

**REPORT OF THE JOINT COMMITTEE
AS PER ORDER DATED 21.01.2021 & 03.02.2021
IN THE MATTER OF OA NO. 186/2020**

SUBMITTED TO

**HON'BLE NATIONAL GREEN TRIBUNAL
SOUTHERN BENCH
CHENNAI**

APRIL, 2021

**BEFORE THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI
Original Application No. 186 of 2020 (SZ)**

IN THE MATTER OF:

Tribunal on its own motion - SUO MOTU Based on the News item in The New Sunday Express Newspaper Dated: 20.07.2020, "Ranipet Residents health at risk due to Pollution; Chromium waste killing agriculture in Ranipet Poses long-term health risks."

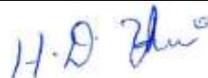
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Place: Chennai
Date: 16.04.2021




H.D. VARALAXMI, M.Tech
 Regional Director
 CENTRAL POLLUTION CONTROL BOARD
 (MoEF & CC, Govt. of India)
 Regional Directorate (Chennai)
 2nd Floor, 77-A, South Avenue Road,
 Ambattur Industrial Estate, Chennai - 600 054

Report of the Joint Committee in the matter of OA No. 186/2020
(As per Hon'ble National Green Tribunal, Southern Zone, Chennai
Order dated 21.01.2021 & 03.02.2021)

1. Background

The Hon'ble National Green Tribunal, Southern Zone, Chennai has taken Suo Motu case on the basis of the newspaper report published in "The New Sunday Express Newspaper Edition dated: 20.07.2020 under the captions "Ranipet residents health at risk due to pollution; Chromium waste killing agriculture in Ranipet, poses long-term health risks". In the matter of OA no. 186 of 2020 constituted a committee and directed that;

".....9. In order to ascertain the present state of affairs and also the remedial measures to be taken for the purpose of rectifying this hazard in a permanent manner, we feel it appropriate to appoint a joint committee comprising of 1) a Senior Scientist from Ministry of Environment, Forest and Climate Change (MoEF&CC), Regional office, Chennai 2) a Senior Scientist from Central Pollution Control Board, Regional Office, Chennai 3) a Superintending Engineer from Public Works Department and Water Resources Organisation 4) a Chief Engineer or a Senior Officer deputed from the Office of the State Ground and Surface Water Resources Data Centre, Chennai 5) the District Collector, Ranipet District, or a Senior Officer not below the rank of Assistant Collector or Sub Divisional Magistrate deputed by the District Collector 6) a Senior Officer from the State Industries Department and 7) a Senior officer from Tamil Nadu State Pollution Control Board as deputed by the Chairman, Tamil Nadu State Pollution Control as designated by its Chairman to inspect the area in question and submit a factual as well as action taken report, if there is any violation found.

10. The committee is directed to go into the question regarding the source of pollution and the ground water quality in that area and what are all the remedial measures already taken in view of the directions given by the Hon'ble Apex Court in Vellore Citizens Case (Welfare Forum Vs Union of India and others (1996) 5 SCC 647) disposal of hazardous substance generated by the industries and its violation the nature of violation taken by the regulating authorities against the person who are committing such repeated violations, action plan that has been prepared and its stage of implementation and its result and whether any alternate provision has been made for providing clean potable water to the locality of the people, if it is infected Chromium and Lead and submit a report including assessment of environmental

compensation for the damage caused and the remedial measures to be taken to rectify the same and restore the water bodies from pollution.

11. The committee is also directed to conduct the water analysis test of the nearby water bodies and also ground water that is being supplied to the people in the locality. They can also assess the hazard quotient of that area and prepare an action plan with longer and shorter measures with lesser timelines, so as to remedy the situation.

12. They are also directed to inspect the individual industries in the industrial estate to ascertain as to whether all environmental laws mechanism are being strictly adhere to by them and if there is any violation found then, they are directed to take action against those violators including issuing necessary direction for closure until remedial measures are taken which will improve the situation apart from environmental compensation against those violating industries. ‘

13. The Central Pollution Control Board, Regional Office, Chennai will be the nodal agency for co-ordination and for providing all necessary logistics for this purpose.

14. The committee is directed to submit the report to this Tribunal on or before 25.11.2020...”

As per the scope of the direction given by Hon’ble Tribunal, Central Pollution Control Board has already taken up the study for preparation of Detailed Project Reports (DPRs) for remediation of contaminated areas in the country under National Clean Energy Fund (NCEF) project. The chromium contaminated area at Ranipet, Tamil Nadu has been identified as one of the priority area requiring remediation. In this regard, a status report was filed by CPCB on 24th November 2020 and requested six-month time for carrying out inspection of the industries located in the SIPCOT, Ranipet.

Further, Hon’ble Tribunal in its order dt. 03.02.2021 stated and directed as follows;

“... 8. It is quite unfortunate that Central Pollution Control Board (CPCB) who has been made a member of the committee, of conducting the inspection regarding the present status on the basis newspaper report, to submit the remedial measures and also the progress of the programme that has been earlier started for this purpose. If the Central Government scheme has been withdrawn then, what is the nature of steps taken by the State Government and the regulating authorises to remedy the situation. The directions mentioned in the status report will not be sufficient for the purpose of effective disposal of the case. It is for them to prepare

an action plan on the basis of the findings including the health study with they are expected to conduct including the contamination of water, the source of contamination the remedial measures to be taken to resolve the issue permanently and also indicate the temporary measures which will have to be taken for the purpose of mitigating the situation till permanent solution is implemented etc.

9. They are also expected to calculate the cost required for restoration and environmental compensation to be recovered from the persons who are responsible for causing such disaster.

10. The State Government is also expected to come with a proper action plan as it is not a simple issue which can be solved at the regulators level. A policy decision will have to be taken by the Government as to how such larger public interest disaster needs to be managed and to co-ordinate with concerned departments which are all required for the purpose of implementation of the policy, so as to achieve the goal which was intended by such scheme or policy that has been taken and also the implementation should be monitored by an Apex level responsible officer, so as to give necessary directions and guidelines as to how this will have to be implemented in its letter and its spirit, so as to protect the life of the people in that area especially when such serious things have been noticed by the Hon'ble Apex Court in Vellore Citizens' case (Welfare Forum Vs Union of India and others (1996) 5 SCC 647) as mentioned above.

11. When this was pointed out the counsel appearing for the Central Pollution Control Board (CPCB) submitted that they will take into account the directions given by the Tribunal in its letter and its spirit and come with a proper and effective report so as to resolve the issue. They wanted six months time for filing the status report. But three months have already lapsed after appointing the committee, but not even an interim report has been filed for this purpose. So under such circumstances we feel that three more months' time can be given to the committee to proceed with the work and file a report. If they are not able to file the final report, at least, they have to file an interim report regarding the nature of work done by them and the nature of studies conducted by them etc..."

The committee is directed to submit the report on or before 19.04.2021.

2. Constitution of Committee

In compliance of the Hon'ble Tribunal the committee constituted with the following members;

1. Sub-Collector, Ranipet (Rep. District Collector)
2. Scientist D, MoEF&CC, RO, Chennai
3. Scientist D, CPCB, RD, Chennai
4. Joint Chief Environmental Engineer, O/o JCEE (M), TNPCB, Vellore
5. Superintending Engineer, WRD, Pennaiyar Basin Circle, Tiruvanamalai
6. Executive Engineer, Ground Water Department, Vellore
7. Project Officer, SIPCOT, Ranipet
8. Deputy Director, DISH, Vellore

3. Committee Meeting

Upon the constitution of the committee, a meeting was conducted on 16.12.2020 at Collectorate Office headed by the District Collector, Ranipet.

Discussion about Chromium dumpsite:

The status report dt. 24.11.2020 filed by CPCB was discussed. The joint committee felt that as per the scope of the committee directed by Hon'ble Tribunal was already completed and reported under NCEF project of MoEF&CC with remediation cost estimation. At present, remediation work is pending, which is to be carried out by TN State. Since financial matters is involved to remediate the site as well as affected area, Government of Tamilnadu needs to take further action.

District Collector informed that Govt. of Tamilnadu has written letter to Govt. of India for financial support to execute remediation works.

CPCB member informed that as per the terms of NCEF project scheme, Central funding for preparation of DPRs and remediation of contaminated area was 40% of the total project cost. The remaining 60% is to be met from State Government through Polluter Pays Principle/Public-Private Partnership/State support, etc. The said project was initiated in 6 States including Tamil Nadu who had given in-principle approval for funding State's share of 60%. The project for preparation of DPRs including TCCL contaminated area at Ranipet, Tamil Nadu was initiated in the year 2014. However, NCEF Project of MoEF&CC has been

discontinued by Government of India. CPCB has completed Detailed Project Report for remediation of chromium contaminated site at Ranipet, Tamilnadu based on detailed site investigation including human health risk assessment studies. The DPR along with templates of bid document was forwarded to Government of Tamil Nadu and TNPCB for execution of remediation works.

Since the TCCL was operated by State Government Department, TIDCO and also by few private entities, funds for remediation may be apportioned to both TN State as well as the other responsible parties, who operated the plant.

Discussion about inspection of industries

Further, the committee discussed about the inspection of industries located in SIPCOT, Ranipet. TNPCB informed that, there are 349 industries including 17 categories, Red, Orange Green & CETPs.

The committee decided to carry out the inspection of water polluting industries 17 categories, Red (Large & Medium) & CETPs during December 22 to 24, 2020 and informed the TNPCB to submit the details of other violating water polluting industries Red (Small) & Orange.

Discussion about assessment of Water Quality

In the matter of OA no. 131/2020, Hon'ble Tribunal directed the committee to assess the water quality to know the impact of pollution due to M/s Tirumalai Chemicals Ltd. In this matter, the committee has carried out monitoring of ground water, surface water & soil/sediment in and around the industry, which is adjacent to the M/s Tamilnadu Chromates & Chemicals Ltd., (M/s TCCL) on 16.12.2020. In the matter of OA no. 186/2020, the committee is directed to assess the present water quality. Since both the issue pertained in the same area, the committee decided to utilise the information submitted in the OA no. 131/2020. The findings in the matter of OA no. 131/2020 also reveals that chromium contamination is observed in the nearby surface water bodies & ground water. The findings are as follows;

- 1) During the study, Oxalic acid presence is identified in most of the location around the SIPCOT industrial area and its downstream and in all water bodies. To identify the sources of oxalic acid, inlet effluent samples of Common Effluent

Treatment Plant (CETP) were collected and same is found, which shows the oxalic acid pollution may be due to Tanneries/CETPs earlier/past discharge.

- 2) Presence of Hexavalent Chromium were also identified in the water bodies, which is due to the continuous seepage water flowing from openly stored sludge present in the closed unit of M/s Tamilnadu Chromate and Chemical Ltd., (TCCL).
- 3) Untreated sewage flow from nearby residential areas is also polluting the water bodies.
- 4) The drains/ channels connecting to the water bodies belongs to SIPCOT industrial area as well as the other local bodies found grown with bushes/plants, which results industries taking chances for illegal discharge.
- 5) The surface water bodies namely Puliyanannu lake, Karai lake, Sitheri lake and their drains were not properly maintained. Due to improper maintenance of drains, the water flow is affected, which leads to formation of wetland.

