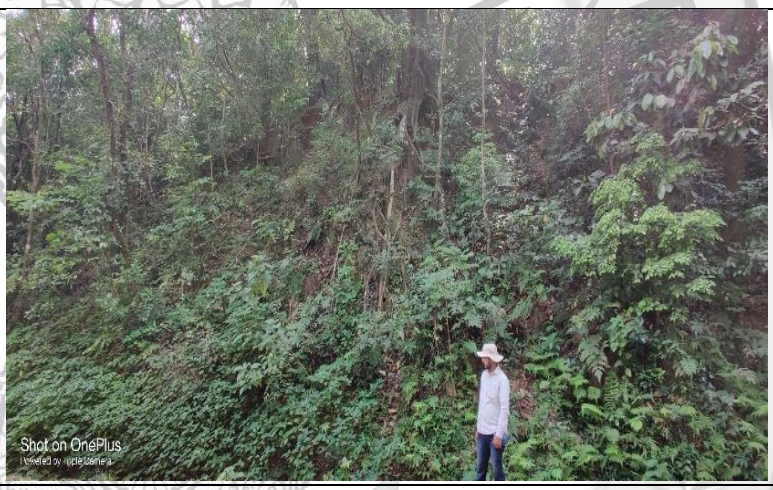
No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/99
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°05'07.56"N
8	Longitude	75°28'23.62"E
9	Length	~6m
10	Width	~18m
11	Height	~5m
12	Area	~108m^2
13	Depth	~1m
14	Volume	~108m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Not distinct
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes and culvert of suitable dimension required on upslope.
38	Remarks, if any	The area is metastable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on cut slope at road bench level during heavy incessant rainfall due to over saturation of slope.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/100
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 5'7.17"N
8	Longitude	75°28'22.73"E
9	Length	~10m
10	Width	~22m
11	Height	~8m
12	Area	~220m^2
13	Depth	~1.5m
14	Volume	~330m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss

`

26	Structure	Not distinct
27	Land use/ Land cover	Moderate vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes and culvert of suitable dimension required on upslope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered and jointed rock.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/101
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)

`

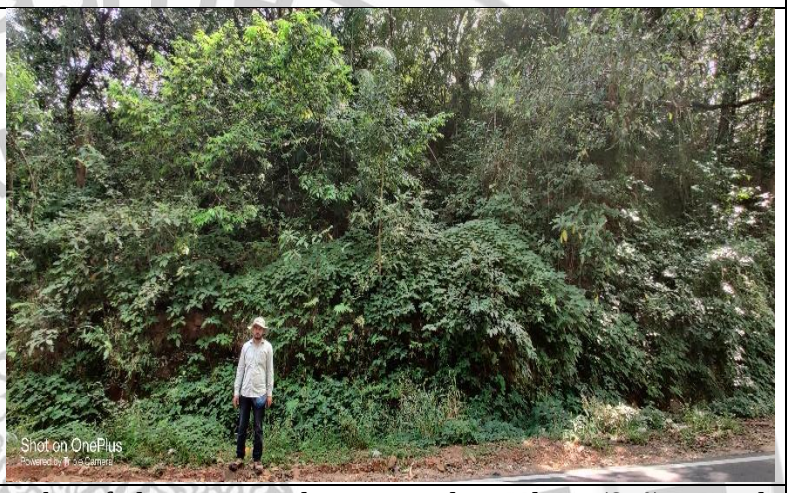
7	Latitude	13° 5'4.46"N
8	Longitude	75°28'15.71"E
9	Length	~18m
10	Width	~35m
11	Height	~15m
12	Area	~630m^2
13	Depth	~.5m
14	Volume	~315m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss
26	Structure	Jointed and fractured
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Rock failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of deep seated joint and fracture system.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/102
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 5'2.51"N
8	Longitude	75°28'12.42"E
9	Length	~8m
10	Width	~15m
11	Height	~6m
12	Area	~120m^2
13	Depth	~1.5m
14	Volume	~180m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	1. Drainage management on slope is required. 2. Lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of deep seated joint and fracture system.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/103
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'56.84"N
8	Longitude	75°28'09.63"E
9	Length	~8m
10	Width	~15m
11	Height	~6m
12	Area	~120m^2
13	Depth	~.5m
14	Volume	~60m^3
15	Run out distance	~10m

`

16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	Lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/104
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'46.8"N
8	Longitude	75°28'11.1"E
9	Length	~8m
10	Width	~12m
11	Height	~7m
12	Area	~96m^2
13	Depth	~.5m
14	Volume	~48m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	III

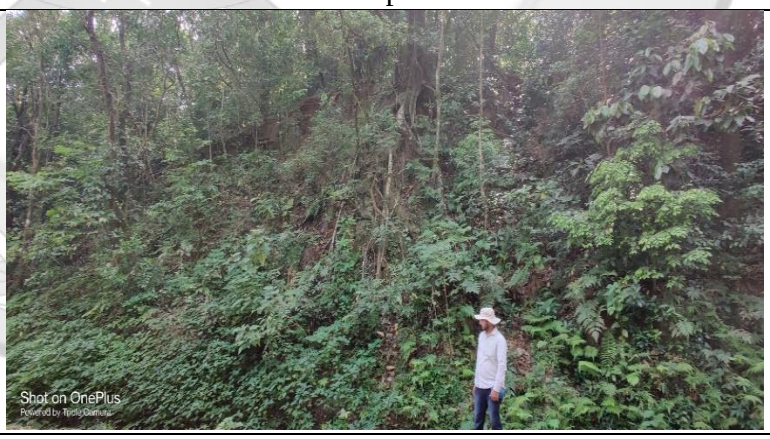
No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/105
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'43.8"N
8	Longitude	75°28'12.1"E
9	Length	~10m
10	Width	~45m
11	Height	~7m
12	Area	~450m^2
13	Depth	~.5m
14	Volume	~225m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is meta stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/106
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'39.436"N

`

8	Longitude	75°28'16.096"E
9	Length	~14m
10	Width	~28m
11	Height	~10m
12	Area	~392m^2
13	Depth	~2m
14	Volume	~784m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable and slump zone
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.

