

BEFORE THE NATIONAL GREEN TRIBUNAL SOUTHERN ZONE

AT MADRAS

O.A. NO 261 OF 2024

Suo Moto - News Item titled,

"Unscientific work by NHAI led to Shirur Landslide Geological Survey of India report"
appearing in the Indian Express dated 02.08.2024

M/s. National Highway Authority of India ^{vs.} and Ors. ... Respondents

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DATED AT CHENNAI ON THIS THE 27th DAY OF SEPTEMBER 2024


2nd
COUNSEL FOR RESPONDENT
^

भारत सरकार
GOVERNMENT OF INDIA
भारतीय भूवैज्ञानिक सर्वेक्षण
GEOLOGICAL SURVEY OF INDIA



**Note on the preliminary assessment of landslide at Shirur, Uttara
Kannada District, Karnataka, India**

एम4एलएस/ एनसी/एसआर/एसमू- केजी/2024/50072
M4LS/NC/SR/SU-KG/2024/50072

कायय सत्र 2024-25
Field season 2024-25

Engg. Geology & Landslide Division
State Unit: Karnataka & Goa
Southern Region

July 2024

Preliminary Note on Shirur Landslide, Uttara Kannada District, Karnataka, India.

Introduction:

The landslide incident at Shirur village, Ankola Taluk, in Uttara Kannada district occurred on 16th July 2024 at approximately 08:30 Hrs. The location of the event is at the left-hand side of Chainage number 148.000 (14.603554°N / 74.371219°E) of NH-66 (**Fig.1**). The landslide is characterized as a deep rotational debris flow with approximate dimensions: Length - 110m, Width - 130m, and Height - 50m. This event obstructed communication through the National Highway, with a runout distance exceeding 150m, depositing debris material into the river channel. Local reports indicate that the substantial volume of debris influx into the river caused an impact wave, resulting in the destruction of four houses on the opposite bank.

The Geological Survey of India investigated the landslide on the 17th and 18th of July, with the primary aims of understanding the geogenic causes of the landslide, assessing the potential for reactivation, and developing temporary remedial measures to restore communication, which can be implemented by the district administration.

NH-66, which passes through the area, makes a left bend at Shirur village and runs parallel to the right bank of the Gangavali River until the Gangavali highway bridge. To facilitate four-lane traffic, the hill slopes in this road section had to be modified. Satellite imagery from Google Earth (**Fig.2**) shows that slope modifications have been initiated in the area since 2017, with modifications up to 40m in height. Local reports indicate that the location of the Shirur landslide was modified with benches measuring 6m x 2m.

Geology and Geomorphology:

The area is part of the Western Ghat mountain ranges and exposes rocks of the Archean age. The rock type at the site is Pyroxenite of the Motimakki Ultramafites, overlain by a thick weathered horizon and soil layer. The hill slope near the landslide is a low dissected hill with an elevation difference of approximately 200m from the ridge top to bottom. Morphometrically, the slope angle ranges from 30° to 40° (**Fig. 3**). The drainage pattern is dendritic, with the drainage map of the study area, prepared from DEM, showing a few first-order drainages along the hill slope.

Susceptibility Status as per NLSM:

The slope sector from Chainage number 147.400 to 148.200 shows Moderate to High susceptibility according to the National Landslide Susceptibility Map of the Geological Survey of India (**Fig. 4**).

General Observations:

