



Disaster Management

Musharraf Faruqui, IAS

Chairman & Managing Director, TGRPDCL



Disaster Management

First part

- What is Disaster Management
- Authorities /Norms
- Role at sub-div / Dist /state

Second part

- Case study of SLBC Tunnel Collapse
- Learnings for administrators

Disaster management in India

- The National Disaster Management Authority (NDMA), headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005.
- Evolution of NDMA
- Emergence of an organization is always an evolutionary process. Establishment of NDMA has also gone through the same processes. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the 2001 Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms.

THE DISASTER MANAGEMENT ACT, 2005

No. 53 OF 2005

[23rd December, 2005.]

An Act to provide for the effective management of disasters and for matters connected therewith or incidental thereto.

BE it enacted by Parliament in the Fifty-sixth Year of the Republic of India as follows:—

CHAPTER I PRELIMINARY

- 1. (1) This Act may be called the Disaster Management Act, 2005.**
- (2) It extends to the whole of India.**
- (3) It shall come into force on such date as the Central Government in the Official Gazette appoint; and different dates may be appointed for different States, and any reference to commencement of that provision in that State.**

MINISTRY OF LAW AND JUSTICE
(Legislative Department)

New Delhi, the 29th March, 2025/Chaitra 8, 1947 (Saka)

The following Act of Parliament received the assent of the President on the 29th March, 2025 and is hereby published for general information:—

THE DISASTER MANAGEMENT (AMENDMENT) ACT, 2025

No. 10 OF 2025

[29th March, 2025.]

An Act to amend the Disaster Management Act, 2005.

BE it enacted by Parliament in the Seventy-sixth Year of the Republic of India as follows:—

1. (1) This Act may be called the Disaster Management (Amendment) Act, 2025.

(2) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint.

Short title and commencement.

Natural Hazards

Cyclone

Tsunami

Heat Wave

Landslide

Urban Floods

Floods

Earthquakes

Man made Hazards

Chemical

Nuclear

Biological

NDMA

- **DISASTER MANAGEMENT FRAMEWORK**

- NDMA – PM is the Chairperson
- SDMA – Chief Minister is the chairperson – SEC (CS)
- DDMA – District Collector

- **NIDM**

- **National Disaster Response Force (NDRF)**

- **National Disaster Response Fund (NDRF) and SDRF for Rescue/recovery**

- **Mitigation Funds – reconstruction/ permanent measures**

-ALLOCATION AS PER 15TH FC TO STATES

(Period 2022-26, MHA Letter No. 33-03/2020-NDM-I Dated 10.10.2022, modified vide letter No. 33-03/2020-NDM-I Dated 11.07.2023)

S.No.	Items	Norms of Assistance
A	Response & Relief [40% of State Disaster Risk Management Fund (SDRMF) i.e. equal to 50% of SDRF allocation for the year]	
1	Gratuitous Relief	
	a) Ex-Gratia payment to families of deceased persons.	Rs. 4.00 lakh per deceased person, including those involved in the relief operations or associated in preparedness activities, subject to the certification regarding cause of death from the appropriate authority.
	b) Ex-Gratia payment for loss of a limb or eye(s).	Rs. 74,000/- per person, when the disability is between 40% and 60%. Rs. 2.50 lakh per person, when the disability is more than 60%. Subject to certification by a doctor from a hospital or dispensary of Government, regarding the extent and cause of disability.
	c) Grievous injury requiring hospitalization	Rs. 16,000/- per person requiring hospitalization for more than a week. Rs. 5400/- per person requiring hospitalization for less than a week.

SDRF – CENTRE:STATE 75:25 AND 90:10

B.	Recovery & Reconstruction: (30% Of SDRMF i.e. equal to 37.50% of SDRF allocation for the year)	
10	Housing	
	a) Fully damaged/ destroyed houses and severely damaged houses	
	i) Pucca house	Rs. 1,20,000/- per house, in plain areas.
	ii) Kutcha House	Rs. 1,30,000/- per house, in hilly areas.
	b) Partially Damaged Houses (Other than huts) where the damage is at least 15%	
	i) Pucca house	Rs. 65,00/- per house.
	ii) Kutcha House	Rs. 4,000/- per house.
	c) Damaged/ destroyed huts:	Rs. 8,000/- per hut. (Hut means temporary, make shift unit, inferior

<p>nature) of damaged infrastructure]</p> <p>(1) Roads & bridges, which may include the following activities:</p> <p>i) Filling up of breaches and potholes, use of pipe for creating waterways, repair and stone pitching of embankments.</p> <p>ii) Repair of breached culverts.</p> <p>iii) Providing diversions to damaged/ washed out portions of bridges to restore immediate connectivity.</p> <p>iv) Temporary repair of approaches to bridges/ embankments of bridges, repair of damaged railing bridges, repair of causeways to restore immediate connectivity, granular sub base, over damaged stretch of roads to restore traffic.</p>	<p>Assessment of requirements: Based on the assessment of need, as per States' notified schedule of rates for repairs, by SEC and recommendation of the Central Team (in case of NDRF).</p> <p>In case of repair of roads, assistance will be given based on the notified Ordinary Repair (OR) and Periodical Renewal (PR) of the State. In case OR & PR is not available, then assistance will be provided as per rate prescribed in this item. However, in any case, the assistance will be provided at the rate whichever is lower.</p> <p>Prescribed rate are as under:-</p> <ul style="list-style-type: none"> ➤ Repairs of State Highways /Major District Roads(MDR). <ul style="list-style-type: none"> - in normal areas -- @ Rs. 1.00 lakh /km; - in hilly areas -- @ Rs. 1.25 lakh /km ; ➤ Repairs of Rural/village Roads with culverts <ul style="list-style-type: none"> - in normal areas -- @ Rs. 60,000/- km ; - in hilly areas -- @ Rs. 75,000 / km ; ➤ Repairs of RCC Culvert/Bridge <ul style="list-style-type: none"> - in normal areas -- @ Rs 60,000 per culvert; - in hilly areas -- @ Rs 75,000/- per culvert.
<p>(2) Drinking Water Supply Schemes, which may include the following activities:-</p> <p>i) Repair of damaged platforms</p>	<p>Damaged drinking water supply schemes will be eligible for assistance as per actual, subject to a ceiling of Rs 2.00 lakh per damaged scheme.</p>

ITEMS NOT COVERED

<ul style="list-style-type: none"> a) Colleges and other educational institutions buildings. b) Major/ medium Irrigation Schemes. c) Flood control and anti Erosion Protection work. d) Hydro Power Project/ HT Distribution systems/ Transformers and sub stations. e) High Tension Lines (above 11 kv). f) State Government Buildings viz. departmental/ office building, departmental/ residential quarters, religions structures, patwarkhana, Court premises, play ground, forest bungalow property and animal/ bird sanctuary etc. g) Long terms/ permanent restoration work. h) Procurement of equipments/ machineries under NDRF. i) National Highways. j) Sectors such as Telecommunication and Power (except immediate restoration of power supply), which generate their own revenues, and also undertake immediate repair/ restoration works from their own funds/ resources, are excluded.

Allocation and Release of Funds from SDRF and NDRF during 2025-2026

As on 30.11.2025

(Rs. in crore)

Sl. No.	Name of the State	Allocation of SDRF			Releases from SDRF		Releases from NDRF for		
		Central Share	State Share	Total	1 st Instalment	2 nd Instalment	Natural disasters	M of Fire services	PDNA (R&R)
1	2	3	4	5	6	7	8	9	10
1.	Andhra Pradesh	1088.00	361.60	1449.60	544.00	--	--	--	--
2.	Arunachal Pradesh	243.20	27.20	270.40	237.20#	--	--	34.536	--
3.	Assam	751.20	83.20	834.40	375.60	--	49.85	--	304.99
4.	Bihar	1376.80	459.20	1836.00	688.40	--	--	76.704	--
5.	Chhattisgarh	420.00	140.00	560.00	400.00#	--	--	--	--
6.	Goa	11.20	4.00	15.20	5.60	--	--	--	--
7.	Gujarat	1287.20	428.80	1716.00	1854.00#	--	--	76.239	--
8.	Haryana	477.60	159.20	636.80	238.80	--	--	26.241	--
9.	Himachal Pradesh	397.60	44.00	441.60	198.80	198.80	107.15	23.52	451.44
10.	Jharkhand	552.00	184.00	736.00	276.00	--	--	33.294	--
11.	Karnataka	768.80	256.00	1024.80	384.40	384.40	--	--	--
12.	Kerala	306.40	101.60	408.00	153.20	--	--	36.32	78.168
13.	Madhya Pradesh	1770.40	589.60	2360.00	885.20	--	--	89.145	--
14.	Maharashtra	3132.80	1044.00	4176.80	1566.40	1566.40	--	138.09	--
15.	Manipur	40.80	4.80	45.60	29.20#	--	114.88	16.20	--
16.	Meghalaya	64.00	7.20	71.20	60.00#	--	--	--	--
17.	Mizoram	45.60	4.80	50.40	22.80	--	--	14.40	--
18.	Nagaland	40.00	4.80	44.80	20.00	20.00	--	14.42	--
19.	Odisha	1560.00	520.00	2080.00	780.00	--	--	--	--
20.	Punjab	481.60	160.80	642.40	240.80	240.80	--	--	--
21.	Rajasthan	1440.00	480.00	1920.00	720.00	--	--	87.51	--
22.	Sikkim	48.80	5.60	54.40	24.40	24.40	--	11.612	76.15
23.	Tamil Nadu	992.00	330.40	1322.40	496.00	--	522.34	--	--
24.	Telangana	436.80	145.60	582.40	218.40	--	--	57.04	--
25.	Tripura	67.20	7.20	74.40	25.20	--	--	--	--
26.	Uttar Pradesh	1880.80	626.40	2507.20	1836.00#	--	--	--	--
27.	Uttarakhand	911.20	100.80	1012.00	455.60	455.60	--	--	291.15
28.	West Bengal	983.20	328.00	1311.20	491.60	--	--	--	--
Total: -		21,575.20	6,608.80	28,184.00	13,227.60	2890.40	794.22	735.271	1201.898

= includes arrears of previous year.

5	Comprehensive Implementation of School Safety Guidelines	<p>Deliver a bundled solution comprising all the components listed under Categories A to D including.</p> <ul style="list-style-type: none"> ● Preparation or updation of the School Disaster Management Plan (SDMP). ● Development of a School Exit Map for evacuation planning and drills. ● Creation of a School Profile in the prescribed format as per the National School Safety Programme (NSSP) template. ● Capacity building on a single identified hazard/emergency. ● One-day awareness or sensitization activity to promote disaster risk literacy and preparedness. ● Resource inventory and mapping, including identification of safety equipment, exits, and fire extinguishers. ● Establishment of a mechanism for timely alerting of students and staff, and a school-specific disaster preparedness checklist to guide readiness actions ● Monitoring, evaluation, and reporting <p>Submit a consolidated report with individual activity documentation and a final school safety compliance summary.</p>	Rs.40,000/-
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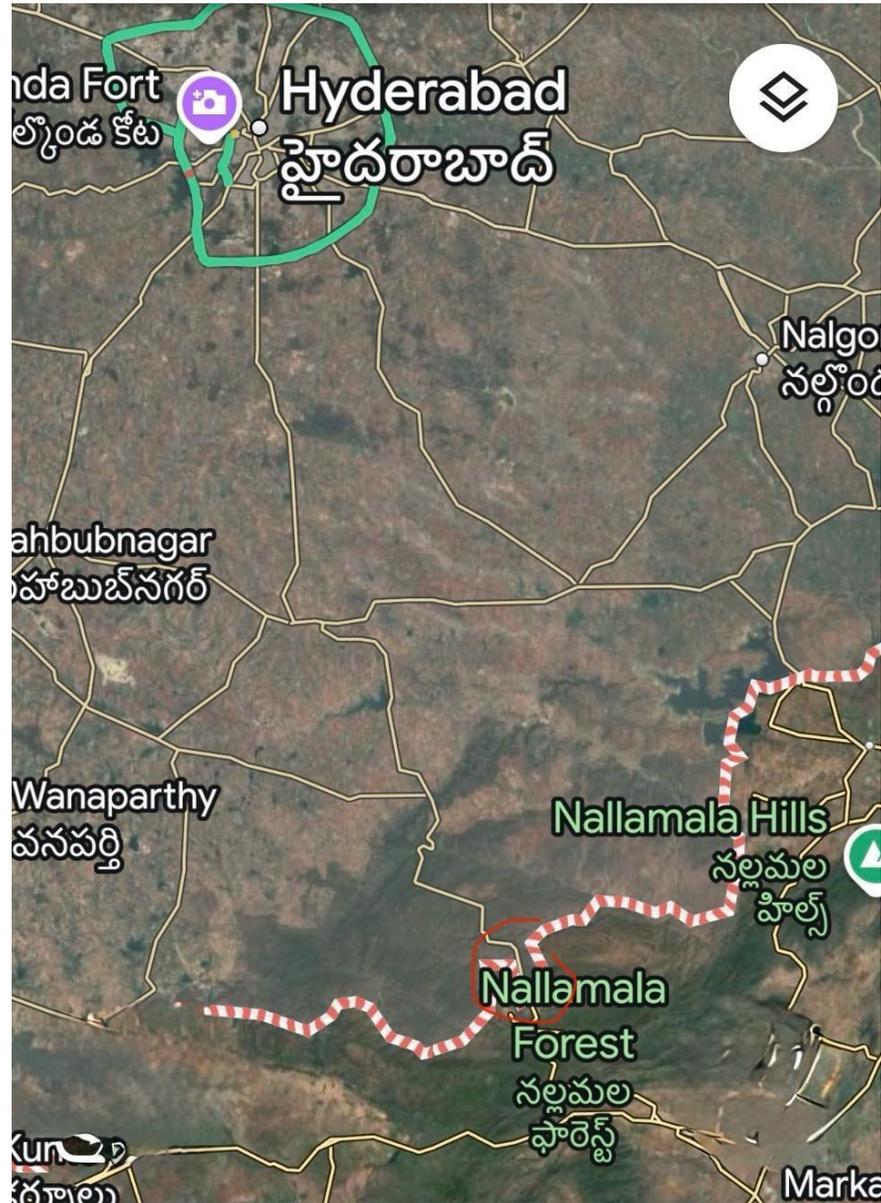
SLBC tunnel collapse learnings for Administrators