`

41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/107
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'39.647"N
8	Longitude	75°28'17.618"E
9	Length	~20m
10	Width	~28m
11	Height	~15m
12	Area	~560m2
13	Depth	~2.5m
14	Volume	~1400m3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.

`

37	Remedial measures	The lined drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable and slump zone
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/108
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'40.837"N
8	Longitude	75°28'19.421"E
9	Length	~20m
10	Width	~35m
11	Height	~15m
12	Area	~700m^2
13	Depth	~2.5m
14	Volume	~1750m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive

`

21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Moderate vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable and slump zone
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/109
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08

`

5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'41.734"N
8	Longitude	75°28'21.143"E
9	Length	~20m
10	Width	~25m
11	Height	~12m
12	Area	~500m^2
13	Depth	~2m
14	Volume	~1000m^3
15	Run out distance	~10m
16	Type of Material	Earth
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive, Enlarging
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Granite gneiss and Amphibolite (Weathered)
26	Structure	Indistinct
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Barren
36	Geo-scientific Causes	Shallow translational failure occurred on vertical cut slope at road bench level during heavy incessant rainfall on highly weathered and jointed rock.
37	Remedial measures	The lined Drainage with weep holes required on upslope.
38	Remarks, if any	The area is unstable and slump zone
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Debris failure occurred on vertical cut slope (85°) at road bench level during heavy incessant rainfall at interface of weathered rock and soil.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/110
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'40.34"N
8	Longitude	75°28'21.70"E
9	Length	~32m
10	Width	~55m
11	Height	~30m
12	Area	~1760m^2
13	Depth	~1m
14	Volume	~1760m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded

`

35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35° can be done to maintain the slope geometry to stabilize the slope and to reduce the chances of slope failure.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall on highly weathered, jointed and deformed granite gneiss. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The excessive flow can flow through the culvert constructed in proximity. As engineering measures slope gradation of 25-35°can be done to maintain the slope geometry to stabilize the slope and to reduce the changes of slope failure. The area is unstable and likely to fail in heavy incessant rainfall.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/111
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'38.33"N
8	Longitude	75°28'20.17"E
9	Length	~10m
10	Width	~28m
11	Height	~8m
12	Area	~280m^2
13	Depth	~1m
14	Volume	~280m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. The retaining wall to be constructed at road bench level.
38	Remarks, if any	The area is unstable slump zone.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/112
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'37.19"N
8	Longitude	75°28'19.29"E
9	Length	~15m
10	Width	~18m
11	Height	~9m
12	Area	~270m^2
13	Depth	~1m
14	Volume	~270m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated

`

20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Jointed and weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/113
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'35.74"N
8	Longitude	75°28'18.26"E
9	Length	~15m
10	Width	~30m
11	Height	~8m
12	Area	~450m^2
13	Depth	~1m
14	Volume	~450m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Jointed and weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. Vertiver grass on slope will strengthen the cohesive strength of the soil.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/114
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'34.75"N
8	Longitude	75°28'17.68"E
9	Length	~12m
10	Width	~55m
11	Height	~10m
12	Area	~660m^2
13	Depth	~1m
14	Volume	~660m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate

`

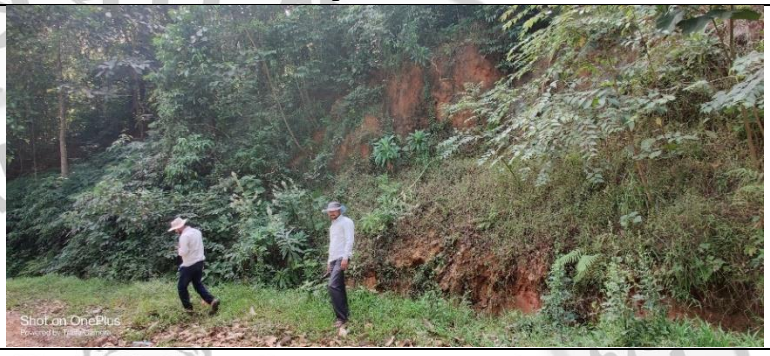
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Jointed and weathered Granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	1. The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Vertiver grass on slope will strengthen the cohesive strength of the soil.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.

`

41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/115
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'34.2"N
8	Longitude	75°28'15.5"E
9	Length	~13m
10	Width	~30m
11	Height	~10m
12	Area	~360m^2
13	Depth	~1m
14	Volume	~360m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Jointed and weathered Granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil.

`

37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Vertiver grass on slope will strengthen the cohesive strength of the soil.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/116
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'32.57"N
8	Longitude	75°28'12.19"E
9	Length	~15m
10	Width	~20m
11	Height	~13m
12	Area	~300m^2

`

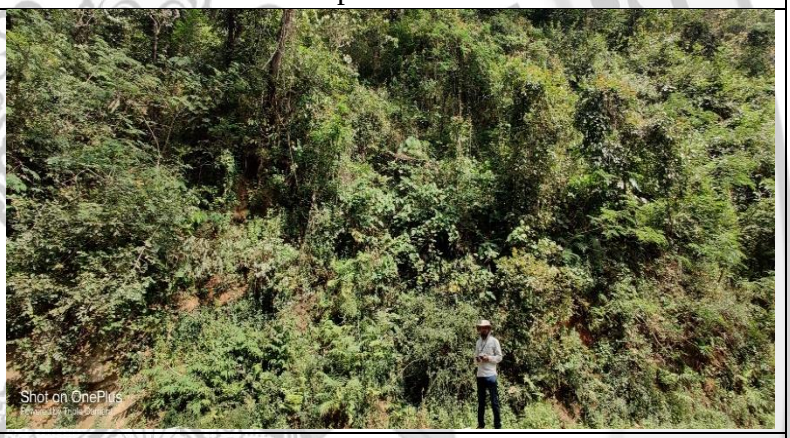
13	Depth	~1m
14	Volume	~300m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Jointed and weathered Granite gneiss (Felsic) and amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Vertiver grass on slope will strengthen the cohesive strength of the soil.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level