4. About M/s Tamilnadu Chromate & Chemical Ltd., (M/s TCCL), Ranipet

A brief history obtained from SIPCOT, Ranipet about the M/s TCCL ownership. M/s TCCL, is a TIDCO joint venture company promoted during 1972 in association with Sh. K. K. Mohiadeen for implanting the project for the manufacture of Basic Chromium Sulphate. The promoters agreement was terminated due to equity contribution failure. Thereafter, the company was managed by TIDCO through its nominee directors till Jan 1989 except for initial two years period of operation. During 1988, TIDCO disinvested its shareholding in favour of Sh. C. V. Sridhar, who was appointed as CMD of TCC to Sh. Ashok Balasubramanian. The plant was not operated after 1995-96 as TNPCB issued notice to stop production until the solid waste is disposed off.

TNPCB in its letter to Industries Department stated that 1.52 lakhs tonnes (out of 2.27 lakhs tonnes of chrome sludge) was generated during 1975 to 1988 when the management was with TIDCO and the balance 0.75 lakhs tonnes was generated during management of Sh. C. V. Sridhar and Sh. Ashok Balasubramaniam. Major 67% of waste generated during TIDCO tenure.

Further details of progress on criminal prosecution & steps for remediation initiated by TNPCB against TCC & promoters is enclosed as **Annexure III**.

5. Present Status of Remediation of Chromium Dumpsite

During the committee visit, it is observed that the seepage from the dumpsite is flowing through the drains and meeting to the surface water bodies (Karai Lake and its over flow finally meets River Palar). Remediation process is not carried out so far.

It is submitted that in compliance to the direction of Hon'ble NGT, Principal Bench, New Delhi order dt. 29.02.2021 in the matter OA No. 804/2017 in the matter of Rajiv Narayan & Ors. Vs. Union of India & Ors. with respect to contaminated sites in India, CPCB has convened a meeting with SPCBs/PCCs on 16.03.2021 to discuss Action Plan with roadmap and specific timelines for carrying out preliminary/detailed site investigation, preparation of DPRs, execution of remediation works, lifting of hazardous waste. Issues discussed w.r.t to State of Tamil Nadu is given below

Tamil Nadu: There is 01 contaminated site for which DPR has been prepared and forwarded the same to Government of Tamil Nadu and TNPCB for execution of Remediation works.

a) TNPCB informed that since the cost of actual remediation as per the DPR is very high, it is proposed to lift and disposal of hazardous waste through TSDF.

CPCB conveyed that Interim measures also proposed in DPR as per the request of TNPCB/Govt. of TN for capping of waste and contaminated soil along with storm water drainage system with a cost of about Rs. 12 crores. Afterwards, groundwater remediation by applying Pump & Treat method may be implemented initially for 5 years. It was also explained that cost of remediation will appear high due to inclusion of GW remediation cost over a period of 15 years. However, actual cost may be much lower. Initial cost of remediation may focus up 1-2 years O&M cost of GW remediation. While preparing DPR cost of transferring to TSDF was discussed however, it was deferred due to cost consideration.

CPCB has suggested TNPCB that once DPR is accepted by Project Steering Committee (PSC) headed by Chairman, CPCB remediation work needs to be executed within the timelines stipulated in DPR.

A copy of Minutes of Meeting held on 16.03.2021 is enclosed as **Annexure-I**

Upon the communication of aforesaid Minutes of Meeting, TNPCB has furnished following action plan to CPCB vide letter dated 10.04.2021. A copy of TNPCB letter dated 10.04.2021 is enclosed as **Annexure-II**.

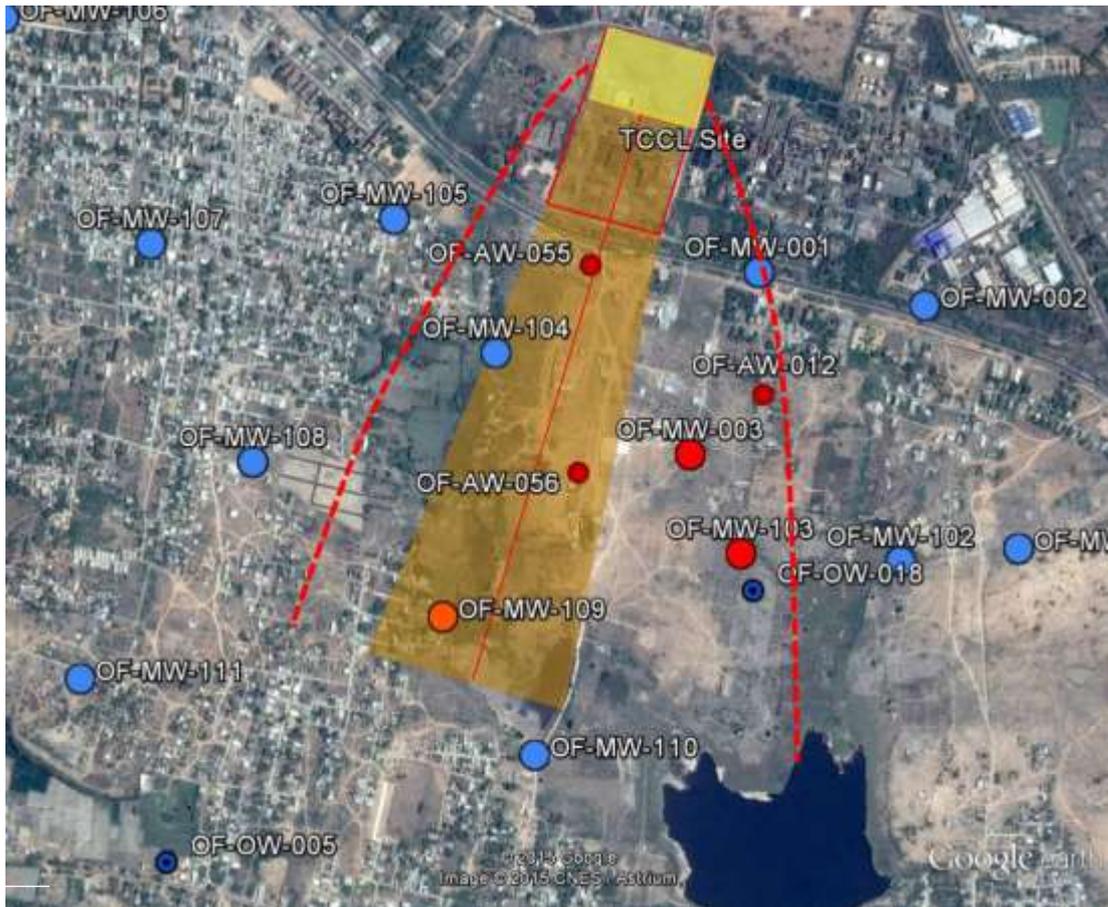
- *The option of shifting accumulated waste at M/s TCCL site, Ranipet to TSDF secure landfill disposal is dropped. The implementation of “Interim Remedial Measures of Soil & Waste Remediation” at TCCL, Ranipet as per DPR prepared by consultant of CPCB is under consideration.*
- *Consultant has been asked to present on the methodology as per DPR & to involve in the preparation of Technical & Cost Bid documents. Time requirement is one month (before 31st May 2021).*
- *The proposal along with required documents to get approval of the Board including budget to meet from Environmental Compensation Fund. Time requirement is three months (before 31st August 2021).*

6. Summary of the Site Investigation & Findings as per DPR

Detailed site investigation was carried out by taking samples from 63 soil boreholes, 30 monitoring wells, 12 sediment boreholes, existing open wells, hand pumps, 11 bore water and 14 surface water samples. Key findings of detailed site investigation is given below:

- The main source of contamination is the waste dump located in the northern portion of the Site;
- Secondary sources of contamination attributed to abandoned CETP pumping wells located north of Site;
- Total Chromium and Hexavalent Chromium, have been identified as contaminants of concern in soils, groundwater and surface waters. Results indicates that the total and hexavalent chromium contamination is mainly limited to the on-site waste dump area and along the groundwater contamination plume migrating to off-site towards south of TCCL site. Further surface water impacts in the form of seepage from TCCL site flowing in open drains towards off-site areas in south of TCCL site.
- There is active contamination in surface drains due to seepage on-site waste dump at TCCL as well as run-off from dumpsite during monsoon.

- Sediment samples in receiving water bodies does not show hexavalent Chromium above its Limit of Reporting (LoR) but total chromium was detected in concentrations above the reference criteria.
- Cluster wells installed within TCCL premises in southwest corner (groundwater flow direction is northeast to southwest) indicate that total and Hexavalent Chromium in groundwater observed up to a depth of 45m below ground level (bgl) with maximum concentrations occurring at 30m bgl;
- At TCCL premises, the maximum concentration of hexavalent chromium was 5,596 mg/kg in soil and 277.6 mg/l in groundwater. In off-site areas, hexavalent chromium in groundwater observed between 0.18 mg/l to 49.43 mg/l. The permissible drinking water standard for chromium is 0.05 mg/l.
- Total and hexavalent chromium concentrations exceeded reference levels in the off-site groundwater sampling locations up to 0.5 km south of Site. Traces of contamination was found along the groundwater plume towards southwest direction from site up to a distance of about 2 kilometers, after which no contamination in groundwater was noticed further downstream towards the Palar River. The reason for the same is attributed to obstruction to groundwater flow influenced by naturally occurring geological fault.
- The off-site area with chromium contamination in groundwater are residential areas, comprising of open spaces, ponds along with limited agricultural activity.
- The monitoring and abstraction wells located off-site which have reported Total and Hexavalent Chromium in concentrations exceeding reference levels are indicated in red in the below Figure.



- Most of the off-site exceedances in groundwater are occurring within the modelled path (or in close proximity) and thus the exceedances are in agreement with the particle tracking model
- The Human Health Risk Assessment (HHRA) was carried out as part of the study to derive site specific remediation target levels (SSTLs) for remediation.

6.1 Remedial Measures of Waste & Soil as per the DPR

Based on the multi-criteria evaluation of the shortlisted techniques proposed for Waste and Soil remediation, excavation with on-site treatment and backfilling on and on-site engineered secured landfill (SLF) has been found to be the most sustainable option. This approach is intended to reduce the concentration of chemicals of concern (CoC) down to an acceptable level and eliminates further migration of Hexavalent Chromium from waste and/or soil into groundwater or surface water as applicable. This does not remediate the contaminants in the groundwater or surface water and therefore groundwater and surface impacts need to be addressed simultaneously.

Summary of Remedial Technology for the Site

Matrix	Location	Selected Option
INTERIM		
Soil and Waste	On-site	Capping of existing waste dump with provision for storm water collection
FULL SCALE		
Waste and Soil	On-site	Excavation, Treatment, and Backfilling in on-site engineered secured landfill (SLF)
Groundwater	On-site and Off-site	Pump and Treat with Source Removal and Hydraulic Containment System

An interim remedial plan for limiting the surface run-off and limiting leaching of hexavalent chromium into groundwater is also presented in sections below. The interim plan consists of capping the existing waste on-site by grading and engineering a cap to limit any contamination from leaching into groundwater during monsoons. Along with the cap, a storm water drainage network is also proposed prevent any surface water run-off from the site.

A copy of Detailed Project Report (DPR) for remediation of chromium contaminated sites at Ranipet, Tamil Nadu is enclosed as **Annexure-IV**.