in

Disaster Management

Musharraf Faruqui, IAS

Chairman and Managing Director, TGRPDCL

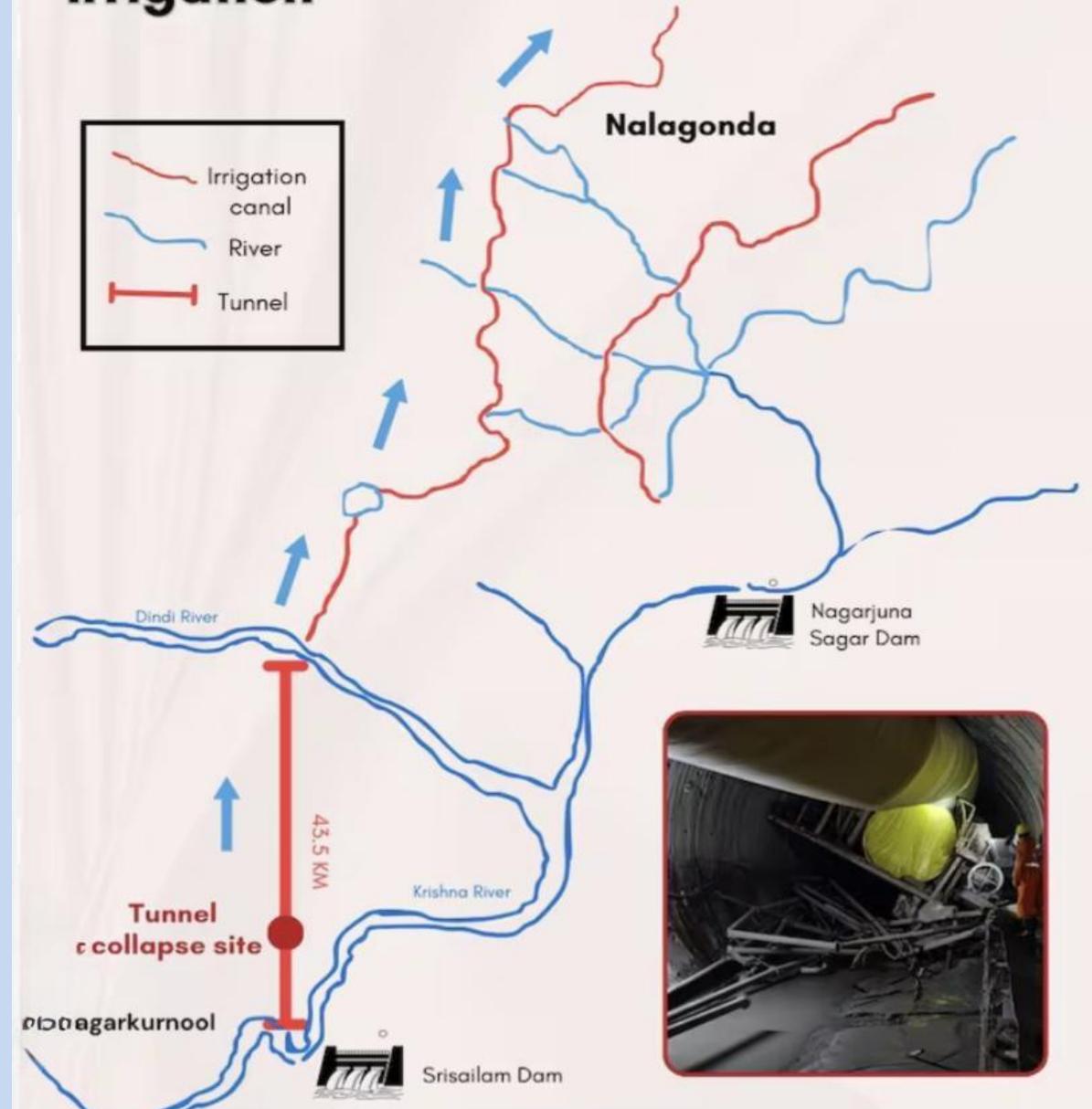


Srisailam Left Bank Canal (SLBC)

- World's longest tunnel (43.93 kms)
- without any intermediate access

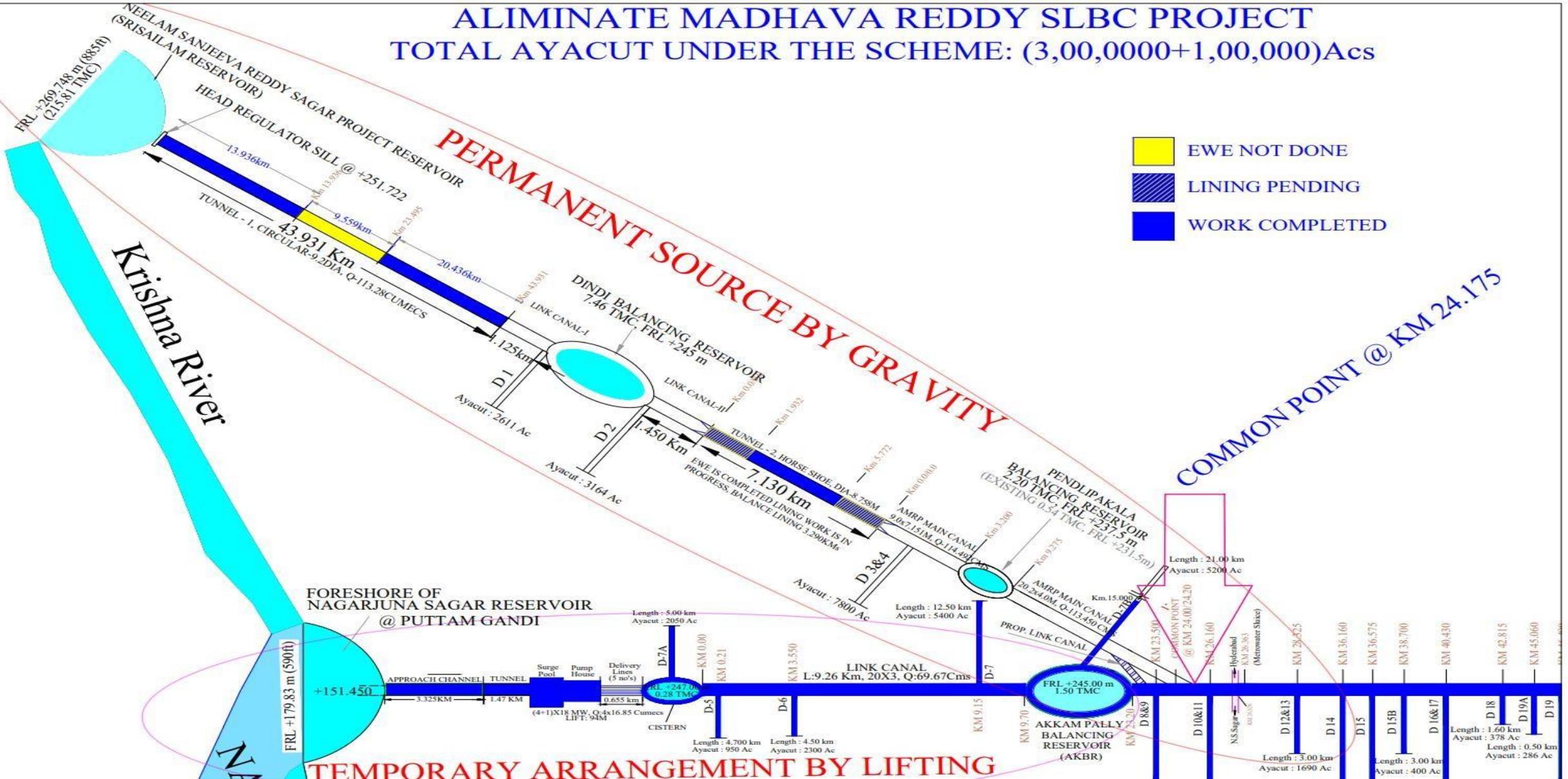
Telangana Tunnel Collapse

SLBC Tunnel's Role in Regional Irrigation



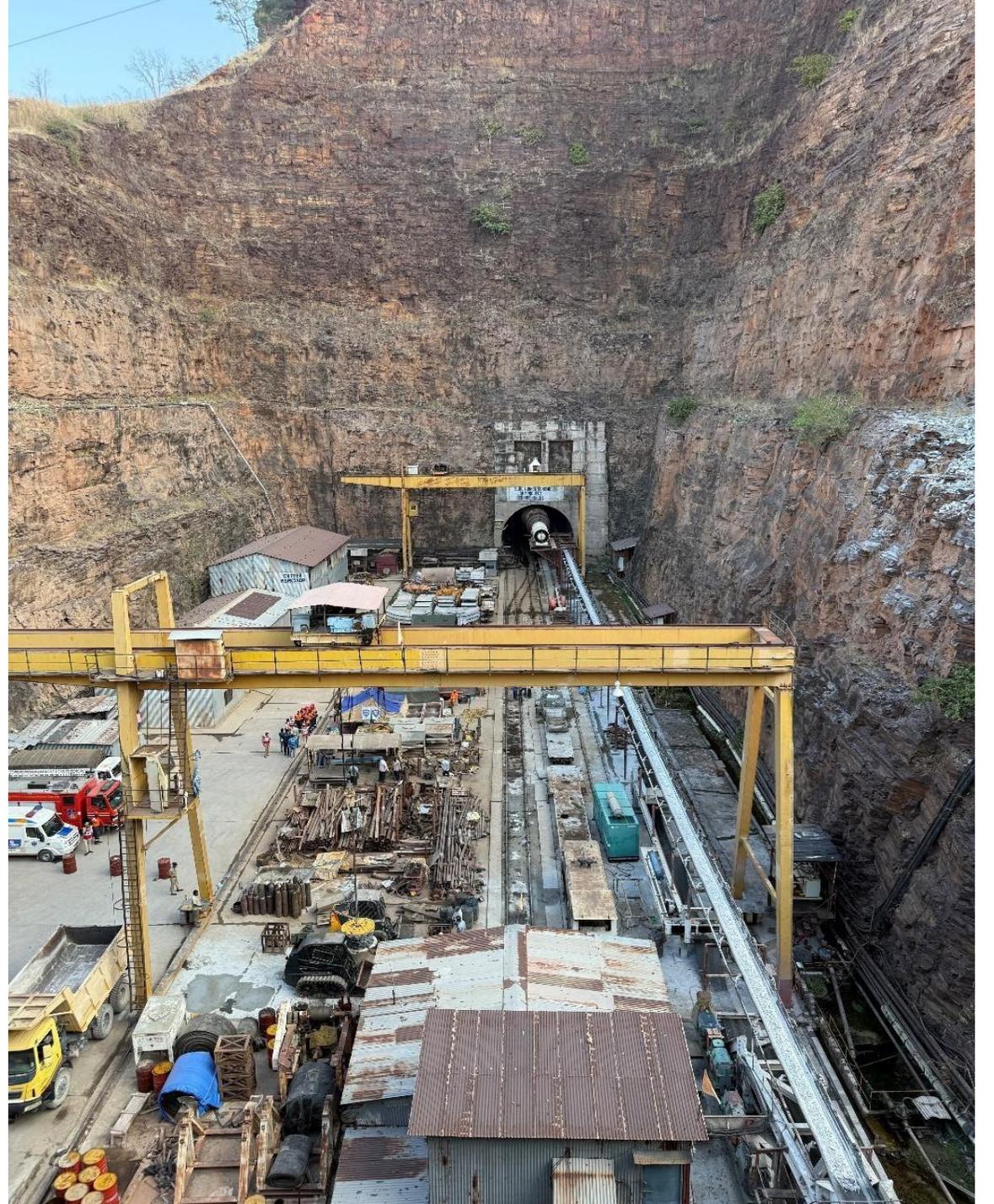
SLBC Tunnel Project Layout

ALIMINATE MADHAVA REDDY SLBC PROJECT
 TOTAL AYACUT UNDER THE SCHEME: (3,00,000+1,00,000)Acs



Why SLBC ?