`

		during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/117
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'37.45"N
8	Longitude	75°28'6.27"E
9	Length	~8m
10	Width	~14m
11	Height	~6m
12	Area	~112m^2
13	Depth	~1m
14	Volume	~112m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities

`

31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Vertiver grass on slope will strengthen the cohesive strength of the soil.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/118
2	State	Karnataka
3	District	Dakshin Kannada

`

4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'41.44"N
8	Longitude	75°28'2.42"E
9	Length	~15m
10	Width	~55m
11	Height	~10m
12	Area	~825m^2
13	Depth	~1.5m
14	Volume	~1237.5m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable Slump zone.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/119
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/08
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'43.12"N
8	Longitude	75°28'0.45"E
9	Length	~22m
10	Width	~35m
11	Height	~18m
12	Area	~770m^2
13	Depth	~1.5m
14	Volume	~1155m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single

`

22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/120
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'46.15"N
8	Longitude	75°27'57.71"E
9	Length	~55m
10	Width	~45m
11	Height	~18m
12	Area	~2475m^2
13	Depth	~2.5m
14	Volume	~6187.5m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/121
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'46.80"N
8	Longitude	75°27'55.83"E
9	Length	~35m
10	Width	~30m
11	Height	~22m
12	Area	~1050m^2
13	Depth	~2m
14	Volume	~2100m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging

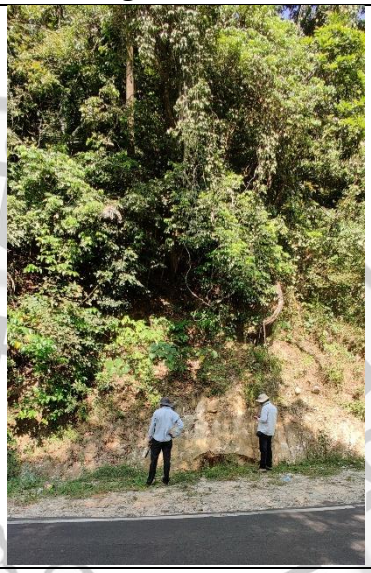
`

21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/122
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'47.29"N
8	Longitude	75°27'52.87"E
9	Length	~28m
10	Width	~38m
11	Height	~22m
12	Area	~1064m^2
13	Depth	~3m
14	Volume	~3192m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.The retaining wall (~75m) on opposite side is damaged.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. The retaining wall to be constructed at road bench level.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/D/48O8/2021/123
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'46.13"N
8	Longitude	75°27'52.82"E
9	Length	~18m
10	Width	~25m
11	Height	~15m
12	Area	~450m^2
13	Depth	~2.5m

`

14	Volume	~1125m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of

`

		on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/124
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13°04'45.76"N
8	Longitude	75°27'50.72"E
9	Length	~11m
10	Width	~30m
11	Height	~9m
12	Area	~330m^2
13	Depth	~2m
14	Volume	~660m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil

`

33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope required.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/125
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'45.26"N
8	Longitude	75°27'48.66"E
9	Length	~9m
10	Width	~22m
11	Height	~8m
12	Area	~198m^2
13	Depth	~2m
14	Volume	~396m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope required.
38	Remarks, if any	The area is unstable slump zone.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/126
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'35.40"N
8	Longitude	75°27'25.21"E
9	Length	~16m
10	Width	~30m
11	Height	~12m
12	Area	~480m^2
13	Depth	~1.5m
14	Volume	~720m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging

`

21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/127
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'33.01"N
8	Longitude	75°27'24.68"E
9	Length	~16m
10	Width	~35m
11	Height	~12m
12	Area	~560m^2
13	Depth	~1.5m
14	Volume	~840m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered amphiboilite (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/128
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'29.40"N
8	Longitude	75°27'25.12"E
9	Length	~9m
10	Width	~20m
11	Height	~7m
12	Area	~180m^2
13	Depth	~1m
14	Volume	~180m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging

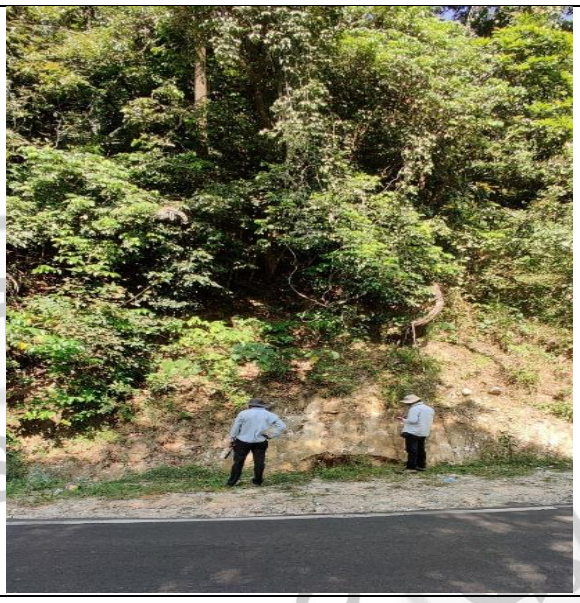
`

21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable Slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/129
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'29.77"N
8	Longitude	75°27'27.49"E
9	Length	~9m
10	Width	~40m
11	Height	~7m
12	Area	~360m^2
13	Depth	~1m
14	Volume	~360m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and Enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable Slump zone.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/130
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'30.42"N
8	Longitude	75°27'29.82"E
9	Length	~10m
10	Width	~45m
11	Height	~8m
12	Area	~450m^2
13	Depth	~1.2m
14	Volume	~540m^3
15	Run out distance	~15m
16	Type of Material	Debris

`

17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive, Widening and Enlarging
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion

`

		by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/131
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'28.51"N
8	Longitude	75°27'23.88"E
9	Length	~10m
10	Width	~45m
11	Height	~8m
12	Area	~450m2
13	Depth	~1.2m
14	Volume	~540m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive, Widening and Enlarging
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic) and amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road

`

		bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/132
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'30.35"N
8	Longitude	75°27'22.17"E
9	Length	~18m
10	Width	~45m
11	Height	~15m
12	Area	~810m^2
13	Depth	~1.5m

`

14	Volume	~1215m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic) and amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	1.The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at

`

		road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/133
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'32.78"N
8	Longitude	75°27'21.89"E
9	Length	~12m
10	Width	~38m
11	Height	~10m
12	Area	~456m^2
13	Depth	~2m
14	Volume	~912m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic) and amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest

`

36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/134
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'33.65"N
8	Longitude	75°27'21.63"E
9	Length	~35m
10	Width	~28m
11	Height	~30m

`

12	Area	~980m^2
13	Depth	~3.5m
14	Volume	~3430m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic) and amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of

`

		on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/135
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'35.16"N
8	Longitude	75°27'22.00"E
9	Length	~18m
10	Width	~35m
11	Height	~15m
12	Area	~630m^2
13	Depth	~1.5m
14	Volume	~945m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded

`

35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable slump zone.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/136
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'36.16"N
8	Longitude	75°27'22.52"E

`

9	Length	~12m
10	Width	~22m
11	Height	~9m
12	Area	~264m^2
13	Depth	~1m
14	Volume	~264m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

		
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/137
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'38.45"N
8	Longitude	75°27'22.14"E
9	Length	~12m
10	Width	~22m
11	Height	~9m
12	Area	~264m^2
13	Depth	~1m
14	Volume	~264m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive

`

21	Style	Successive
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/138
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'41.79"N
8	Longitude	75°27'22.62"E
9	Length	~20m
10	Width	~35m
11	Height	~10m
12	Area	~700m^2
13	Depth	~1m
14	Volume	~700m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/139
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'42.88"N
8	Longitude	75°27'21.75"E
9	Length	~12m
10	Width	~28m
11	Height	~9m
12	Area	~336m^2
13	Depth	~1m
14	Volume	~336m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and enlarging

`

21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/140
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'40.12"N
8	Longitude	75°27'21.06"E
9	Length	~12m
10	Width	~28m
11	Height	~25m
12	Area	~336m^2
13	Depth	~1m
14	Volume	~336m^3
15	Run out distance	~15m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Widening and enlarging
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. In downslope direction concrete grouting with weep holes done to strengthen the slope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/141
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'36.92"N
8	Longitude	75°27'21.37"E
9	Length	~15m
10	Width	~28m
11	Height	~12m
12	Area	~420m^2
13	Depth	~1m
14	Volume	~420m^3
15	Run out distance	~15m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/142
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'36.14"N
8	Longitude	75°27'20.63"E
9	Length	~22m

`

10	Width	~28m
11	Height	~20m
12	Area	~616m^2
13	Depth	~1.5m
14	Volume	~924m^3
15	Run out distance	~15m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with

`

		weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/143
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'36.14"N
8	Longitude	75°27'20.63"E
9	Length	~15m
10	Width	~28m
11	Height	~10m
12	Area	~420m^2
13	Depth	~1.5m
14	Volume	~630m^3
15	Run out distance	~15m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/144
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'34.10"N

`

8	Longitude	75°27'19.04"E
9	Length	~15m
10	Width	~30m
11	Height	~12m
12	Area	~450m2
13	Depth	~1.5m
14	Volume	~675m3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/145
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'31.03"N
8	Longitude	75°27'13.86"E
9	Length	~25m
10	Width	~20m
11	Height	~8m
12	Area	~500m^2
13	Depth	~1m
14	Volume	~500m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Thick Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil

`

32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/146
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'31.37"N
8	Longitude	75°27'9.07"E
9	Length	~12m
10	Width	~50m
11	Height	~8m
12	Area	~600m^2
13	Depth	~.5m
14	Volume	~300m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Thick Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2.Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/147
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73), 6th Curve
7	Latitude	13° 4'32.27"N
8	Longitude	75°27'9.98"E
9	Length	~7m
10	Width	~50m
11	Height	~6m
12	Area	~350m^2
13	Depth	~1.5m
14	Volume	~525m^3
15	Run out distance	~15m
16	Type of Material	Debris
17	Type of movement	Slide

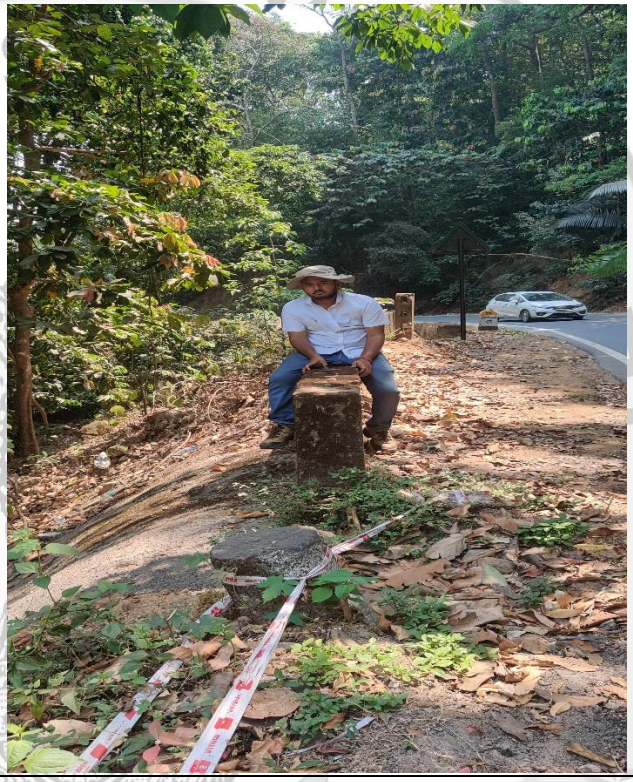
`

18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old and Reactivated
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure occurred on convex turn of the road on cut slope on overburden material due to excessive slope saturation due to heavy rainfall.
37	Remedial measures	1.Draiange management on upslope at road bench level is required to prevent water seepage and saturation in the downslope direction. 2. Clogging of weep holes should be timely monitored and maintained for free passage of water on slope.
38	Remarks, if any	The retaining structure is constructed for toe support .
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/148
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'33.38"N
8	Longitude	75°27'10.20"E
9	Length	~12m
10	Width	~15m
11	Height	~9m
12	Area	~180m^2
13	Depth	~2m
14	Volume	~360m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Old, Suspended
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	1.The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

