BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,
SOUTHERN ZONE- CHENNAI

O.A NO. 180 of 2023
AND
O. A NO.183 OF 2023

IN THE MATTER OF
Tribunal on its own motion SUOMOTU based on the Visual media titled Chennai Rains Makkalai Vathaikkum Oil Companies- Shocking Story - Michaung Ground Report covered by on VIKATAN TV Chennai dt.06.12.2023

with

The District Collector Chennai District
And Ors. ...Respondents

AND

R.L. Srinivasan, Chennai. ...Applicant (s)

Versus

The Tamil Nadu Coastal Zone Management Authority,
Rep. by its Member Secretary, Chennai and Ors. ...Respondent(s)

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Filed by
Thiru.S. Sai Sathya Jith,
Advocate, Chennai.

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SOUTHERN ZONE- CHENNAI

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The Tamil Nadu Coastal Zone Management Authority, Rep. by its Member Secretary, Chennai and Ors.

...Respondent(s)

REPORT FILED ON BEHALF OF THE RESPONDENT - TAMIL NADU POLLUTION CONTROL BOARD

I, J. Josephine Sahayarani, D/o. Jesu Rajan, Christian, aged about 57 years, having my office at 76, Mount Salai, Guindy, Chennai-600032, do hereby solemnly affirm and sincerely state as follows:-

1. I am the Joint Chief Environmental Engineer, Tamil Nadu Pollution Control Board (TNPCB), Chennai -600 032, and I am authorized to file this Report duly approved by the Chairperson as on behalf of the Respondent Tamil Nadu Pollution Control Board (TNPCB). I am well acquainted with the facts of the case from the records.

2. It is respectfully submitted that on 06.09.2024, the Tamil Nadu Pollution Control Board has filed its report before the Hon'ble

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TAMIL NADU POLLUTION CONTROL BOARD
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CHENNAI 600 032.

Tribunal(SZ), Chennai and it may be pleased to take as part and parcel of this case.

3. It is submitted that a meeting was conducted on 03.09.2024 at TNPCB, Corporate Office Guindy with the Technical Team formed vide G.O (Ms) No.178 Dated 10.12.2023 and the team evaluated the oil spill impact assessment study report and bioremediation study report conducted in the Ennore Creek area

4. It is respectfully submitted that the above mentioned team has concluded with the following remarks inter alia that:-

   a. In the final report by the Technical Team which was submitted to the Government in January 2024, the team had inferred that the quantity of oil washed away might be more than 400 KL. This was derived by the team based on the information such as slop oil quantity from daily operation, crude receipt quantities, total sludge accumulation in the premises, characteristics of slop oil, cleaning frequency etc.,

   b. Now, IIT in their report has given their most conservative estimate as 647 cu.m. or 517 tonnes which is close to the technical team's observations.

   c. Therefore, the total spilled oil may be considered as 647 cu.m or 517 tonnes for computation of damages caused. Assessment of the environmental damage caused by the oil spillage and the cost of restitution of environment will be calculated by the methodology adopted in the research publication "Oil spill & cleanup costs by Cao Thi Thu Trang, Institute of Marine environment & Resource, Vietnam". This methodology of cost calculation was used in similar NGT matter in OA No. 18 of 2020/EZ (Praveen Kumar Singh Vs Damodar Valley corporation & Ors.).

5. It is respectfully submitted that a meeting was scheduled on 14.10.2024 with the following Technical Team members for computation of the damages caused.

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a) Thiru.R.Kannan, Member Secretary, TNPCB - Chairman
b) Dr.G.Saravanan, Principal Scientist, Chennai Zonal Centre, CSIR- NEERI –Member
c) Ms.H.D.Varalaxmi, Scientist-E & Regional Director, Regional Directorate, Central Pollution Control Board, Chennai – Member
d) Prof V.T.Perarasu, Department of Chemical Engineering, Anna University Chennai – Member.

6. It is respectfully submitted that the team computed the total damages caused using the methodology adopted in the research publication "Oil spill & cleanup costs" by Cao Thi Thu Trang, Institute of Marine environment & Resource, Vietnam and furnished a detailed report titled "Technical Team Report on Computation of Environmental Compensation to be levied to Chennai Petroleum Corporation Limited for the Oil Spillage in Ennore Creek Area during the floods caused by Michaung Cyclone in December 2023" (Enclosed as **Annexure I**)

7. It is respectfully submitted that based on the report, the total clean-up cost of an oil spill is the sum of the response costs, the value of the socioeconomic damage and the environmental cost and these costs are calculated using the following formulae

   a) Total response cost = base per-gallon response cost (based on oil type/volume/response method) x medium modifier x spill amount
   b) Total socioeconomic damage cost = per-gallon socioeconomic cost x socioeconomic cost modifier x spill amount
   c) Total environmental damage cost = per-gallon environment cost x 0.5 (freshwater + wildlife modifier) x spill amount

8. It is respectfully submitted that in this case, the response activities were carried out by CPCL with the help of specialized cleaning agencies, skilled man power and sophisticated machineries/ equipments in Buckingham Canal, Kosasthalaiyar River & Ennore Creek. As a result of cleaning, a total of 2,20,040 litres of oil-water

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mixture and 663.5 tonnes of oil laden soil & debris have been removed from oil affected area. As the total cost for these activities were borne by CPCL, the response cost is calculated as nil.

9. It is respectfully submitted that on calculation using the above mentioned formulae, the socio-economic damage cost totals to USD 2472793.6 and total environmental damage cost totals to USD 2668577.8. The time value for money is calculated using the compounding of inflation rate which is taken as 6.78% in this case.

10. It is respectfully submitted that the team vide their report has recommended to recover a total of ₹73,68,00,906/- (Rupees Seventy Three Crores Sixty Eight Lakhs Nine Hundred and Six only) as a Socio Economic Damage Cost (₹35,43,71,708/-) and Environmental Damage Cost (₹38,24,29,198/-) due to oil spill occurred during December 2023.

11. It is respectfully submitted that the IIT Madras has submitted their further report on 12.09.2024 (Enclosed as **Annexure II**) with the following long term strategies for prevention and remediation:

    a. Consider elevating oil sludge and slop oil storage tanks or implementing dykes to contain any potential spills. These measures can help minimize the risk of contamination and mitigate the impact of future accidents.
    b. Implement measures to prevent the discharge of oil from storm water locations, such as installing appropriate containment systems or improving drainage infrastructure.
    c. Given the heavy siltation and long term contamination of oil in the canal consider dredging the canal to enhance its carrying capacity. This action can help improve water flow and reduce the risk of further contamination
    d. Continuous monitoring of the storm water drains in the Ennore industrial area is mandatory to prevent and track contamination from industries.

e. The storm water outlets from the Manali area which drain into Kosasthalaiyar River should be monitored periodically or with an online on camera-based sensor for any oil release. In the event of an accidental spill there should be an overflow arrangement to stop oil within the CPCL premises.

f. In the long-term, Buckingham canal should be taken up for remediation by desilting and other appropriate measures and other appropriate measures since the pollutants are reaching the Ennore creek and the Bay of Bengal affecting the coastal flora and fauna.

g. An epidemiological study must be conducted to assess the long-term human health effects including cancer risk along with eco-toxicological study for other living systems

Under the above circumstances, it is humbly prayed that this Hon'ble National Green Tribunal may be pleased to pass such further or other orders as this Hon'ble Tribunal may deem fit and proper in the facts of this case and thus render justice.

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JOINT CHIEF ENVIRONMENTAL ENGINEER
TAMIL NADU POLLUTION CONTROL BOARD
No.76, MOUNT SALAI, GUINDY,
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VERIFICATION

I, J. Josephine Sahayarani, D/o. Jesu Rajan, working as Joint Chief Environmental Engineer, having office at No. 76, Anna Salai, Guindy, Chennai-32, do hereby submit that the above contents are true to the best of my knowledge and belief through records.

23/X/2024

JOINT CHIEF ENVIRONMENTAL ENGINEER
TAMIL NADU POLLUTION CONTROL BOARD
No.76, MOUNT SALAI, GUINDY,
CHENNAI-600 032.

TECHNICAL TEAM REPORT ON COMPUTATION OF ENVIRONMENTAL COMPENSATION TO BE LEVIED TO CHENNAI PETROLEUM CORPORATION LIMITED FOR THE OIL SPILLAGE IN ENNORE CREEK AREA DURING THE FLOODS CAUSED BY MICHAUNG CYCLONE IN DECEMBER 2023

OCTOBER 2024

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1. EXECUTIVE SUMMARY

In the first week of December 2023, a severe cyclonic storm 'Michaung' hit the coast of Chennai and its neighboring Tiruvallur and Chengalpattu districts. The cyclone resulted in heavy floods in Manali Industrial area including Chennai Petroleum Corporation Limited (CPCL) and caused ingress of oil from CPCL that found its way to Buckingham Canal and Kosasthalaiyar River finally reaching the Ennore Creek Area. The spilled oil affected mangroves in the creek and damaged the boats, fishing nets causing major livelihood concern to the local fisher folks and other communities. Under the guidance of Government, CPCL carried out the remediation works from 12.12.2023 to 31.12.2023 with the help of specialized cleaning agencies, skilled man power and sophisticated machineries/equipments in Buckingham Canal, Kosasthalaiyar River &Ennore Creek. As a result of cleaning, a total of 2,20,040 litres of oil-water mixture and 663.5 tonnes of oil laden soil & debris have been removed from oil affected areas.

Meanwhile, the assessment study of oil spill and cleaning/bioremediation of oil spill in Ennore Creek, Buckingham Canal, and Kosasthalaiyar River through biodispersants were carried out by Indian Institute of Technology, Madras & National Institute of Oceanography, Goa respectively.

Further, the Hon'ble NGT (SZ) vide OA No. 180 of 2023 took up suo moto based on the visual media titled Chennai Rains : Oil Companies - Shocking Story - Michaung Ground Report covered by on Vikatan TV Chennai dated 06.12.2023 regarding Ennore Creek oil spillage. In this regard, the matter was heard on 02.04.2024 wherein the Hon'ble Tribunal had directed that after receipt of the report from the IIT - Madras and NIO - Goa, let the TNPCB compute the extent of damage caused due to the oil spill on the mangroves

Now, the technical team has analysed the reports and have considered the total spilled oil as 647 cu.m or 517 tonnes for computation of damages caused. Assessment of the environmental damage caused by the oil spillage and the cost of restitution of environment will be calculated by the methodology adopted in the research publication *"Oil spill & cleanup costs by Cao Thi Thu Trang, Institute of Marine environment & Resource, Vietnam"*. This methodology of cost calculation was used in similar NGT matter in OA No. 18 of 2020/EZ (Praveen Kumar Singh Vs Damodar Valley Corporation &Ors.

Based on this method, various factors have been considered such as socioeconomic cost, environment cost, freshwater vulnerability and habitat & wildlife vulnerability for the computation of environmental compensation.

The total compensation for the subject spill is calculated to be Rs.73,68,00,906/- (Rupees Seventy Three Crores Sixty Eight Lakhs Nine Hundred and Six only).

2. DESCRIPTION OF EVENTS

2.1. In the aftermath of the oil spill incident , the Government of Tamil Nadu constituted a Technical Team vide G.O (Ms) No.178 dated 10.12.2023 with the following Experts/officers to ascertain the cause of the oil leak in the Ennore Creek area

- Thiru.R.Kannan, Member Secretary, TNPCB - Chairman
- Dr.G.Saravanan, Principal Scientist, Chennai Zonal Centre, CSIR- NEERI –Member
- Tmt.H.D.Varalaxmi, Scientist -E & Regional Director, Regional Directorate, Central Pollution Control Board, Chennai – Member
- Thiru V. Kumar, Commandant, Indian Coast Guard – Member
- Prof.V.T.Perarasu, Department of Chemical Engineering, Anna University Chennai – Member.

2.2. The technical team has submitted their final report on 11.01.2024 to the Government with a remark that the quantity of oil washed away might be more than 400 KL. This was derived by the team based on the information obtained of CPCL such as slop oil quantity from daily operation, crude receipt quantities, total sludge accumulation in the premises, characteristics of slop oil, cleaning frequency etc.,

2.3. The oil spill assessment study and cleaning/bioremediation of oil spill in Ennore Creek, Buckingham Canal, and Kosasthalaiyar River through biodispersants were carried out by Indian Institute of Technology, Madras & National Institute of Oceanography, Goa respectively.

2.4. The Hon'ble Tribunal had directed TNPCB that after receipt of the report from the IIT - Madras and NIO - Goa, let the TNPCB to compute the extent of damage caused due to the oil spill on the mangroves. Also, Government vide letter dated 24.06.2024 has requested to obtain comments from the Expert Committee on the study reports

2.5. The final reports by IIT Madras & NIO, Goa was submitted in August 2024.

2.6. The technical team met on 03.09.2024 and evaluated the reports and concluded that the total spilled oil may be considered as 647 cu.m or 517 tonnes for computation of damages caused

2.7. The team again met on 14.10.2024 to compute and finalize the environmental compensation using the method which was used in NGT OA No. 18 of 2020/EZ (Praveen Kumar Singh Vs Damodar Valley corporation &Ors.)

3. ENVIRONMENT COMPENSATION & FACTORS CONSIDERED FOR ITS CALCULATION

Environment compensation is a term used for the process through which the financial responsibility for environmental damage is transferred back to those who cause the damage. Environmental compensation is a policy instrument for the protection of the environment which works on the Polluter Pay Principle.