- The initial total cost @Rs 2500 is now about Rs 4638 crs.
- 30 TMC Water runs through gravity
- Will save about Rs 750 crs pa on lift irrigation
- Plus creating new areas under assured irrigation (3 lakh acres)



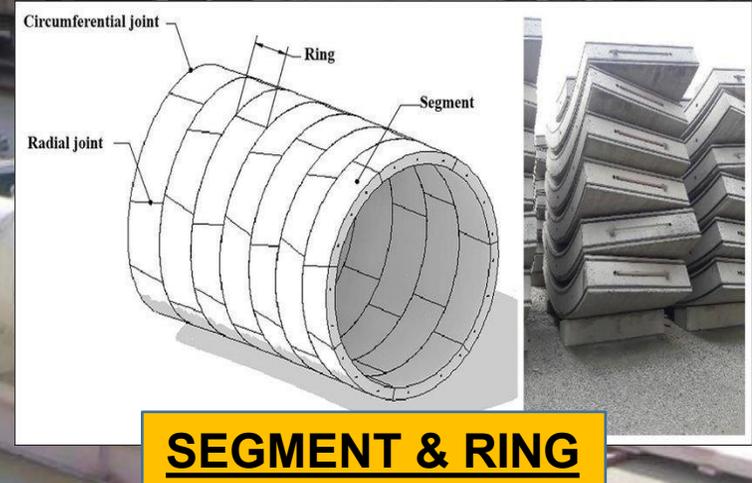
Background

TUNNEL 1 WORKS

- 43.94 Km Tunnel Alignment - under Reserve Forest & Tiger Reserve
- No Geotechnical Exploration
- Work based on walkover Survey & Surface Observations only
- 300-500 m Overburden
- TBM used due to Supreme Court Restrictions on Blasting
- Two TBMs
 - Inlet Side Progress • 13.954 Kms (Work Stopped on 22 Feb 2025)
 - Outlet Side Progress • 20.43 Kms (Work Stopped since Jan 2023)
- Pumping Stations @ 2500 m from Inlet – 50 HP pumps to dewater tunnel – 3500 lpm

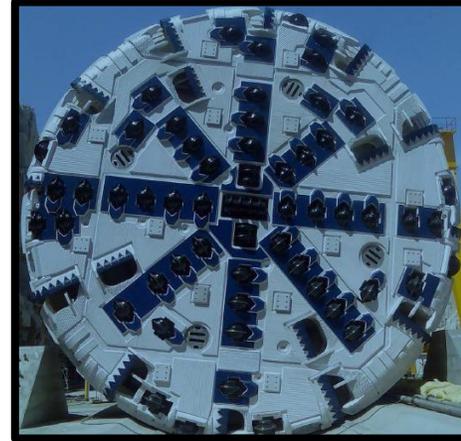
Double Shield TBM

- Three Storey Structure
- 07 Main Gantries with ramp
- 128.5 m Long
- Items Placed on Top
- Loco Moves Inside for Manpower & Material



SALIENT FEATURES : SLBC TBM

- ✓ **10 m Dia Double shield Hard Rock Tunnel Boring Machine – 9.2 m Internal**
- ✓ **Length of Double Shield : 12.40 m**
- ✓ **Length of Back- up System : 116 m**
- ✓ **Total Weight : 1500 T**
- ✓ **Conveyor System throughout for mucking**
- ✓ **Ventilation duct throughout till working face**



CUTTERHEAD



LOCOMOTIVE & CONVEYOR SYSTEM

ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025

✓ 0815 Hrs – Water accompanied with silt entered tunnel at Chainage 13.934 Km (20 m behind Cutter Head). Followed by a huge amount of Debris & Water after 20 mins

Two JAL Engineers

- Ring Building Area

Two JAL Workers

- Dewatering near Ring Building Area

Two Robbins Employees Two

- Ring Building Area

JAL Workers

- P Gravel Platform (Top of Zero Gantry)

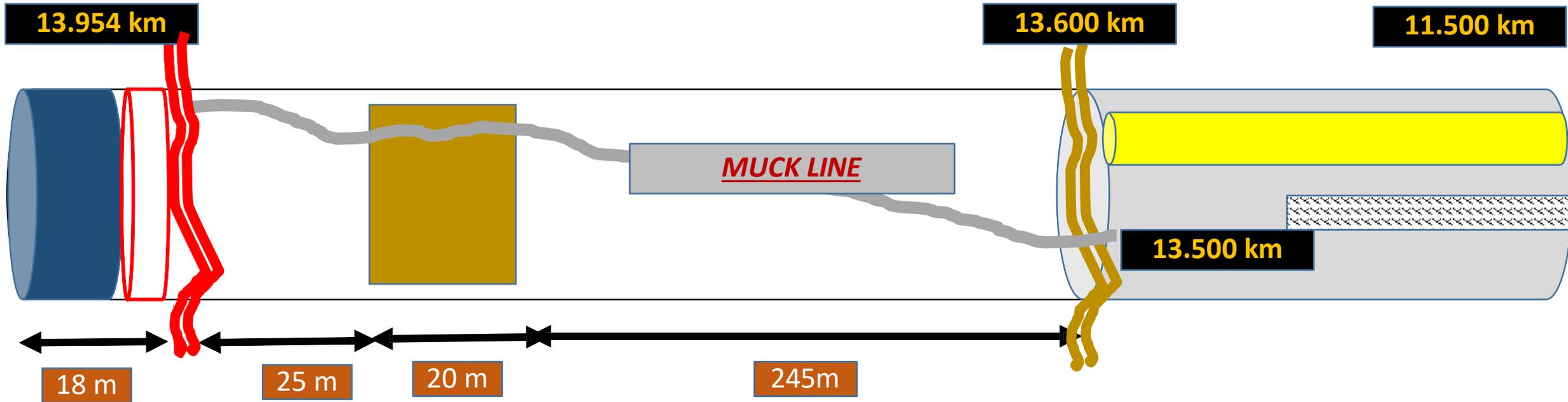
✓ Muck 350 m & Water – 2.5 Km : Silkiyara was 57 m dry muck

✓ Water went up from 3500 lpm to 10,000 lpm for few hrs

✓ Locomotive till 11.5 Km due to water, Conveyor & Ventilation Duct damaged

✓ 130 meters long TBM buried

ASSESSMENT : 26 FEB



- NHIDCL rep - Increasing water levels and movement of muck inside first 2-3 days
- NDMA team recce on 26 Feb 2025
- Muck height 8 m at collapse point and almost 2 m high 350 m from collapse.
- 03 rings(1.6 m each) had collapsed and another 3-4 rings deformed
- Muck had pushed out many components from top of the TBM incl one gantry behind by 300 m which were blocking the access of tunnel around 13.600 Km.

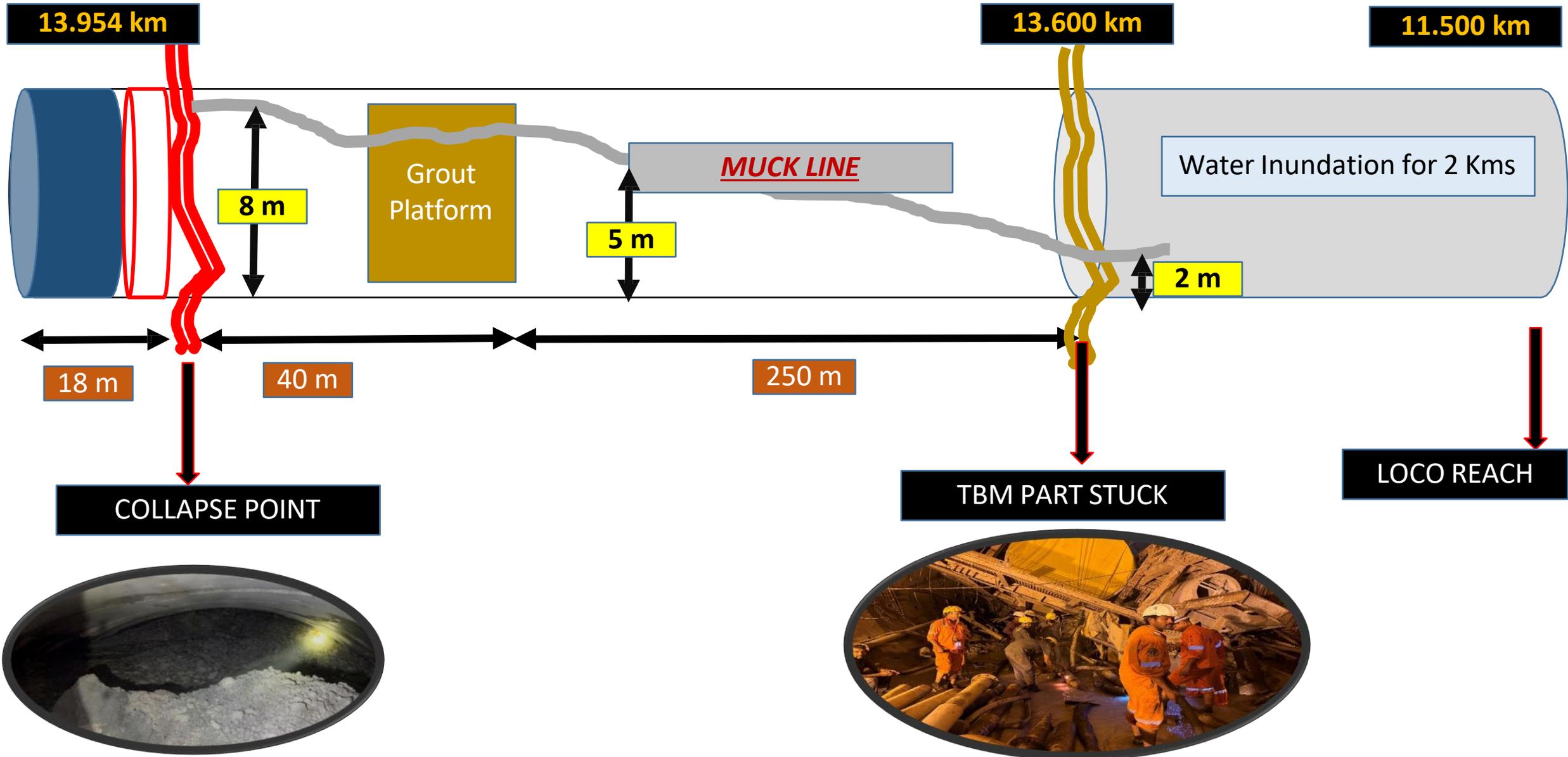
ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025

- One Complete Gantry
- All Electrical panels, tanks and accessories on TBM top storey
- 60 m of Heavy Metal Cutting
- Not accessible for cutting due to water accumulation behind