		2. In downslope direction concrete grouting with weep holes done to strengthen the slope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

`

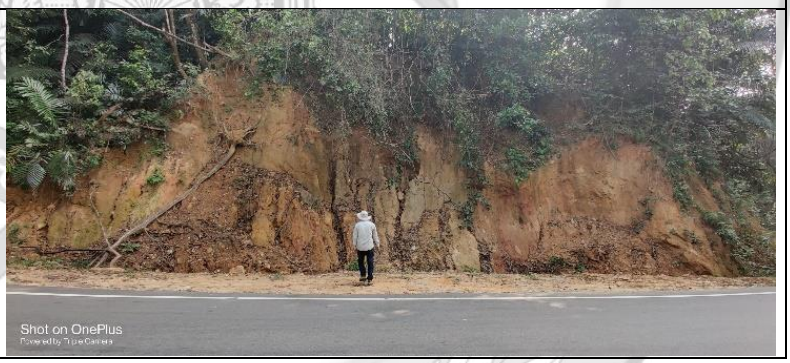
No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/149
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'36.21"N
8	Longitude	75°27'6.08"E
9	Length	~12m
10	Width	~15m
11	Height	~8m
12	Area	~360m^2
13	Depth	~.5m
14	Volume	~180m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	The shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.

`

38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/150
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'33.35"N
8	Longitude	75°27'2.95"E
9	Length	~13m
10	Width	~25m
11	Height	~10m
12	Area	~325m^2
13	Depth	~1.5m
14	Volume	~487.5m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

		
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/151
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'30.62"N
8	Longitude	75°27'1.46"E
9	Length	~20m

`

10	Width	~25m
11	Height	~18m
12	Area	~500m^2
13	Depth	~1.5m
14	Volume	~750m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Old, can get Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable. At 13° 4'30.61"N/ 75°27'0.50"E gabion wall is broken.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/152
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'28.18"N
8	Longitude	75°26'58.42"E
9	Length	~18m
10	Width	~22m
11	Height	~13m
12	Area	~396m^2
13	Depth	~1.5m
14	Volume	~594m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall

`

30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/153
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8 (10th curve)
5	Name of the slide	Charmadi ghat road (NH-73)
6	NH/SH/Locality	Charmadi ghat road (NH-73)
7	Latitude	13° 4'33.69"N
8	Longitude	75°28'17.89"E
9	Length	~18m
10	Width	~22m
11	Height	~13m
12	Area	~396m^2
13	Depth	~1.5m
14	Volume	~594m^3
15	Run out distance	~25m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	New
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered granite gneiss (Felsic)
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of highly weathered rock and soil.
37	Remedial measures	The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon. 2. In concrete grouting with weep holes done to strengthen the slope.

`

38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Shallow translational failure got reactivated and widened on the extensive vertical cut slope (75°) at road bench level during heavy incessant rainfall and initiated at interface of on highly weathered rock and soil. The lined drainage with weep holes should be constructed at the upslope direction at road bench level to prevent water seepage and saturation in the downslope direction and to avoid toe cutting and erosion by flowing water during monsoon.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/154
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'26.5"N
8	Longitude	75°28'37.4"E
9	Length	~12m
10	Width	~18m
11	Height	~10m
12	Area	~216m^2
13	Depth	~1.5m
14	Volume	~324m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil in adjoining hillslope in proximity of nala section which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes is required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/155
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'25.42"N
8	Longitude	75°28'37.3"E
9	Length	~16m
10	Width	~28m
11	Height	~13m
12	Area	~448m^2
13	Depth	~1.5m
14	Volume	~672m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is meta-stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/156
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'24.7"N
8	Longitude	75°28'36.42"E
9	Length	~9m
10	Width	~10m
11	Height	~6m
12	Area	~90m^2
13	Depth	~1.5m
14	Volume	~135m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope

`

25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is meta stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope is required.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/157
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'22.1"N
8	Longitude	75°28'33.9"E
9	Length	~15m

`

10	Width	~35m
11	Height	~12m
12	Area	~525m^2
13	Depth	~2m
14	Volume	~1050m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	I

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/158
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'22.1"N
8	Longitude	75°28'25.8"E
9	Length	~15m
10	Width	~45m
11	Height	~45m
12	Area	~675m^2
13	Depth	~2.5m
14	Volume	~1687.5m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is meta-stable

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope is required.
41	Pdf	Attached
42	Alert	II

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/159
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'08.3"N
8	Longitude	75°28'24.0"E
9	Length	~20m
10	Width	~28m
11	Height	~15m
12	Area	~560m^2
13	Depth	~2.5m
14	Volume	~1400m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/160
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate

`

6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'06.1"N
8	Longitude	75°28'22.7"E
9	Length	~15m
10	Width	~20m
11	Height	~12m
12	Area	~300m^2
13	Depth	~2m
14	Volume	~600m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/161
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'04.3"N
8	Longitude	75°28'23.2"E
9	Length	~18m
10	Width	~35m
11	Height	~15m
12	Area	~630m^2
13	Depth	~1.5m
14	Volume	~945m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/162
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'02.8"N
8	Longitude	75°28'19.2"E
9	Length	~15m
10	Width	~25m
11	Height	~12m
12	Area	~375m^2
13	Depth	~1m
14	Volume	~375m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide

`

18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Moderate Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/163
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'06.4"N
8	Longitude	75°28'10.8"E
9	Length	~12m
10	Width	~28m
11	Height	~10m
12	Area	~336m^2
13	Depth	~1.5m
14	Volume	~504m^3
15	Run out distance	~10m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Shear failure of slope resulted due to loss in effective cohesion of slope forming material during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is meta-stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/164
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'18.8"N
8	Longitude	75°27'54.4"E
9	Length	~12m
10	Width	~25m
11	Height	~10m
12	Area	~300m^2
13	Depth	~1m
14	Volume	~300m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019

`

24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/165
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8

`

5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'21.3"N
8	Longitude	75°27'45.5"E
9	Length	~18m
10	Width	~35m
11	Height	~15m
12	Area	~630m^2
13	Depth	~1m
14	Volume	~630m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Dense Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	

`

40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/166
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'25.9"N
8	Longitude	75°27'44.8"E
9	Length	~18m
10	Width	~45m
11	Height	~15m
12	Area	~810m^2
13	Depth	~2.5m
14	Volume	~2025m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/167
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'28.9"N
8	Longitude	75°27'45.6"E
9	Length	~18m
10	Width	~75m
11	Height	~15m
12	Area	~1350m^2

`

13	Depth	~2.5m
14	Volume	~3375m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/DK/48O8/2021/168
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'29.8"N
8	Longitude	75°27'41.5"E
9	Length	~12m
10	Width	~18m
11	Height	~10m
12	Area	~216m^2
13	Depth	~2m
14	Volume	~432m^3
15	Run out distance	~10m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/DK/48O8/2021/169
2	State	Karnataka
3	District	Dakshin Kannada
4	Toposheet	48O/8
5	Name of the slide	Banjar Estate
6	NH/SH/Locality	Banjar Estate
7	Latitude	13° 4'33.7"N
8	Longitude	75°27'37.4"E
9	Length	~35m
10	Width	~18m
11	Height	~35m
12	Area	~630m^2
13	Depth	~2.5m
14	Volume	~1575m^3
15	Run out distance	~10m

`

16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive
21	Style	Successive
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Lowly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse Vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Coffee+Silver Oak (Plantation)
36	Geo-scientific Causes	Landslide initiated at interface of highly weathered rock and soil on vertical cut slope which lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition.
37	Remedial measures	1. Lined drainage with weep holes required. 2. Easing of slope is required.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	 

`

40	Summary/Abstract	Landslide initiated at interface of highly weathered rock lead to loss in effective shear and cohesive strength of the soil during incessant rainfall condition. Lined drainage with weep holes required. Easing of slope required.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/170
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'16.10"N
8	Longitude	75°29'18.77"E
9	Length	~357m
10	Width	~35m
11	Height	~215m
12	Area	~13125m^2
13	Depth	~1m
14	Volume	~13125m^3
15	Run out distance	~345m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected

`

34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion of valley portion lead to loss in effective shear and cohesive strength of the soil.
37	Remedial measures	The reinforced retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon.
38	Remarks, if any	The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion leading to loss in effective shear and cohesive strength of the soil. The retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon. The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/171
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate

`

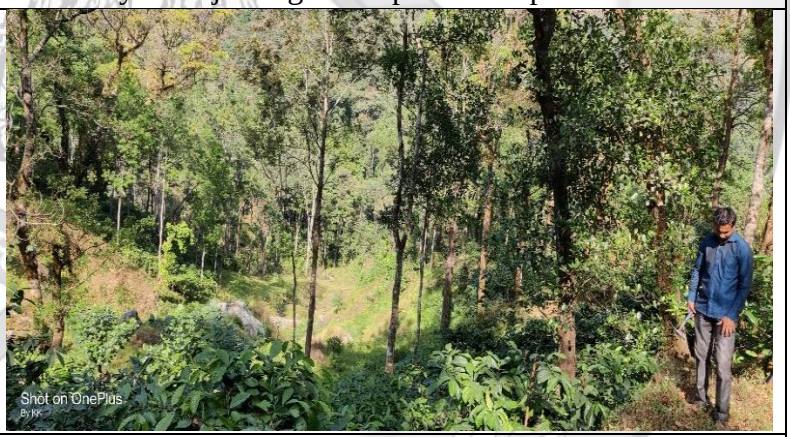
7	Latitude	13° 7'23.64"N
8	Longitude	75°29'35.95"E
9	Length	~35m
10	Width	~35m
11	Height	~20m
12	Area	~1225m^2
13	Depth	~3m
14	Volume	~3675m^3
15	Run out distance	~345m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Landslide initiated on upslope at interface of highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. The sub-surface water level rises on slope
37	Remedial measures	The retaining structure i.e. gabion wall with wire mesh at road bench level can be constructed to resist upslope movement towards downslope direction.
38	Remarks, if any	The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated on upslope at interface of highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The sub-surface water level rises on slope. The retaining structure i.e. gabion wall with wire mesh at road bench level can be constructed to resist upslope movement towards downslope direction. The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/172
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'23.38"N
8	Longitude	75°29'38.07"E
9	Length	~12m
10	Width	~35m
11	Height	~8m
12	Area	~420m^2
13	Depth	~1.5m
14	Volume	~630m^3
15	Run out distance	~345m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated

`

20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss/Amphibolite
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	1.Landslide initiated on upslope at interface of highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. The sub-surface water level rises on slope
37	Remedial measures	The retaining structure i.e. gabion wall with wire mesh at road bench level can be constructed to resist upslope movement towards downslope direction.
38	Remarks, if any	The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated on upslope at interface of highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The sub-surface water level rises on slope. The retaining structure i.e. gabion wall with wire mesh at road bench level can be constructed to resist upslope movement towards downslope direction. The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/173
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'18.00"N
8	Longitude	75°29'41.06"E
9	Length	~10m
10	Width	~35m
11	Height	~7m
12	Area	~350m^2
13	Depth	~1m
14	Volume	~350m^3
15	Run out distance	~345m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	1.Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. Scouring along stream channel along stream course.
37	Remedial measures	Lined drainage should be constructed along the cut slope.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. Scouring along stream channel along stream course. Lined drainage should be constructed along the cut slope.
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/174
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'19.84"N
8	Longitude	75°29'43.46"E
9	Length	~10m
10	Width	~35m
11	Height	~7m
12	Area	~350m^2
13	Depth	~1m
14	Volume	~350m^3
15	Run out distance	~345m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate

`

19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	1.Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. Scouring along stream channel along stream course.
37	Remedial measures	Lined drainage should be constructed along the cut slope.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. Scouring along stream channel along stream course. Lined drainage should be constructed along the cut slope.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/175
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'21.58"N
8	Longitude	75°29'43.31"E
9	Length	~15m
10	Width	~28m
11	Height	~11m
12	Area	~420m^2
13	Depth	~3m
14	Volume	~1260m^3
15	Run out distance	~345m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Saprse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	1.Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. Litho-contact zone between amphibolite and granite gneiss are weaker zone to initiate slope failure.
37	Remedial measures	1.Lined drainage should be constructed along the cut slope.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated adjoining to nala on highly weathered rock and rock during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The litho-contact zone between amphibolite and granite gneiss.The lined drainage should be constructed along the cut slope
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/176
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'52.02"N
8	Longitude	75°28'59.50"E
9	Length	~123m
10	Width	~35m
11	Height	~106m
12	Area	~4305m^2
13	Depth	~1m
14	Volume	~4305m^3
15	Run out distance	~65m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure

`

23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Foot track Road washed off
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	1.Landslide initiated adjoining to nala on highly weathered rock and rock on upward rrising slope during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. 2. The paleo sub-surface water channel got reactivated. 3. The failure initiated from the topographic break.
37	Remedial measures	Plantation should be done on failed rock mass.
38	Remarks, if any	The area is unstable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated adjoining to nala on highly weathered rock and rock on upward rrising slope during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The paleo sub-surface water channel got reactivated
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/177
2	State	Karnataka

`

3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'31.58"N
8	Longitude	75°29'12.29"E
9	Length	~42m
10	Width	~40m
11	Height	~25m
12	Area	~1620m^2
13	Depth	~3m
14	Volume	~4860m^3
15	Run out distance	~65m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	The shear failure of rock resulted due to loss in effective cohesion due to slope saturation.
37	Remedial measures	Plantation on slope required.
38	Remarks, if any	The area is meta-stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The paleo sub-surface water channel got reactivated.
41	Pdf	Attached
42	Alert	III

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/178
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'37.74"N
8	Longitude	75°29'16.79"E
9	Length	~13m
10	Width	~15m
11	Height	~8m
12	Area	~195m^2
13	Depth	~2m
14	Volume	~390m^3
15	Run out distance	~40m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope

`

25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	The loss in effective cohesion due to excessive slope saturation.
37	Remedial measures	Plantation on slope should be done.
38	Remarks, if any	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	 
40	Summary/Abstract	Landslide initiated during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The paleo sub-surface water channel got reactivated.
41	Pdf	Attached
42	Alert	II

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/179
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'35.53"N
8	Longitude	75°29'13.71"E
9	Length	~16m
10	Width	~35m
11	Height	~10m
12	Area	~560m^2
13	Depth	~2m
14	Volume	~1120m^3
15	Run out distance	~20m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Sparse vegetation
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	Vertical cut slope failure due to disturbance in slope geometry.
37	Remedial measures	Planattaion on slope.
38	Remarks, if any	The area is meta-stable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The paleo sub-surface water channel got reactivated
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/180
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'32.11"N
8	Longitude	75°29'13.13"E
9	Length	~150m
10	Width	~75m
11	Height	~22m
12	Area	~11250m^2
13	Depth	~2m
14	Volume	~22500m^3
15	Run out distance	~20m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	Loss in effective cohesion due to slope saturation during incessant rainfall leading to shear failure of slope.
37	Remedial measures	The plantation of slope will increase cohesive strength of the soil.
38	Remarks, if any	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated during incessant rainfall condition due to loss in effective shear and cohesive strength of the soil.
41	Pdf	Attached
42	Alert	III

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/181
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'38.12"N
8	Longitude	75°29'17.17"E

`

9	Length	~55m
10	Width	~75m
11	Height	~10m
12	Area	~4125m^2
13	Depth	~3m
14	Volume	~12375m^3
15	Run out distance	~20m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	Loss in effective cohesion due to slope saturation during incessant rainfall leading to shear failure of slope.
37	Remedial measures	The plantation of slope will increase cohesive strength of the soil.
38	Remarks, if any	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated during incessant rainfall condition due to loss in effective shear and cohesive strength of the soil.
41	Pdf	Attached
42	Alert	III

`

No.	Field	Description
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/182
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Alekhan Estate
6	NH/SH/Locality	Alekhan Estate
7	Latitude	13° 7'38.12"N
8	Longitude	75°29'17.17"E
9	Length	~200m
10	Width	~75m
11	Height	~55m
12	Area	~15000m^2
13	Depth	~3m
14	Volume	~45000m^3
15	Run out distance	~20m
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	New
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	No Damage recorded
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Plantation
36	Geo-scientific Causes	Loss in effective cohesion due to slope saturation during incessant rainfall leading to shear failure of slope.
37	Remedial measures	The plantation of slope will increase cohesive strength of the soil.
38	Remarks, if any	The area is unstable.