The following factors affect the estimation of the environmental costs and damage caused by oil spills

- **Oil type** - Oils are complex mixtures with a wide variety of properties. When oil is spilled on the surface of the sea, it undergoes physical and chemical changes. These processes include evaporation, dispersion, dissolution and sedimentation. They result in the disappearance of the oil from the sea surface. On the other hand, the formation of an oil-water emulsion and the increase of viscosity promote the persistence of the oil in the ecosystem. The marine environment assimilates oil through the long - term process of biodegradation. In general, light oil and light crude oils do not persist on the surface of the sea for long, as a result of the fast evaporation of the volatile components and the easy dispersion, especially when the sea is rough. Clean - up cost in these cases are low as a rule. But, other types of oil such as heavy crude, emulsified crude and heavy fuel oils are persistent in the environment, because they contain a high ratio of non-volatile components and they have a high viscosity. Clean - up of these oils in the environment is difficult and the cost may be very high. Light oil products attract fire and explosion risks. Their toxicity is higher than heavy oils. Heavy oils have the ability to settle and accumulate in the bottom sediment.
- **Location of the spill** – The location of an oil spill has an important effect on the clean-up cost. The location is decisive for the response a rescue team can provide and for the damage to natural and social resources, the economy and the environment. The location also influences the behaviour of the oil and the way it relates to the hydro-meteorological characteristics (wind direction, currents, waves, tides, and water depth) of the area. Also, the type of the coast affects the clean-up cost. Influencing factors include the proximity of a reserve, of biologically sensitive areas, or a World Heritage

site. All these will increase the clean-up cost. The clean-up cost for oil spills differs for on shore and offshore incidents. On shore, common, simple methods can be used. As a rule, they are available in the area. In offshore, the clean-up costs increase because it necessitates more sophisticated equipment including airplanes, ships, a skilled response team, etc. However, recovery of oil off shore may be more effective than onshore.

- **Weather** - Weather and surface conditions are important to mitigate the effects of an oil spill. Good weather contributes to a faster clean-up. It also decides the mixing response and emulsifying tendency.
- **Local Response Capacity –** The response capacity of the Rescue Center for oil spills depends on its equipment's (buoy, airplane, oil containment, ship, rescue boat, and chemicals), the rescue teams (trained and skilled professionals) and the preparedness to rescue. Worldwide, this capacity varies according to the attitude of the region, the media, and the competent agencies.

4. CALCULATION OF ENVIRONMENT COMPENSATION

The clean-up cost of an oil spill is the sum of the response costs, the value of the socioeconomic damage and the environmental cost.

a) Total response cost = base per-gallon response cost (based on oil type/volume/response method) x medium modifier x spill amount

The base per-gallon response cost is the cost to eliminate 1 gallon of oil from the environment. The base per-gallon response cost depends on the response methods such as mechanical cleaning, dispersing, in-situ treatment or manual removal approaches. The base per-gallon response cost to remove different amounts of different oil types is shown in **Annex 1**. The medium modifier is a value that differs for an oil spill in open water, wetland, mudflat, soil, or sand. Medium modifier values are listed in **Annex 3.**

However, in this case, the response activities were carried out by CPCL with the help of specialized cleaning agencies, skilled man power and sophisticated machineries/ equipments in Buckingham Canal, Kosasthalaiyar River & Ennore Creek. As a result of cleaning, a total of 2,20,040 litres of oil-water mixture and 663.5 tonnes of oil laden soil & debris have been removed from oil affected areas.

The total cost for these activities were borne by CPCL. Therefore, the response cost is calculated as nil.

b) **Total socioeconomic damage cost = per-gallon socioeconomic cost x socioeconomic cost modifier x spill amount.**

The per-gallon socioeconomic cost corresponds with the impact of 1 gallon of oil to the local and regional tourism, commercial fishing, recreational facilities, national parks, marine resources, seascapes, private property and waterway and port operation impacts. This cost depends on the oil type and the spill size. Unit price estimations are listed in **Annex 2.** The socioeconomic cost modifier differs according to the socioeconomic sector that is impacted.

In this case, the per gallon socio-economic cost ranges from USD 80 to USD 500 based on the type of oil and the environment in which the spillage has happened. The socio-economic cost modifier value is considered as 0.1 as the Manali-Ennore area is an industrial zone. With these, the socio-economic damage cost totals to USD 2472793.6

c) **Total environmental damage cost = per-gallon environment cost x 0.5 (freshwater + wildlife modifier) x spill amount**

The per-gallon environment cost corresponds with the cost of the damage caused by 1 gallon of oil. Damage costs are estimated by the amount of money that is necessary to repair the environmental damage. This cost is shown in **Annex 2.**

For this calculation, the value of per gallon environment cost ranges from USD 30 to USD 85 based on the type of oil and the environment in which the spillage has happened. The freshwater vulnerability and habitat & wildlife sensitivity is considered as 0.4 & 0.4 respectively. The total environmental damage cost is calculated as USD 2668577.8.

d) **Time value for money**

The time value for money is calculated using the compounding of inflation rate as given in **Annex 7**. The inflation rate is considered as 6.78% in this case.

With all these parameters, the environmental compensation is calculated as ₹73,68,00,906/- (Rupees Seventy-Three Crore Sixty-Eight Lakh Nine Hundred and Six only). The detailed calculation is enunciated in **Table 1**.

Table 1: Environmental Compensation Calculation for the oil spill caused in Ennore

Particulars	Oil present in Soil	Oil pools in islands and B.Canal overflow	Oil sheen on B.Canal and K River	Oil stains and inundation in residential area	Oil stains on mangroves and river banks
Oil Type	Heavy Oil	Heavy Oil	Heavy Oil	Heavy Oil	Heavy Oil
Method	Mechanical (50%)	Mechanical (50%)	Mechanical (50%)	Mechanical (50%)	Mechanical (50%)
Volume of Oil (cu.m)	487	31.4	11.55	117	0.3849
Volume of Oil (Gallons)	128652	8295	3051	30908	101.7
Cost Modifier value	0.6	1	1	0.55	1.1
Base per-gallon response cost (USD/gallon)	0	0	0	0	0
Per-gallon socioeconomic cost (USD/gallon)	100	500	500	200	80
Socioeconomic cost modifier	0.1	0.1	0.1	0.1	0.1
Per-gallon environment cost (USD/gallon)	30	70	70	65	85
Cost Modifier Value (Freshwater Vulnerability)	0.4	0.4	0.4	0.4	0.4
Cost Modifier Value (Habitat and Wildlife sensitivity)	0.4	0.4	0.4	0.4	0.4
Total Response Cost (USD)	0	0	0	0	0
Total Socioeconomic damage cost (USD)	1286520	414750	152550	618160	813.6
Total Environment Damage Cost (USD)	1543824	232260	85428	803608	3457.8
Total Cost (USD) (2005)	2830344	647010	237978	1421768	4271.4
Total Cost (Rupees) (2005)	124535136	28468440	10471032	62557792	187941.6
Total Cost (Rupees) (2023)	405611628	92721866.82	34104209.24	203751075.2	612126.8326
Total Environment Compensation (rupees)	₹ 73,68,00,906				
Average Inflation rate from 2005 to 2023 is 6.78% applied as per formula mentioned in Annex 7. Number of years considered as 18 years (from 2005 to 2023)					
1 USD was equivalent to 44 Indian rupees in 2005					

5. RECOMMENDATIONS

The committee was informed that total response cost was borne by M/s CPCL, hence it is recommended to recover a ~~total~~ sum of ₹73,68,00,906/- (as a Socio Economic Damage Cost (₹35,43,71,708/-) and Environmental Damage Cost of (₹38,24,29,198/-)) due to oil spill occurred during December 2023.

6. REFERENCES

a. "Oil Spill & Clean up cots", Trang, Cao Thi Thu, 2006
b. "Development of Oil Spill Response Cost – Effectiveness Analytical Tool", Etkin, Dagmar Schmidt, Welch, Jeff, 2005

Signature of Committee Members

Dr.G.Saravanan, **Principal Scientist,** **CSIR - NEERI**	**Prof V.T.Perarasu,** **Department of Chemical Engineering,** **Anna University**
Tmt. H.D.Varalaxmi, **Scientist – E & Regional Director,** **CPCB, Chennai**	**Thiru.R.Kannan,** **Member Secretary,** **TNPCB**

Annexure

Annex 1: Per-gallon Oil Spill Response Cost as used in EPA BOSCEM (in USD)
(Etkin, 2005)

Oil type	Volume (gallons)	Mechanical				Dispersants		In-situ Burn	
		0%	10%	20%	50%	Low	High	50%	80%
Light fuel	<500	100	85	70	57	36	25	26	13
	500-1,000	98	83	68	55	35	24	25	12
	1,000-10,000	97	82	67	54	34	23	24	11
	10,000-100,000	87	72	59	41	26	18	18	9
	100,000-1,000,000	74	62	49	26	17	10	10	5
	>1,000,000	31	26	17	12	11	6	7	3
Heavy oils	<500	440	386	335	310	140	89	125	64
	500-1,000	438	385	334	309	139	88	124	63
	1,000-10,000	436	384	333	308	138	87	123	62
	10,000-100,000	410	359	308	267	103	62	103	51
	100,000-1,000,000	179	154	128	103	59	54	72	41
	>1,000,000	87	77	67	36	53	49	56	26
Crude oils	<500	220	199	189	153	85	53	75	48
	500-1,000	218	197	187	151	84	52	74	47
	1,000-10,000	215	195	185	149	82	51	72	46
	10,000-100,000	195	185	174	138	74	31	62	31
	100,000-1,000,000	123	118	113	92	49	29	36	16
	>1,000,000	92	82	76	64	58	13	22	11
Volatile distillates	<500	-	103	-	-	-	-	-	-
	500-1,000	-	102	-	-	-	-	-	-
	1,000-10,000	-	100	-	-	-	-	-	-
	10,000-100,000	-	55	-	-	-	-	-	-
	100,000-1,000,000	-	23	-	-	-	-	-	-
	>1,000,000	-	7	-	-	-	-	-	-

Annex 2: Socioeconomic and Environmental Base Per-Gallon Coast as used in EPA BOSCEM *(Etkin, 2005)*

Oil type	Volume (gallons)	Base Cost (USD/gallon)	
		Socioeconomic	Environmental
Light fuel	<500	65	48
	500-1,000	256	45
	1,000-10,000	400	35
	10,000-100,000	180	30
	100,000-1,000,000	90	15
	>1,000,000	70	10
Heavy oils	<500	80	85
	500-1,000	330	80
	1,000-10,000	500	70
	10,000-100,000	200	65
	100,000-1,000,000	100	30
	>1,000,000	90	25
Crude oils	<500	150	95
	500-1,000	600	90
	1,000-10,000	900	85
	10,000-100,000	500	75
	100,000-1,000,000	200	40
	>1,000,000	175	35
Volatile distillates	<500	50	90
	500-1,000	200	87
	1,000-10,000	300	80
	10,000-100,000	140	73
	100,000-1,000,000	70	35
	>1,000,000	60	30

Annex 3: EPA BOSCEM Response Cost Modifiers for Location Medium Type Categories *(Etkin, 2005)*

Category	Cost Modifier value
Open Water/Shore*	1.0
Soil/Sand	0.6
Pavement/Rock	0.5
Wetland	1.6
Mudflat	1.4
Grassland	0.7
Forest	0.8
Taiga	0.9
Tundra	1.3

Annex 4: EPA BOSCEM Socioeconomic and Cultural Value Rankings *(Etkin, 2005)*

Value Rank	Soil Impact Site (s) Description	Examples	Cost Modifier Value
Extreme	Predominated by areas with high socioeconomic value that may potentially experience a large degree of *long-term* impact if oiled.	Subsistence/ commercial fishing, aquaculture areas	2.0
Very High	Predominated by areas with high socioeconomic value that may potentially experience some *long-term* impact if oiled.	National park/reserves for ecotourism/natur e viewing; historic areas	1.7
High	Predominated by areas with medium socioeconomic value that may potentially experience some *long-term* impact if oiled.	Recreational areas, sport fishing, farm/ranchland	1.0
Moderate	Predominated by areas with medium socioeconomic value that may potentially experience *short-term* impact if oiling occurs.	Residential areas; urban/suburban parks; roadsides	0.7
Minimal	Predominated by areas with a small amount of socioeconomic value that may potentially experience *short-term* impact if oiled.	Light industrial areas; commercial zones; urban areas	0.3
None	Predominated by areas already moderately to highly polluted or contaminated or of little socioeconomic or cultural import that would experience little short- or long-term impact if oiled.	Heavy industrial areas; designated dump sites	0.1

Annex 5: EPA BOSCEM Freshwater Vulnerability Categories *(Etkin, 2005)*

Category	Cost Modifier Value
Wildlife Use	1.7
Drinking	1.6
Recreation	1.0
Industrial	0.4
Tributaries to drinking/recreation	1.2
Non-specific	0.9

Annex 6: EPA BOSCEM Habitat and Wildlife Sensitivity Categories *(Etkin, 2005)*

Category	Cost Modifier value
Urban/Industrial	0.4
Roadside/Suburb	0.7
River/Stream	1.5
Wetland	4.0
Agricultural	2.2
Dry grassland	0.5
Lake/Pond	3.8
Estuary	1.2
Forest	2.9
Taiga	3.0
Tundra	2.5
Other sensitive areas	3.2

Annex 7: Calculation of Time value of money

Given that money changes with time as a result of inflation rate that act as a compound interest, the following formula can be used

$FV = PV\ (1+i)^n$

FV = Future Value

PV = Present Value

i = Interest rate (inflation)

n = Number of times the interest is compounding i.e., in years

ASSESSMENT OF ENNORE OIL SPILL DURING MICHAUNG CYLCONE

March 2024

Environment Engineering Division

Department of Civil Engineering

Indian Institute of Technology Madras, Chennai–600036

Executive Summary

The "MICHAUNG" cyclonic storm caused extensive oil spillage from Chennai Petroleum Corporation Limited (M/s CPCL). The resulting contamination adversely affected biodiversity, daily life, and livelihoods in the impacted regions. IIT Madras research team conducted acomprehensive field assessment, mapping oil contamination across 20 zones. Notable hotspots included stormwater outlets ofM/s CPCL, residential areas and industrial areas in Ennore. Field surveys, mapping efforts using drones, questionnaire surveys provided deep insights into the extent of oil contamination. Oil pools, sheens, and stains were observed in residential, industrial, and natural areas, threatening biodiversity, and public health.