TBM PART STUCK AT 13.600 KM

STATUS ON 26 FEB 2025



ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025



COLLAPSE ZONE : 13.934 KM

ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025



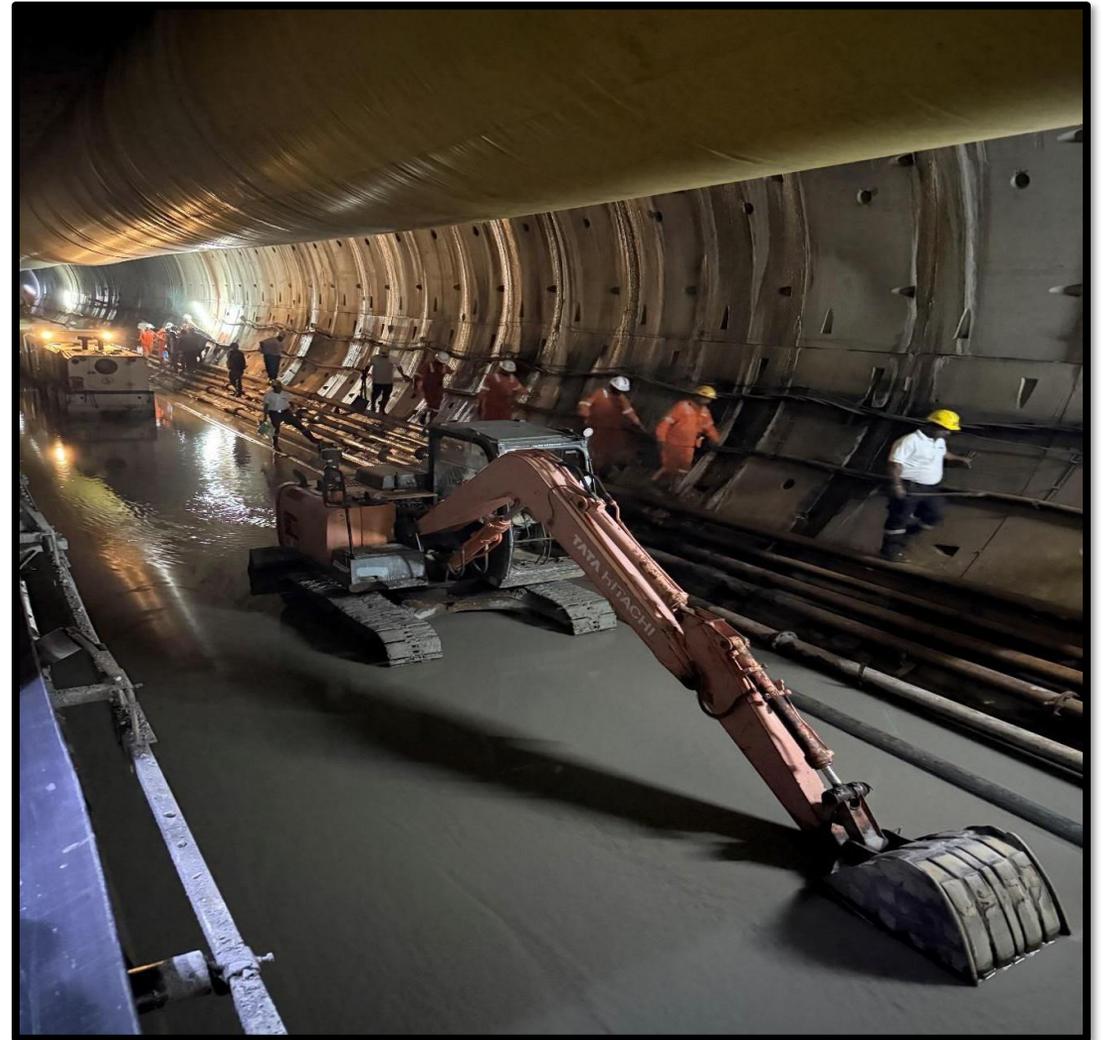
Cavity

- Material from ahead & above
- Spiral Chute like Cavity on left

ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025



MUCK & DEBRIS KM 13.700



SILT & WATER ON LOCO TRACK

ADVERSE GEOLOGICAL EVENT ON 22 FEB 2025



SILT FLOW INSIDE TUNNEL



**GROUT PLATFORM 40 M BEHIND
COLLAPSE ZONE**

RESCUE OPERATIONS

CONSTITUTION OF MULTI-AGENCY TEAM (25)

CENTRAL GOVT (11)	STATE GOVT (08)	PVT AGENCIES (06)
NDMA	District administration	Rat miners & Kerala Miners
Indian Army – Engrs & AMC	Police Dept	Navayuga
Kerela Police - HRDDs	HYDRAA	Proboscope co.
NDRF	SCCL	L&T
South Central Railways	Disaster Mgt Dept	Anvi Robots co.
National Centre of Seismology	Health Dept.	JAL
Indian Navy - Divers	SDRF	
NGRI	Fire Department	
GSI		
BRO		
NHIDCL		
NRSC		

ARRIVAL OF RESCUE TEAMS

22.02.2025

- DISTRICT ADMINISTRATION - 73
- POLICE DEPARTMENT - 200
- HEALTH DEPT - 21
- JAYPEE-75
- ROBBINS - 9
- NDRF - 138
- HYDRAA - 64
- SCCL(Singareni) – 220
- SDRF- 102

23.02.2025

- GSI-2
- RAT MINORS-14
- NAVAYUGA -8
- DISASTER MGT.DEPARTMENT
- ENT
- MoRTH/NHIDCL – 1
- NDMA-1

24.02.2025

- L&T & SOLINAS -12
- DRONE -13
- NAVY - 6
- ARMY ENGINEERS - 67
- ARMY MEDICAL-8
- PROBOSCOPE -6
- BRO - 2

ARRIVAL OF RESCUE TEAMS

25.02.2025

- MEIL -73

26.02.2025

- RAILWAY-31

27.02.2025

- NGRI-4

27.02.2025

- NDMA-1

05.03.2025

- NCS -5

06.03.2025

- IIT PROFESSORS
-2
- CADAVER
DOG SQUAD
& RESCUE -7

07.03.2025

- ANVI
ROBOTIICS - 6

ARRIVAL OF RESCUE TEAMS

Sl. No.	Name of the Agency	Date of Arrival of Rescue teams	No of Officers/Staff / Soldiers / Others
1	JAL	22.02.2025	75
2	NDRF	22.02.2025	138
3	HYDRAA	22.02.2025	64
4	SCCL (Singareni)	22.02.2025	61
5	SDRF	22.02.2025	102
6	NAVAYUGA	22.02.2025	8
7	GSI	23.02.2025	2
8	RATMINERS	23.02.2025	14
9	L & T & SOLINAS	24.02.2025	12
10	DRONE	24.02.2025	13
11	NAVY	24.02.2025	6
12	ARMY ENGINEERS	24.02.2025	67
13	ARMY MEDICAL	24.02.2025	8
14	PROBOSCHOPE	24.02.2025	6
15	RAILWAY	26.02.2025	31
16	NDMA EXPERTS	26.02.2025	1
17	NGRI	27.02.2025	4
18	ANVI ROBOTICS	04.03.2025	2
19	It proffesors	06.03.2025	2
20	KERALA POLICE+DOG	07.03.2025	6
21	Doctor	10.03.2025	5
22	KERALA POLICE	11.03.2025	4
23	DC. WITH GUNMAN	12.03.2025	2
24	HDD DOG	13.03.2025	1
25	K. Dog Squad & Rescue	18.03.2025	7
26	CHINTPURNI	19.03.2025	6
27	K. RESCUE X	20.03.2025	3
	TOTAL		634

>1500 (Mar 5 – 25)

RESCUE OPERATIONS 30 DAYS (22 FEB to 24 MAR)

- Loco Trips - 6 per day – 180 Trips till date
- Workers inside over 30 days - 7706
Total man hours inside Tunnel 46,236
- Workers outside Tunnel per day
 - 400 First 7 Days
 - 250 Later 23 Days
 - 59,200 man hours
- 800 Tonnes of metal scrap & 1500 cubic metre of muck transported out

**1,05,436 Man
Hours
(March 22) !**

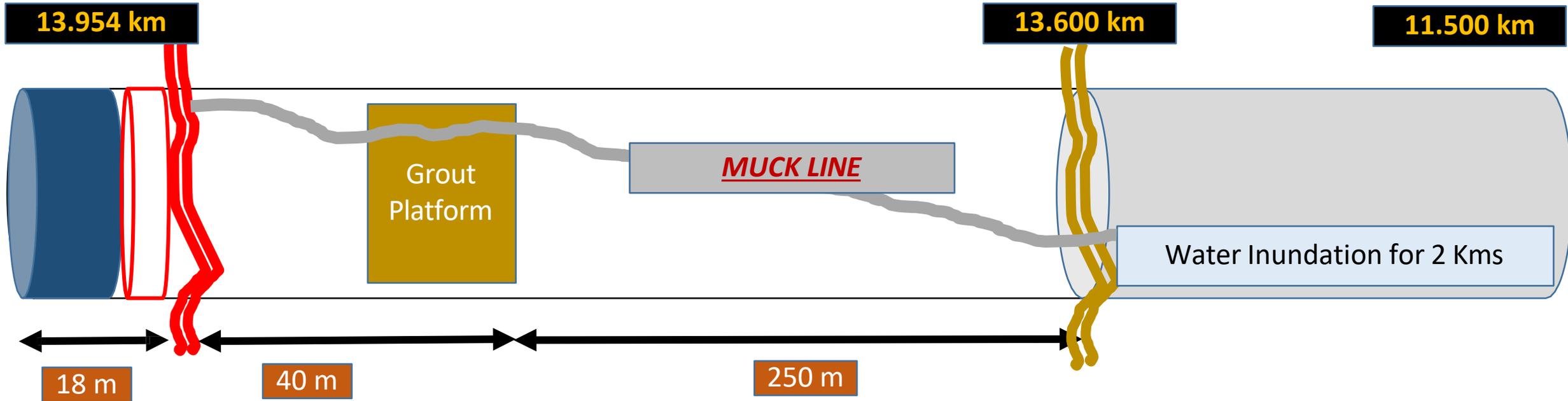
- Simultaneous Phases of Work carried out - safety of rescue crew kept in mind
- All available scientific advice & tech used
- Logical advancement of operation by systematically searching areas



DETAILS OF TRAPPED PERSONS

Name of Person	Designation	DOB	Address	Aadhar No	Company
MANOJ KUMAR	P.E. (Mech)	08-02-1974	UP	8526 4123 1126	JAL
SRI NIWAS	Sr. FE	25-07-1975	UP	6188 6648 6762	JAL
SANDEEP SAHU	LABOUR	15-08-1997	Jharkhand	407293518558	PRW-Mangra Sahu
JAGTA XESS	LABOUR	04-08-1988	Jharkhand	601158712574	PRW-Mangra Sahu
SANTOSH SAHU	LABOUR	01-01-1988	Jharkhand	805922408860	PRW-Mangra Sahu
ANUJ SAHU	LABOUR	20-06-2000	Jharkhand	980129781284	PRW-Mangra Sahu
SUNNY SINGH	General Operative	18-11-1990	J&K	568115718692	Robbins
GURPREET SINGH	Erector Opt	01-01-1985	Punjab	532618952363	Robbins

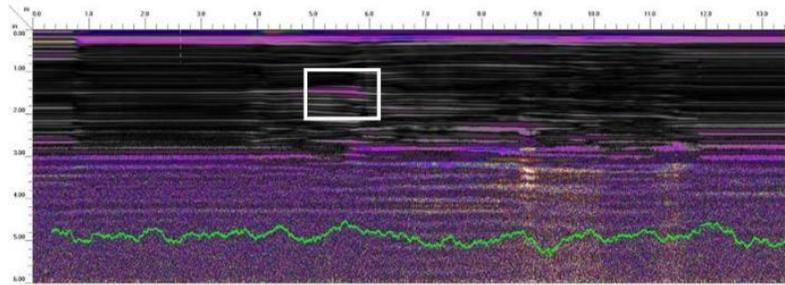
OUTLINE STRATEGY



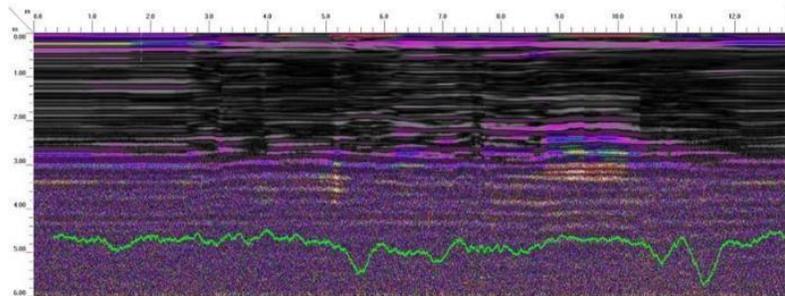
- ✓ Guidance & Continuous Review – Incident Commander, DC & SP, Synergy of Agencies
- ✓ Work with Safety – Deformation Monitoring/ Safety Piers
- ✓ Divide Work into Phases & allocate resources - Priority early Induction of Equipment/ mechanise
- ✓ Identify Hotspots for quicker recovery – Scenario Building, Personal Accts & Use of tech
- ✓ Search all Areas Possible – Find OR Eliminate Possibility !

Ground Penetrating Radar (GPR) - NGRI

GPR Profiles in the investigated area:



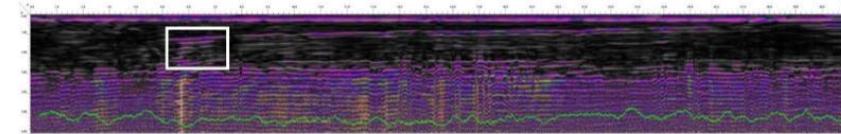
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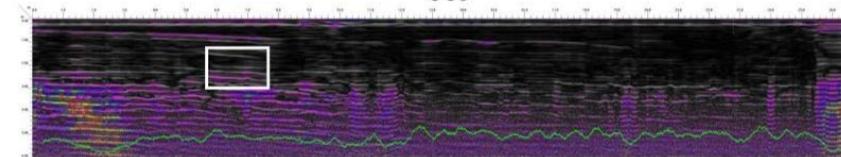
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Observations:

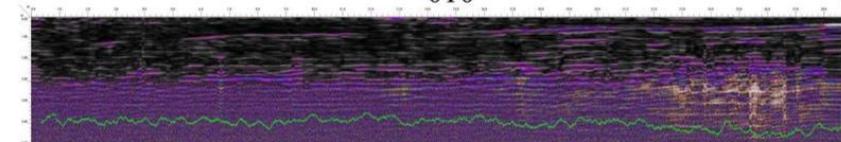
Between 4.8 - 6 m and at ~ 1.5 m depth along the profile-1 a distinct hyperbolic reflection was observed, indicative of a subsurface anomaly. The anomaly exhibits higher dielectric contrast than the surrounding matrix, suggesting the presence of a foreign object.