- ✚ The site has a very thick weathered rock and in-situ clay-rich lateritic soil (having thickness ranging from 5-15m) exposed by slope cutting.
- ✚ The pyroxenite rock in the area is highly weathered, topped by a thick soil cover. The fresh pyroxenite rock exposed at the toe tapers, providing minimal natural toe buttress or support for the slid zone.
- ✚ Natural drainage flows have been disturbed due to slope modifications.
- ✚ The slide area and the left flank are structurally deformed, presenting friable and gouge-like material.
- ✚ The landslide movement is extremely rapid and currently active, with the potential for enlargement.
- ✚ The adjoining slope on the right of the landslide has a gradient of approximately 40° without benches. Fresh tension cracks present in this area may lead to failure in case of continuous rainfall (**Fig. 5**). The debris thickness here is also considerable. Tension cracks of 2 feet depth were observed in the left flank also (**Fig. 6**).
- ✚ Multi-temporal satellite imagery indicates anthropogenic interference on the slopes from Chainage number 147.400 to 148.200 since 2017, with some landslide scars above the cut slopes.
- ✚ The 3-day antecedent rainfall in the area was 503 mm, causing saturation of the thick debris material and lithomarge, thereby increasing pore water pressure.
- ✚ **The steep gradient of the cut slope, presence of highly weathered rock, thick debris, saturation due to rainfall, and lack of toe support are the primary causative factors of the debris flow.** Intense rainfall acted as the trigger for the landslide.
- ✚ The high relief and overburden material in the hill slope suggest that retrogression of the slide is probable during prolonged rainfall.

Immediate Measures:

- Clear the debris in a phased approach, beginning with the lower sections. Use heavy machinery carefully to avoid disturbing the upslope. Employ spotters to monitor any slope movement. Vehicular traffic at night may be restricted/halted till the landslide site stabilizes.
- Refrain from removing debris material, including large boulders, on the hillward side below the landslide for the time being.
- Construct temporary channels to divert water away from the debris-clearing area to prevent further destabilization.
- No further modifications should be made to the hillward slope.

- Debris material may be cautiously removed only from the outer lane of the road. Traffic may resume in the outer lane after debris clearance. Continuous monitoring of the slope using spotters is crucial, and vehicular movement must be halted if any slope movement is detected, especially during prolonged rainfall.