Two sources of the oil spill into the environment were identified. One being the storm water discharge outlet at the south-eastern wall of CPCL into the Buckingham Canal and the other being the storm water canal discharging into surplus canal of KosasthalaiyarRiver. The flood levels of the KosasthalaiyarRiver rose to 5 to 6 ft above the Buckingham Canal bund level causing the entry of oil and water into the adjoining residential areas of Ernavoor and Sathyamoorthy Nagar.Residents affected due to oil flooding have reported skin allergies and inhalation of oil from stain can result in chronic illness.

The mangroves along the banks and the islands in KosasthalaiyarRiver were impacted up to a height of 10 ft near the surplus canal and 3 ft in other areas with complete loss of mangrove saplings.The oil is likely to be stagnant in burrows made by crabs which can severely impact the mangroves and the associated flora and fauna.The team observed several dead fish and crabs and oil coated birds.

Laboratory analysis of water, soil and sediment samples revealed Total Petroleum Hydrocarbon (TPH) concentrations ranging from 13.6 to 120 g/kg in sediments with permissible limits by CPCB is 5 to 10 g/Kg . The oil estimates from our assessment done after CPCLs cleanup is about 517 tonnes and the oil/water/soil sludge removed by CPCL is 393 tonnes. Fingerprinting analysis using GC-MS suggests that it could be slop oil or furnace oil or mix of both.

The Tamil Nadu Pollution Control Board's survey of M/s CPCL premises has suspected breaches in stormwater drainage systems and potential risks associated with oil storage and handling practices. An assessment of the open tanks in M/s CPCL premises indicated that 417 tonnes of oil could have been stored before flooding which is less than 517 tonnes + 393 tonnes of mixture estimated. This mismatch suggests that the flood induced release from the

open tanks may not have been the sole reason of the oil spill. Other possibilities could be breach of oil from enclosed storage tanks of CPCL premises.

The concentrations largely exceeding permissible levels and continuously releasing the toxic compounds from oil to water, soil and sediments causing continuing damage to the ecosystem which calls for remedial action.

Recommendations:

Oil Spill response plan for inland oil spills should be prepared for better preparedness for future disasters of this kind. The plan should list the action to be taken, equipments to be available and roles and responsibilities of different departments. Urgent remedial actions are imperative to mitigate the environmental and socio-economic consequences of this oil spillage. In addition, efforts should focus on long term environmental restoration, alongside regulatory measures to enhance industrial safety. The following recommendations are made for the Mikchang oil spill.

1. The oil spills in the banks of the creek, redhills surplus canal and islands of river which are still remaining in the site have to be removed immediately and bioremediation initiated.
2. Diversion of the northern storm water drain entry from Redhills surplus canal to the Buckingham canal is recommended to prevent accidental entry of oil in the KRiver in future.
3. The stormwater outlets in the oil industries should be redesigned to contain the oil within the premises and let out only the water.
4. There should be an immediate action to clean up the soil islands thoroughly, monitor the mangrove health and plant mangrove saplings to restore the density of the mangroves in Kosasthalaiyar River.
5. The stored oil water and oil –soil mix along with absorbent sponges should be disposed in hazardous waste incinerator.
6. Bioremediation of oil sludge stored in CPCL should be done in a sheds with a proper roof and wall so that oil doesn't leach back during the rain events.
7. A study must be conducted to assess the long-term ecological health and ecosystem services of the KR and human health risk due to the prolonged exposure to contaminated air, water and fish consumed in the region.

Contents

1. Introduction

A severe cyclonic storm named "MICHAUNG" which formed over the Bay of Bengal, resulted in exceptionally heavy rainfall in the coastal districts of North Tamil Nadu and South Andhra Pradesh states (IMD, 2023). Chennai city experienced significant rainfall, with the Nungambakkam Meteorological Station recording a maximum of 530 mm between December 2 and 4, 2023. This extreme weather event had detrimental effects on the daily lives, livelihoods, and biodiversity of the affected regions.

Chennai Petroleum Corporation Limited, also known as CPCL, which stands as one of the foremost public sector refining companies in India, found itself at the centre of another crisis. Cyclone Michaung led to the leakage of oil deposits from M/s CPCL's guard ponds and stormwater drain ponds. These deposits were released on the flood plains of Kosasthalaiyar River and into the Buckingham Canal. The oil was carried along with the flood water through these waterways ultimately reaching the Ennore Creek and contaminating the Bay of Bengal.

The IIT Madras research team started their field campaign to assess the oil spill contaminations in water and sediments for a 12 km stretch in Buckingham Canal. The field campaign encompassed various activities, including flow measurements in Buckingham Canal, the collection of water and sediment samples, and mapping the spread of oil contamination in the affected area. This preliminary assessment report provides in-depth findings from both field investigations and laboratory analysis, offering insights into the severity of the oil spill contamination. Additionally, it provides a summary of the coast guard's estimation of the oil spill, along with insights gathered from the Tamil Nadu Pollution Control Board (TNPCB) Committee Report.

Figure 1: Oil spread near Ennore railway bridge

2. Mapping the Extent of Oil Contamination

IITM started their on-site investigations after the first response measures undertaken by CPCL. By then, oily sludge of 393 tonnes floating on the river and the banks were contained using booms and removed using skimmers(The Hindu Bureau, 2023 and Pandey K, 2023).During our physical survey by boat and by road between 14th and 26th December 2023, we observed oil marks along the banks of the Kosasthalaiyar River (K River) and the Buckingham Canal (B Canal), identifying20 zones where oil accumulation was notably high.

Zone 1: Entry Point 1 - Storm water canal discharge into surplus canal of Kosasthalaiyar River
Zone 2: Kattukuppam
Zone 3: B/w railway and road bridge
Zone 4: Near Ennore railway bridge
Zone 5: Thazhankuppam
Zone 6: Ennorekuppam
Zone 7: Nettukuppam
Zone 8: Bridge pier/island in K River - Sadayankuppam
Zone 9: Oil overflowed along B Canal
Zone 10: In mangrove islands
Zone 11: Ernavoor and Sathyamoorthy Nagar residential area
Zone 12: Ernavoor and Sathyamoorthy Nagar industry/marsh accessible areas
Zone 13: Storm water drain outside M/s CPCL
Zone 14: Storm water drains inside M/s CPCL
Zone 15: Land area within M/s CPCL, IAL, Steel
Zone 16: Oil staining the soil embankment in B Canal and K River
Zone 17: Oil staining the mangroves
Zone 18: River and canal sediments
Zone 19: Marine sediments and oil lost to sea
Zone 20: Entry Point 2 - Storm water discharge outlet at the south-eastern wall of CPCL into the Buckingham Canal

There was a large amount of oil stagnation near Ennore Creek due to the combination of tidal activity and the river mouth's influence. In this season, the wave and tidal movements tend to carry particles toward the shoreline in a southwest direction. As a result, it takes longer for substances such as oil, to be dispersed back into the ocean. Zone 1 is a hotspot where a large influx of oil came from the storm water drain from M/s CPCL, entering the floodplains of K River, and eventually contaminating the river. In all the accessible zones we had collected soil, water and some river sediment samples and quantified the oil that had been contaminated.

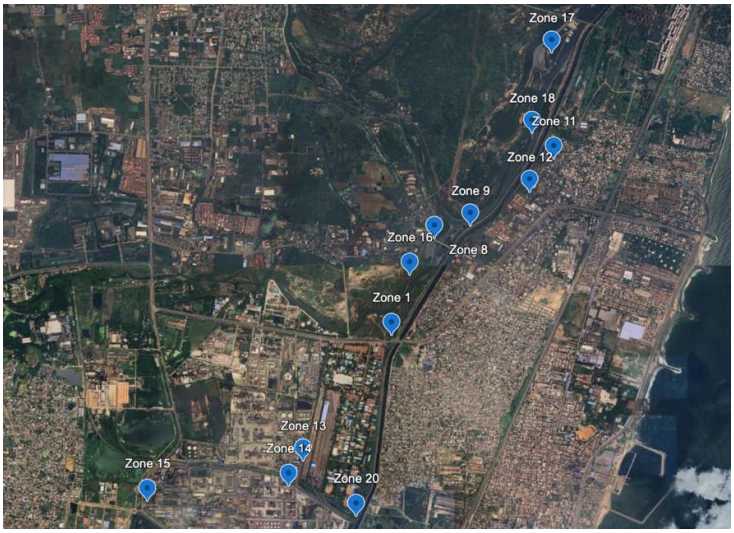

Figure 2: Contamination Zones from CPCL premises to the midstream of Buckingham Canal

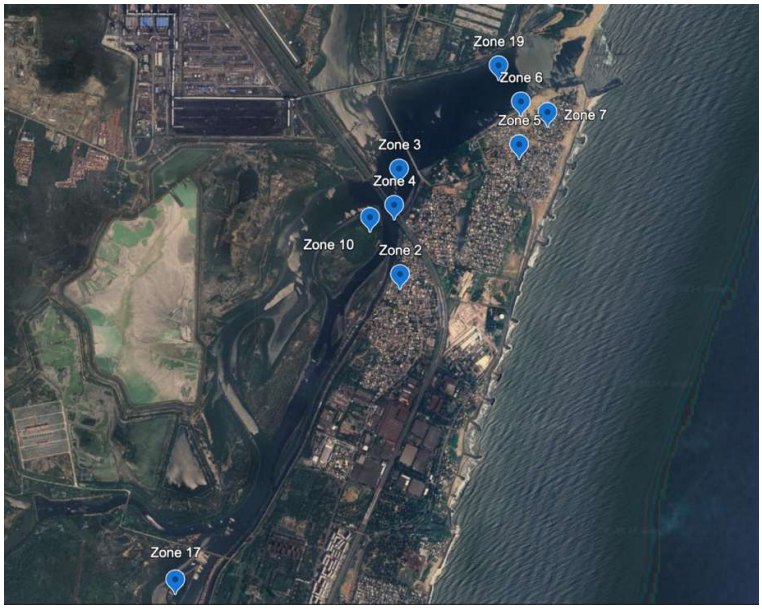

Figure 3: Contamination Zones from midstream of Buckingham Canal to Ennore Creek

During the flood event, B Canal experienced overflow of oil mixed water, inundating the residential areas of Ernavoor (Zone 11). Lamp posts positioned within the residential vicinity along the B Canal exhibited signs of oil spillage, while flood-affected houses showed oil stains on their walls, reaching heights of 5 to 6 feet. The overflowing oil mixed water adversely affected vegetation, residential buildings, vehicles, and the open wells that serve as sources of groundwater. The field images below provide visual representation of the extent of oil contamination within the residential zones of Ernavoor.

Figure 4: Highest oil mixed water level 7.5 feet above normal water level during the cyclone

Figure 5: Collection of samples from the oil overflown along the banks of B Canal.

Figure 6: Oil marks observed in the residential localities of Ernavoor.

Assessment Regions:

The extensive presence of heavy oil was detected in various locations along our route, indicating a significant spill. IIT Madras team surveyed along the B Canal and K River to identify the extent of the spill along the width and length of the waterways. We have divided the assessment regions to three stretches:

1. Downstream from Ennore Thermal Power Station (ETPS) to Creek:

Figure 7 illustrates the flow of oil, represented by red arrows, along the B Canal and K River after the floodwaters receded. Dotted lines signify the presence of oil stains along all banks of these water bodies and islands. Hotspots, where substantial oil deposits occurred, are highlighted as red patches along the eastern banks of the Creek, extending from Kattukuppam to Nettukuppam.

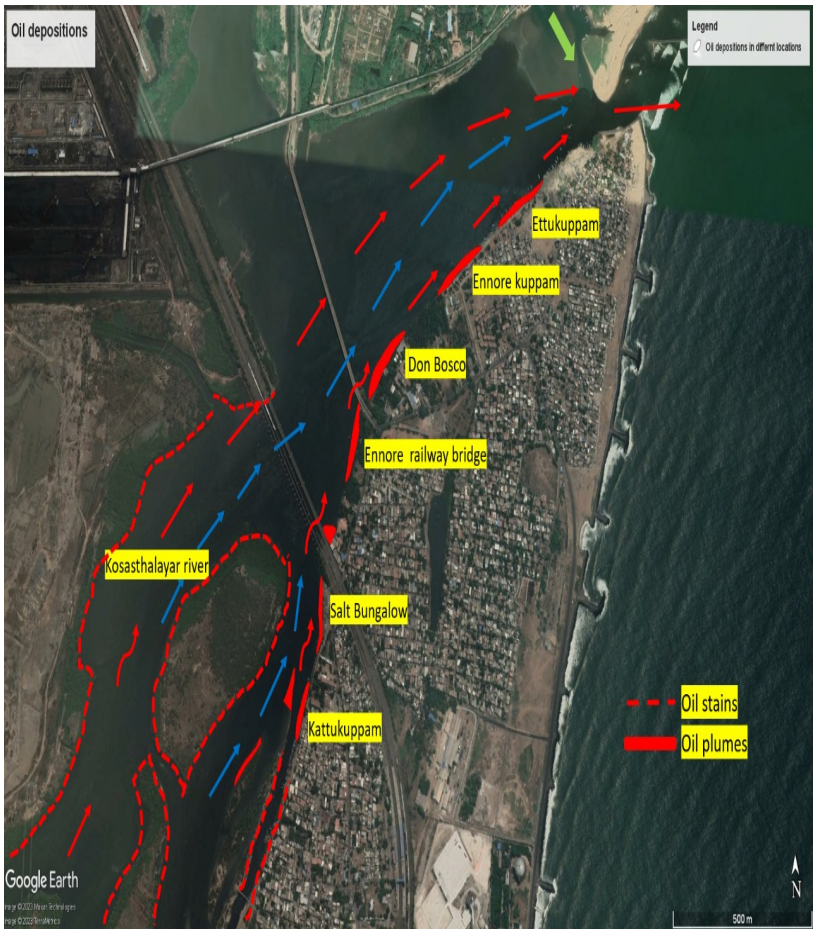

Figure 7: Assessment Region 1 - Downstream from ETPS to Creek Area

2. Midstream from Ennore Thermal Power Station (ETPS) to Manali High Road Bridge:

The midstream stretch of B Canal extending from the junction of K River and surplus canal from Redhillsup to ETPS is the crucial area to pay attention. The surplus from Puzhal and Poondi Lakes discharged high quantum of water into the two K River branches which trapped the oil in this mid-stream stretch. The flood water rose to 7 to 9ft in this section carrying the oil with it, over the B Canal bank into the adjoining residential and industrial areas of Ernavoor and SathyamoorthyNagar. Oncethe flood water/surplus water receded, the oil must have flown downstream into the Kattukuppam all the way to Nettukuppam.