009



010



011

Observations:

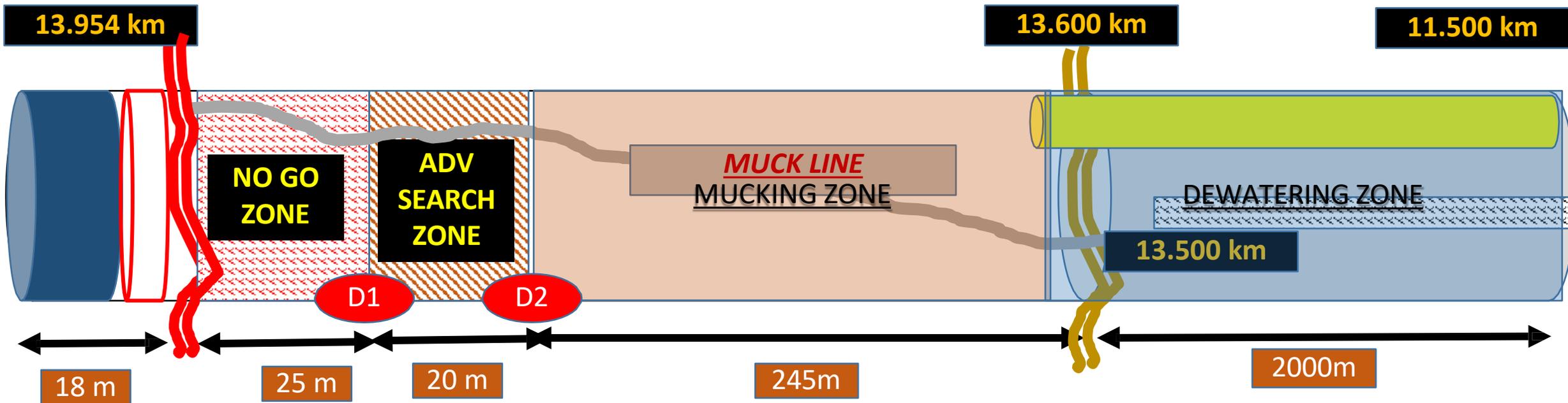
Profile 009: A distinct hyperbolic reflection was observed between 5 m and 7 m distance at 1.5 m depth, indicating the presence of a foreign object with a noticeable dielectric contrast.

Profile 010: Between 5.8 m and 6.2 m distance at a depth range of 2.2 m to 3 m, an anomalous subsurface reflection was detected, suggesting the presence of a foreign object with differing material properties from the surrounding matrix.

Cadaver Dogs-Kerala



PHASING OF SEARCH OPERATION



✓ Phase wise Plan

- Phase I : Desilting & Dewatering to increase Loco Reach
- Phase II : Cutting Stuck TBM parts & Mucking of the Tunnel from behind
- Phase III : Advanced Manual Interventions at possible hotspots

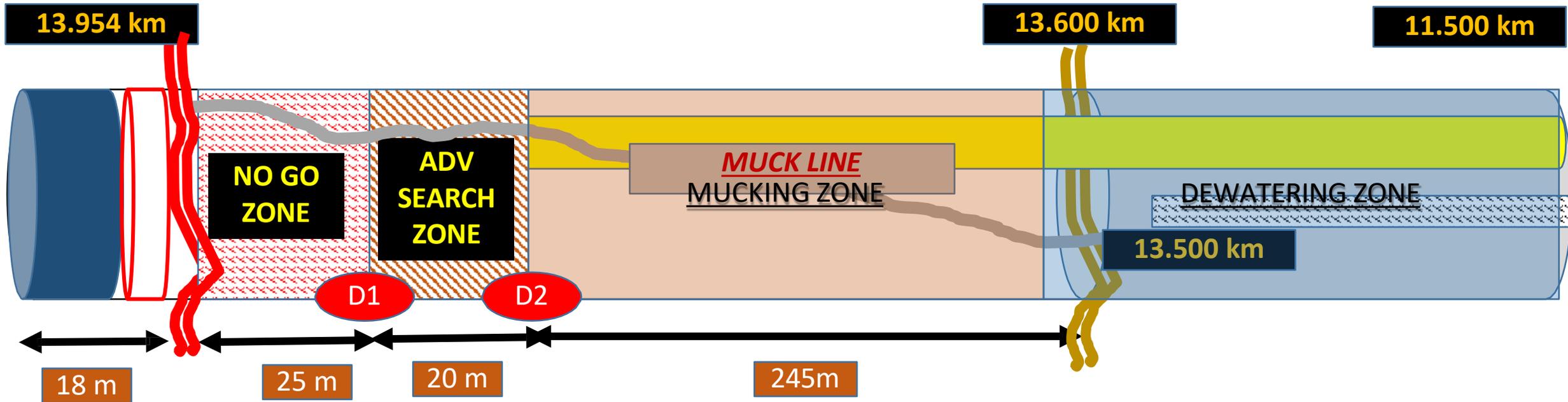
- High Risk High Probability

✓ Phases conducted concurrently

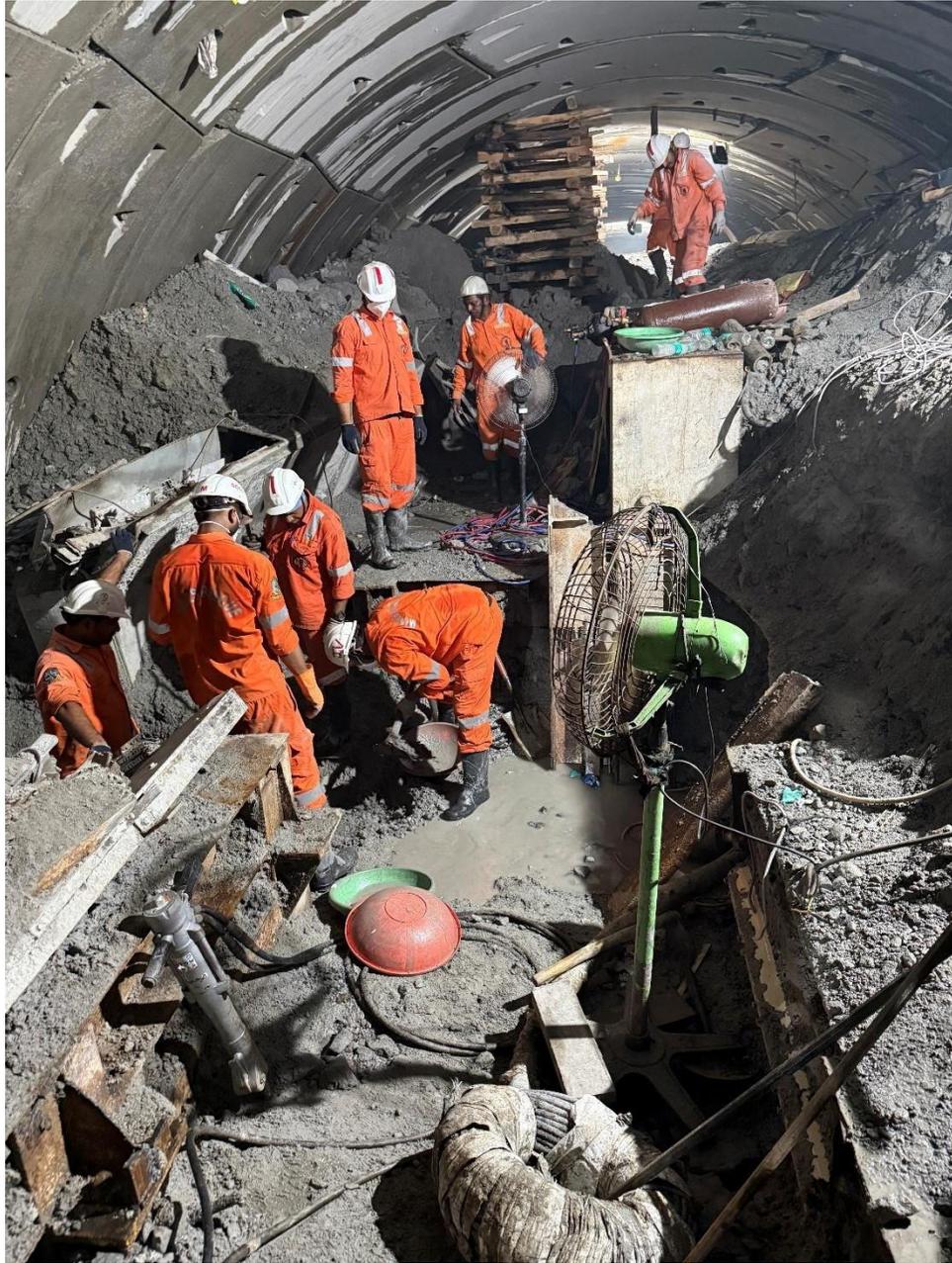
✓ NO GO Zone as per GSI inputs - Probability of workers under Collapse Zone !!



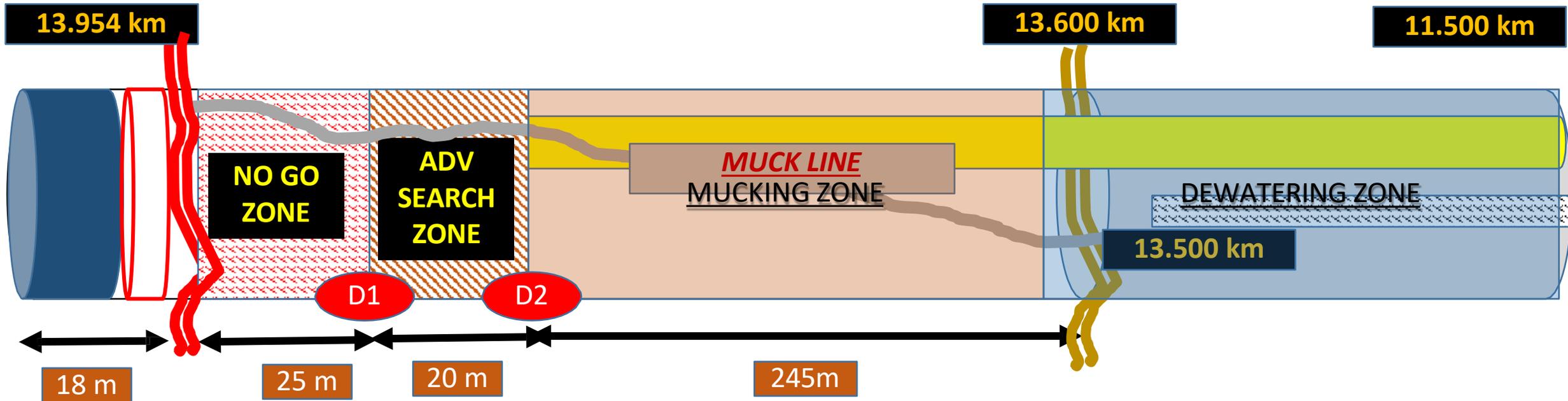
PROGRESS OF SEARCH OPERATION



- ✓ Simultaneous work on Advance Search Zone & Dewatering, TBM part Cutting
- ✓ Channelising water & Cutting Steel Parts for Manual Interventions at Adv Search Zone
- ✓ Inputs by Tunnel Staff & Odour based search at D2 – Cadaver Dog confirmation
- ✓ Adv Search Zone backed by GPR Inputs – later found to be false alarms
- ✓ Ventilation & Lighting Extended



PROGRESS OF SEARCH OPERATION



- ✓ Continuous Scientific Inputs – GSI, NSC, NGRI & NRSA
- ✓ Use of GPR (NGRI), Sniffer Dogs & Cadaver Dogs
- ✓ Complete Search – Eliminate High Risk High Probability Areas First
- ✓ Mucking started immediately on TBM part removal (60 m steel cut)



MANAGEMENT OF DISASTER

Man management – 25 plus organisations / admn. hierarchy/
interpersonal

Planning & execution – close supervision &

monitoring Lead from front – stay put for 50 days

VIP visits.

Media management- daily press briefing / site visits

Razed TBM parts cleared, way paved for faster silt lift

Rescuers close to find second of the missing workers in SLBC tunnel

BALU PULIPAKA | DC HYDERABAD, MARCH 11

The search and rescue operations for seven workers still missing 18 days after the disaster hit the SLBC tunnel in Nagarkurnool district, on Tuesday received some high-technology help in the form of robots which, officials hope, will reach extremely critical zones in the collapse site and obviate the need for a human effort to reach there.

As on Tuesday evening, rescuers were continuing their search for the seven missing workers. On Sunday, the body of Gurpreet Singh from Punjab, was retrieved and sent to his family in Punjab.