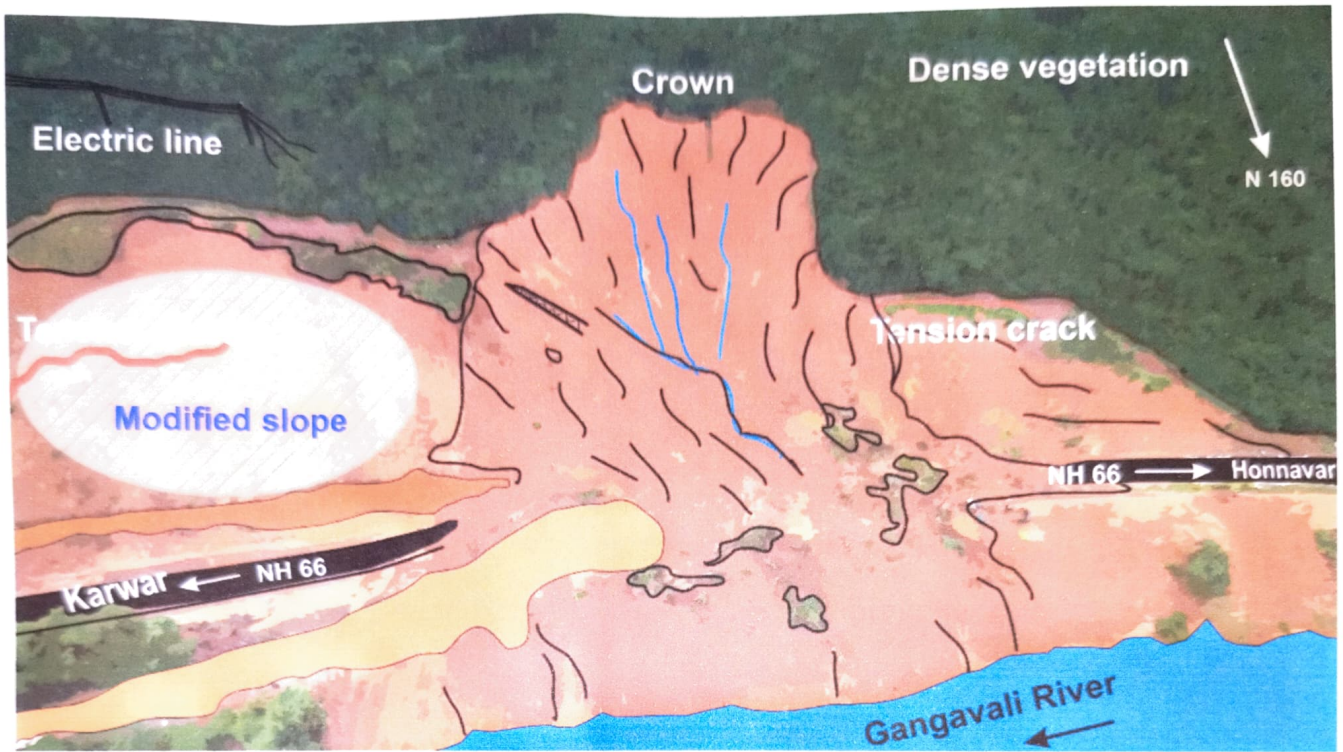


Fig.1: Schematic diagram of Shirur landslide (not to scale)



Fig.2 Multi-temporal satellite imageries of the landslide zone.

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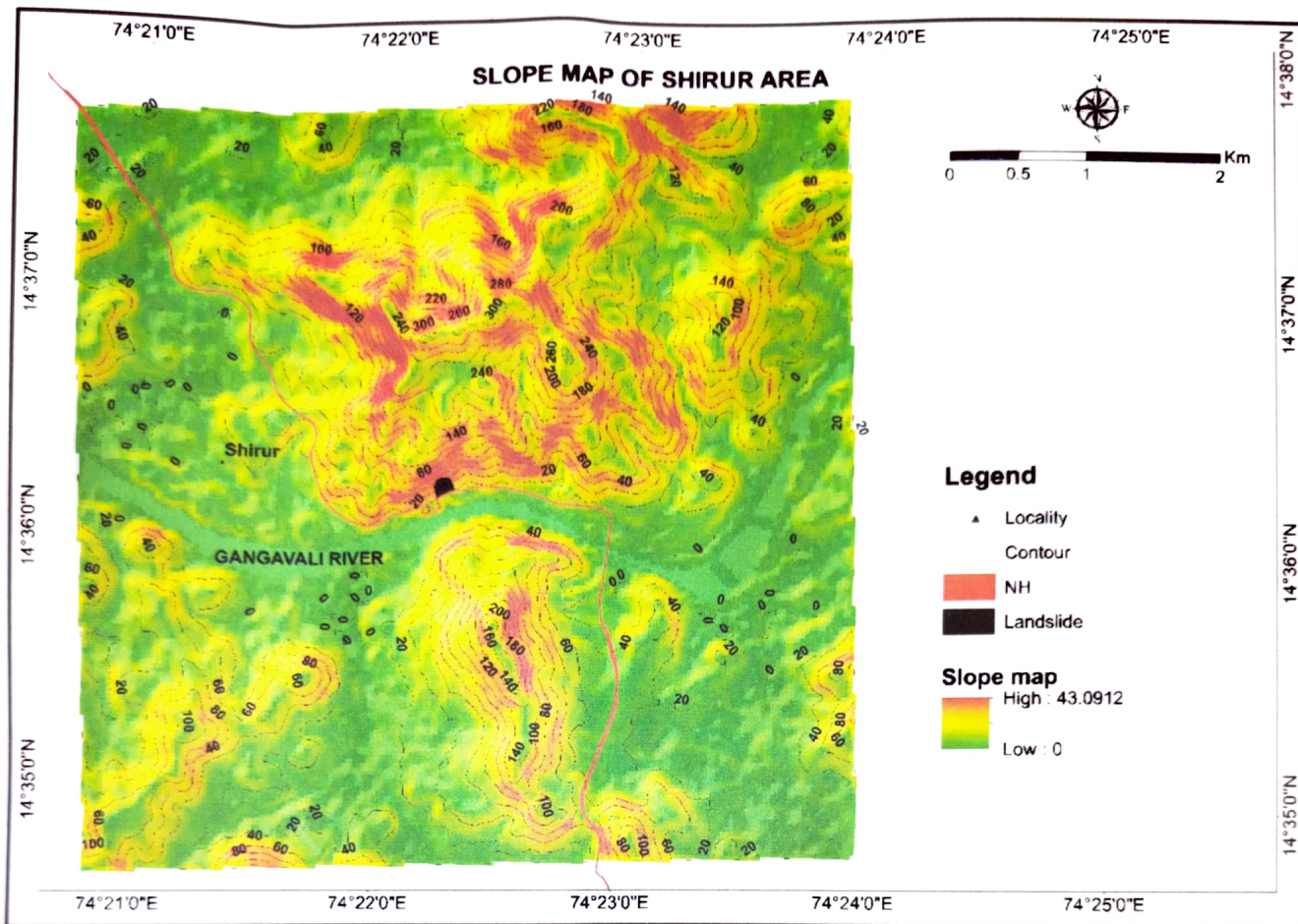