Figure 8: Assessment Region 2 - Midstream From ETPS to Manali High Road Bridge

3. Upstream of B Canal from Manali High Road to Kodungaiyur

Two oil discharges from the M/s CPCL stormwater drain have occurred in the locations: one in the south (entry point 2), directly into the B Canal, and another in the north (entry point 1), flowing through the stormwater drain adjacent to India Additives, into the flood plains of K River (Zone 1 indicated by the large red patch). Stormwater drains within M/s CPCL were tracked, revealing breaches in the outlet and walls, with all drains and tanks heavily stained with oil.Numerous open oil-water collection tanks were present at ground level, lacking preventive measures to contain oil during flooding or to prevent its escape from the premises.

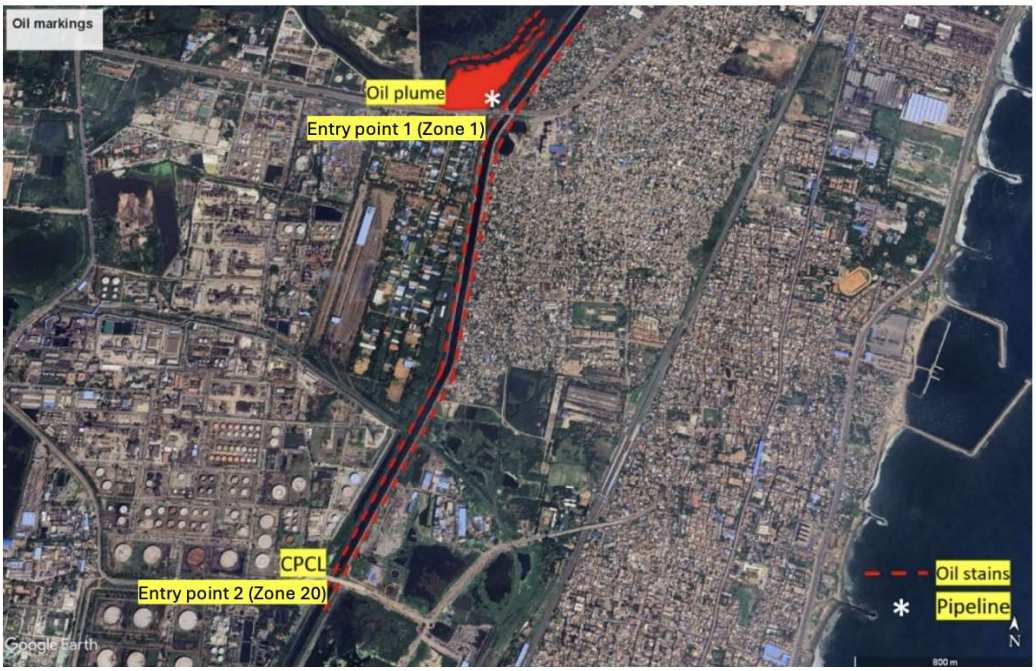

Figure 9: Assessment Region 3 - Upstream of B Canal from Manali High Road toKodungaiyur showing the entry point of oil into the Buckingham Canal and KosasthalaiyarRiver

The soil samples collected at Zone 1 had oil markings present up to 2m (max.) depth from the surface. This may have long-term impacts on the region as it is mostly an unconfined aquifer where there are possibilities of contamination of the ground water.

Figure 10: Drone image of Zone 1

Figure 11: Close up view of Zone 1

Verified through drone camera images, the dark patches in the above image signify the presence of oil pools surrounding the stormwater outlets flowing towards the K River. Extensive sampling of soil and water at this contaminated site revealed high oil content. Upstream from this contaminated site, deposits of oil-contaminated sludge are still present, likely resulting from backflow from this leakage point. However, no significant oil spill or sludge deposition was observed beyond 100 meters from this location, indicating that Zone 1 is likely the initial point of oil spillage or the source itself.

Figure 12: Earth moving machinery at the oil spill site

Figure 13: B canal possibly breached and oil stain covered.

Numerous earthmoving machines were on-site (Figure 13), along with several laborers tasked with covering the oil stains in the floodplain. Arrows pointing towards the two locations in the Buckingham Canal(Figure 14)distinctly indicate that the bund has been reworked following the oil spill, with one section appearing clean and the other section visibly stained with oil.

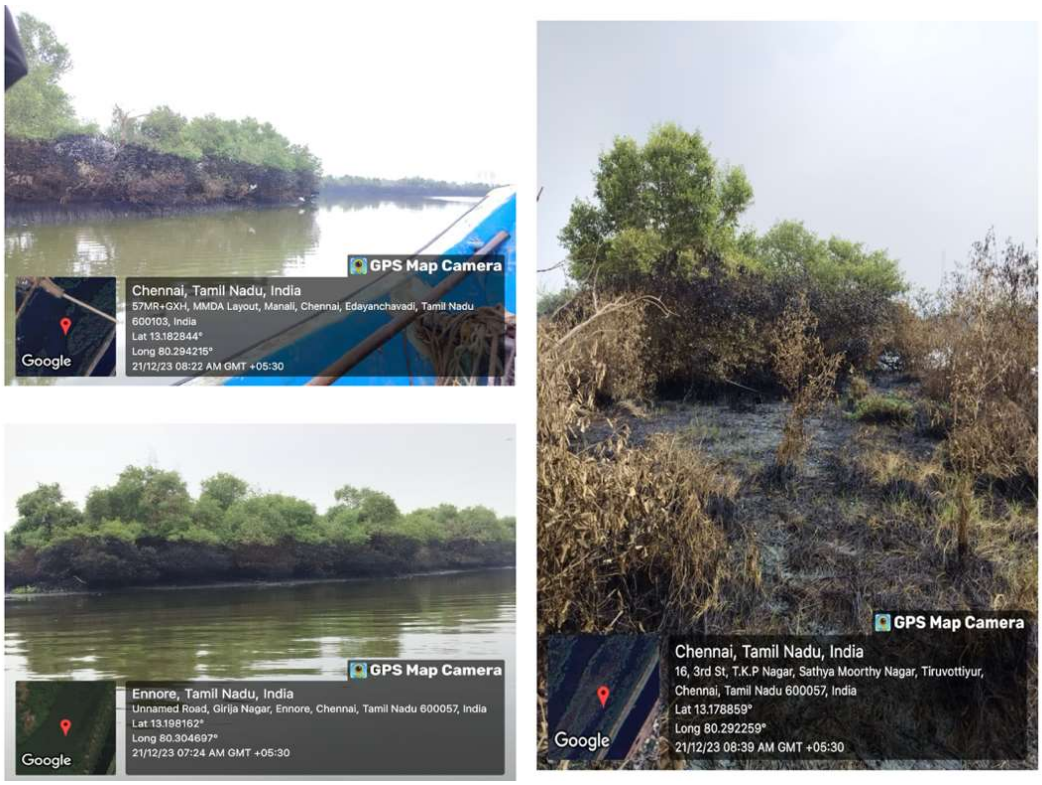

Figure 14: Mangroves with severe oil contamination

Figure 15: Dead birds, crabs, and fishes found in the contaminated site

The oil spill has posed a significant threat to biodiversityin the affected area, impacting mangroves and various organisms such as crabs, fishes, and birds.Visual observation of dead fishes, large number of crabs in the mangrove islands and dead mangrove saplings and 4 to 8 feet of oil-stained mangroves was documented(Figure 15 and 16). M.S. Swaminathan Research Foundation and National Centre for Coastal Research studies have documented these impacts. Long term sublethal damage to the mangroves can be assessed only through periodic monitoring. On the mangrove islands, the oil is likely to be stagnant in burrows made by crabs which can severely impact the mangroves and the associated flora and fauna. The benthic organisms such as shrimp and crabs in Kosasthalaiyar River and mangroves will take months or years to come back to normal if the contaminated soil is not removed or bio-remediated.This has severely affected the livelihood of the fishing villages along KosasthalaiyarRiver who now must go to the sea.

3. Field Assessments and Sampling

Field assessments were conducted along Buckingham Canal utilizing boats and by road in areas inaccessible by boat. Water and sediment samples were systematically collected at 500-meter intervals. Water samples, including any oil present, were obtained from both the top and bottom of the canal using a bailer. The depth of the canal was measured with a staff gauge, and flow velocity was assessed using an ultrasonic flow sensor. Sampling locations along a 12 km stretch from Indian Oil Cooperation Limited (IOCL) in Tondiarpet to Ennore Creek in Buckingham Canal are illustrated in Figure 2. Soil sediments and oil deposits were collected using a grab sampler and analysed in the laboratory for Total Petroleum Hydrocarbon (TPH) via gravimetry and gas-chromatography analysis.

Figure 16: Sampling locations along Buckingham Canal

Figure 17: Collecting sediment samples using a grab sampler

Figure 18: Sediment samples with the oily sludge were collected from midstream and banks

Figure 19: Depth measurement

Figure 20: Sampling of soil cores

Figure 21: Collecting water samples using a bailer

3.1 Drone Surveys

A drone survey was carried out to quantify the oil contamination spatially. Drones were employed to capture the hyper-spectral aerial images, that will help us differentiate water from oil. The drone images captured (Figure 24) show the oil sheen floating on B canal and K River.

Figure 22: Capturing high-resolution images using drone survey

Figure 23: Drone images showing oil contamination in B Canal and K River

3.2 Water Characteristics Measured Insitu:

In-situ water quality measurements, such as pH and total dissolved solids (TDS), were measured using a field probe, revealing pH values ranging from 7.4 to 8.0 and TDS values between 500 and 850 mg/L. The table below shows the insitu-water characteristics of the water samples.

Table 1: Insitu- water characteristics

Sample ID	Latitude	Longitude	Water level [m]	pH		TDS [mg/L]	
				Top water	Bottom water	Top water	Bottom water
SL 1	13.2200	80.31833	0.5	7.88	-	842	-
SL 2	13.21666	80.31638	1	7.97	7.80	804	855
SL 3	13.21305	80.31416	1	7.95	8.04	852	845
SL 4	13.20916	80.3125	1	7.92	7.99	844	840
SL 5	13.205	80.31027	1.5	7.88	7.94	824	824
SL 6	13.20217	80.30834	-				
SL 7	13.15433	80.28454	-	7.66	-	671	-
SL 8	13.1415	80.27866	-	7.63	7.73	683	700
SL 9	13.16015	80.2876	-	7.47	7.44	761	795
SL 10	13.16441	80.28916	-	7.7	7.65	740	744
SL 11	13.16938	80.28973	-	7.78	7.67	786	765
SL 12	13.17541	80.29114	-	7.61	7.54	733	752
SL 13	13.17923	80.29366	-	7.51	7.59	732	741
SL 14	13.18276	80.29591	-	7.66	-	634	-
SL 15	13.19324	80.30388	-	7.66	7.62	736	739
SL 16	13.18568	80.29944	-	7.87	7.72	759	751
SL 17	13.18949	80.30199	-	7.81	7.52	770	778
Nettukuppam	13.2311	80.32602	0.9	7.71	7.78	496	758
Thazhankuppam	13.22935	80.32321	0.8	7.77	7.68	581	624
DonBosco	13.22817	80.32137	0.6	7.93	8.00	457	498
EnnoreBridge	13.22726	80.3205	0.5	7.06	7.12	586	560
Salt Bungalow	13.22573	80.31999	0.7	7.04	7.11	536	924

3.3 Flow Measurement

Water flow measurements were carried out using an ultrasonic flow measurement device - FLOWFLAT. The velocity values ranged from 0.1 m/s to 0.7 m/s. The measurements were conducted in 10 locations within the B Canal and Ennore Creek at different depths based on the location's available flow depth. The table below summarises the velocity magnitudes in the B Canal and Ennore Creek.