7. Inspection of Industries by joint Committee

Out of 349 industries, 47 no. of industries are water polluting including CETPs, RED & Orange categories. There are two CETP's are in operation for treating Tannery Effluents generates from 99-member tannery units. The industries inspected by the committee during December 22 to 24, 2020 are listed below and individual industries observation are as follows;

Operational during inspection:

- i. M/s Malladi Drugs &Pharmaceuticals Limited (Unit 1)
- ii. M/s Malladi Drugs &Pharmaceuticals Limited (Unit 3)
- iii. M/s Arjun Chemicals Pvt Ltd

- iv. M/s Ranipet SIDCO Finished Leathers Effluent Treatment Company (P) Ltd (CETP)
- v. M/s SIPCOT-SIDCO Phase-II Entrepreneur Finished Leather Effluent Treatment Co. (P) Ltd. (CETP)
- vi. M/s Ultramarine and Pigments Ltd
- vii. M/s Sviss Labs Private Limited
- viii. M/s Thirumalai Chemicals Limited

Non-operational during inspection:

- ix. M/s Greaves Cotton Limited, Light Engines, Unit-II,
- x. M/s Alchymars Icm Sm Private Limited (Unit-II)
- xi. M/s Murugappa Morgan Thermal Ceramics Limited
- xii. M/s Mitsubishi Heavy Industries India Precision Tools Limited

7.1 M/s Malladi Drugs & Pharmaceuticals Limited (Unit I)

- The unit is consented for the production of Ephedrine Hydrochloride - 10.0 MT/M from molasses and benzaldehyde as raw material.
- The unit has obtained consents under Water & Air Act with validity till March 31, 2021 and Hazardous waste authorisation with validity till 19.06.2022 obtained for used oil and spent carbon only.
- The unit has installed ETP of capacity 300 KLD. The treatment plant consists of Bioreactor, RO plant, Multi effect evaporator (MEE). Triple effect evaporator (TEE), Fluidised immobilised carbon cell oxidation (FICCO) & Clarifier.
- The concentrate from TEE is sent for co-processing to cement industry.
- The condensate water from MEE & TEE is further treated in FICCO treatment system to reduce the COD. The treated effluent from FICCO is consented to reuse in process, cooling tower & gardening.
- The unit is claiming that presently, the treated effluent is completely reused in process, cooling tower, boiler not used for gardening purpose and achieving ZLD.
- The unit has installed pH, COD, BOD & TSS online analyser in the outlet of treated effluent.
- Earlier, the unit is carrying out the bio composting of the concentrated effluent. It is informed that bio composting was stopped before September 2020. Presently, the concentrate is being sent for co-processing to cement industry.

- The yeast sludge generated was used along with press mud for bio composting. Since composting is stopped, presently the yeast sludge is being disposed along with concentrate for co-processing, whereas no approval has been obtained so for this disposal method.
- The sludge generated in the FICCO treatment is removed through clarifier. This sludge is being presently sent to TSDF, whereas the characteristics of the sludge is not carried out.
- The unit has not obtained HW Authorisation for the generation, storage & disposal of spent solvent residue generated from the process, off specification product and chemical drums/barrels/containers/ bags. It is informed that spent solvent residue is being sent to co-processing through M/s Raj Pharma Transporter, whereas the quantity and name of the co-processing unit is not provided by the industry. The solvents used in the process are Toluene, Methanol & Acetone.
- The unit has installed three boilers of capacities 4 TPH, 3.5 TPH & 6 TPH using fuel Biogas/furnace oil (4 TPH) & wood respectively. It is informed that 3.5 TPH boiler is regularly used for operation and remaining two are stand by. So OCEMS is installed to the 3.5 TPH boiler stack & connected to CPCB/TNPCB server. Whereas on verification of records of boiler operation, 6 TPH boiler is also operated regularly and no OCEMS system is installed.
- Individual wet scrubber is installed as APCD to boilers 3.5 TPH & 6 TPH. During inspection, both the boilers operated and scrubbers are not in operation.
- The unit has installed & connected flow meters of Bio reactor feed, RO permeate & MEE-TEES condensate to CPCB. Whereas in TNPCB server additional flow meters connected are RO feed, MEES feed & TEES feed.
- The spent solvent residue & re-processing materials are kept stored in the open yard.
- Even though, the unit stopped bio composting process before September 2020, the bio compost is still kept in the open yard without any covering, which lead to the carryover of compost during the rainy season. This carry over is collected in the lagoon and same is witnessed by the presence of sludge deposit in the lagoon.

7.2 M/s. Malladi Drugs and Pharmaceuticals Ltd., (Unit-III)

- The unit is consented for the production following products

Pseudo Ephedrine Hydrochloride	12 TPM
Alprazolam	0.012 TPM
Propranolol Hydro Chloride	24 TPM
Albendazole	0.180 TPM
Theophylline	3 TPM
Dapsone	1.8 TPM
Atenolol	48 TPM

- The unit has obtained consents under Water & Air Act with validity till March 31, 2021 and Hazardous waste authorisation with validity till 19.06.2022 obtained for used oil and spent carbon only.
- The unit has installed ETP of capacity 194 KLD. The industry is segregating the low & high TDS effluent. The low TDS effluent is treated in ETP consisting of collection tank, equalisation tank, aeration tank, settling tank, activated carbon filter, multi effect evaporator & Agitated thin film dryer. High TDS stream is consisting of neutralisation multi effect evaporator & Agitated thin film dryer.
- The low TDS treated effluent after treatment is taken directly to MEE without RO system, where huge amount of energy is required to concentrate.
- Acetic acid is generated as by-product from the process, which is not incorporated in the consent obtained from TNPCB
- The unit has not obtained HW Authorisation for the generation, storage & disposal of spent solvent residue generated from the process, off specification product and chemical drums/barrels/containers/ bags. It is informed that spent solvent residue is being sent to co-processing through M/s Raj Pharma Transporter, whereas the quantity and name of the co-processing unit is not provided by the industry. The solvents used in the process are Toluene, iso propyl alcohol, Methanol & Acetone.
- The spent solvent residue & re-processing materials are kept stored in the open yard.
- The unit was not in operation during the committee visit due to closure direction issued by District Coordination Committee (DCC) & TNPCB. The closure issued because the industry was sending concentrate FCE wastewater through tanker lorry without any permission/ consent. It was informed that concentrate is also given to M/s

Raj Pharma Transporter. Industry claims that this waste water (concentrate FCE) is used as raw material by M/s Maha Tripurasundari industries pvt. Ltd., Telangana.

- In view of violation, TNPCB has imposed environmental compensation for Rs. 47,10,000/- and same is paid by the industry.

7.3 M/s SVISS LABSS PVT LIMITED

- The unit is consented for the production of seven products. The details are as follows;
 - Theophylline – 6 TPM
 - Amniophylline – 4 TPM
 - Caffeine – 2 TPM
 - Chloramphenicol powder – 0.80 TPM
 - Ibuprofen – 11.60 TPM
 - Chloramphenicol palmitate – 2.5 TPM
 - Trimethoprim – 5 TPM
- As per the information submitted by the unit, the products & by products produced last three financial years are tabulated below

Product & By Product manufactured	Product Manufactured in TPA		
	2017-18	2018-19	2019-20
Ibuprofen Stage –I Iso Butyl Acetophenone	185.21	211.94	215.79
Aluminium Chloride Liquid	8350	9205	9540
HCl	137.5	159	161.8

- The unit has not obtained consents for by product Aluminium Chloride Liquid & HCl.
- The unit has obtained consents under water & Air Act with validity till 31.03.2021.
- The unit has not obtained authorisation under hazardous waste rules for generation, storage & disposal of off specification/ contaminated product.
- The total fresh water consumption is 72.79 KLD, which is met through SPICOT supply. At present the unit is producing one product and generating 1.2 KLD of waste water (0.6 KLD from lab & floor washing and 0.6 KLD from softener, cooling tower & blow down).
- The unit has submitted that the installed capacity of ETP is 1.2 KLD. The unit has provided separate treatment system for low TDS stream & high TDS stream. Whereas, the unit claims lab & floor washing as high TDS stream, which

scientifically not correct. This effluent can be treated in ETP rather than taking directly to evaporator. Treating this effluent in present evaporator system provided in the plant is not technically & economically viable.

- The unit has installed own designed evaporator, where design inlet concentration of TDS is not known and it is informed that the unit is achieving TDS around 1 lac concentration. The observed TDS of the sample which is fed to evaporator is 3982 mg/l and to achieve the said TDS concentration 1 lac mg/l huge amount of energy is required.
- The unit has installed single stage RO system, where the reject concentration observed is 2700 mg/l.
- The effluent generated from the process is High TDS stream, which can't be treated in ETP due to high strength of effluent.
- The unit claims that no process effluent is generated, whereas the process wash water is being recycled. As per the information submitted by the unit, the fresh water is used for washing of organic layer, in such case additional water is being getting accumulated along with recycle water and moreover continuous recycling may also lead to contamination in the product. So in any case of time chances are there for disposal of wash water to ETP, this quantity generation is not mentioned.
- As per the consent, the trade effluent generation for the consented seven products is 24 KLD, whereas the unit has provided only 1.2 KLD ETP capacity against the consented quantity.
- The unit has provided collection, neutralisation & evaporator for high TDS effluent treatment.
- Low TDS effluent is directly taken to RO system and the reject is sent to Evaporator along with high TDS effluent for concentration. Then the concentrate is sent to elevated solar evaporation pond. The unit has not provided any treatment system for the low TDS effluent generated from softener, cooling tower & blow down before treating in RO, which may affect the working performance of the RO system.
- Before installation of evaporator system, ZLD is achieved through ground level solar evaporation pond. TNPCB directed to remove this SEP after installation of evaporator, whereas the unit still having the system and effluent is present.
- The unit has installed flow meter at outlet of ETP only.

7.4 M/s Ultramarine & Pigments Ltd.

- The unit is consented for the production of following products with installed capacity and its present production;

Products	Consented Qty	Present
Synthetic Detergents (Powder, paste, cake etc)	4000 MT/Month	2500 MT/Month
Sulphonic Acid	1350 MT/Month	1350 MT/Month
Alpha Olefin Sulphonate	1000 MT/Month	1000 MT/Month
Ultramarine Blue	200 MT/Month	200 MT/Month

- The total water consumption including process and other activities like washing, boiler, domestic is 106.9 KLD, which is met through SIPCOT water supply and wastewater generation from process is 9.1 KLD and domestic is 4.5 KLD.
- The unit has obtained consents under water Act & Air Act with validity till 31.03.2021 and Hazardous waste authorisation with validity till 31.03.25
- The unit is achieving ZLD. The treatment system consisting of settling tank, RO (3 stages), MEE & ATFD.
- During the inspection, it is observed that settling tank is not properly maintained and found with algae growth.
- TDS is measured in RO water to know the working performance, it is observed that TDS in feed, permeate & reject is 3000 mg/l, 580 mg/l and 4500 mg/l respectively, which shows poor performance of RO due to improper maintenance.
- Fugitive emission of SO₂ was observed in the kiln area due to leakages.
- During inspection, upgradation of kiln was observed and the waste generated is found stored in open yard.