Fig. 3. Slope map of Shirur area derived from SRTM DEM

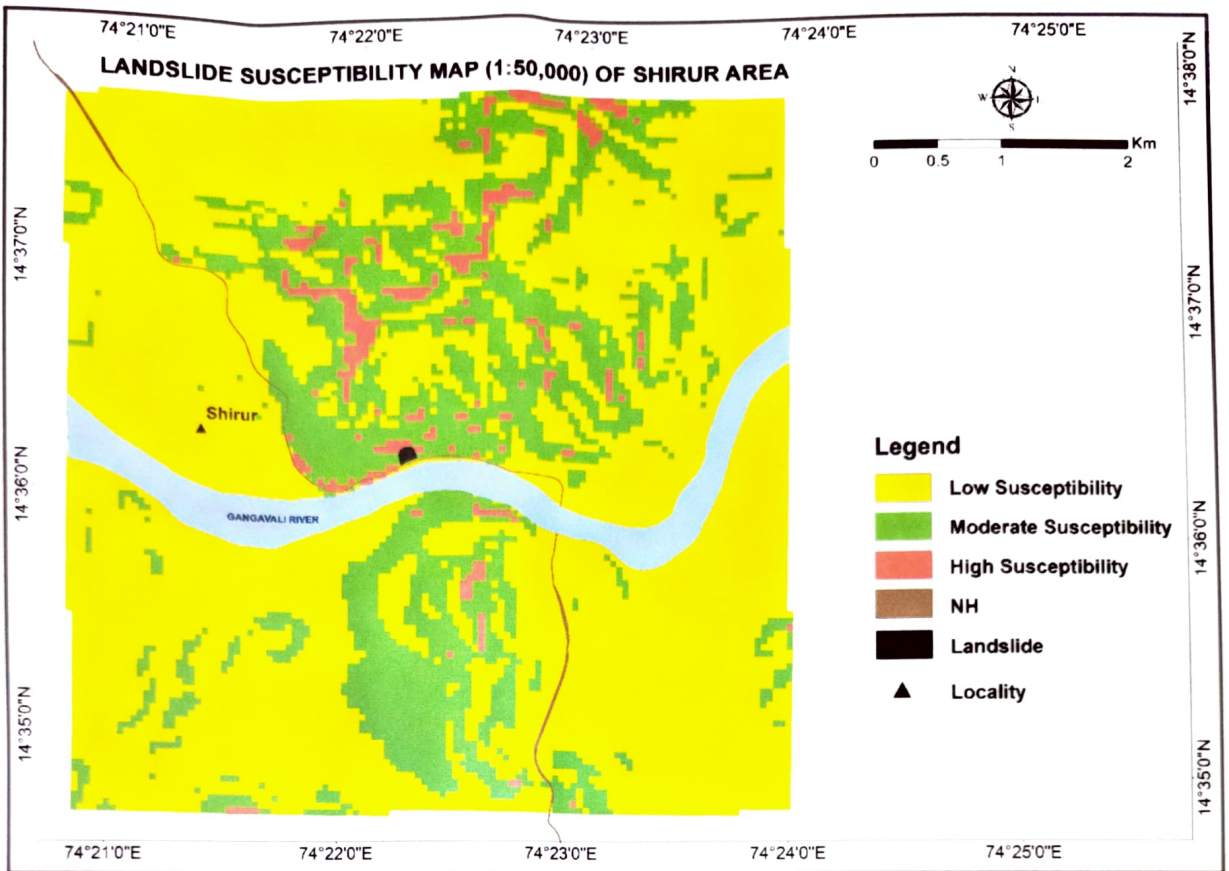


Fig. 4 National Landslide Susceptibility Map of Shirur area, (NLSM GSI)



Fig. 5 Transverse cracks on the right flank of the landslide



Fig. 6 Transverse cracks on the left flank of the landslide

Long-term Measures:

- The gradient at the slope sector from 147.400 to 148.200 should adhere strictly to BIS codes for slope gradient with benching, based on the geotechnical properties of the soil. The bench width should enable the slope segments to act independently, as prescribed in IS code 14680:1999.
- Benches should be provided with lined ditches or drainage to reduce erosion and infiltration along with slope reinforcement measures.
- The natural drainage path is modified due to extensive slope cutting at the site. A culvert with sufficient diameter pre-cast pipes should be provided to accommodate water and debris discharge at the toe of the landslide at Ch. No. 148.000.
- Monitor for tension cracks and possible displacement of slope material at the crown area.

- Given the excess subsurface water flow, engineered slopes should include provisions to drain subsurface water, such as perforated horizontal pipes of appropriate diameter, depending on site conditions.
- A comprehensive geotechnical investigation is recommended to determine appropriate slope stabilization strategies for the Shirur site.



No	Field	Description
1	Slide No (LS .No.)	KA/UK/48J06/2024/01
2	State	Karnataka
3	District	Uttara Kannada
4	Toposheet	48J06
5	Name of the slide	Shirur Slide
6	NH/SH/Locality	NH-66
7	Latitude	14.603554° N
8	Longitude	74.371219° E
9	Length	110m
10	Width	130m
11	Height	~50m
12	Area	~13000m ²
13	Depth	~10m
14	Volume	~1,30,000m ³
15	Run out distance	170 m
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Enlarging
21	Style	Single
22	Failure mechanism	Deep rotational failure
23	History	Initiation-16-07-2024, 08:00 am
24	Geomorphology	Low dissected hill
25	Geology	Pyroxenite
26	Structure	Foliation - 210°/45°; J1- 35°:30°; J2 – 80°:295°; J3 - 80°:230°
27	Land use/ Land cover	Dense vegetation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	7 at the time of investigation