Table 2: Velocity values in different locations of B Canal

Sample ID	Latitude	Longitude	Velocity [m/s]	Depth of flow [m]	Depth of velocity measurement [m]
SL2	13.21666	80.31638	0.255	0.5	0.15
			0.385		0.40
SL3	13.21305	80.31416	0.645	1	0.40
			0.734		0.90
SL4	13.20916	80.3125	0.334	1	0.30
			0.390		0.90
SL5	13.205	80.31027	0.400	1.5	0.50
			0.452		1.00
			0.496		1.20
SL6	13.20217	80.30834	0.214	0.3	0.25
SL7	13.15433	80.28454	0.308	0.15	0.10
SL10	13.16441	80.28916	0.104	0.2	0.10
			0.117		0.15
SL12	13.17541	80.29114	0.150	0.38	0.15
			0.472		0.35
Nettukuppam	13.2311	80.32602	0.214	0.9	0.30
			0.243		0.6
Thazhankuppam	13.22935	80.32321	0.105	0.8	0.3

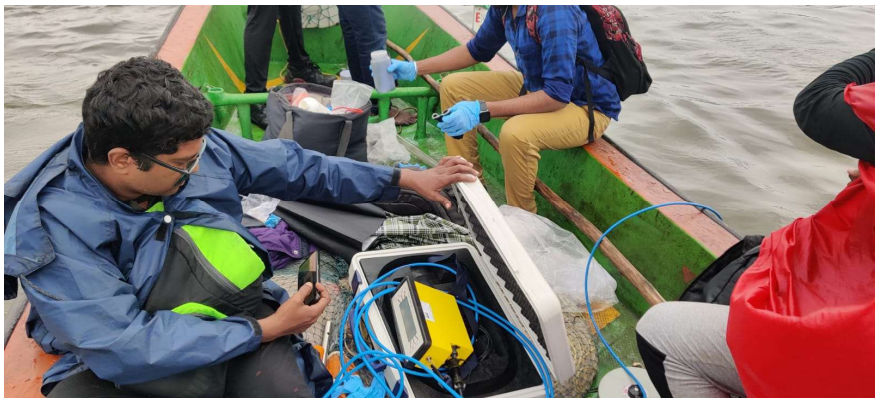

Figure 24: Water quality using field probe and flow measurement using FLOWFLAT

3.4 FloodWater Level Measurement at M/s CPCL Premises

The installation of water level meters at M/s CPCL by IIT Madras provided valuable data regarding the timing and extent of the peak water level, particularly noting the peak occurring on December 6th, 2023.This suggests that a significant influx of water has exacerbated the spread and impact of the oil spill in several ways.

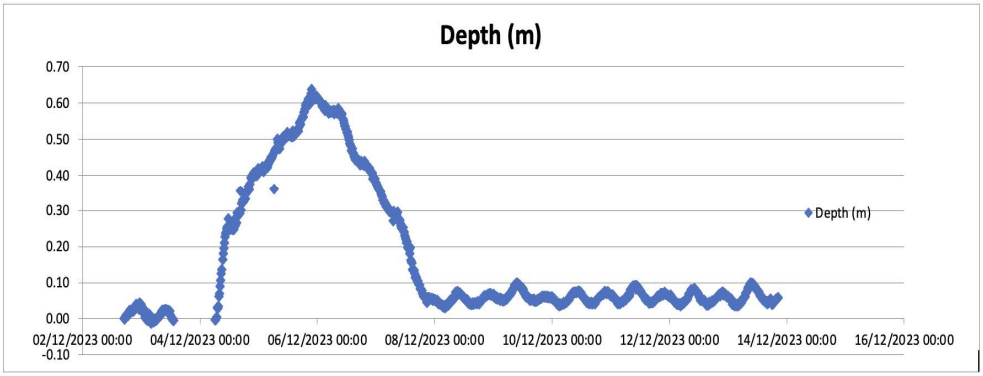

Figure 25: Water level metre at M/s CPCL West Gate

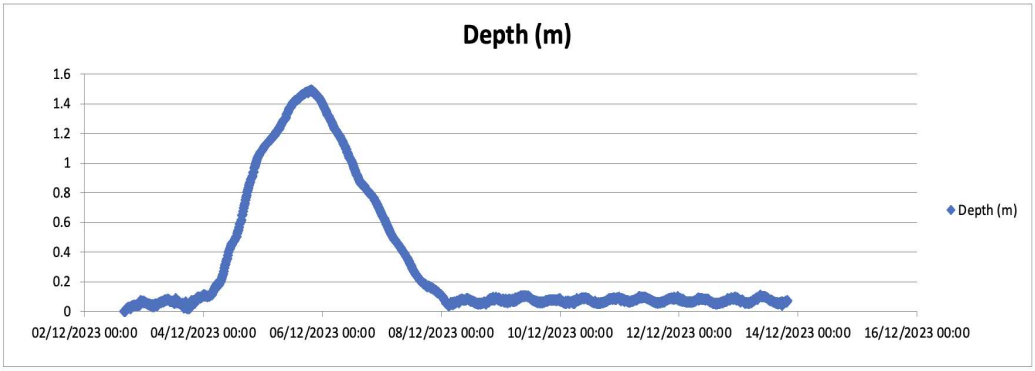

Figure 26: Water level metre at Bottling plant at CPCL

4. Laboratory Analysis

Oily sludge, a semi-solid waste, contains hazardous hydrocarbon substances and is composed of an emulsion of water, petroleum hydrocarbons, heavy metals, and solid particles. Water and sediment samples collected continuously over a three day period in various locations along the B Canal and K River were subjected to analysis for Total Petroleum Hydrocarbon (TPH) utilizing both gravimetric and gas chromatography-mass spectrometry (GC-MS) methods. The TPH content in water ranged from 0.28 to 7.21 grams per litre (g/L), while in sediments, it ranged from 13.6 to 120 grams per kilogram (g/kg). These findings indicate the extent of hydrocarbon contamination in both the aquatic environment and sedimentary deposits within the affected areas.

Table 3: TPH concentrations in water and sediments

Contaminations in 7 Zones which notably showed a high level of oil contamination		**Water**	**Sediments**
Location	**Area [sq.m.]**	**TPH [g/L]**	**TPH [g/Kg]**
Zone 1Entry Point 1 - Storm water canal discharge into surplus canal of Kosasthalaiyar River	100601	1-2.27	13.6-30.44
Zone 2(Kattukuppam)	3007	6.195 - 7.21	NA
Zone 3 (B/w railway and road bridge)	3163	5.32-7.13	18-31.8
Zone 4 (Near Ennore railway bridge)	2886	1.02-2.5	15.32-41
Zone 5 (Thazhankuppam)	5139	0.28-0.54	38-40.38
Zone 6 (Ennorekuppam)	3742	sample not collected	sample not collected
Zone 7 (Nettukuppam)	3232	2.45-3.01	46-46.55
Location	**Area [sq.m.]**	**TPH [g/L]**	**TPH [g/Kg]**
Buckingham Canal	121765	0.43-3.29	33-110
Kosasthalaiyar River	1032988	0.44-0.97	17-38.9
Residential areas near B Canal (oil pool)	11403	NA	24-120

Gas Chromatography Mass Spectrometry analysis was conducted to determine the type of oil that was spilled during the floods. A total of four samples, specifically the field sample, crude oil, furnace oil, and slop oil, were subjected to analysis using GC- MS. The chromatogram of the field sample was compared with those of crude oil, furnace oil, and slop oil to accurately identify the source of the oil. Upon examination of the chromatogram patterns, a precise retention time match was identified between the field sample and furnace oil. However, upon analysing the individual compounds in each chromatogram (across all four samples) for their m/z fragmentation pattern, it was noted that many compounds in the field sample (such as Decane, Dodecane, Tridecane, Hexadecane, Phytane, etc.) corresponded with those in slop oil and furnace oil. Consequently, it is plausible that the oil present in the flood water originated from either furnace oil or slop oil. To precisely identify the source of the oil type, bio-marker fingerprinting analysis is required.

5. Quantification of Oil in the Contaminated Areas

The total oil present in the major environmental compartments during our sampling events in the 20 zones can be summarized into five categories:

a. Oil present in soil:

The soil contamination extent was surveyed by boat and by road through physical investigation and through drone investigation to identify the impacted zones. The total area of the impacted zones were estimated using Google Earth Pro.The depth of soil contamination varied between 1-2.5 feet in Zone 1 to 8.Referring to the results of laboratory analysis an average oil concentration of 30g/kg was considered for the estimates. The most conservative estimate of volume of oil that could be entrapped in the soil is 487cu.m.

Table 4: Volume of oil estimated in soil

Hotspots/Area		Volume of soil contaminated [cu.m.]	Mass of soil contaminated [kg]	Oil measured in soil [kg]	Volume of oil [cu.m.]	Conservative estimate of volume of oil assuming only 1/3rd of the soil mass is contaminated [cu.m.]
Location	**Area [sq.m.]**	**Upto 1 foot depth = 0.3 m**	**Specific gravity of soil = 2.65**	**TPH concentration ~ 30g/kg**	**Density of oil ~ 0.8 kg/m^3**	
Zone 1: Entry Point 1 - Storm water canal discharge into surplus canal of Kosasthalaiyar River	30296	9088.8	24085.32	722.55	903.19	**270.95**
Zone 2 (Kattukuppam)	3007	902.1	2390.56	71.71	89.64	**26.89**
Zone 3 (B/w railway and road bridge)	3163	948.9	2514.58	75.43	94.29	**28.28**
Zone 4 (near Ennore railway bridge)	2886	865.8	2294.37	68.83	86.03	**25.81**
Zone 5 (Thazhankuppam)	5139	1541.7	4085.50	122.56	153.20	**45.96**
Zone 6 (Ennorekuppam)	3742	1122.6	2974.89	89.24	111.55	**33.46**
Zone 7 (Nettukuppam)	3232	969.6	2569.44	77.08	96.35	**28.90**
Zone 8 (bridge pier/ island in KRiver near Sadayankuppam)	3000	900	2385	71.55	89.43	**26.83**
Total volume of oil [cu.m.]						**487.12**

Note:

- **Area was estimated using Google Earth Pro.**
- **Average TPH measured in soil samples were 30g/kg.**
- **Average density of oil is assumed as 0.8 kg/m^3**
- **We assumed only 1/3rd of the soil mass is contaminated.**

Figure 27: Soil Contamination Zones

Figure 28: Soil Contamination Zones

Figure 29: Oil contamination in Zone 1

Figure 30: Oil contamination in Zone 8

b. Oil pools in islands and B Canal overflow:

Oil was found ponding along the B Canal in the upstream stretch where maximum flood levels had taken the oil above the bank of the canal and into the eastern residential and industrial areas. Oil was also found ponding within the mangrove islands after the flood water receded.Area of the contamination zones for oil pools were estimated using Google Earth Pro.The conservative estimate of volume of oil ponded is 31.4 cu.m.

Table 5: Volume of oil estimated in oil pools

Oil pools in hotspots	Area [sq.m.]	Volume of oil in for 1 mm ponding depth [cu.m.]	Volume of oil for 5 mm ponding depth [cu.m.]	Volume of oil for 10 mm ponding depth [cu.m.]	Conservative estimate of volume of oil (1 mm ponding depth) [cu.m.]
Overflowed along B canal	11403	11.40	57.01	114.03	**11.40**
In mangrove islands	10000	10	50	100	**10**
Oil pool near pipelines	10000	10	50	100	**10**
Total volume of oil [cu.m.]		31.40	157.01	314.03	**31.40**

Note:

- **Area was estimated using Google Earth Pro.**

Figure 31: Oil pools near B Canal

c. Oil sheen on Buckingham Canal and Kosasthalaiyar River:

Oil sheen was found on B Canal and K River, where the volume of oil has been calculated for 0.01 mm and 0.05 mm thickness. Area of the contamination zones for oil sheen wereprovided by the coast guard.A conservative estimate would be around 11.54 cu.m. 0.01 mmthickness. It should be noted that CPCL has already removed major part of the oily sludge floating on the river using booms and skimmers amounting to 393 tonnes.

Table 6: Volume of oil as oil sheen estimated on B Canal and K River

Oil sheen in water courses from drone				
Location	**Area [sq.m]**	**Volume of oil for 0.01 mm sheen thickness [cu.m.]**	**Volume of oil for 0.05 mm sheen thickness [cu.m.]**	**Conservative estimate of volume of oil (0.01 mm sheen thickness) [cu.m.]**
Buckingham Canal	121765	1.21	6.08	**1.21**
Kosasthalaiyar River	1032988	10.32	51.64	**10.32**
Total volume of oil [cu.m.]		11.54	57.73	**11.54**
Note: • **Area was estimated by the coast guard.**				

Figure 32: Oil sheen on B Canal

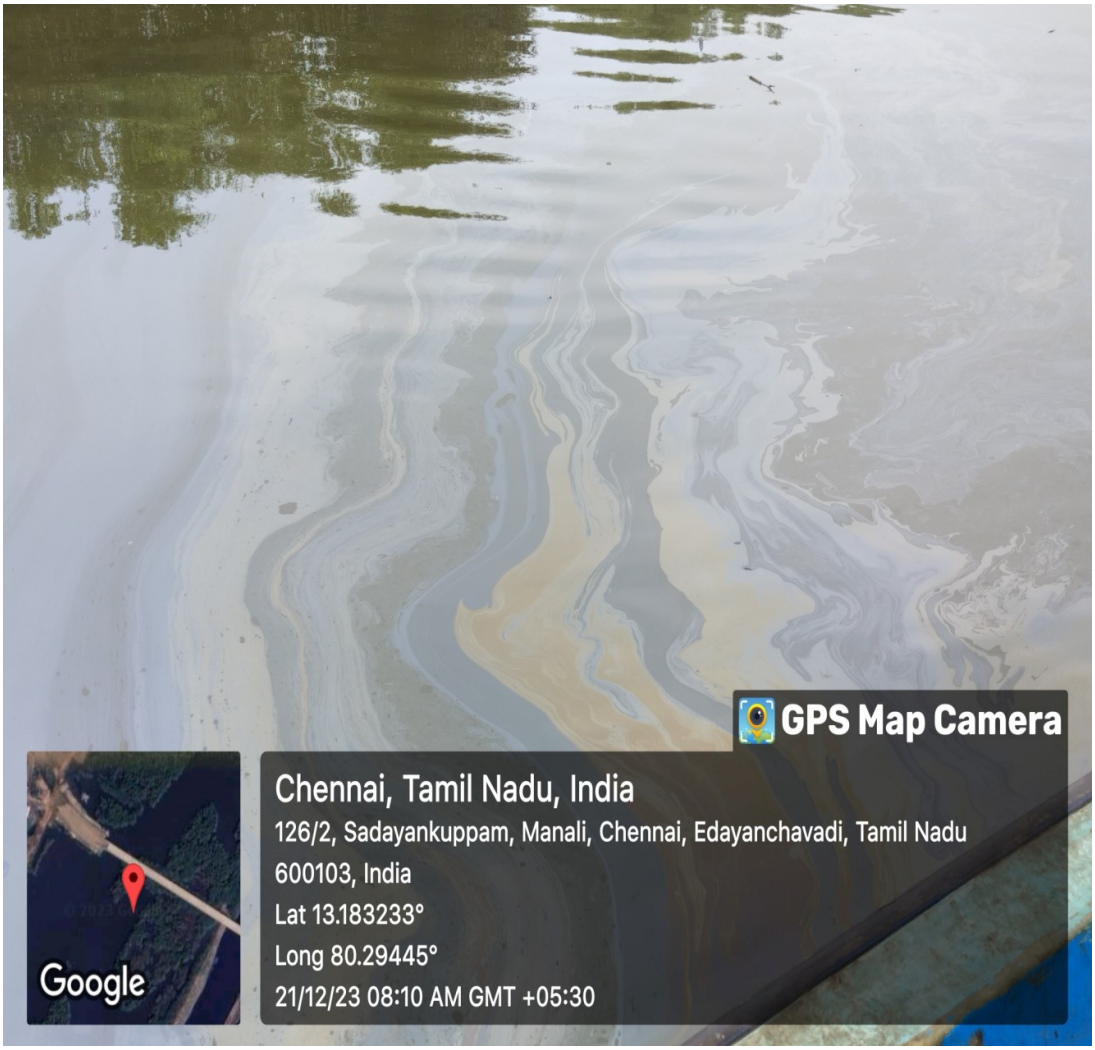

Figure 33: Oil Sheen on K River

d. Oil present in residential and industrial areas:

A survey team was deployed to assess the spread of oil in the residential and industrial zone. The team marked the oil level and referenced it with Mean Sea level using DGPS survey at every location. Three levels of inundation with total area inundated and the oil level in each zone was marked in different colours.