"Today we managed to clear the debris of the TBM that was thrown back when the collapse occurred and now the excavator can reach to the rear end of the machine. This has opened up the space for the excavator to desilt the area up to the TBM much faster," special chief secretary, disaster relief Arvind Kumar, supervising the rescue operations at the tunnel site, said on Tuesday.

He also said the two human remains detection dogs of the Kerala police, Maya and Murphy, were taken into the tunnel by their handlers for the third time on Tuesday. "They are able to broadly indicate where the bodies of the missing persons might be. This is because of the water flowing into the tunnel and carrying the smell of the bodies. Had the conditions been dry, they would have been able to pinpoint the location of the missing persons," he said.

The rescuers are hopeful that they will be able to retrieve at least one more body on Wednesday where digging through 12 feet of silt has been completed. Before reaching the body, the rescuers will have to cut through the thick second tier steel platform of the TBM and this part of the work is expected to be completed by Wednesday afternoon.

While all the digging and the search for the missing workers, in the spots indicated by sniffer dogs, was being done manually by specialist rescuers from Singareni Collieries, and members of the rat min-



1 & 2. Before, now: Huge sections of the tunnel boring machine that were broken and thrown back around 100 metres when SLBC tunnel collapsed on February 22, were cleared after a laborious cutting process by SCR engineers. The first picture shows the spot on March 4, the second on March 11. 3. Rescue workers from Singareni Collieries carry a jack hammer drill into the SLBC tunnel on Wednesday. 4. A communication tower that will enable an autonomous rover to communicate with the Anvi Robotics team reached the SLBC tunnel site on Wednesday. The rover will search in the hazardous final 50 metres of the tunnel collapse site.

All eyes on specially-trained rescue dogs

SYED OMAR FAROOQ | DC HYDERABAD, MARCH 11

The crucial breakthrough in the rescue and relief operations at the SLBC tunnel, which collapsed on February 22, came on Sunday, thanks to the help of specially trained dogs of the Kerala police.

These canines, called human remains detection (HRD) dogs, or cadaver dogs, found a place in disaster-related operations in India after Kerala's top cop Loknath Behera saw their skills during a foreign trip. He found them to be a right fit for Kerala police as the state witnessed frequent flooding and landslides.

The first set of two dogs, Maya and Murphy, belonging to the Belgian Malinois breed, were brought to Kerala Police Academy in March 2020 from the Punjab Home Guards, when they were seven and six months old,

ers team, from Wednesday, an autonomous rover with the ability to dig will be deployed. According to Vijay Jagadam of Anvirobotics, they set up a communication network to operate the robots on Tuesday and two communication robot units to transmit real time data to a control



Kerala cadaver handler and trainer Prabhath D. (second from right) along with the cadaver dogs Maya and Murphy in SLBC tunnel detecting the cadaver on Monday.

respectively. The third dog Angel was brought from the Sashasthra Seema Bal, Alwar, Rajasthan. Maya was officially introduced into the force first, becoming the first

room outside at the tunnel inlet site have been set up. "Tomorrow (Wednesday), a sludge robot, an autonomous rover which can dig deep, and can reach depths of up to 15 to 20 metres will be deployed. It has cameras and sensors which can help find the persons buried in the silt. It will

- Maya, Murphy and Angel belong to Belgian Malinois, widely used by police and security forces, including in operations against Osama bin Laden.
- The K9 trio has detected 24 bodies in Kerala and one in SLBC tunnel.
- They are popular as police, assistance and search and rescue dogs.

successfully detected 24 bodies so far, police officials said. According to Prabhath D., the handler of Murphy and Maya, the canines had to face their first challenge during a landslide at Pettimudi in Munnar while they were being trained on August 8, 2020.

Prabhath, who holds subedar rank, and works at State Dog Training School (SDTS) of the Kerala Police Academy, said that they use the methods used in the most advanced countries to train the K9 force.

Each of the three dogs have undergone nine months training and have an excellent track record in detecting human remains after natural disasters. They have

start its work at a location where sniffer dogs indicated some of the workers may be buried," he said. This robot, Arvind Kumar said, would explore and search for the missing workers in the last 50 metres of the tunnel, which Geological Survey of India scientists had to

be approached with great caution as conditions can turn unstable very quickly. Once it is certain that the robot can do its job, then the final 50 metres with silt piled up anywhere between 5 and 9 metres, will become more accessible, while ensuring safety of the rescuers.

While the work has not gotten the rescuers anywhere close to finding the tunnel workers missing since the February 22 incident, seven more of whom need to be found after the body of one of them, Gurpreet Singh was retrieved on last Sunday, rescuers have found that there are some 'empty' pockets between the three steel tiers of the tunnel boring machine. But what this might mean in terms of finding the missing seven workers and whether any took refuge in such spots, is highly uncertain, rescuers said.

"We may be at a phase where work can really speed up from tomorrow," special chief secretary, disaster management,

Arvind Kumar said on Wednesday. This speeding up is expected to be aided by an autonomous sludge removing robot that will be put to work in the last 50 metres stretch of the tunnel — considered hazardous given the unstable conditions in that section. And joining the new machine will be a new 50-member strong team of stone cutters from the Vaddera community, a prospect that was never on the cards, indicating the need for fresh solutions to emerging problems to be solved inside the tunnel.

The machine from Anvi Robotics, was taken inside the tunnel on Wednesday. Equipped with various

SLBC rescue continues to throw new challenges

Vaddera boulder breakers to a lend hand, robot reaches spot

BALU PULIPAKA | DC HYDERABAD, MARCH 12

Every day is throwing up a new challenge to be met, and a problem to be solved, deep under the Nallamala hills of Nagarkurnool district where rescue workers, and officials have been battling unforgiving conditions inside the disaster-stricken SLBC tunnel inlet section for the past 19 days. These conditions include a combination of silt and large rocks piled up several metres high, water gushing in at the rate of around 3,000 to 5,000 litres a minute, hidden and broken parts of the tunnel boring machine that can cause serious injuries, and worst of all, not just enough air to breathe in the final 200 to 400 metres of the tunnel, but with each day, progress is being made in the search efforts to find seven more of the missing workers feared to be buried under a tunnel boring machine some 13 km inside the tunnel.

While the work has not gotten the rescuers anywhere close to finding the tunnel workers missing since the February 22 incident, seven more of whom need to be found after the body of one of them, Gurpreet Singh was retrieved on last Sunday, rescuers have found that there are some 'empty' pockets between the three steel tiers of the tunnel boring machine. But what this might mean in terms of finding the missing seven workers and whether any took refuge in such spots, is highly uncertain, rescuers said.

"We may be at a phase where work can really speed up from tomorrow," special chief secretary, disaster management,



An autonomous sludge removing robot that can also 'see' and dig, being taken into the SLBC tunnel on Wednesday. — BY ARRANGEMENT

Worker's body reaches his village

DC CORRESPONDENT HYDERABAD, MARCH 12

The mortal remains of Gurpreet Singh, a tunnel boring machine erector operator working for Robbins USA, who died in the SLBC tunnel collapse in Nagarkurnool district on February 22, have reached his native village of Cheema Kalan in Taran district of Punjab on Wednesday.

Gurpreet Singh is survived by his wife, two chil-

dren, and his mother. He was 40. According to Nagarkurnool district collector Bada Vath Santosh, Gurpreet Singh's body was handed over to his wife Rajvinder Kaur and members of his family by officials who accompanied it. Also handed over was an ex gratia cheque for Rs 25



Gurpreet Singh

lakh from the state government to the family. Eight tunnel workers were trapped in and around the machine when a section of the tunnel roof collapsed. Gurpreet Singh's body was the first to be found and a search is still underway for the remaining seven missing workers.

Wednesday, engineers repaired the air inlet vent till the last point of the tunnel ensuring a constant supply of fresh air. "Till today, just a few could work near the machine because the air was just not enough. From now, more people can work closer to the end section of the tunnel, and this will mean faster progress in the search. And to channel the water out of the work area, a 30 metre trench has been dug which should make digging in the drier silt faster. But the challenge is to cut through the machine's different tiers through thick steel plates to reach deeper in the search," Arvind Kumar said.

Their job will be to break down the large rocks into small pieces so they can be taken on the conveyor belt along with the silt," Arvind Kumar, said. On