31	People affected	4 people critically injured on the opposite bank
32	Live-stock loss	NA
33	Communication	Road blockage
34	Infrastructure	Road damaged, 4 houses destroyed, one tea stall washed away, two high tension power transmission towers destroyed, two trucks washed away
35	Agriculture/forest/Barren	Forest

36	Geo-scientific Causes	<ol style="list-style-type: none"> 1. The site has a very thick weathered rock and in-situ clay-rich lateritic soil exposed by slope cutting. 2. The pyroxenite rock in the area is highly weathered, topped by a thick soil cover. The fresh pyroxenite rock exposed at the toe tapers, providing minimal natural toe buttress or support for the slid zone. 3. Natural drainage flows have been disturbed due to slope modifications. 4. The slide area and the left flank are structurally deformed, presenting friable and gouge-like material. 5. <i>The steep gradient of the cut slope, presence of highly weathered rock, thick debris, saturation due to rainfall, and lack of toe support are the primary causative factors of the debris flow</i>
37	Remedial measures	<p>Immediate Measures:</p> <ul style="list-style-type: none"> ▪ Clear the debris in a phased approach, beginning with the lower sections. Use heavy machinery carefully to avoid disturbing the upslope. Employ spotters to monitor any slope movement. ▪ Refrain from removing debris material, including large boulders, on the hillward side below the landslide for the time being. ▪ Construct temporary channels to divert water away from the debris-clearing area to prevent further destabilization. ▪ No further modifications should be made to the hillward slope. ▪ Debris material may be cautiously removed only from the outer lane of the road. Traffic may resume in the outer lane after debris clearance. Continuous monitoring of the slope using spotters is crucial, and vehicular movement must be halted if any slope movement is detected, especially during prolonged rainfall. <p>Long-term Measures:</p> <ul style="list-style-type: none"> ▪ The gradient at the slope sector from 147.400 to 148.200 should adhere strictly to BIS codes for slope gradient with benching, based on the geotechnical properties of the soil. The