The area under each zone is given below along with presumed depth of oil which was present when the flood water inundated their area. The average quantum of oil inundation is estimated as 117cu.m. assuming only 0.1mm of oil.

Figure 34: Map showing three levels of inundation

Table 7: Volume of oil estimated in residential and industrial areas

Oil mark in the residential areas	Area [sq.m.]	Volume of oil for 0.1 mm oil layer [cu.m.]	Volume of oil for 0.5 mm oil layer [cu.m.]	Volume of oil for 1 mm oil layer [cu.m.]	Volume of oil for 5 mm oil layer [cu.m.]	Conservative estimate of volume of oil (0.1 mm oil layer) [cu.m.]
Ernavoor high impact > 1m	452959	45.29	226.47	452.95	2264.79	**45.29**
Ernavoor medium impact 0.5 to 1.0.m	628017	62.80	314.00	628.01	3140.08	**62.80**
Ernavoor low impact <0.5 m	31700	3.17	15.85	31.7	158.5	**3.17**
Behind IOCL	66135	6.61	33.06	66.13	330.67	**6.61**
Total volume of oil in cu.m.		117.88	589.40	1178.81	5894.05	**117.88**

Note:

- **Area was estimated by the surveyor.**

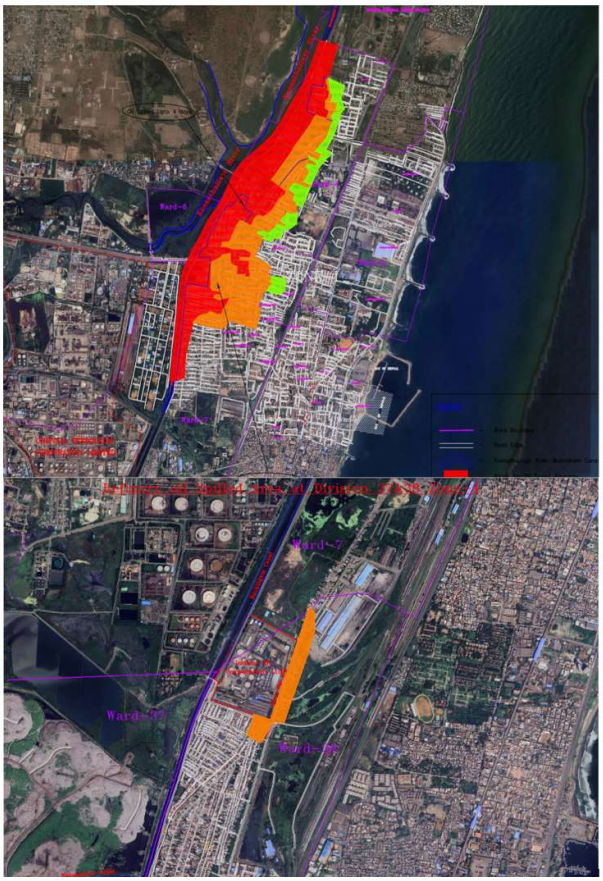

Figure 35: Close up view of the affected residential and industrial areas

Figure 36: Oil stains seen on the walls of the residentials buildings

e. Oil stains on mangroves and river banks:

Based on theobserved length and height of the stains left behind on the banks of the K River and B canal, we estimated the oil on the river banks and mangroves assuming different thicknesses of oil layer starting from 0.01 mm, 0.1 mm and 1 mm. The average volume of oil inundation is conservatively estimated as 0.38 cu.m. assuming only 0.01 mm of oil thickness.

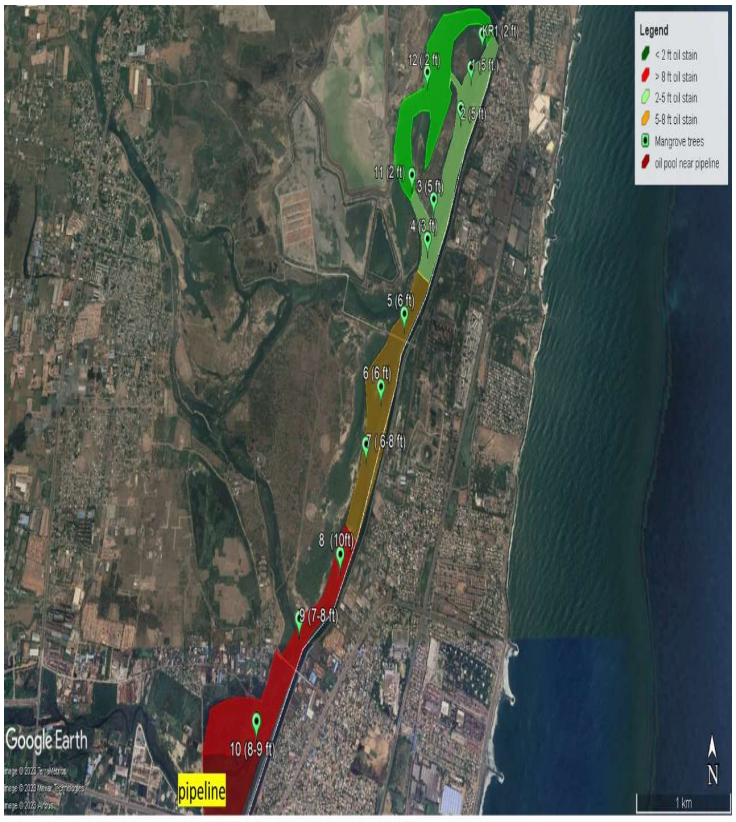

Figure 37: Classifying the K River with the height of the oil mark in different stretches

Table 8: Volume of oil estimated on mangroves and river banks

Volume of oil estimated on river banks	**Length [km]**	**Height of oil mark [m]**	**Volume of oil for 0.01 mm oil layer [cu.m.]**	**Volume of oil for 0.1 mm oil layer [cu.m.]**	**Volume of oil for 1 mm oil layer [cu.m.]**	**Conservative estimate of volume of oil (0.01 mm oil layer) [cu.m.]**
Buckingham canal sections	15.1	0.3	0.04	0.45	4.53	**0.04**
Kosasthalaiyar section 1	11.4	0.3	0.03	0.34	3.42	**0.03**
Kosasthalaiyar section 2	5.8	0.3	0.01	0.17	1.74	**0.01**
Kosasthalaiyar section 3	4.7	0.3	0.01	0.14	1.41	**0.01**
Ennore Creek (Kattukuppam to Kosathalaiyar River mouth)	1.9	0.3	0.0057	0.057	0.57	**0.0057**
Volume of oil estimated on mangroves						
Kosasthalaiyar section 1, 2ft oil mark	11.4	0.6	0.068	0.68	6.84	**0.068**
Kosasthalaiyar section 2, 5ft oil mark	5.8	1.5	0.087	0.87	8.7	**0.087**
Kosasthalaiyar section 3, 8ft oil mark	4.7	2.4	0.11	1.12	11.28	**0.11**
Total volume of oil in cu.m.			0.38	3.84	38.49	**0.38**

Note:

- **Length of the river and canal were estimated by the surveyor.**

Figure 38: Oil stains on the banks of B Canal

Figure 39: Oil stains on the mangroves

Overall Estimates:

The oil present in the environment as observed between December 14th TO 24th, 2023 and reconfirmed on February 22nd, 2024 based on our best possible estimates and accessibility are below:

Table 9: Summary

Contamination Zone	Most Conservative Estimate
Volume of oil estimated in soil [cu.m.]	487
Volume of oil estimated in oil pools[cu.m.]	31.4
Volume of oil as oil sheen estimated on Buckingham Canal and Kosasthalaiyar River[cu.m.]	11.55
Volume of oil estimated in residential and industrial areas[cu.m.]	117
Volume of oil estimated on river banks and mangroves[cu.m.]	0.3849
Total volume of oil present in the environment [cu.m.]	**647.3349**
Total volume of oil present in the environment [tonnes] (assuming 1 cubic meters of oil = 0.8 metric tonnes)	**576.128061**

In summary the oil present in the environment is estimated to be 647cu.m.or 576 tonnes (most conservative). This estimate is provided here considering the uncertainty of the depth of oil in pools, extent of depth and uniformity of soil contamination, film thickness on mangroves and walls of the residential areas.

Also these estimates has not been considered:

1. ***Floating oily sludge removed by CPCL from the surface water and banks of Kosasthalaiyar River and Buckingham canal (393 tonnes as reported in the news media).***
2. ***Sediments (TPH content in sediments ranged from 13.6 to 120 grams per kilogram (g/kg)) - Only random sampleshad been taken and a complete assessment cannot be done due to flowing water.We can take it up in future studies which will be conducted in more detail for impact assessment.***
3. ***Water (TPH content in water ranged from 0.28 to 7.21 grams per litre (g/L)) – Variable with time and space due to continuous leaching of oil from banks and soil and sediment. However, it remains relatively minor compared to soil contamination.***
4. ***Other upstream locations inside and outside CPCL inundated by high flood where oil was observed.***
5. ***Inaccessible islands and marshlands of Kosasthalaiyar River.***
6. ***Oil released into sea and coasts beyond Ennore Creek.***
7. ***CPCL premises – Soil and storm water drains within premises which were observed to have oil.***

6. Oil Estimates in Open Tanks of M/s CPCL

Google Earth images were used to assess the open tanks in M/s CPCL close to the two storm water outlets. The total area of these open tanks are worked out as 95,058 sq.m.

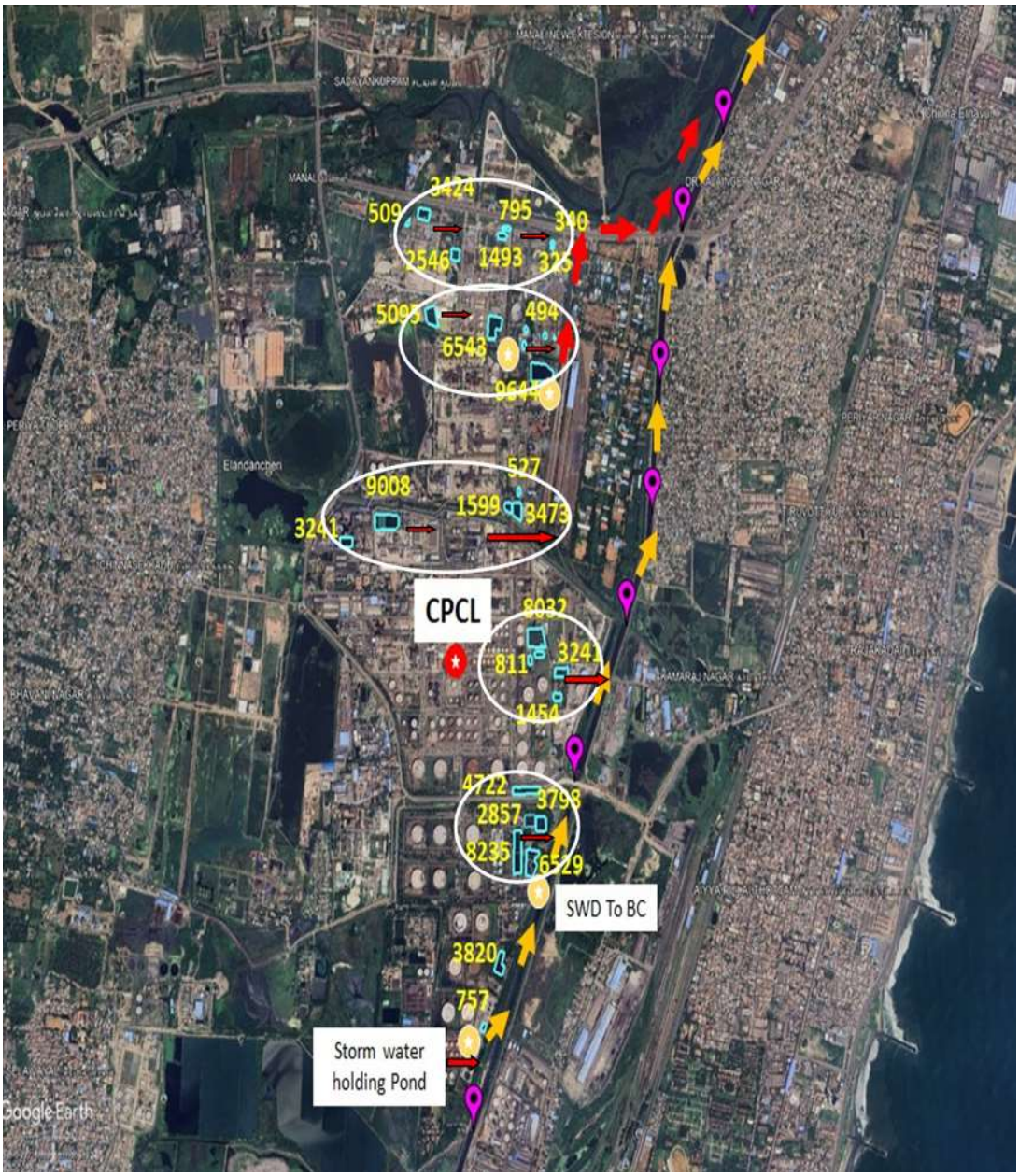

Figure 40: Open tank locations and area in sq.m.