7.5 M/s Arjun Chemicals Pvt Ltd.,

- The unit is consented for production of Dynasize – 500 MTM, Dynasol – 300 MTM & AKD/ Composize - 580 MTM. During the committee inspection, unit was not in operation.
- The unit has obtained consent under water & Air Act with validity till 31.03.2021.
- The source of fresh water is met through SPICOT supply. The unit has installed RO system for the fresh water supplied by SIPCOT. The total fresh water consumption is about 52 KLD, in which 10 KLD of RO reject is used for gardening.

- As per the consented condition, the unit has installed electromagnetic flow meter for discharge of RO reject whereas online TDS meters is not provided at discharge point.
- The unit claims that no wastewater is generated from the process. The vessels/ reactors are being washed with solvent at time of changeover of other batch product production and the washed solvent is stored and again used in the process.
- The unit has provided wet scrubber to rosin crusher & melter.
- TNPCB has imposed environmental compensation for Rs. 5,00,000/- based on the inspection carried out under CEPI action plan and same is paid by the industry.

7.6 M/s P A FOOTWEAR P LTD. Unit-II

- The unit is involved in production of Semi-Finished to finished leather with consented quantity of 37.50 T/M.
- The total water consumption is 27 KLD, which is met through SIPCOT water supply and reuse of RO permeate.
- The consented quantity of waste water generation is 25 KLD, whereas the unit presently generating 19 KLD.
- The unit was member of CETP till 2016 and thereafter, the effluent generated in the plant is treated in their own ETP.
- The unit is achieving ZLD, the treatment system installed are neutralisation, primary clarifier, Aeration, secondary & tertiary clarifier, filter, RO system (3 stage), salzberg mechanical dryer.
- Salzberg mechanical dryer will not effectively work to concentrate the effluent & salt out.
- The unit has obtained consents under water Act & Air Act with validity till March 31, 2022 and Hazardous waste authorisation with validity till 14.04.2024.
- During the inspection, wet sludge & salt (semi solid) is found stored in open drums.
- The unit has installed seven flow meters and connected to TNPCB server.

7.7 M/s Thirumalai Chemicals Ltd

- In the matter of OA no. 131/2020, the committee constituted by Hon'ble NGT inspected the unit and given the following recommendations;
- As the unit was observed for non-compliance of consent order conditions, discharges noticed in violation of consent conditions, internal discharge to the environment -land, water and air resulting into acute injury or damage to the environment and injection of treated /partially treated /untreated effluents to the ground water and based on repeated violations, the unit was directed by TNPCB to restrict the production of 50 % of its consented quantity so as to achieve zero liquid discharge consistently till the commencement & effective functioning of newly constructed ZLD components. As the unit is in the process of establishing ZLD system and started trial runs for validation of the equipment to achieve Zero liquid discharge with respect to treating effluents, the unit shall be allowed to operate in full load only after ensuring the complete/full-fledged operation of upgraded ETP by TNPCB. The full-fledged operation of ZLD system should be commenced within four months-time by the TCL. Further, the conditions issued by TNPCB are to be complied within three-months times.
- After commissioning of upgraded ETP, adequacy test needs to be carried out by an independent govt academic/research institution like IIT Madras and to certify that the unit has achieved 100% ZLD capacity.
- TCL shall, in consultation with reputed institute such as IIT, Madras, prepare a DPR within three months-time, for the remediation of the land where the untreated effluent was discharged within the industry site and execute the task of remediation of contaminated site, under the supervision of TNPCB. The entire cost for the study and remediation shall be borne by the industry as per polluter pays principle.
- In view of the non-compliance by M/s TCL, TNPCB imposed environmental compensation twice of Rs. 18,60,000 vide order dated 13-11-2019 and Rs. 17,40,000 vide order on 9-12-2020. Both the compensations were paid by TCL on 13-12-2019 & 22-1-2021 respectively.

7.8 M/s. Ranipet SIDCO Finished Leather Effluent Treatment Company Limited (Phase I)

- The CETP is established for treatment of tannery effluent. The member units are involved in processing Semi finished to finish leather. Totally 88 tanneries are member of this CETP, in which 79 units are in operation.
- The CETP is designed for treatment of 2.5 MLD wastewater, TNPCB has restricted the effluent generation to 75 % i.e 1875 KLD. Presently CETP receives wastewater around 1 to 1.5 MLD within the restricted quantity.
- The treatment unit comprises of Receiving Sump, Equalization tank, flash mixture, Primary Clarifier, Aeration tank I & II, Secondary Clarifier, Reactor Clarifier, Multi Grade filters, Ultra filters, 3 stage R.O system, Multi Effect Evaporator (MEE), Centrifuge and filter press.
- The CETP generates approximately around 12 TPD sludge and disposed to TWML Gummidipoondi & Arunachala Enterprises (for Co – Processing), Karur. At accumulated sludge stored is around 1300 Tons.
- At present no prescribed standards for CETP inlet effluent, however all the member units are discharging the effluent after pre settling. The sludge removed by the member units is being disposed through CETP.
- As per the record of CETP, as on 30th November 2020 total salt Accumulated is around 12403.28 MT.
- CETP has installed 18 flow meters which are connected to TNPCB server & CPCB server.
- Construction activities is being carried out by the CETP for upgradation of treatment units, during the inspection coloured seepage was noticed below the ground level/foundation area and samples were collected to know the characteristics of seepage. The observed values are TDS - 31030 mg/l, Chloride – 9050 mg/l and sulphate 1960 mg/l, COD – 4872 mg/l & BOD – 768 mg/l. As per the analysis report, it clearly indicates the contamination is due to tannery effluent.
- During the inspection, the committee instructed TNPCB & CETP to stop the construction activities until identifying the sources of pollution and take necessary action after identification of sources.
- CETP has obtained consents under Water & Air Act with validity till 31.03.2022, whereas HW Authorisation expired on 31.03.2020.

- CETP has not obtained HW Authorisation for Storage & disposal of chemical drums/barrels/containers/ bags.

7.9 M/s. SIPCOT & SIDCO Phase 2 Entrepreneur Finished Leather Effluent Company (P) Ltd

- The CETP is established for treatment of tannery effluent. The member units are involved in processing Semi finished to finish leather. Totally 20 operational tanneries are member of this CETP and proposed member tanneries are 20 units.
- The CETP is designed for treatment of 2.5 MLD wastewater, presently it receives wastewater around 1 to 1.5 MLD. The treatment unit comprises of Receiving Sump, Equalization tank, flash mixture, flocculator, Primary Clarifier, Aeration tanks, Secondary Clarifier, flash mixture, flocculator, Pressure sand Filter, Reactor Clarifier, Neutralization tank, Ultra filters, Organic scavengers, R.O (2 stage) systems, Multi Effect Evaporator (MEE), Centrifuge and filter press.
- CETP is upgrading the treatment system such as oxidation pond, 3rd stage RO and MEE with ATFD.
- All the member units are discharging the effluent to CETP without pre-treatment and inlet norms for CETP is also not prescribed by TNPCB.
- CETP has installed 18 flow meters which are connected to TNPCB server & only two flow meters (inlet & OHT) to CPCB server.
- The CETP generates approximately around 0.8 - 1 TPD sludge and disposed to TWML Gummidipoondi. Sludge is disposed as on December, 2020 is 1557 tons.
- As per the record of CETP, as on December 2020, the total salt accumulated is around 679 MT.
- The sludge stored in the SLF facility (old & new) is 4979 Tons. This SLF facility found in damage condition.
- CETP has obtained consents under Water Act & Air Act with validity till 31.03.2022, whereas the HW Authorisation expired on June 2020.
- CETP has not obtained HW Authorisation for Storage & disposal of chemical drums/barrels/containers/ bags.

8.0 Environmental Compensation Calculation:

Chromium contamination is mainly due to the dumpsite of M/s TCCL. The actual remediation cost for restoration of the environment as per DPR shall be borne by the M/s TCCL.

The committee has noticed other violation of the following industries in handling of hazardous waste generation, storage & disposal as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

- i. M/s Malladi Drugs & Pharmaceuticals Limited (Unit I)
- ii. M/s Malladi Drugs & Pharmaceuticals Limited (Unit 3)
- iii. M/s Sviss Labss Private Limited
- iv. M/s Ranipet SIDCO Finished Leathers Effluent Treatment Company (P) Ltd (CETP)
- v. M/s SIPCOT-SIDCO Phase-II Entrepreneur Finished Leather Effluent Treatment Co. (P) Ltd. (CETP)

So, the committee calculated Environmental Compensation as per the “Determination of Environmental Compensation to be recovered for violation of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016” as in the matter of OA No. 804 of 2017 (Earlier OA No.36/2012) Principal Bench, New Delhi. The methodology adopted as per the above said report is detailed below;

Approach for calculating environmental compensation:

The following quantity based environmental compensation calculation in Rupees may be used and be imposed on violating facility operator:

$$\text{Environmental Compensation (EC)} = Q \times \text{ERF} \times R$$

Where, Q is noticed¹ or observed¹ quantity (in tonne) of hazardous or other wastes which have not been managed in compliance with various provisions of the Acts/Rules/Guidelines/conditions of the authorisation/directions issued by CPCB/SPCB/PCC/MoEF&CC (barring procedural violations which have not caused environmental damage)

ERF = Environmental Risk Factor which is a number denoting the increasing degree of risk to the environment and human health due to the scenarios as given in the Table

Sl. No.	Violation	ERF	
		For Hazardous Waste	For Other* Waste
1.	When hazardous and other wastes is disposed at unauthorised place or handed over or sold to unauthorised party	1.5	0.03
2.	When treatment has not been imparted, as required, but only partial treatment has been given (by TSDF/Actual user)	1.0	0.2
3.	When product (derived from hazardous or other waste) is not conforming to prescribed specification or is specified for restricted use but sold in open market against (in case of actual user)	1.0	0.2
4.	Wastes found stored beyond the stipulated period (refer Rule 8 of the HOWM Rules, 2008)	0.1	0.05

**Applicable to waste generated indigenously only*

R= Environmental Compensation factor, which may be taken as Rs. 30,000.

Case I: If authorisation has been taken at any point of time, in such cases, Q may be taken as below:

Q= Quantity in terms of tone/per year, as specified in authorisation (one year =300 days)
x Y

Where, Y is Number of years of operation of the facility and may be considered as given in Table. In case authorisation is given in quantity/day, then convert in tone/year by multiplying the same with 300 days.