LOCO ACCESS

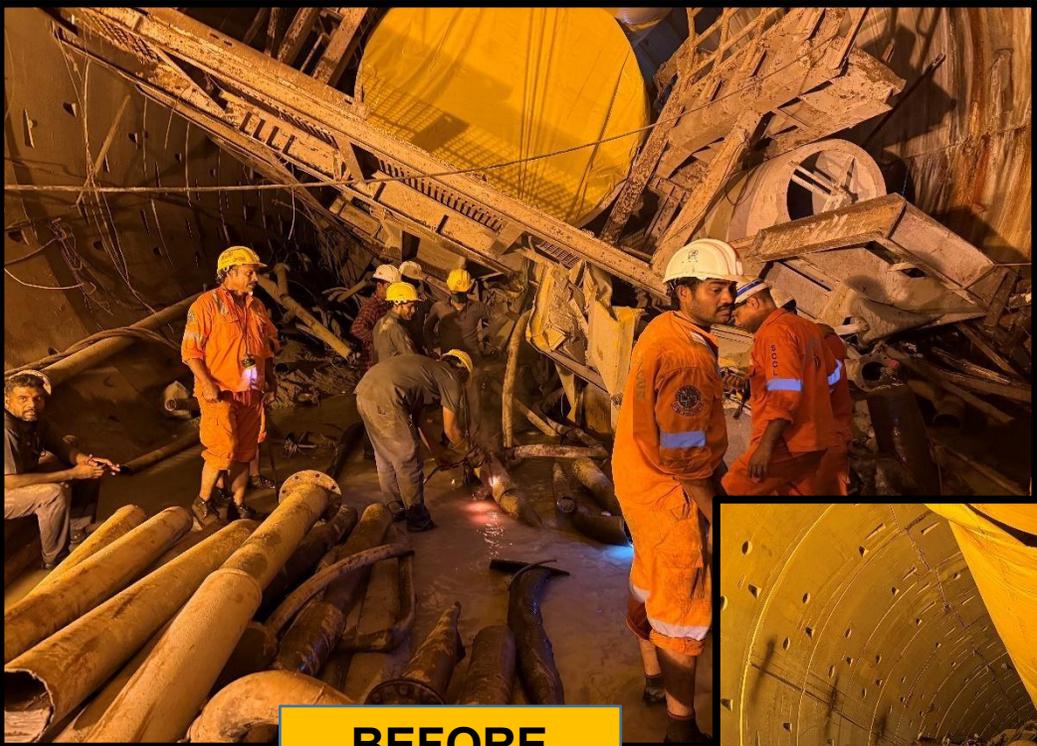


BEFORE
Km 11.500

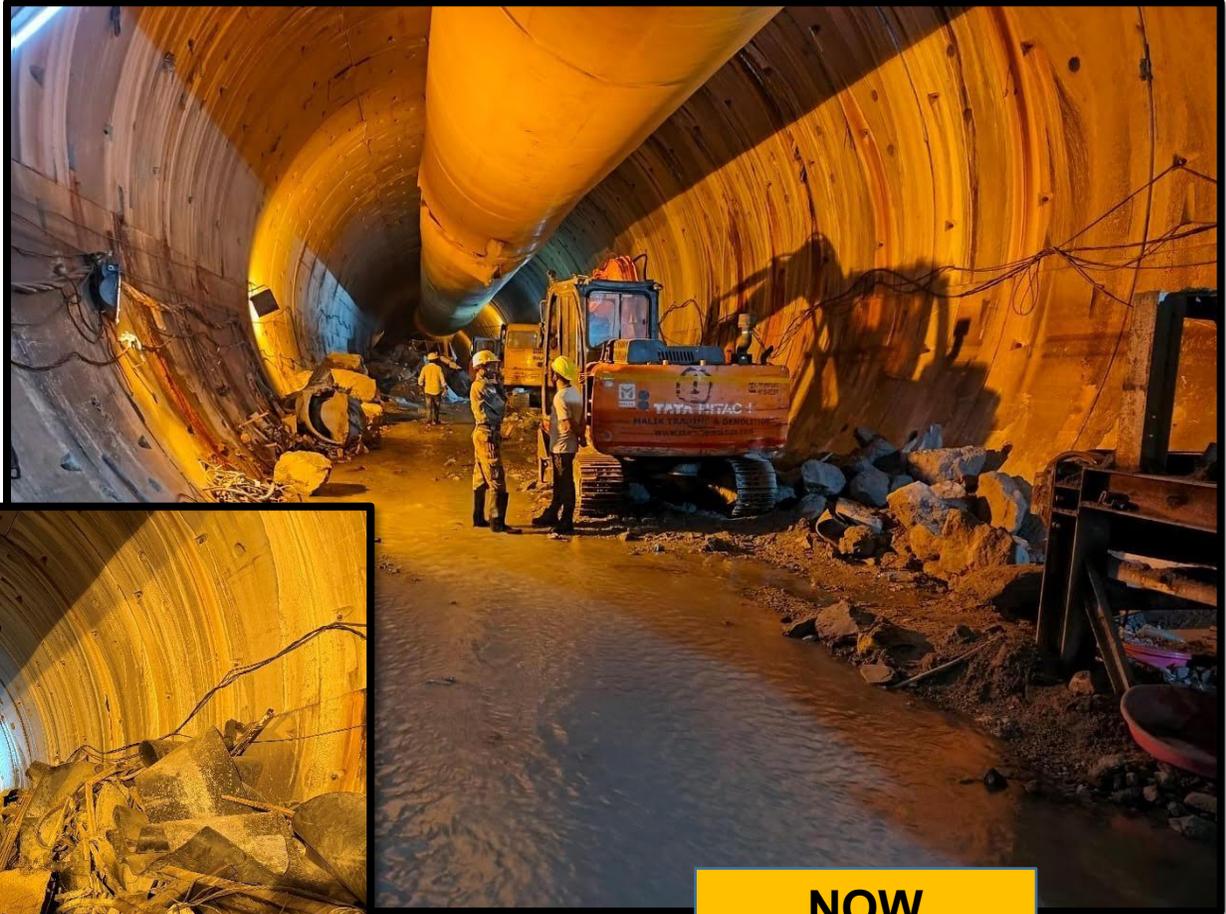


NOW
KM 13.600

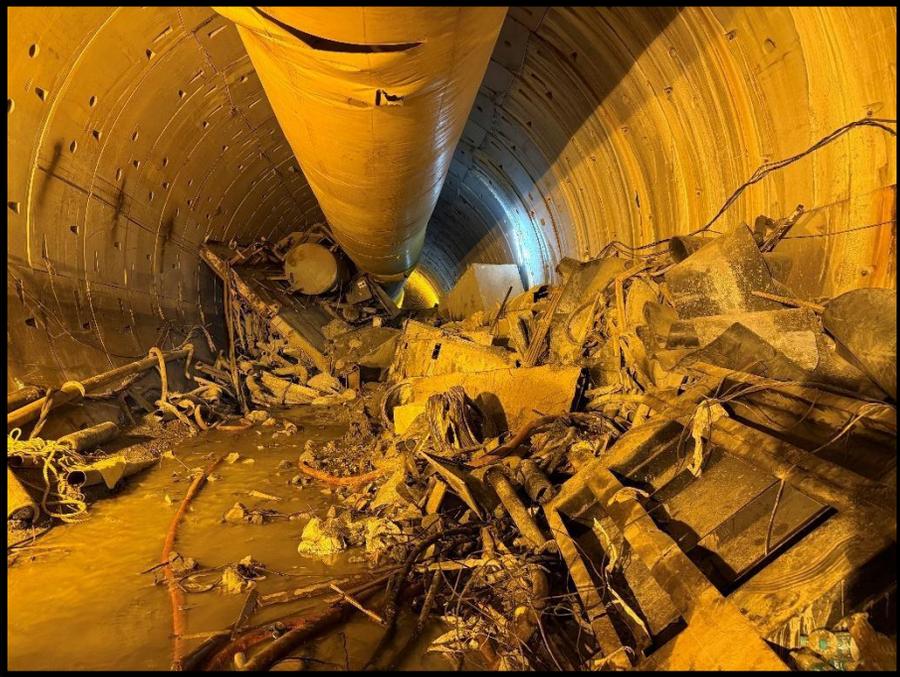
TBM PART CUTTING



BEFORE

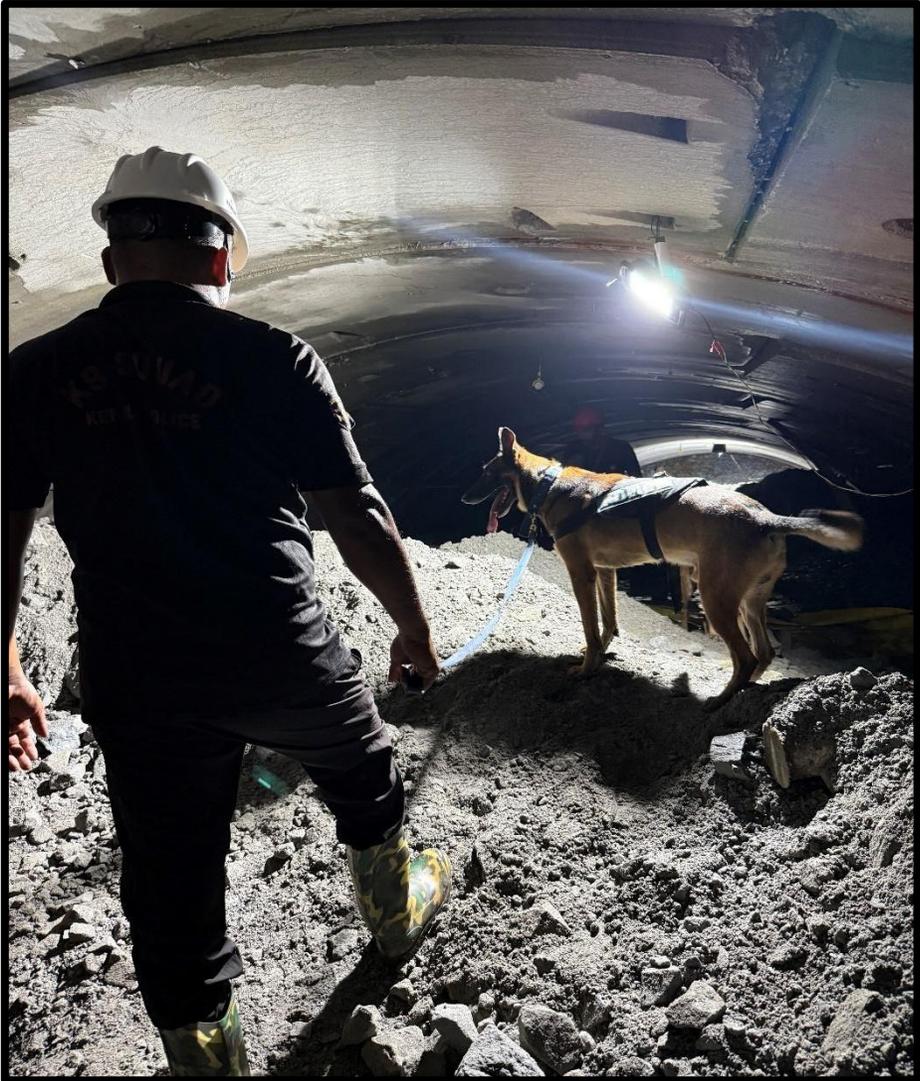


NOW



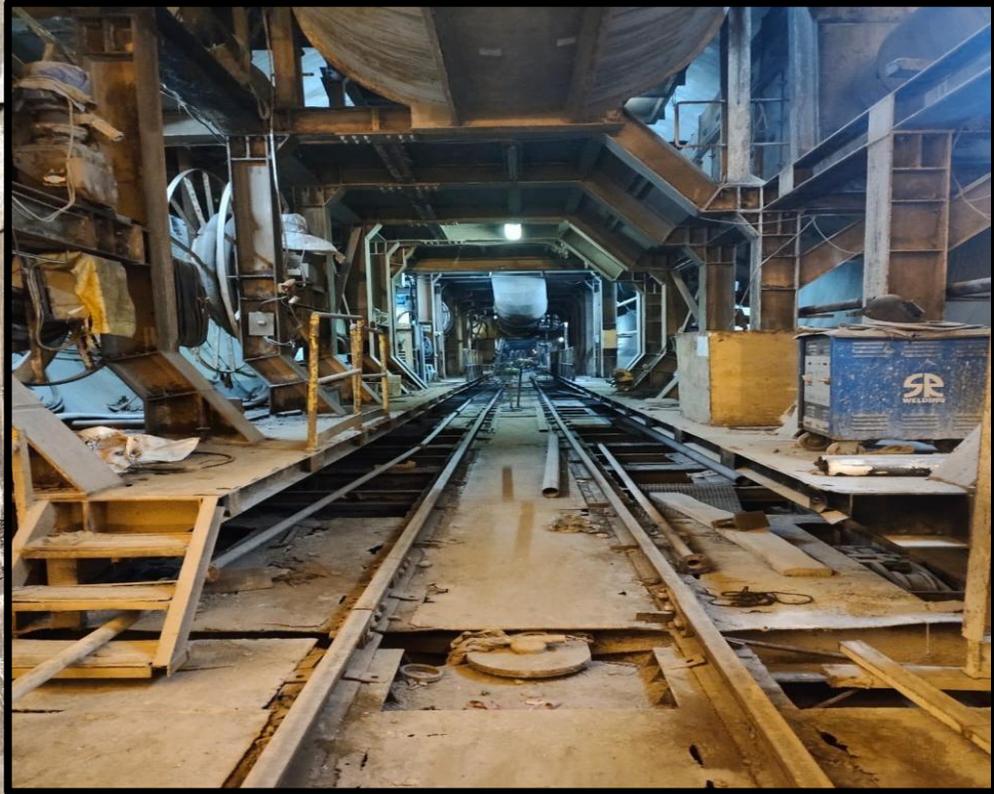
60 m of Steel Cut !!