We identified 12 out of 29 tanks containing oil-contaminated water, with six of them discharging into the stormwater drain located north of M/s CPCL (Zone 1), while the remaining six drained into the southern drain of the premises (Zone 20). Table 9 provides an average estimate of the volume of oil stored in these tanks based on varying oil thicknesses of 1mm and 5mm.

Table 10: Location and area of open tanks present in M/s CPCL

Tank ID	Latitude	Longitude	Open tank Area sq.m]
0	13.1585	80.2839	3241
1	13.1747	80.278	2547
2	13.159	80.2821	812
3	13.1592	80.2826	1192
4	13.1598	80.2825	8032
5	13.1644	80.274	9008
6	13.1648	80.2809	1599
7	13.1647	80.2814	3473
8	13.1654	80.2816	527
9	13.17	80.2829	9645
10	13.1719	80.2802	6544
11	13.1764	80.2762	3424
12	13.1757	80.281	795
13	13.1754	80.2807	1493
14	13.1723	80.2766	5096
15	13.1714	80.2832	483
16	13.1713	80.2837	129
17	13.1751	80.2836	341
18	13.1749	80.2836	326
19	13.1761	80.2752	509
20	13.1711	80.2819	714
21	13.1717	80.282	491
22	13.1637	80.2716	3241
23	13.1476	80.2802	3820
24	13.1514	80.2821	6529
25	13.1518	80.2813	8236
26	13.1528	80.2826	3799
27	13.1576	80.2836	1454
28	13.1529	80.282	2857
29	13.1541	80.2818	4702

Note:

- **Areas of the tanks were estimated by the surveyor.**
- **The tanks highlighted in blue drain to the northern storm water drain.**
- **The tanks highlighted in green drain into southern storm water drain.**
- **The other tanks were reported to not contain any oil mixed water.**

Table 11: Volume of oil estimated in the open tanks of M/s CPCL

Volume of oil estimated in the open tanks of M/s CPCL	**Tanks that drain to northern storm water drain**	**Tanks that drain into southern storm water drain**
	6544	3799
	9645	2857
	491	8236
	1599	6529
	3473	4701
	527	3820
Total area of tanks [sq.m.]	**22279**	**29942**
Volume of oil in tanks for 1 mm oil layer [cu.m.]	22.27	29.94
Volume of oil in tanks for 5 mm oil layer [cu.m.]	111.39	149.71

The volume of oil estimated in these exposed tanks amounts to261cubic meters or 209tonnes, representing an oil thickness of 5mm.The oil estimates from our assessment (517 tonnes) and the oily sludge removed by CPCL (393 tonnes) together sums up to 910 tonnes without including the inaccessible areas and bottom sediments of B Canal and K River. This mismatch suggests that the flood induced release from the open tanks may not have been the sole reason of the oil spill. Other possibilities could be breach of oil from other storage tanks of CPCL premises.

7. Coast Guard Assessment:

On the 14th or 15th of December 2023, an assessment was conducted by the coast guard to estimate the oil spill, ten days after the flooding incident. Despite the passage of time, remnants of oil and sheen were still detected in both inland water bodies and the sea. Estimates were derived from observations made via their helicopter-mounted camera, revealing approximately 11.6 cubic meters of oil in inland water and 12.4 cubic meters in the sea.

It's important to note that these figures may underestimate the actual volume of oil present, as there could have been higher levels of oil in the intervening days between the spill release and the assessment on December 15th. Additionally, the assessment did not fully account for the oil present in various other environments. This includes oil present in the soil, pooled on land surfaces, present on islands, coating the banks of rivers, and the stains on mangrove forests. The assessment also did not consider oil dispersed within water columns or deposited within sediments. Therefore, the actual extent of the oil contamination may be greater than indicated by the coast guard's estimate.For more detailed infirmation please refer to Appendix A.

8. Tamil Nadu Pollution Control Board's Survey of M/s CPCL Premises:

The Tamil Nadu Pollution Control Board deployed its technical team to conduct an inspection at M/s CPCL, where they identified areas of concern. A Technical Committee Report was subsequently released, evaluating various sections including the stormwater drainage system, petcoke processing area, the ETP area, sludge storage tanks and ponds, sludge bioremediation process area, and crude oil storage area. Numerous observations were documented during the inspection, indicating potential areas of environmental risk.

According to the report, the average quantity of slop oil collected from different sources of the M/s CPCL premises and stored in slop tanks typically ranges between 50 KLD to 150 KLD. However, during the flood, this collection process would likely have been halted, presenting a substantial risk of washout from the ponds and effluent treatment plants. Additionally, the accumulation of oil-bearing sludge in the sludge ponds that occurred due to the maintenance of eight crude oil/sludge storage tanks, also posed a potential risk of overflow into nearby drains and water bodies during the flood. The team estimated that more than 400 KL of slop oil may have been washed away due to rising water levels.Despite severe weather alerts, M/s CPCL reportedly lacked sufficient precautionary measures to address oil spillage, highlighting a critical gap in disaster preparedness. For more information on quantity of slop oil collected, total quantity of sludge, mass balance etc., please refer to Appendix B.

9. Recommendations and Scope for Future Work

Recommendations for Post-Oil Spill Environmental Management and Remediation:

1. To analyze oil mass balance records from CPCL for more insights and investigate CPCL premises for soil and groundwater contamination.
2. To conduct thorough assessments after the restoration efforts of Kosasthalaiyar River, its sediments, islands, mangroves and flood plains at the surplus canal before declaring previously contaminated zones as safe. If oil residues are found restoration activity should be initiated again considering the sensitivity of the ecosystem including soil, water, flora and fauna.
3. To dispose of oil sludge and oil stained absorbent pads, gloves, boots, reeds and mangrove branches in hazardous waste incinerators.
4. To bioremediate excavated soil in covered sheds with proper monitoring, thereby restoring contaminated soil to a healthier state.
5. There should be an immediate action to clean up the islands thoroughly and plantmangrove saplings to restore the density of the mangroves in Kosasthalaiyar river.

Long Term Prevention Strategies:

1. Consider elevating oil sludge and slop oil storage tanks or implementing dykes to contain any potential spills. These measures can help minimize the risk of contamination and mitigate the impact of future accidents.
2. Implement measures to prevent the discharge of oil from stormwater locations, such as installing appropriate containment systems or improving drainage infrastructure.
3. Given the heavy siltation and long term contamination of oil in the canal consider dredging the canal to enhance its carrying capacity. This action can help improve water flow and reduce the risk of further contamination.
4. Continuous monitoring of the storm water drains in the Ennore industrial area is mandatory to prevent and track contamination from industries.
5. The storm water outlets from the Manali area which drain into Kosasthalaiyar river should be monitored periodically or with an online on camera-based sensor for any oil release.

6. In the event of an accidental spill there should be an overflow arrangement to stop oil within the CPCL premises.
7. In the long-term, Buckingham canal should be taken up for remediation by desilting and other appropriate measuresand other appropriate measures since the pollutants are reaching the Ennore creek and the Bay of Bengal affecting the coastal flora and fauna.
8. An epidemiological study must be conducted to assess the long-term human health effects including cancer risk along with ecotoxicological study for other living systems.

It is strongly suggested that restoration activities for soil and sediment and mangroves should be taken up or a war footing and completed within a year. A post restoration monitoring and assessment should be done to give proper closure to the project and benefit theKosasthalaiyar ecosystem.

10. Conclusion

The oil spill in Ennore water bodies during the Michaung Cyclone, has led to extensive environmental degradation and socio-economic impacts in the affected regions of North Chennai. This preliminary assessment reportunderlines the severity and spatial extent of the oil contamination in Buckingham Canal, Kosasthalaiyar River and its surrounding areas.

Field investigations revealed oil accumulation in various zones along the banks, islandsand surplus canals of the Kosasthalaiyar River and banks of Buckingham Canal, with significant hotspots identified. The spillage not only contaminated water bodies but also inundated residential areas, causing damage to property, vegetation, and livelihoods. Moreover, the spill has posed a significant threat to biodiversity - affecting mangroves,birds and aquatic organisms. The quantification of the impact will be assessed in Phase 2 of the project.

The field surveys and mapping of the oil spill's aerial extent using drones provided valuable insights into the movement of oil and spatial distribution of contamination. Laboratory analysis of water and sediment samples confirmed widespread total petroleum hydrocarbon contamination indicating the intensity of the contamination. Flooding of CPCL’s open tanks during the flood was suspected as a primary source of the spill by Tamil Nadu Pollution Control Board. The estimates derived from IITM’scomprehensive analysis observed

approximately 517 tonnes in the soil, sediment and water environment in addition to 393 tonnes of oilwater and oil-soil removed by CPCL.

Addressing the aftermath of the oil spill requires collaborative efforts from various stakeholders, implementing the recommendations outlined in this report, undertaking further research and continuous monitoring to mitigate the impacts of the oil spill and restore the well-being of affected communities and ecosystems in the Ennore region.

11. Appendix

A. Coast Guard Assessment

BUCKINGHAM CANAL/ KOSATHALAIYAR RIVER AREA

Dear Madam,

1. Kindly refer to your letter T6/TNPCB/F.12753/RL/2023 dated 13 Dec 23.

2. TNPCB vide letter ibid requested assistance of this Headquarters for estimation of quantum of Oil Spill in Ennore Creak, Buckingham Canal and Kosathalaiyar River area. Accordingly, this Headquarters deputed an expert team for quantity assessment of oil spill in the above areas.

3. **Oil Spill Quantity assessment at Ennore Creek/ Buckingham Canal/ Kosathalaiyar River Area.**

(a) **Oiled Area Measurement: -**

Ser	Name of Canal/River	Area in Sq.Mtr	Oiled Area
(i)	Buckingham canal	6100 x 60 =366000	90% = 329400
(ii)	Kosathalaiyar river	4900 x 260 =1274000	30% = 382200
(iii)	Ennore creek	1550 x 950 =1472500	10% = 147250

(b) **Appearance Coverage Allocation: -**

Ser	Name of Canal/River	Sheen	Rainbow	Metal
(i)	Buckingham canal	10%	70%	20%
(ii)	Kosathalaiyar river	10%	40%	10%
(iii)	Ennore creek	10%	30%	10%

Scanned with OKEN Scanner

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(c) **Thickness band of above appearance: -**

(i) Sheen : 0.04 µm to 0.3 µm
(ii) Rainbow : 0.3 µm to 5.0 µm
(iii) Metal : 5.0 µm to 50 µm

(d) **Minimum Volume of spilled oil calculations: -**

Ser	Name of Canal/River	Sheen (0.04 µm)	Rainbow (0.3 µm)	Metal (5.0 µm)
(i)	Buckingham canal	(329400X10%) X 0.00000004 = 0.0013	(329400 x 70%) x 0.0000003= 0.0692	(329400 x 20%) x 0.000005 =0.3294
(ii)	Kosathalaiyar river	(382200X10%) X 0.00000004= 0.0015	(382200 x 70%) x 0.0000003 = 0.0803	(382200 x 20%) x 0.000005 =0.3822
(iii)	Ennore creek	(147250X10%) X 0.00000004= 0.0006	(147250 x 70%) x 0.0000003 = 0.0309	(147250 x 20%) x 0.000005 = 0.1473
Minimum Volume of Spilled Oil				1.043 K

(e) **Maximum Volume of spilled oil calculations: -**

Ser	Name of Canal/River	Sheen (0.3 µm)	Rainbow (5.0 µm)	Me... (50 µm)
(i)	Buckingham canal	(329400X10%) X 0.0000003 = 0.009882	(329400 x 70%) x 0.000005 = 1.1529	(329400 x 20%) x 0.000050 =3.294
(ii)	Kosathalaiyar river	(382200X10%) X 0.0000003 = 0.01147	(382200 x 70%) x 0.000005 =1.3377	(382200 x 20%) x 0.000050=3.822
(iii)	Ennore creek	(147250X10%) X 0.0000003= 0.00442	(147250 x 70%) x 0.000005 =0.5154	(147250 x 20%) x 0.000050= 1.4725
Maximum Volume of Spilled Oil				11.620 KL Appx

Ser	Name of Canal/River	Sheen (0.3 µm)	Rainbow (5.0 µm)	Metal (50 µm)
(i)	Buckingham canal	(329400X10%) X 0.0000003 = 0.009882	(329400 x 70%) x 0.000005 = 1.1529	(329400 x 20%) x 0.000050 =3.294
(ii)	Kosathalaiyar river	(382200X10%) X 0.0000003 = 0.01147	(382200 x 70%) x 0.000005 =1.3377	(382200 x 20%) x 0.000050=3.822
(iii)	Ennore creek	(147250X10%) X 0.0000003= 0.00442	(147250 x 70%) x 0.000005 =0.5154	(147250 x 20%) x 0.000050= 1.4725
Maximum Volume of Spilled Oil				11.620 KL Appx

4. **Oil Spill Quantity Assessment at Sea.** The assessment of spill at sea was carried out through aerial recce / ships. It was observed that traces of spilled oil were found in appx 20 Sq.Km area from Kasathalaiyar river mouth to Kasimedu Harbour.