Case II: If authorisation has not been taken at any point of time for all or any given category of hazardous or other waste being generated/utilized

When above scenario comes to the notice of SPCB/PCC/CPCB, it may be difficult to find Q as records pertaining to quantity of generation/utilization of hazardous or other waste may not be available. In such case, a generalised way of calculating Environmental Compensation (EC) in Rupees may be used as below:

$$EC \text{ (in Rupees)} = T \times S \times C \times ECF \times Y$$

Where, ***T = Type of facility factor*** and may be taken as below from Table:

Sl. No.	Scale of operation	Factor
1.	(i) Actual user procuring hazardous waste from outside their premises including importing hazardous or other waste from other country	1.5
2.	(i) Actual user engaged in utilizing/ recycling of only other wastes which are generated indigenously, and; (ii) All facility other than at Sl. No. (1) and 2(i) above	1

S = Scale of Operation factor of the facility and may be taken from below Table:

Scale of operation	Scale Factor
Large	1.5
Medium	1
Small or Micro	0.5

C = Category of Facility factor and be taken from below Table;

Scale of operation	Scale Factor
Red Category	1
Orange Category	0.2
Green Category	0.05

ECF = Environmental Compensation Factor, which is summation of one or more ECF, as applicable, as given in below Table:

Sl. No.	Type of operations from where waste is generated	ECF
1.	Main Process (when significant quantity of waste generation like spent acid, process sludge, spent solvent, etc.)	45,00,000
2.	Pollution control equipment like ETP, APCDs, etc. such as ETP sludge, incineration bottom residues, cyclone residue, etc.	35,00,000
3.	Ancillary equipment used for supporting the industrial process such as DG set, etc.	10,00,000

4.	Handling of hazardous chemicals and wastes (waste packaging materials like emptied drums/bags/etc. contaminated with hazardous chemicals/wastes) and Cleaning activities like cotton/cloth waste contaminated with oil/grease/grease, hazardous chemical storage tank, etc.	20,00,000
5.	Other operations not listed above	10,00,000

Y = Number of years of operation of the facility and may be considered from below Table:

Years of Operations	Factor to be taken
More than 03 years	5
Equal to less than 03 years	Actual duration of operation in months/12

Committee decided to consider *Case 1 formula*, incase the industries applied for the hazardous waste authorisation for the left out categories.

8.1 M/s. Malladi Drugs & Pharmaceuticals Limited (Unit I)

Violation Noticed: HW Authorisation not obtained & applied for generation, storage & disposal of spent solvent residue generated in the process, off specification products, chemical drums/barrels/containers/ bags.

$$\text{Environmental Compensation (EC)} = Q \times \text{ERF} \times R$$

Q = Quantity in terms of tone/per year, as specified in authorisation x Y

Quantity in terms of tone/per year = 18.2

Y = Number of years of operation = 5

ERF = Environmental Risk Factor = 1.5

R = Environmental Compensation factor, which may be taken as Rs. 30,000.

$$EC = (18.2 \times 5) \times 1.5 \times 30000 = \text{Rs. } 40,95,000$$

EC calculated for M/s. Malladi Drugs & Pharmaceuticals Limited (Unit I) is Rs 40,95,000/- (Rupees fortylakhs ninety-fivethousand)

8.2 M/s. Malladi Drugs & Pharmaceuticals Limited (Unit 3)

Violation Noticed: HW Authorisation not obtained & applied for generation, storage & disposal of spent solvent residue generated in the process, off specification products, chemical drums/barrels/containers/bags.

$$\text{Environmental Compensation (EC)} = Q \times \text{ERF} \times R$$

Q = Quantity in terms of tone/per year, as specified in authorisation x Y

Quantity in terms of tone/per year = 41.6

Y = Number of years of operation = 5

ERF = Environmental Risk Factor = 1.5

R = Environmental Compensation factor, which may be taken as Rs. 30,000.

$$\text{EC} = (41.6 \times 5) \times 1.5 \times 30000 = \text{Rs. } 93,60,000$$

EC calculated for M/s. Malladi Drugs & Pharmaceuticals Limited (Unit 3) is Rs 93,60,000/- (Rupees Ninety-three lakhs sixty thousand)

8.3 M/s Sviss Labss Private Limited

(i) Violation Noticed: HW Authorisation not obtained for generation, storage & disposal of off specification products.

$$\text{EC (in Rupees)} = T \times S \times C \times \text{ECF} \times Y$$

T = Type of facility factor = 1

S = Scale of Operation factor = 1

C = Category of Facility factor = 1

ECF = Environmental Compensation Factor = 45,00,000

Y = Number of years of operation = 5

$$\text{EC} = 1 \times 1 \times 1 \times 45,00,000 \times 5 = \text{Rs. } 2,25,00,000$$

(ii) Violation Noticed: Not obtained Consent for By products till date.

Environmental compensation is calculated using Pollution Index Formula

$$\text{EC} = \text{PI} * \text{N} * \text{R} * \text{S} * \text{LF}$$

PI = Pollution Index, RED category industry (PI = 80)

R = Rupees Factor (**R = 250**)

S = Scale of Operation, Medium Scale (**S = 1**)

LF = Location Factor, CEPI Area (**LF = 2**)

N= Number of days for which violation took place is the period between the day of violation observed/ due date of compliance of directions and the day of compliance verified by CPCB/ SPCB/ PCC. *for interim compensation calculation no. of days taken from date of committee visit 22.12.2020 to 31.03.2021.* (**N = 100 days**)

$EC = 80 * 100 * 250 * 1 * 2 = Rs. 40,00,000 = Rs 40 lakhs.$

Total EC = Rs. 2,25,00,000 + Rs. 40,00,000 = 2,65,00,000/-

Total EC calculated for M/s. Sviss Labs Pvt. Ltd., is Rs 2,65,00,000/- (Rupees Two Crores Sixty-five Lakhs)

8.4 M/s Ranipet SIDCO Finished Leathers Effluent Treatment Company (P) Ltd (CETP)

Violation Noticed: HW Authorisation not obtained& applied for generation, storage & disposal of chemical drums/barrels/containers/ bags.

Environmental Compensation (EC) = Q x ERF x R

Q = Quantity in terms of tone/per year, as specified in authorisation x Y

Quantity in terms of tone/per year = 1

Y = Number of years of operation = 5

ERF = Environmental Risk Factor = 1.5

R= Environmental Compensation factor, which may be taken as Rs. 30,000.

$EC = (1 \times 5) \times 1.5 \times 30000 = Rs. 2, 25,000$

EC calculated for /s Ranipet SIDCO Finished Leathers Effluent Treatment Company (P) Ltd is Rs 2,25,000/- (Rupees two lakhs twenty-five thousand)

8.5 M/s SIPCOT-SIDCO Phase-II Entrepreneur Finished Leather Effluent Treatment Co. (P) Ltd. (CETP)

Violation Noticed: HW Authorisation not obtained & applied for generation, storage & disposal of chemical drums/barrels/containers/bags.

$$\text{Environmental Compensation (EC)} = Q \times \text{ERF} \times R$$

Q = Quantity in terms of tone/per year, as specified in authorisation x Y

Quantity in terms of tone/per year = 0.75

Y = Number of years of operation = 5

ERF = Environmental Risk Factor = 1.5

R = Environmental Compensation factor, which may be taken as Rs. 30,000.

$$EC = (0.75 \times 5) \times 1.5 \times 30000 = \text{Rs. } 1,68,750$$

EC calculated for M/s. SIPCOT-SIDCO Phase-II Entrepreneur Finished Leather Effluent Treatment Co. (P) Ltd., is Rs 1,68,750/- (Rupees one lakh sixty-eight thousand seven hundred fifty only)

8.6 Environmental Compensation imposed on other industries by TNPCB:

TNPCB has imposed environmental compensation on 28.01.2020 for 24 nos. of violating industries in the SPICOT industrial area based on the inspection as per OA 1038/2019 order dt. 14.09.2019 and also based on the routine/ public complaint inspections. Since the said order was stayed by Hon'ble Supreme Court many industries not paid the compensation. The details are as follows;

S.No.	Name of Industry	Environmental Compensation Imposed in Lakhs	Amount Received in Lakhs	Balance to be received in Lakhs
1	M/S. Snap Natural And Alginate Products P Lt	10	0	10
2	M/S. Alchymars Icm Sm Private Ltd Unit Ii, Previously Ramnath Chemicals,	8.6	8.6	0
3	M/S. Arjun Chemicals Pvt Ltd	5	5	0
4	M/S. Greaves Cotton Limited	5	5	0
6	M/S. Bright sun Leathers,	1	1	0
7	M/S. Hide Craft(Tan Leathers & Chemical Pvt Ltd),	1	1	0

8	M/S. Hi Q Leathers,	1	1	0
9	M/S. Prestige International,	1	0	1
10	M/S. Standard Chemicals And Leathers,	1.18	0	1.18
11	M/S. Titan Leather Exports Unit Ii	1	0	1
12	M/S. Joseph Exports	1	1	0
13	M/S. Vks Exports,	1	1	0
14	M/S. Winner Leather Creation,	1	1	0
15	M/S. Jay Ar Enterprises	1	1	0
16	M/S. Pioneer Leder Tex P Ltd	1	0	1
17	M/S. Sri Hari Leathers	1	1	0
18	M/S. Hariharan Leathers Crr Leathers Unit B	1	1	0
19	M/S. Siva Leathers Pvt. Ltd	1	1	0
20	M/S. Sunrise Tanners	1	1	0
21	M/S. Vinyork Leather Works	1	0	1
22	M/S. Sns Leathers	1	1	0
23	M/S. Sri Thirumalai Leathers	1	0	1
24	M/S. Mahalakshmi International	1	0	1

The committee in the matter of OA no. 186/2020 decided that same amount shall be imposed on the industries as calculated by TNPCB.

9. Recommendations for industries:

Tamilnadu Pollution Control Board may be directed to issue notice to the following industries and take appropriate action accordingly.

M/s Malladi Drugs & Pharmaceuticals Ltd., (Unit I)

- The unit shall obtain proper consent for disposal of bio yeast sludge by mixing with TEE concentrate, which is sent for co-processing.
- Characteristics of the sludge generated from clarifier after FICCO treatment shall be carried and accordingly consent/ authorisation shall be obtained from TNPCB for generation, storage & disposal.
- The unit shall obtain HW Authorisation for generation, storage & disposal of spent solvent residue generated in the process, off specification products & chemical drums/barrels/containers/ bags. Accordingly, waste shall be disposed to authorised recycler or pre- processor or co-processor or TSDF.

- Since the industry is operating both the boilers 3.5 TPH & 6 TPH regularly, OCEMS shall installed in the stack attached to 6 TPH boiler also for the parameter PM.
- Since the industry is claiming ZLD system and not using the treated effluent for gardening, online analyser for the parameters pH, COD, BOD & TSS may be removed. To ensure that no effluent used for gardening, the unit shall install flow meter for the treated effluent reuse.
- To verify the ZLD system, flow meters in the RO reject, FICCO inlet and treated effluent reuse shall be installed & connected to CPCB and TNPCB server as well as the flow meters RO feed, MEES feed & TEES feed connected to TNPCB shall also be connected to CPCB server.
- The unit shall provide proper shed for the storage of spent solvent residue as well as for reprocessing materials/ solvents.
- The unit shall take necessary steps to remove the compost placed in the open yard. The compost shall be bagged & stored properly. The sludge in the collection lagoon shall also be removed, stored & disposed properly.
- EC calculated by the committee for violation of HW Rules is Rs 40,95,000/- (Rupees forty lakhs ninety-five thousand) and same shall be remitted to CPCB

M/s. Malladi Drugs and Pharmaceuticals Ltd., (Unit-III)

- The unit shall install RO system for treatment of low TDS effluent before sending to MEE.
- The unit shall obtain consent from TNPCB for the production of Acetic Acid as by-product.
- The unit shall obtain HW Authorisation for generation, storage & disposal of spent solvent residue generated in the process, off specification products & chemical drums/barrels/containers/ bags. Accordingly, waste shall be disposed to authorised recycler or pre- processor or co-processor or TSDF.
- The unit shall stop sending the concentrate FCE wastewater to any of recycler or industries without obtaining consent/approval from TNPCB.
- The unit shall provide proper shed for the storage of spent solvent residue as well as for reprocessing materials/ solvents.
- EC calculated by the committee for violation of HW Rules is 93,60,000/- (Rupees Ninety-three lakhs sixty thousand) and same shall be remitted to CPCB

M/s Sviss Labss Pvt Ltd.