		<p>bench width should enable the slope segments to act independently, as prescribed in IS code 14680:1999.</p> <ul style="list-style-type: none"> ▪ Benches should be provided with lined ditches or drainage to reduce erosion and infiltration along with slope reinforcement measures. ▪ The natural drainage path is modified due to extensive slope cutting at the site. A culvert with sufficient diameter pre-cast pipes should be provided to accommodate water and debris discharge at the toe of the landslide at Ch. No. 148.000. ▪ Monitor for tension cracks and possible displacement of slope material at the crown area. ▪ Given the excess subsurface water flow, engineered slopes should include provisions to drain subsurface water, such as perforated horizontal pipes of appropriate diameter, depending on site conditions. ▪ A comprehensive geotechnical investigation is recommended to determine appropriate slope stabilization strategies for the Shirur site.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	<p>The landslide incident at Shirur village, Ankola Taluk, in Uttara Kannada district occurred on 16th July 2024 at approximately 08:30 Hrs. The steep gradient of the cut slope, presence of highly weathered rock, thick debris, saturation due to rainfall, and lack of toe support are the primary causative factors of the debris flow. As immediate measure</p>

Annexure - I

		<i>Clear the debris in a phased approach, beginning with the lower sections. Use heavy machinery carefully to avoid disturbing the upslope. Employ spotters to monitor any slope movement. A comprehensive geotechnical investigation is recommended to determine appropriate slope stabilization strategies for the Shirur site.</i>
41	Pdf	Attached
42	Landslide category	I

BEFORE THE NATIONAL GREEN TRIBUNAL SOUTHERN BENCH, CHENNAI

O.A.No. 261 of 2024

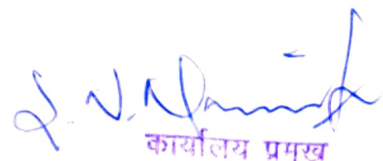
Suo Moto - News Item titled "Unscientific work by NHAI led to Shirur landslide Geological Survey of India report" appearing in the Indian Express dated 02.08.2024.

M/s. National Highway Authority of India and Ors. ^{Vs.} ... Respondents

REPLY AFFIDAVIT OF 2ND RESPONDENT

I, S.N. Mariappan, Son of Sinnanagappan, aged about 58 years, occupying the post of Director & Head of Office, in the Geological Survey of India, having their office at Chennai, do hereby solemnly affirm and sincerely state as follows:-

1. I am occupying the post of Director & Head of Office, in the Geological Survey of India and I am well acquainted with the facts of the case and I am competent to swear this Reply affidavit.
2. I submit that in so far as the Suo moto proceedings initiated by this Hon'ble Tribunal in Paragraph 1 of the Order dated 12.08.2024 this Respondent categorically and unequivocally states that the term "unscientific" has neither been used nor implied at any point in the Geological Survey of India (GSI) report. Therefore the news item appeared in the Indian Express dated 02.08.2024 have been exaggerated and used the words which have not been used by us.
3. In so far as para 2 of the Order dated 12.08.2024 is concerned, this Respondent reiterates the fact that this Respondent i.e. The Geological Survey of India (GSI) have not indicated in their preliminary report that unscientific work by the National Highways Authority of India (NHAI) led to the Shirur landslide. Furthermore, no member of the GSI team has conducted a press conference or interview making such a statement. The headline is not a verbatim account of



कार्यालय प्रमुख

HEAD OF OFFICE

पा.भू.स., राज्य इकाई: टी.एन.एवं.पी., चेन्नई-32.
GSI, SU: TN & P, Chennai-600 032.