Scanned with OKEN Scanner

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Based on the observation, the quantity assessment is as follows: -

(a) **Oiled Area Measurement**

(i) Area from Helo data : 20 Sq.Km
(ii) Area covered with oil : 50%
(iii) Oiled Area : 20 x 50% = 10 Sq.Km

(b) **Appearance Coverage Allocation**

(i) Sheen : 80 %
(ii) Rainbow : 20%

(c) **Thickness band of above appearance**

(i) Sheen : 0.04 µm to 0.3 µm
(ii) Rainbow : 0.3 µm to 5.0 µm

(d) **Minimum Volume of spilled oil: -**

(i) Appearance Sheen : 10 Km^2 x 80% x 0.04 µm = 0.32 M^3
(ii) Appearance Rainbow: 10 Km^2 x 20% x 0.3 µm = 0.6 M^3
(iii) **Minimum Volume:** 0.32 M^3 + 0.6 M^3 **= 0.92 M^3 (0.92 KL)**

(e) **Maximum Volume of spilled oil: -**

(i) Appearance Sheen : 10 Km^2 x 80% x 0.3 µm =2.4 M^3
(ii) Appearance Rainbow: 10 Km^2 x 20% x 5 µm = 10 M^3
(iii) **Maximum Volume:** 2.4 M^3 + 10 M^3 **= 12.4 M^3 (12.4**

Regards,

Your sincerely,

(AS Ali)
Commandant
Regional Ops & Plans Officer
for Commander
Coast Guard Region (East)

B. Tamil Nadu Pollution Control Board's Survey of M/s CPCL Premises

6. Findings of the Team based on the information provided by the M/s CPCL:

As per the suggestions of the Team TNPCB requested M/s CPCL to provide certain details viz; quantity of slop oil, O&M details, the mass balance of raw materials, sludge storage, etc. M/s CPCL has submitted the following details vide letter dated 14.12.2023, the details are as below;

<table>
<tr><th>SI NO</th><th>Information requested</th><th>Information provided by CPCL</th></tr>
<tr><td>i</td><td>Oily waste material collected from day to day operations, from all the storm water ponds, ETPs and other sources and its quantity, its storage method and disposals details</td><td>Slop Oil quantity collected from storm water ponds, ETPs and other sources for the last three months is furnished below
<table>
<tr><td>Month</td><td>Quantity, KL</td></tr>
<tr><td>September</td><td>1939</td></tr>
<tr><td>October</td><td>4528</td></tr>
<tr><td>November</td><td>1238</td></tr>
</table>
Slop oil is stored in Slop Tanks and reprocessed with Crude.</td></tr>
<tr><td>ii</td><td>Whether cleaning operation carried out before Michaung flood, its collection details.</td><td>Details of major activities carried out as part of pre monsoon preparedness is furnished below:
▪ Storm water canal cleaning
▪ Building roof cleaning
▪ Dewatering pumps checking & availability</td></tr>
<tr><td>iii</td><td>Whether all the refineries are in operation during the flood, if not details shall be furnished. Further receipt of crude oil from 1st December 2023 to 9th December 2023 shall be furnished</td><td>Out of 3 Refineries, only one Refinery was in operation during flood. Other two Refineries were under circulation.
Details of Crude Oil Receipt from 01.12.23 to 09.12.23 is furnished below:
<table>
<tr><td>Date</td><td>Crude receipt in TMT</td></tr>
<tr><td>01.12.23</td><td rowspan="4">No receipt</td></tr>
<tr><td>02.12.23</td></tr>
<tr><td>03.12.23</td></tr>
<tr><td>04.12.23</td></tr>
<tr><td>05.12.23 20.48 hrs to 07.12.23 06.00 hrs</td><td>135</td></tr>
<tr><td>09.12.23 18.54 hrs to 11.12.23 hrs 07.12 hrs</td><td>99</td></tr>
</table></td></tr>
<tr><td>iv</td><td>Total quantity of Sludge stored inside the premises and its method of disposal</td><td>Quantity of Sludge Stored in CPCL is 2300 KL in sludge pond. The sludge would be mechanically treated to extract oil and residual material would be bioremediated. Extract oil would be reprocessed thro' crude tanks</td></tr>
<tr><td>v</td><td>Frequency of conducting spillage deduction along with details of records maintained.</td><td>Spillage Detection & Repair study is carried out yearly once in CPCL and the report is submitted to TNPCB regularly. The latest report is submitted in Jan 23 (Annexure-A)</td></tr>
<tr><td>vi</td><td>Mass balance of raw material and product manufactured</td><td>Mass balance in Tons/ day furnished below
<table>
<tr><td>Crude through put</td><td>28.8</td></tr>
<tr><td>LPG</td><td>1.0</td></tr>
<tr><td>Naphtha</td><td>2.4</td></tr>
<tr><td>Petrol (M.S)</td><td>3.0</td></tr>
<tr><td>ATF</td><td>3.2</td></tr>
<tr><td>Diesel</td><td>15.0</td></tr>
<tr><td>Lobs/Wax</td><td>0.8</td></tr>
<tr><td>Bitumen</td><td>1.2</td></tr>
<tr><td>Internal fuel</td><td>2.2</td></tr>
</table></td></tr>
<tr><td>vii</td><td>Number of unused storage tanks and number of it for maintenance

The details of date of clean in progress taken for crude oil tanks, slops storage and other.</td><td>Details of idle and M&I tanks is furnished as Tanks released and under Maintenance
<table>
<tr><th>Sl. No.</th><th>Tank No.</th><th>Service</th><th>Remarks</th></tr>
<tr><td>1</td><td>343</td><td>DWO(HH)</td><td>Released in Oct 23</td></tr>
<tr><td>2</td><td>412</td><td>SK(LAB)</td><td>Released in Sep 23</td></tr>
<tr><td>3</td><td>418</td><td>ATF</td><td>Released in Oct 23</td></tr>
<tr><td>4</td><td>107</td><td>Crude</td><td>Released in Oct 23</td></tr>
<tr><td>5</td><td>820</td><td>Dry slop</td><td>Released in Sep 23</td></tr>
<tr><td>6</td><td>310</td><td>HN/DAO</td><td>Released in Mar'23</td></tr>
<tr><td>7</td><td>311</td><td>IN/HN/DAO</td><td>Released in Mar'23</td></tr>
<tr><td>8</td><td>309</td><td>Raff</td><td>Released in Jun'23</td></tr>
<tr><td>9</td><td>201</td><td>RFO</td><td>Released in Jun'23</td></tr>
<tr><td>10</td><td>204-D-1</td><td>VBU Feed</td><td>Released in Jun'23.</td></tr>
<tr><td>11</td><td>312</td><td>IN/HN/DAO</td><td>Released in Sep'23</td></tr>
<tr><td>12</td><td>919</td><td>Wax</td><td>Released in Oct'23</td></tr>
<tr><td>13</td><td>345</td><td>DWO/RAFF</td><td>Released in Sep'23</td></tr>
</table>
Details of tanks unused tanks:
<table>
<tr><th>Sl. No.</th><th>Tank No.</th><th>Service</th></tr>
<tr><td>1</td><td>806</td><td>Slop Oil</td></tr>
<tr><td>2</td><td>383</td><td>Wax</td></tr>
<tr><td>3</td><td>384</td><td>Wax</td></tr>
</table></td></tr>
<tr><td>viii</td><td>Details of the sludge stored in the open yard</td><td>All sludge is stored in concrete pit with impervious layer and is at higher elevation.</td></tr>
<tr><td>ix</td><td>Any operations carried out to protect the refinery to avoid untoward incidents during the flood time</td><td>➢ One Refinery out of 3 Refineries was operated to maintain product supply to market.
➢ Tractors trailers & fire truck were operated to bring Manpower & Material inside Refinery</td></tr>
<tr><td>x</td><td>The details of Characteristics of waste oil collected from ETPs & storm water collection ponds</td><td>Slop oil is a mixture of oil collected from various sources. Slop Oil is reprocessed with crude. Since the qty of slop oil is very minimal, analysis is not required. However as per instruction, one sample was analysed today (14.12.23) and the result is furnished below.
a) Density-0.873 gm/cc
b) Sulphur- 2.09 %
c) Flash- 37 Deg C
d) Viscosity @ 40 Deg C- 6.6</td></tr>
<tr><td>xi</td><td>The details of products sent to Manali customers and control mechanism provided to safe guard during no demand period</td><td>
<table>
<tr><td>Industry</td><td>Products</td><td>In case of No demand</td></tr>
<tr><td>TPL</td><td>LABFS</td><td>Will be absorbed in Diesel pool / converted to ATF</td></tr>
<tr><td>MPL</td><td>Propylene</td><td>Will be sold as LPG</td></tr>
<tr><td>KPL</td><td>PBFS</td><td></td></tr>
<tr><td></td><td>LPBFS</td><td></td></tr>
<tr><td>Cetex Petrochemicals</td><td>Butene2</td><td></td></tr>
<tr><td></td><td>MEKFS</td><td></td></tr>
</table>
</td></tr>
</table>

From the above information, the Team noticed the following;

- As per the information given at Sl. (i), it is inferred that the average slop oil collected from ETPs and other sources ranges from 50 kld to 150 kld. Due to heavy rain since December 03 and 04, 2023, the collection of slop oil might not be happened, this slop oil might be washed away due to rising of water levels in all ponds since the ponds were just above the ground level. As per this information, the quantity washed away might be more than 400 kl.
- As per the information given at Sl.(iv), it is inferred that 2300 kl oil-bearing sludge is being stored in the sludge pond. The same was observed during the team visit and noticed that the sludge stored was up to the brim level, the oil mixed sludge might be washed away to drain due to the flood which is directly leading to the Buckingham Canal.
- As per the information given at Sl(vii), it is inferred that eight crude oil storage tanks were taken for maintenance during September – October 2023. The oil-bearing sludge required to be separated through centrifugation and the same has to be taken for bio remediation. At least 90 days are required to complete one cycle of bio remediation. Eight tanks were taken for maintenance in the last three months, the oil bearing sludge might be stored in the ponds, due to the flood, these sludge might be washed away. One of the nearby industry namely M/s Indian Additives Ltd, reported to the TNPCB team on 04.12.2023 that the mixture of thick Black oil & water was gushed into their premises. The statement of industry also confirms that the probability of washing of oil-bearing sludge from their storage dykes.
- Inspite of sever cyclonic and heavy rain fall alert by IMD and Govt. of Tamil Nadu, the unit is not taken any precautionary measures to contain the oil spillage from their ponds and ETPs. And also unit is not having either flood management plan or emergency contingency plan to contain oil spillage.

12. References

1. BéruBé, K. A., Sexton, K. J., Jones, T. P., Moreno, T., Anderson, S., & Richards, R. J. (2004). The spatial and temporal variations in PM10 mass from six UK homes. Sci Total Environ, 32, 41–53.

2. Chakraborty, P., et al. (2021). Passive air sampling of PCDD/Fs, PCBs, PAEs, DEHA, and PAHs from informal electronic waste recycling and allied sectors in Indian megacities. Environmental Science & Technology, 55(14), 9469-9478.

3. Fernando, H., Ju, H., Kakumanu, R., Bhopale, K. K., Croisant, S., Elferink, C., & Ansari, G. S. (2019). Distribution of petrogenic polycyclic aromatic hydrocarbons (PAHs) in seafood following Deepwater Horizon oil spill. Marine Pollution Bulletin, 145, 200-207.

4. India Meteorological Department. (2023). National Bulletin No. 22 (BOB/06/2023). India Meteorological Department. Retrieved from https://mausam.imd.gov.in/Forecast/marquee_data/22.%20NationalBulletin_22_20231204_0900.pdf

5. Pandey, K. (2023, December 29). *Oil spill in Ennore brings fishing to a standstill*. Mongabay-India. https://india.mongabay.com/2023/12/oil-spill-in-ennore-brings-fishing-to-a-standstill/

6. The Hindu Bureau. (2023, December 16). Oil spill in Ennore Creek | CPCL expects to finish cleaning of water in three days. The Hindu. https://www.thehindu.com/news/cities/chennai/oil-spill-in-ennore-creek-cpcl-expects-to-finish-cleaning-of-water-in-three-days/article67643161.ece

7. Wire. (2023, December 15). 20 tonnes of oil-soaked soil, 7000 litres of affected water removed: TN govt on Chennai oil spill. The Wire. Retrieved from https://thewire.in/environment/20-tonnes-of-oil-soaked-soil-7000-litres-of-affected-water-removed-tn-govt-on-chennai-oil-spill

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL, SOUTHERN ZONE- CHENNAI

O.A NO. 180 of 2023
AND
O. A NO.183 OF 2023

Tribunal on its own motion SUOMOTU based on the Visual media titled Chennai Rains Makkalai Vathaikkum Oil Companies- Shocking Story - Michaung Ground Report covered by on VIKATAN TV Chennai dt.06.12.2023

with

The District Collector Chennai District

And Ors.

...Respondents

AND

R.L. Srinivasan, Chennai.

...Applicant (s)

Versus

The Tamil Nadu Coastal Zone Management Authority& ors

..Respondent(s)

REPORT FILED ON BEHALF OF THE RESPONDENT -TAMIL NADU POLLUTION CONTROL BOARD.

Advocate for Respondent: TNPCB

Thiru.S. Sai Sathya Jith,

Advocate, Chennai.

Date of Hearing :24.10.2024.

Date of filing : 23.10.2024.