- The unit shall obtain consent for the production of by-products Aluminium Chloride Liquid & HCl.
- The unit shall obtain authorisation for generation, storage & disposal of off specification/ contaminated product under hazardous waste rules.
- The unit shall upgrade RO as well as evaporator system for achieving proper treatment.
- The unit shall upgrade the ETP for the consented quantity and also provide proper physiochemical treatment for the effluent generated from lab & floor washing followed by RO. The RO reject shall be treated in MEE to achieve ZLD. The unit shall install ATFD to remove the salt rather than disposing to elevated solar evaporation pond.
- The unit shall ensure no effluent is discharged to the ground level solar evaporation pond and this pond shall be dismantled.
- The unit shall provide proper treatment system for the effluent generated from softener, cooling tower & blow down before taking to the RO system directly.
- As the unit claims no effluent generation from process, so TNPCB shall carry out detail study of the process to estimate exact quantity of waste water generation from process and moreover stream wise waste water generation shall be specified in the consent.
- The unit shall install flow meters at inlet of individual streams, RO inlet, RO reject, RO permeate, MEE inlet & MEE condensate and connect to CPCB/ TNPCB server to verify the ZLD system.
- EC calculated by the committee for violation of HW Rules is Rs 2,65,00,000/- (Rupees Two Crores Sixty-five Lakhs) and same shall be remitted to CPCB.

M/s Ultramarine & Pigments Ltd.

- The unit shall maintain ETP properly and also to take necessary steps to improve the performance of RO system.
- The unit shall arrest the leaks in kiln area as well as provide proper suction system in order to control the fugitive emission.
- The waste generated from kiln upgradation shall be stored in a closed shed and dispose properly with consent from TNPCB.

- The unit shall install flow meters at inlet of ETP, RO (Inlet, permeate & reject) and MEE (inlet & condensate) and same shall be connected to CPCB/TNPCB server to assess the ZLD system.

M/s Arjun Chemicals Pvt Ltd.,

- The unit shall install online TDS meter in the RO reject discharge as per consented condition.

M/s P A Footwear P Ltd., Unit-II

- The unit shall replace existing salzberg mechanical dryer system and upgrade to MEE system
- The unit shall provide proper drying area for the sludge & semi solid and dried solid shall be packed & stored in the closed shed.
- The unit shall connect all online flow meters to CPCB server also.

M/s. Ranipet SIDCO Finished Leather Effluent Treatment Company Ltd., (Phase 1)

- The CETP shall stop its construction activities, until identifying the sources of pollution.
- On identification of sources of pollution, remediation action shall be initiated and TNPCB shall impose the environmental compensation on the defaulter.
- The unit shall install ATFD system as per direction of TNPCB.
- The unit shall obtain valid HW Authorisation from TNPCB and also to incorporate for storage & disposal of chemical drums/barrels/containers/ bags.
- EC calculated by the committee for violation of HW Rules is Rs 2,25,000/- (Rupees two lakhs twenty five thousand) and same shall be remitted to CPCB.

M/s. SIPCOT & SIDCO Phase 2 Entrepreneur Finished Leather Effluent Company (P) Ltd.,

- The CETP shall expedite the upgradation of treatment system.
- CETP shall submit the action plan for removal & disposal of sludge to TSDF present in the SLF facility.

- CETP shall obtain valid HW Authorisation from TNPCB and also to incorporate for storage & disposal of chemical drums/barrels/containers/ bags.
- CETP shall connect all online flow meters to CPCB server.
- EC calculated by the committee for violation of HW Rules is Rs 1,68,750/- (Rupees One lakh sixty-eight thousand seven hundred fifty) and same shall be remitted to CPCB.

Consolidated Table (Environmental Compensation to be paid by the violating industries to CPCB):

S.No.	Name of Industry	Environmental Compensation
1	M/S. Malladi Drugs And Pharmaceuticals Ltd Unit-I	Rs.40,95,000
2	M/S. Malladi Drugs And Pharmaceuticals Ltd Unit-3	Rs.93,60,000
3	M/S. Sviss Labss Private Limited	Rs.2,65,00,000
4	M/S. Ranipet SIDCO Finished Leathers Effluent Treatment Co. Ltd,	Rs.2,25,000
5	M/S. SIPCOT - SIDCO Phase II Entrepreneur , Finished Leather Effluent Treatment Co. Pvt.Ltd.	Rs.1,68,750
6	M/S. Snap Natural And Alginate Products P Lt	Rs.10,00,000
7	M/S. Prestige International,	Rs.1,00,000
8	M/S. Standard Chemicals And Leathers,	Rs.1,18,000
9	M/S. Titan Leather Exports Unit ii	Rs.1,00,000
10	M/S. Pioneer Leder Tex P Ltd	Rs.1,00,000
11	M/S. Vinyork Leather Works	Rs.1,00,000
12	M/S. Sri Thirumalai Leathers	Rs.1,00,000
13	M/S. Mahalakshmi International	Rs.1,00,000

10. Conclusions on Remediation of Chromium Contaminated Site at Ranipet, Tamil Nadu:

As per the terms of NCEF project scheme, Central funding for assessment and remediation of contaminated area was limited to 40% of the total project cost. The remaining 60% is to be met from State Government through Polluter Pays Principle/Public-Private Partnership/State support, etc. Government of Tamil Nadu State had given in-principle approval for funding State's share of 60%. The project for preparation of DPRs including TCCL contaminated area at Ranipet, Tamil Nadu was initiated in the year 2014. However, NCEF Project of MoEF&CC has been discontinued by Government of India. CPCB has completed DPR for remediation of chromium contaminated area at Ranipet, Tamil Nadu based on detailed site investigation including human health risk assessment studies. The DPR along with templates of bid document was forwarded to Government of Tamil Nadu and TNPCB for execution of remediation works.

Since the TCCL was operated by State government department and also by few private entities, funds for remediation may be apportioned to both TN State as well as the other responsible parties, who operated the plant.

As the current scenario in ground level remains same and pollution is being continued as the seepage from the chromium sludge dump yard is flowing to the surface as well as ground water bodies. Hon'ble Tribunal may direct the Govt. of Tamil Nadu to start up remediation work. Since the financial matter is involved, this issue may be taken up in the level of Chief Secretary, Government of Tamil Nadu constituting the monitoring committee for effective progress in the remediation work.

Timelines for implementation & cost estimated as per DPR is as follows:

The schedule of implementation of the selected remedial technology is subject to limiting field conditions. Assuming that the tasks are implemented without undue hindrance of any kind, the anticipated duration for each activity and the overall schedule for installation of the abstraction wells, and connection to the surface water treatment system are presented in Table below for the schedule associated with installation of the water treatment system.

Remedial Implementation Schedule – Groundwater

Anticipated Activity	Sub-activities	Anticipated Duration (months)
Installation of abstraction wells	Installation of abstraction wells	1
	Installation of conveyance piping	1
Installation of Treatment System	Procurement and Installation Instrumentation and Piping Testing and Commissioning	6-9
Operations	Long term monitoring of treatment system	15-20 years

Capital expenditure (CAPEX) is associated with drilling, installation of abstraction wells, and installation of the groundwater treatment system. The cost estimates as per DPR is presented below;

Estimated CAPEX

In total, the cost of installation of the abstraction system, and connecting it with the surface water treatment system is estimated to be Rs. 12 Crore.

Estimated Operating expenditure (OPEX)

Assuming the life of the treatment system to be fifteen (15 years), the OPEX is estimated to be Rs. 1.29 crore per month.

Since no progress made on implementation of remediation work even after finalisation of DPR, Hon'ble NGT shall directed the Govt. of Tamilnadu to implement the following;

- i) Chief Secretary to review the matter periodically by constituting the State Level Monitoring Committee for effective monitoring & supervision of remediation work. The remediation work may be executed as per the DPR prepared by CPCB.
- ii) Government of Tamilnadu shall recover a portion of the cost from the responsible parties/ owner of M/s TCCL. Until the recovery of the cost, the

remediation work shall be initiated by utilising the environmental compensation available with TNPCB.

- iii) TNPCB shall prepare & submit PERT chart on execution of the work in consultation of the Chief Secretary.
- iv) Remediation work may be executed as per authorization and supervision of TNPCB. TNPCB may also engage any competent consultant to monitor and verify the works.
- v) CPCB may provide technical assistance and also verify the remediation works as and when required.



R. Sridhar
Scientist D
MoEF&CC, RO - Chennai



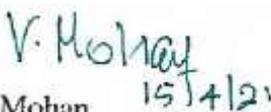
R. Rajkumar
Scientist D
CPCB, RD – Chennai



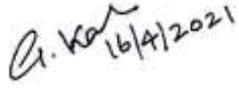
S. Rajan
Joint Chief Environmental Engineer
TNPCB Monitoring Office
Vellore



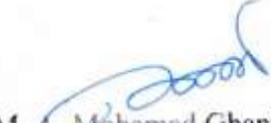
Ravimanohar
SE, WRD, Pennaiyar Basin
Circle
Tiruvanammalai



Mohan
Executive Engineer
Ground Water Department
Vellore



Kalai Selvi
Project Officer
SIPCOT, Ranipet



M. A. Mohamed Ghani
Joint Director of Industrial
Safety & Health I Division
Vellore



K. Elambahavath, IAS
Sub-Collector
Ranipet

Minutes of Meeting with SPCBs/PCC for compliance to the directions of Hon'ble NGT order dated 29.01.2021 in O.A. No. 804 of 2017 in the matter of Rajiv Narayan & Anr. Vs. Union of India & Ors; w.r.t Contaminated Sites in India held on 16.03.2021

In compliance of Hon'ble NGT order dated 29.01.2021 in O.A. No. 804 of 2017 in the matter of **Rajiv Narayan & Anr. Vs. Union of India & Ors**, regarding contaminated sites, a meeting with concerned senior officials of SPCBs/PCC was held through VC on 16.03.2021 to discuss the Action Plans. The meeting was chaired by Member Secretary, CPCB, Delhi.

Meeting was attended by Senior officials of SPCBs/PCC namely; Andhra Pradesh, Assam, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand & West Bengal and dealing officials of CPCB. List of participants is given at **Annexure-I**.

Initiating the meeting, Member Secretary welcomed the participants. The concerned Division in CPCB briefed the agenda of the meeting, and made a presentation on action points to comply with various directions passed by Hon'ble NGT for identification, assessment and remediation of contaminated sites.

Subsequently, Member Secretary, CPCB requested SPCBs/PCCs to present status on implementation of Detailed Project Reports (DPRs) prepared under NCEF Project. Points of discussion given below:

1. **Kerala:** There are 03 contaminated sites for which DPRs have been prepared and forwarded the same to Government of Kerala and Kerala SPCB for execution of Remediation works.

a) With regard to execution of remediation works at Kuzikundam Thodu (Creak), Eloor; Kerala SPCB informed that tendering process is under way.

In this regard, it was suggested that Kerala SPCB need to facilitate the Supervised Committee constituted by Hon'ble NGT (SZ) in OA No. 561 of 2018 in the matter of Shibu Manual Vs. Union of India & Ors. to expedite the entire process of remediation works in time bound manner.

b) With regard to remediation of contaminated sites at Edyaar; Kerala SPCB was requested to issue direction to responsible party to initiate lifting and disposal of waste from the unlined jerosite ponds and execute remediation works as per the DPR. In case of failure to comply, as per the Hon'ble NGT order dated 26.08.2019,

environmental compensation may have to be paid by Kerala SPCB at the rate of Rs. 10 lakh per site.