`

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated during incessant rainfall condition lead to loss in effective shear and cohesive strength of the soil. The paleo sub-surface water channel got reactivated
41	Pdf	Attached
42	Alert	II

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/183
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Sommanakadu Estate
6	NH/SH/Locality	Sommanakadu Estate
7	Latitude	13° 5'48.00"N
8	Longitude	75°28'45.50"E
9	Length	~20m
10	Width	~25m
11	Height	~15m
12	Area	~500m^2
13	Depth	~1.5m
14	Volume	~750m^3
15	Run out distance	~50m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019

`

24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct
27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion of valley portion lead to loss in effective shear and cohesive strength of the soil.
37	Remedial measures	The reinforced retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon.
38	Remarks, if any	The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
39	Photos. Sketch of Plan & section of the slide	 

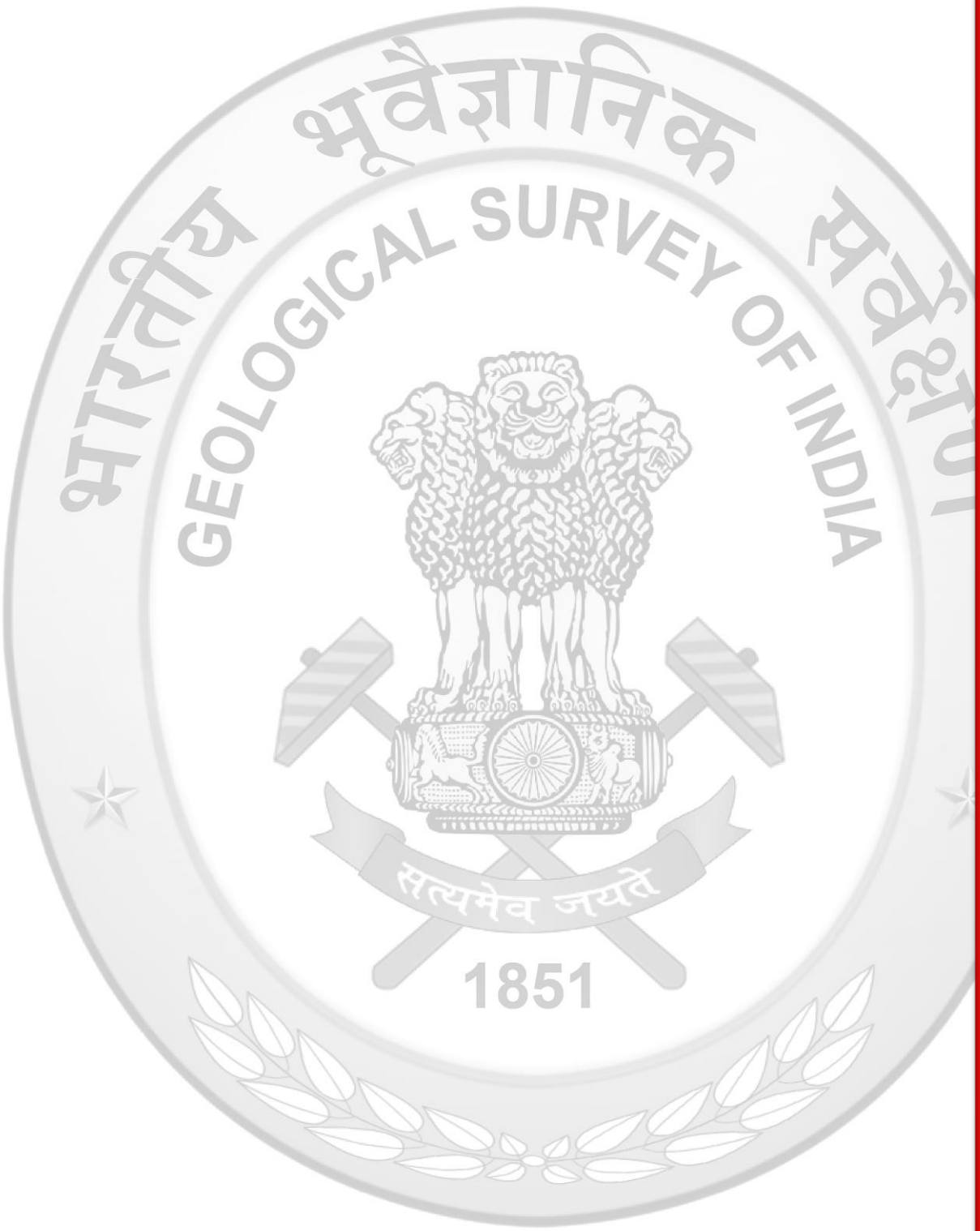
`

40	Summary/Abstract	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion leading to loss in effective shear and cohesive strength of the soil. The retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon. The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
41	Pdf	Attached
42	Alert	I

No.	**Field**	**Description**
1	Slide No (LS .No.)	KAR/CHK/48O8/2021/184
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/8
5	Name of the slide	Sommanakadu Estate
6	NH/SH/Locality	Sommanakadu Estate
7	Latitude	13° 5'46.40"N
8	Longitude	75°28'52.30"E
9	Length	~20m
10	Width	~25m
11	Height	~15m
12	Area	~500m^2
13	Depth	~1.5m
14	Volume	~750m^3
15	Run out distance	~50m
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Reactivated
20	Distribution	Retrogressive and Widening
21	Style	Single
22	Failure mechanism	Shallow Translational Failure
23	History	Old, Reactivation: July 2019
24	Geomorphology	Highly Dissected hillslope, Landform Unit: Slope
25	Geology	Weathered Granite gneiss
26	Structure	Indistinct

`

27	Land use/ Land cover	Barren
28	Hydrological condition	Damp
29	Triggering Factor	Rainfall
30	Death of persons	No Causalities
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road affected
34	Infrastructure	No Damage recorded
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion of valley portion lead to loss in effective shear and cohesive strength of the soil.
37	Remedial measures	The reinforced retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon.
38	Remarks, if any	The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Landslide initiated on steep upslope at interface of highly weathered rock and rock at upslope on 1st order stream channel during heavy rainfall. The excessive water discharge into the watershed initiated headward erosion and lateral erosion leading to loss in effective shear and cohesive strength of the soil. The retaining structure and culvert is constructed on road cross cutting the stream for safer communication and to control the damage of road during monsoon. The area is unstable and scouring effect of water has created instability on adjoining hillslope in flow path of stream.
41	Pdf	Attached
42	Alert	III



Please visit us at https://www.gsi.gov.in