GSI's report. The landslide incidence is due to a combination of multiple factors.

4. I submit that in respect of the Para 3 of the Order dated 12.08.2024 this Respondent states that it has been averred only about the landslide that had occurred and does not deal with the Report of this Respondent.
5. In so far as Para 4 of the Order dated 12.08.2024 is concerned, this Respondent states that the landslide may be due to Multiple factors including anthropogenic activities. The landslide resulted from a complex interplay of geological, hydrological and human factors. Although the exact contribution of each factor cannot be precisely quantified, it is evident that adverse geological and hydrological conditions and modification of the slope's toe were the contributing factors. Additionally, the landslide was triggered by intense rainfall. The combined effect of all these elements induced the landslide. While this being so, the publishing of the Article quoting this Respondent's Preliminary Report would be against the principles enunciated under the Constitution of India for the expression of freedom speech and expression. I submit that the news item does not disclose the actual report that has been given by us.
6. In respect of the para 5 of the Order dated 12.08.2024, it is once again reiterated that we never used the term "Unscientific" as appeared in the news item. Further we had also not given any early warning / alert for the landslide for the area.
7. In so far as the Para 6 to 8 are concerned we submit that this Hon'ble Tribunal has been clothed with all the powers to initiate suo moto action on the basis of the news article and were entitled to raise their concern about the environmental laws.


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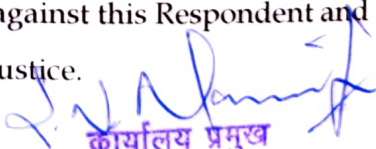
8. I submit that in so far as the landslide is concerned this Respondent states that they were informed on 16.07.2024 i.e. The Geological Survey of India (GSI) State Unit for Karnataka and Goa was notified of the Shirur landslide in Uttara Kannada District on 16th July 2024 at 19:00 hours.

Thereafter on 17.07.2024, the GSI team conducted a preliminary assessment and held discussions with the Assistant Commissioner of Karwar. On 18.07.2024, the GSI team met with officials from the National Highways Authority of India (NHAI) and conducted a site visit to the Shirur landslide area. The team performed a detailed geological investigation of both sides of the landslide and engaged in further discussions with the Assistant Commissioner at the site. In the evening, the team briefed the District Commissioner of Uttara Kannada on the condition of the landslide zone and provided recommendations for both immediate and long-term measures.

On 19.07.2024, the GSI team have evaluated the slope stability of critical sections of National Highway 66, including Shirur. A preliminary report on the Shirur landslide was compiled and submitted to the District Commissioner of Uttara Kannada following approval from the competent authority within the GSI.

9. I submit that this Respondent will submit any further Reports if this Hon'ble Tribunal directs us to do so.

10. For all the reasons stated above it is therefore prayed that this Hon'ble Court may be pleased to drop the suo moto proceedings against this Respondent and pass such further or other orders and thus render justice.


कार्यालय प्रमुख
HEAD OF OFFICE
भा.भू.स., राज्य इकाई: टी.एन.एल.पी., चेन्नई-32
GSI, SU: TN & P, Chennai-600 032

Solemnly affirmed at Chennai on
this the 27th day of September 2024
and signed his name in my presence
after reading the contents herein

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BEFORE ME,
Mediala. Ms/251123
No.366, Law chambers, Highcourt
ADVOCATE, CHENNAI buildings,
Ch-lou


COUNSEL FOR 2nd RESPONDENT

BEFORE THE NATIONAL GREEN
TRIBUNAL SOUTHERN ZONE
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REPLY AFFIDAVIT OF 2ND
RESPONDENT

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Standing Counsel
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