2. **Madhya Pradesh:** There are 03 contaminated sites for which DPR preparation is under way. MPPCB informed that from one of the contaminated site at Plot No. 61-B, waste had been lifted and disposed through TSDF. In case of other contaminated site at Plot No. 54-E wherein hazardous waste is still lying, MPPCB informed that a case has been filed against responsible party for lifting and disposed the same in environmentally sound manner.

MS, CPCB informed that lifting of hazardous waste is a priority action point and failure to do so may attract payment of environmental compensation by MPPCB.

3. **Odisha:** There are 04 contaminated sites for which DPRs have been prepared and forwarded by CPCB to Government of Odisha and Odisha SPCB for execution of Remediation works.

a) With regard to execution of remediation works at mercury contaminated sites at Ganjam, Odisha SPCB informed that remediation work as per DPR is under way. Further, informed that tendering process for construction of new Secured Landfill for disposal of waste from JCL-I, II and III sites is also initiated.

b) In case of chromium contaminated site at Talcher; Odisha SPCB informed that due to high cost for remediation as per DPR, responsible party is unable to taken-up for lifting and disposal of waste through TSDF. Board has also informed that regularly following-up is being made with the responsible party and State Govt.

MS, CPCB has suggested that necessary directions may be issued to Responsible Party for lifting and disposal of hazardous waste. In case of failure to comply, environmental compensation may have to be paid by Odisha SPCB.

4. **Tamil Nadu:** There is 01 contaminated site for which DPR has been prepared and forwarded the same to Government of Tamil Nadu and TNPCB for execution of Remediation works.

a) TNPCB informed that since the cost of actual remediation as per the DPR is very high, it is proposed to lift and disposal of hazardous waste through TSDF.

CPCB conveyed that Interim measures also proposed in DPR as per the request of TNPCB/Govt. of TN for capping of waste and contaminated soil along with storm water drainage system with a cost of about Rs. 12 crore. Afterwards, groundwater

remediation by applying Pump & Treat method may be implemented initially for 5 years. It was also explained that cost of remediation will appear high due to inclusion of GW remediation cost over a period of 15 years. However, actual cost may be much lower. Initial cost of remediation may focus up 1 - 2 years O&M cost of GW remediation. While preparing DPR cost of transferring to TSDF was discussed however, it was deferred due to cost consideration.

MS, CPCB has suggested TNPCB that once DPR is accepted by Project Steering Committee (PSC) headed by Chairman, CPCB remediation work needs to be executed within the timelines stipulated in DPR.

5. **Uttar Pradesh:** There are 07 contaminated sites for which 02 DPRs have been prepared and forwarded the same to Government of Uttar Pradesh and UPPCB for execution of Remediation works.

- i) With regard to remediation of 02 chromium contaminated sites at Rania; UPPCB informed that Govt. of UP has assigned the task to UPSIDA for execution through competent remediation contractor. Further, it is informed that due to receive of single bid for selection of remediation contractor during tendering process, execution of remediation couldn't be initiated.

In this regard, MS, CPCB has suggested that appropriate process may be adopted to justify the costs in single bid. If required, the work may be carried out stage wise.

- ii) In case of remediation of 05 pesticide contaminated sites at Deva Road, UPPCB informed that for further study of the said sites task was assigned to IITR Lucknow to ascertain the extent of contamination in soil/groundwater/surface water/sediment.

In this regard, CPCB informed that DPR is already been approved by Project Steering Committee (PSC) under the chairmanship of Chairman, CPCB after consultation with Technical Expert Committee (TEC) of CPCB including officials of UPPCB. Therefore, UPPCB may direct the responsible party to initiate remediation works as per DPR.

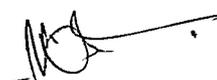
In case of failure to comply, environmental compensation may have to be paid by UPPCB.

6. **West Bengal:** There is 01 contaminated site for which DPR has been prepared and forwarded the same to Government of West Bengal and WBPCB for execution of Remediation works.

- i) WBPCB informed that remediation work is delayed due to COVID-19 pandemic. CPCB conveyed that as the cost of remediation is not high (about Rs. 45 lakh), WBPCB is requested to initiate remediation work immediately.

Recommendations/Action Points:

1. All SPCBs/PCC shall submit Action Points (as per Annexure-II) with proper road-map and specific timelines for carrying out preliminary/detailed site investigation, preparation of DPRs, execution of remediation works, lifting of hazardous waste within 15 days. Further, other Action Points if any, SPCBs/PCC may suggest.
2. SPCBs/PCC shall submit current status of the sites wherein DPRs prepared and remediation works are on-going **within 15 days**.
3. SPCBs/PCC shall constitute State Level Empowered Monitoring Committee (SLEMC) having representatives from Dept. of Environment, Industries Dept., SPCB/PCC, CGWA/SGWA, relevant Experts, etc. for effective implementation of remediation plans.
4. It was decided that in next meeting, Action Plans submitted by SPCBs/PCC may be reviewed after 15 days.



Annexure-I

List of officials participated (through VC)**Chaired by:** Member Secretary, CPCB**CPCB Officials**

1. Sh. B. Vinod Babu, Additional Director & Head, WMD-I, Delhi
2. Sh. G. Rambabu, Scientist-D, WM-I, CPCB, Delhi
3. Sh. Bharat K Sharma, Regional Director, CPCB-RD, Pune
4. Sh. P. Jagan, Regional Director, CPCB-RD, Bhopal
5. Mrs. H. D. Varalaxmi, Regional Director, CPCB-RD, Chennai
6. Sh. M. K. Biswas, Regional Director, CPCB-RD, Kolkata
7. Sh. Prasoon Gargava, Regional Director, CPCB-RD, Vadodara
8. Ms. Anjana Kumari, Scientist-D, RD Bengaluru, CPCB
9. Sh. Amit Thakkar, Scientist-D, CPCB-RD, Vadodara
10. Sh. Sandeep, Scientist-D, RD Kolkata, CPCB
11. Dr. G P Singh, Scientist-D, RD Kolkata, CPCB
12. Dr. Gargi Biswas, RA, WM-I, CPCB, Delhi

SPCB/PCC Officials

1. Sh. Nandkumar Gurav, SO, Maharashtra PCB
2. Sh. D. M. Thaker, SEE, Gujarat PCB
3. Sh. Q. Q. Hassan, EE, WBPCB
4. Sh. H. S. Malviya, SE, MPPCB
5. Dr. Manoj Chauhan, SSO, HPPCB
6. Sh. R. Kannan, ACEE, TNPCB
7. Ms. Mayma, EE, Kerala SPCB
8. Dr. Kiran Jasuja, SSO, PPCB
9. Sh. D. Narendar, SEE, Telangana SPCB
10. Dr. A. K. Swar, CEE, OSPCCB
11. Sh. P. C. Rauta, SEE, OSPCCB
12. Sh. A. K. Anand, RO (Kanpur-Dehat), UPPCB
13. Ms. V. Kathikeyan, EO, Karnataka PCB
14. Sh. Mohan Girap, Goa PCB
15. Sh. Chandan Singh, CEO, UKPCB
16. Sh. P.K. Dutta, Executive Engineer, Assam PCB
17. Sh. M. Jadav, AEE, Haryana PCB
18. Sh. Praveen Kumar Jain, Haryana PCB
19. Sh. Harshvardhan Thakkar, EE, MPPCB
20. Sh. Naveen Gulia, SEE, Haryana PCB
21. Sh. S R Maurya, RO-Saharanpur, UPPCB
22. Representative of Delhi PCC
23. Representative of Jharkand, SPCB
24. Representative of Chhatisgarh, SPCB

Annexure-II				
S. No.	Action Point	Timeline as per order dated 26.08.2019	Timeline as per order dated 01.07.2020	Remarks / expected timelines
i.	SPCBs/PCCs to ensure that the hazardous waste accumulated/lying at following sites shall be disposed off either through TSDF or SLF on priority to stop further contamination: a) wherein Detailed Project Reports (DPRs) already prepared under NCEF Project b) all such identified sites/any new sites, if any	Failure to remove the waste from the identified sites, will result in environmental compensation to be paid at the rate of Rs. 10 lakhs per site from 01.04.2020 by the concerned SPCBs/PCCs to the CPCB. Same rate will apply in respect of such of the 195 probable contaminated sites as are identified as contaminated with effect from 01.01.2021.	3 months	
ii.	Sites for which DPRs prepared under NCEF project, SPCBs shall direct responsible party to initiate remediation works by engaging reputed contractor with intimation to CPCB.		Regarding immediate remediation of contaminated sites, within a period of six months (i.e. 31.01.2021). Environmental damages caused by such sites and loss in terms of monetary resources may also be estimated.	
iii.	In case of Probable contaminated sites, SPCBs/PCC may carry out Preliminary site investigation as per "Reference document on Identification, Inspection and Assessment of Contaminated Sites" prepared by CPCB.	probable contaminated sites, the assessment may be completed within six months (25.02.2020) and thereafter the waste may be removed within next six months (25.08.2020) from sites cleared by	45 days	

Annexure-II				
S. No.	Action Point	Timeline as per order dated 26.08.2019	Timeline as per order dated 01.07.2020	Remarks / expected timelines
	Investigation report shall be submitted to CPCB for further examination [as word (.docx) form] as per format prescribed in aforesaid Reference Document for listing of sites.	the CPCB to be contaminated.		
iv.	<p>In case of Contaminated sites, SPCBs/PCC shall carry out detailed site investigation followed by DPR preparation, as per aforesaid "Guidance document on Assessment and Remediation of contaminated sites in India" issued by MoEF&CC by engaging reputed remediation consultant.</p> <p>Detailed investigation and DPR preparation shall be carried out by responsible party. In case of orphan sites, the same shall be initiated by SPCB themselves.</p>	<p>sites which have already been identified as contaminated may be cleared of the hazardous waste within six months (25.02.2020) so that remediation process may start.</p> <p>The remediation work may start at the sites for which DPRs have been completed within the timelines specified in the DPRs. For the remaining sites, DPRs may be completed expeditiously but not later than one year (25.08.2020) and thereafter remediation may be done as per the timelines in the DPRs.</p>	3 months	
v.	SPCBs/PCC are requested to enlist new site if found any due to anthropogenic activity. Chemicals of Concerns (CoCs) may be decided based on site inspection/historical activity(ies).			

Annexure-II				
S. No.	Action Point	Timeline as per order dated 26.08.2019	Timeline as per order dated 01.07.2020	Remarks / expected timelines
vi.	Financial supports for execution of project on remediation of the contaminated sites may be arranged to SPCBs/PCC so that the detailed investigation studies followed by remediation works can be undertaken on priority - By State/Central Govts.		4 months	
vii.	The Committee for effective implementation of remediation plan at state level, Empowered Monitoring Committee having representatives from Dept. of Environment, Industries Dept., SPCB/PCC, CGWA/SGWA, relevant Experts, etc. shall be constituted.			



TAMIL NADU POLLUTION CONTROL BOARD

From

The Member Secretary
Tamil Nadu Pollution Control
Board,
76, Mount Salai, Guindy,
Chennai - 600 032.