MANUAL INTERVENTIONS





EXCAVATION : SEARCH ZONE



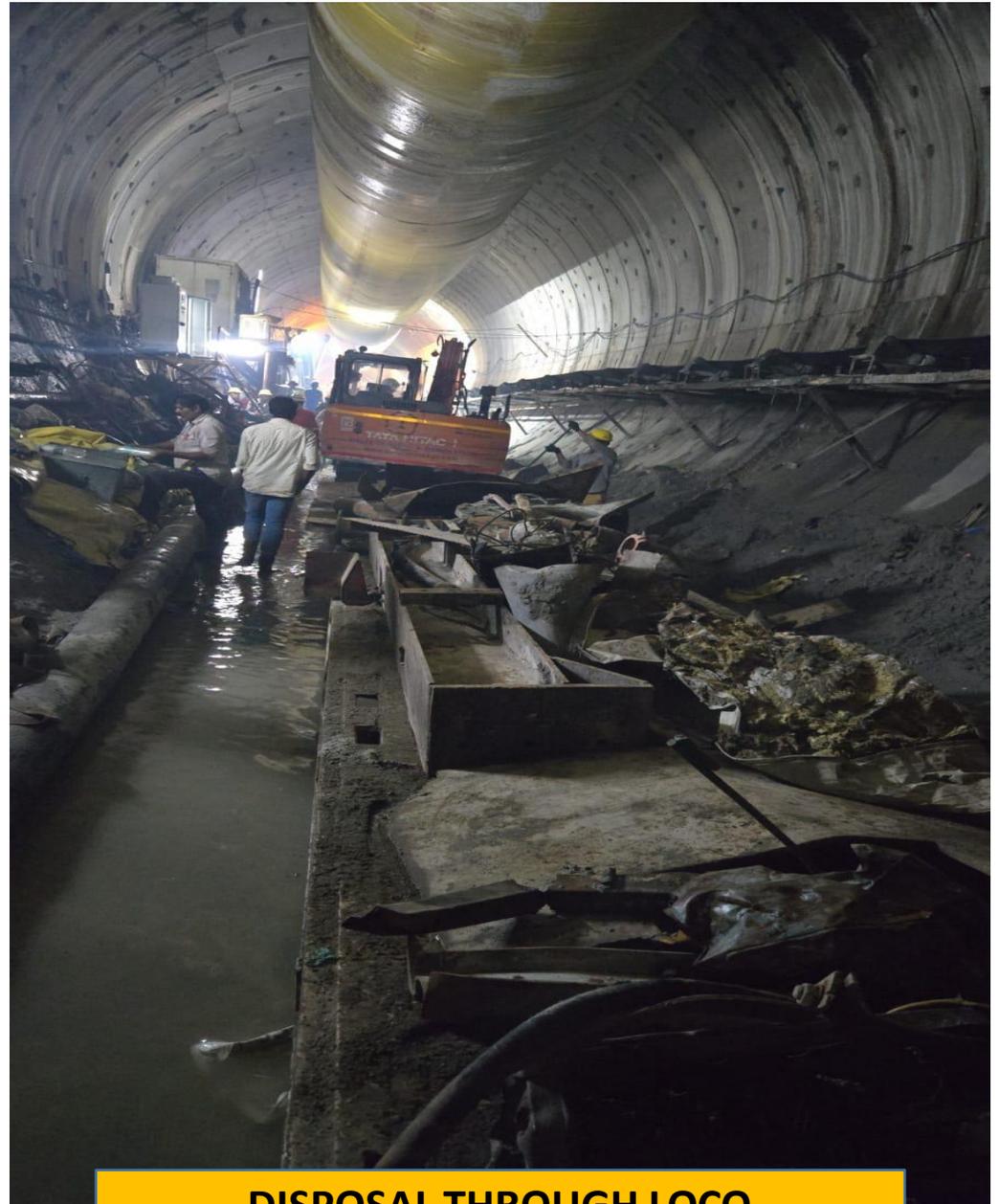
ELIMINATION THROUGH EXCAVATION : D1-D2



BARRIER AT D2



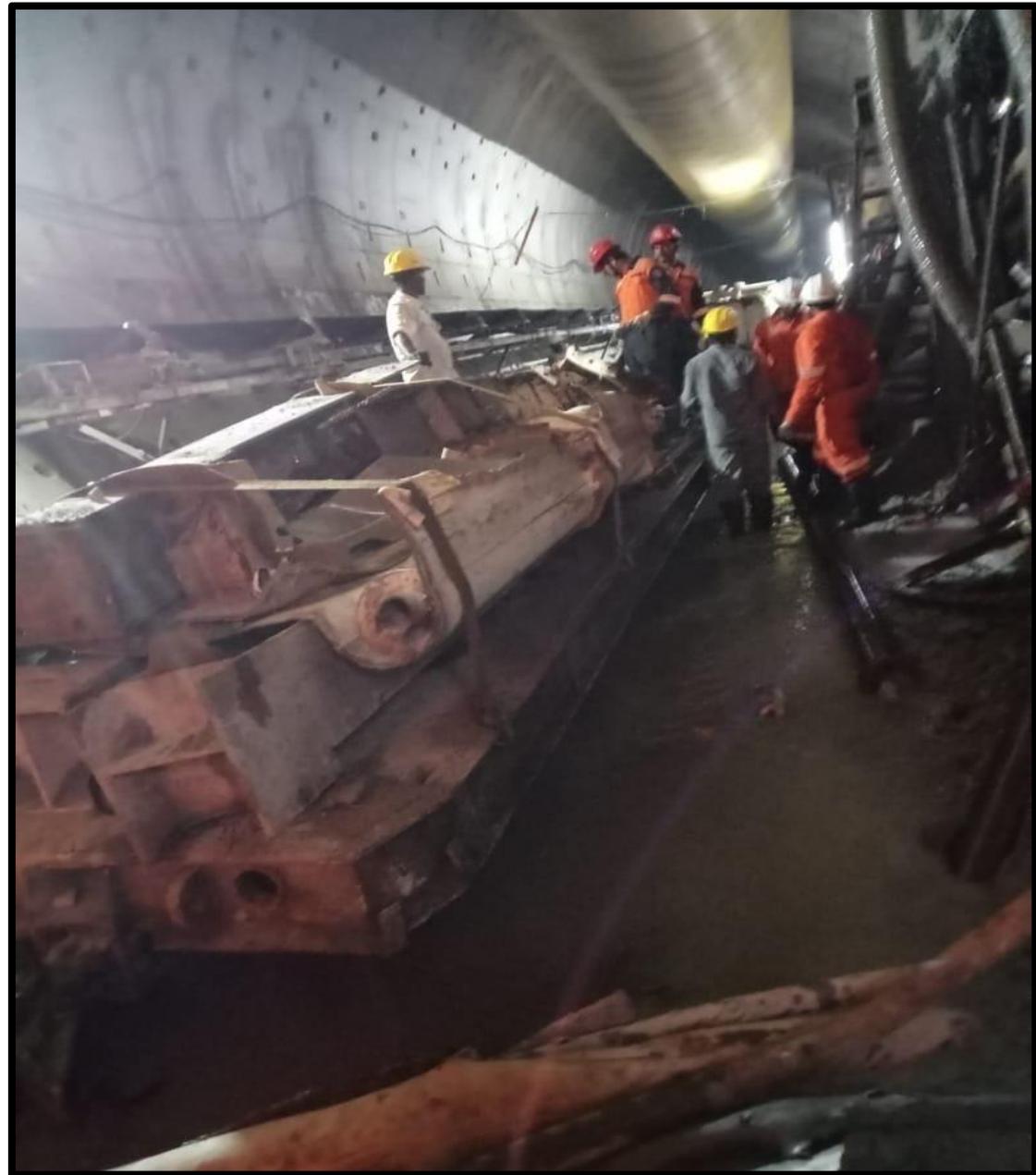
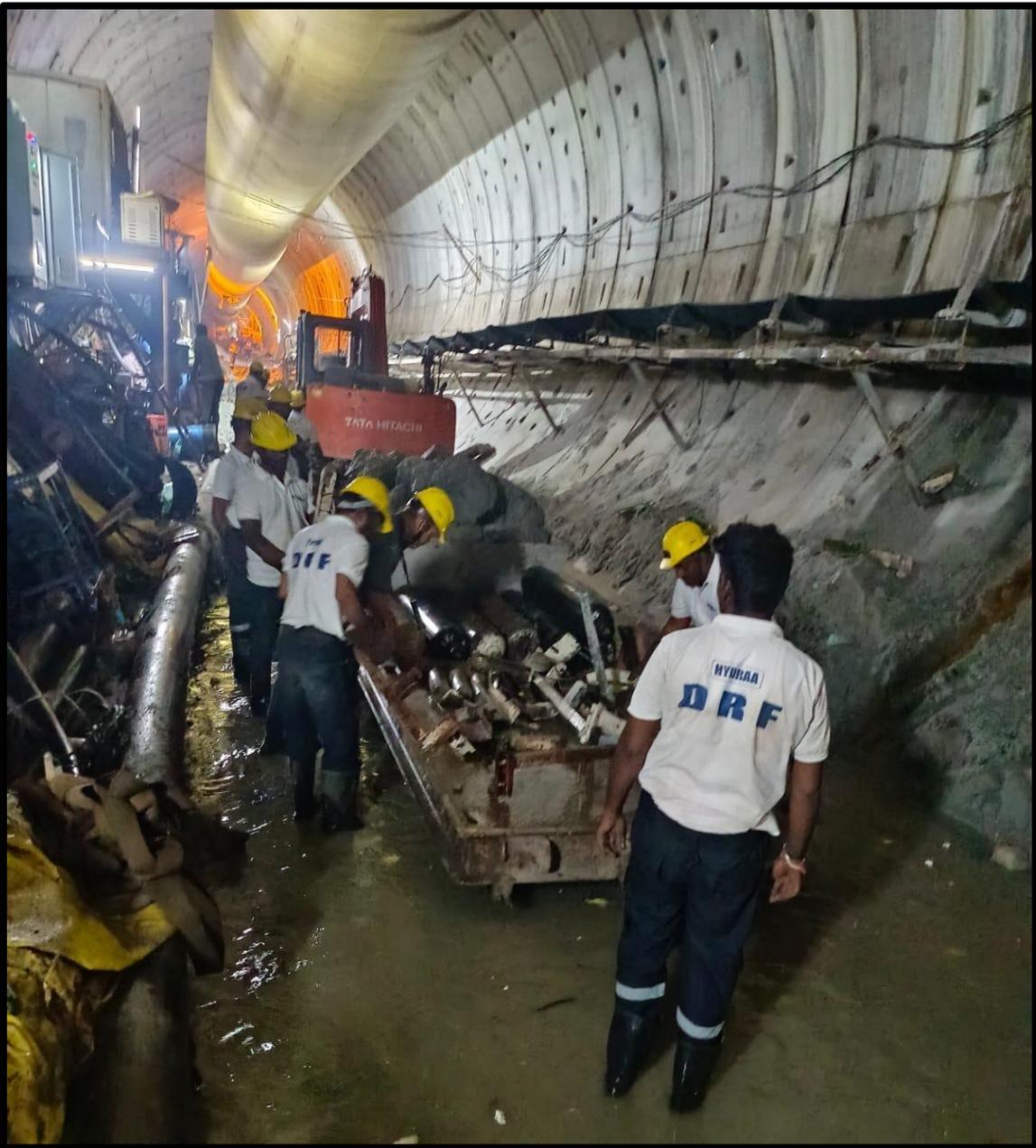
4 + 1 EXCAVATORS FOR MUCKING



DISPOSAL THROUGH LOCO



TRANSPORT OF BOULDERS FOUND IN MUCK

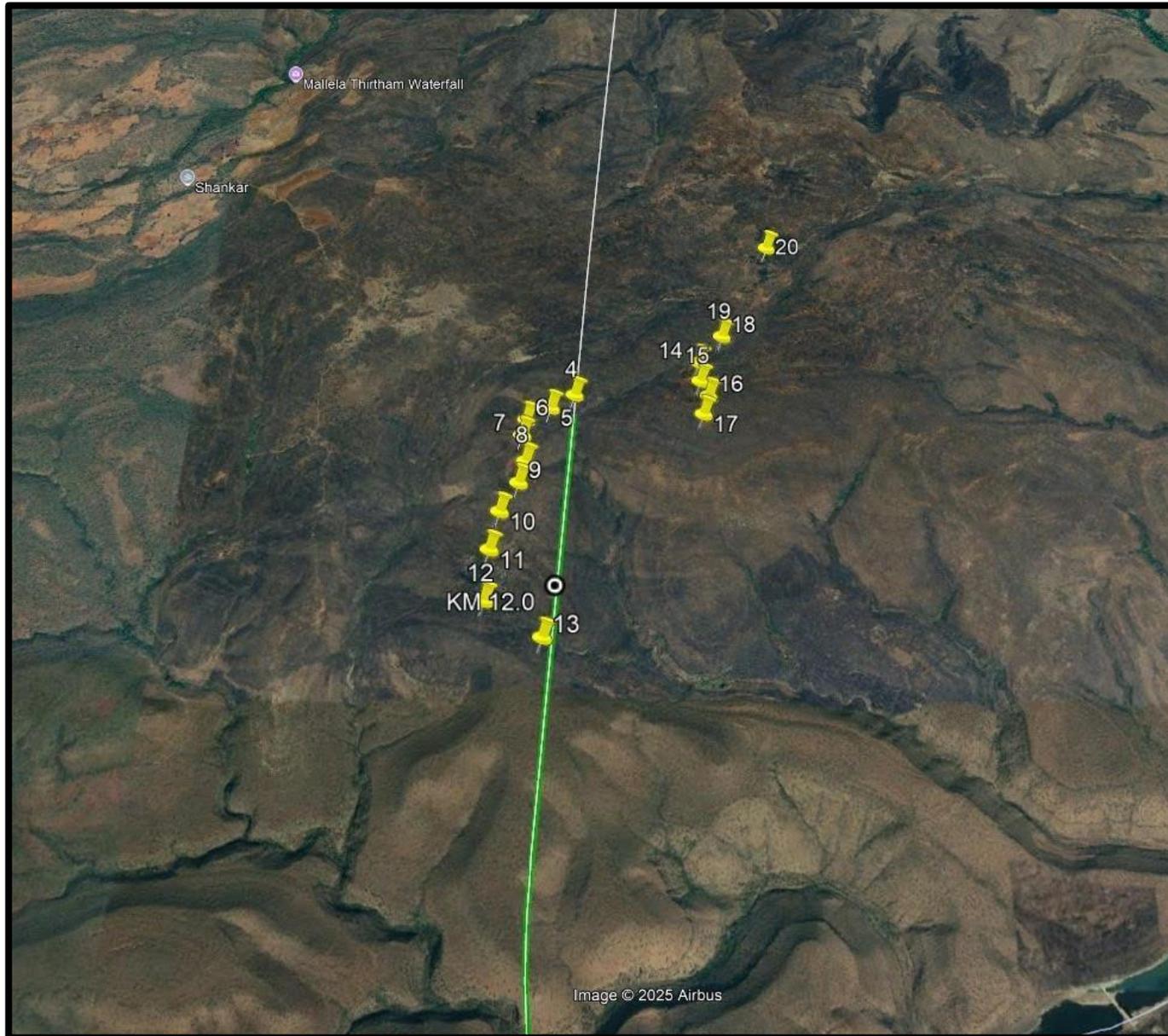


CUT METAL BEING DISPOSED THROUGH LOCO



DEMUCKING OPERATIONS

NATIONAL CENTER FOR SEISMOLOGY INPUTS



Seismicity Monitors

- ✓ 01 Km depth Sensors – Higher Accuracy
- ✓ 05 Km depth Sensors – Larger Extent
- ✓ Placed along Shear Zone
- ✓ Ambient Noise based Interpretation of Stratigraphy
- ✓ Can also aid in Drill & Blast monitoring

Unique challenges in search

- Space restriction - Only mid level excavators can work – even lesser space at bottom
- Flowing Water
- Heavy steel components embedded in silt & muck (2 -8 m high)
- Inflammable Components
- GPR – false alarms due to embedded TBM components
- Cadaver Dogs wef 07 Mar – False Smells due to water, cannot smell deeper than 2 m
- Sniffer Dogs (Feb 24 – Feb 27) – Not much use
- Change in weather – Cavity to be kept under watch especially at Adv Search Zones

Rescue highlights

- Rescuers safety protocols
- Perfect coordination
- No adverse media coverage
- All concerned agencies kept informed One of the toughest operations

Way forward

- Ex-gratia duly following the process
- Cabinet has accorded approval for Completion of the tunnel – observational tech /design as you go

THANK YOU