To

The Additional Director & Divisional Head,
Waste Management -II Division,
Central Pollution Control Board,
Parivesh Bhavan, East Arjun Nagar,
Delhi - 110 032.

Lr. No. T2/TNPCB/F-32554/HWM/NGT-804/2017/2020 dt 10.4.2021

Sir,

Sub: TNPCB - Hazardous Waste Management - Remediation of contaminated site in compliance of orders of Hon'ble NGT(PB), New Delhi dated 07.07.2020 in O.A 804/2017 -Implementing of Interim Remedial Measures at Chrome bearing waste dump at M/s TCCL, Ranipet- Action plan - submitted - Regarding.

Ref: CPCB Lr No. F.No. B-29016/CS(16)-NGT/2019/WM-1 Dt. 23.3.2021

This has reference to the remediation of contaminated site at M/s TCCL, Ranipet.

As required vide reference cited, the action plan in this regard is furnished as below.

1. The option of shifting accumulated chrome bearing waste at TCCL site, Ranipet to M/s TSDF, Gummidipoondi for disposed in the secure land fill is dropped. The implementation of "Interim Remedial Measures of Soil & Waste Remediation" at TCCL, Ranipet as per DPR of M/s ERM India Limited, is under consideration.
2. M/s ERM India Ltd has been asked to present on the methodology of "Interim Remedial Measures of Soil & Waste Remediation" at TCCL Ranipet as per DPR & to involve in the preparation of Technical bid & Cost bid documents. Time requirement is one month (before 31st May 2021).
3. The proposal of Interim - Soil & Waste Remediation measures along with required documents to get approval of the Board including budget to meet from Environmental Compensation Fund. Time requirement is three months(before 31st August, 2021).

4. Process of Tendering and identifying the suitable bidder for execution of work. Time requirement is six months from finalization of the proposal.
5. A committee has been constituted to oversee the work of "Interim Remedial Measures of Soil & Waste Remediation" at TCCL site on technical matters & execution at site.


For Member Secretary

TCCL LIMITED, RANIPET.

Tamilnadu Chromates & Chemicals Limited (TCC) is a TIDCO Joint Sector Company promoted during 1972 in association with Thiru K.K. Mohiadeen for implementing the project for the manufacture of Basic Chromium Sulphate, etc. at Ranipet. Subsequently, the Promoters Agreement with Thiru K.K. Mohiadeen was terminated as he could not bring his equity contribution for project implementation. Thereafter, the Company was being managed by TIDCO through its nominee directors till Jan. 1989 except for initial two years period of operation. During 1988, TIDCO had disinvested its entire shareholding in TCC in favour of Thiru C.V. Sridhar, who was appointed as CMD of TCC with effect from 26.01.1989. Subsequently, Thiru Sridhar sold TCC to Thiru Ashok Balasubramanian son of Thiru Balasubramanian (Reliance). It is learnt that the plant could not be operated after 1995-96 as TNPCB issued notice to stop production until the solid wastage is disposed of.

- 2) During 1996, based on the petition filed by TCC and Ashok Balasubramanian, High Court directed TNPCB to submit a report on clearing the Solid Waste, in response to the criminal prosecution initiated by the TNPCB against the management of TCC.
- 3) As per the Report submitted by TNPCB, the solid waste was dumped in an area of 3.25 hectares with the height of about 3.5 Metre. The huge solid waste has affected the ground water.
- 4) After having heard the views of the then management of TCC and TNPCB, the High Court passed orders on 17.11.2003 interalia that TNPCB has to issue notice to all the managements, right from the inception and then hold an enquiry and fix the extent of liability, having regard to the period of manufacturing process and the solid waste accumulated during the said period and the total amount needed for treating the said solid waste and apportioning

the said liability according to the period of working by the respective managements and the solid waste generated out of the said work.

5) This exercise should be made within a period of six months from the date of receipt of this order. It is seen that the TNPCB received the orders on 16.04.2004.

6) TNPCB provided a copy of the High Court order dated 17.11.2003 to TIDCO during December. Based on the orders of the High Court, TNPCB informed TIDCO in their letter dated 8.10.2004 that as per provision of Section 9(3) of the Environment (Protection) Act 1986. TIDCO shall share the proportionate cost of the study and the cost involved for implementing the short term measures for containment of contamination due to ~~leachate~~^{leachate} arising from the dump as well as the long term measure for remedying the contaminated site and its surroundings. The proportionate cost would be worked out by TNPCB based on the quantity of waste disposed by TCC when it functioned as a joint sector unit between October 1975 to 1989 and TIDCO shall remit its proportionate share accordingly. The estimate of TIDCO's liability is likely to be in a few crores of rupees for permanent measures suggested by TNPCB.

7) TNPCB in its proceedings dated 19.09.2005 issued Show-cause Notice directing TIDCO to explain why penal action under Section 5 of the Environment (Protection) Act, 1986 as amended should not be initiated against TIDCO as previous operator of TCC for the damage being caused to be environment due to the storage of Chromium containing solid waste in an unscientific manner and thereby contravening the provisions of Hazardous Waste (M&H) rules 1989 as amended and also as to why levying of fine should not be imposed. TNPCB also directed TIDCO to comply the direction of Supreme Court Monitoring

Committee to cover the waste pile containing chromium within the premises of TCC with Polythene sheets of required thickness before monsoon to avoid rain water entry into the waste pile/ leachate generation. TNPCB directed TIDCO to cap waste pile immediately and report within 15 days.

8) The Chairman incharge of TNPCB also sent a letter to Secretary to Government, Industries Department stating that 1.52 lakhs tonnes (out of 2.27 lakhs tonnes of Chrome sludge) was generated during 1975 to 1988 when the management was with TIDCO and the balance 0.75 lakhs tonnes was generated when the management was with others namely Thiru C.V. Sridhar and Thiru Ashok Balasubramaniam. As major portion of the wastage was generated (67%) during TIDCO's tenure, the Chairman, TNPCB requested Govt. to initiate necessary action in this regard. It is learnt that TNPCB has engaged NEERI to carry out the study and to furnish the rehabilitation and remediation of chrome contaminated site. NEERI had suggested that the dump site needs to be immediately covered with a temporary impervious liner. The future course of action include covering the waste dump with HDPE sheets, constructions of slurry wall all around the dump site upto the depth of 20 M (app.) from ground level and construction of storm water drain and leachate collection wells, providing full fledged treatment plant of adequate capacity for treating the leachate, selection of appropriate remediation technology among chemical treatment, solidification & stabilization, developing secured landfill and bio-remediation based on the treatment cost and efficiency of the system and finally remediation of chromium waste, soil and surface/ ground water with the selected technology.

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9) In this connection, Chairman i/c., TNPCB has suggested that the matter may be referred to Chief Secretary by the Secretary to Govt., Industries Department for resolving the issue by convening a joint meeting with Industries Department, Environment and Forest Department, TNPCB, SIPCOT and TIDCO. It was learnt that in the file circulated from Environment and Forest Department, the then Chief Secretary suggested to settle the issue among the concerned Departments.

10) Subsequently TNPCB went ahead to initiate proceedings to pass orders against TIDCO and others to take immediate arrangements. The Environment (Protection) Act 1986 was enacted in 1986 and came into effect from 1989. During the period of operation of the said enactment, TIDCO was not in the management of the company. This apart, in the proceedings before High Court, TIDCO was not a party. TIDCO was not put to Notice of the said proceedings. TIDCO came to know of the aforesaid facts and orders of High Court in W.P. No. 7299 of 1995 dated 17.11.2003 only on receipt of references from TNPCB. The above position was informed to TNPCB and the TNPCB informed their inability to help TIDCO and informally advised to move the High Court to get any relief if TIDCO chooses. The above position was placed before the Board of Directors of TIDCO for taking decision as to further action to be taken by TIDCO and based on the advice, TIDCO filed a petition before the High Court. The First Bench after hearing the views of TIDCO and TNPCB passed interim order restraining TNPCB from taking any further action against TIDCO until further orders.

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- 11) Supreme Court Monitoring Committee in their recent visit to Tamilnadu on 5.9.2005, has emphasized that chromium contaminated site warrants immediate action and since the Polluter is a State Government entity, an action plan has to be evolved by TIDCO and the matter be referred to the Chief Secretary for resolving the issue by convening a joint meeting of Industries Department, Environment & Forests Department, Tamilnadu Pollution Control Board, SIPCOT and TIDCO.
- 12) A meeting has been arranged by Chief Secretary and Secretaries, Finance, Industries and Environment and Forest Department, CMD TIDCO and SIPCOT, Chairman, TNPCB on 9.11.2006 in connection with the pollution problem due to solid waste dumped at the site of TCCL. The Chairman, TNPCB informed that NEERI had suggested short term measures to cover the dump site with a temporary impervious liner and also suggested the procedure for covering the waste dump. NEERI is also preparing report on the appropriate long term remediation measures. As the cost of long term measures is likely to be substantial, TNPCB is exploring the possibilities of getting assistance from multilateral institutions like World Bank. The Chief Engineer, TNPCB informed that NEERI had given proposal as a part of short term measures, for construction of slurry wall all around the dump site upto a depth of 20M ground level and also for covering the dump site with temporary impervious liners. The estimate for undertaking the temporary measure is expected around Rs.80.00 lakhs and the cost for long term measures is expected to be around Rs.100-200 crores.

13) It was noted that the plant has been closed for last 10 years. The Secretary, Industries pointed out the urgency of implementing remedial measures.

14) After detailed discussion, the Chief Secretary felt that pending NEERI report and also pending decision in the case before High Court, possibilities of adopting economical measures including construction of concrete platform covered with walls on all sides with suitable height for a suitable area in the unaffected area of the land within the premises of TCCL to accommodate the entire waste dump, may be explored. Agencies/experts in construction may be requested to give suitable options/specifications with cost estimate.

15) It was also decided that on behalf of Government, TIDCO may identify agencies to give detailed engineering report including cost estimate for taking appropriate short term remedial measures as suggested by the Chief Secretary without further delay. Simultaneously, TIDCO may also get expert advice for alternate use of the Chromium Waste. TIDCO may send proposals to Government and such assistance could be considered as a special case. TIDCO was requested to send a report to the Government in 2 to 3 weeks.

16) TNPCB may issue notice to Thiru Ashok Balsubramaniam, the present promoter to take necessary action for removal/covering the waste dump within 30 days from the date of notice.

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17) Simultaneously SIPCOT may also take action to issue a notice to remove the building which is in a dilapidated condition and dangerous to the public. If the owner does not come forward to demolish the building within a period of one month, SIPCOT may examine the possibility of removing the building at the cost and risk of the owner.

18) Based on the above, SIPCOT has issued notice on 30.12.2006 to the Directors of the companies as the company was closed for more than ten years. In the notice SIPCOT has informed that their factory building is in a dilapidated condition and dangerous to the public. Demolition is the only alternative available to protect public interest and properties./ Therefore, they are advised to demolish and remove the debris within two weeks from the date of receipt of this notice failing which SIPCOT is at liberty to proceed with the demolition work at their cost and at their risk and further informed that the matter is most urgent. A report on the compliance should be immediately submitted to SIPCOT.

19) The notices were returned. The undelivered notices were affixed in the premises of Tamilnadu Chromates and Chemicals Ltd. Thiru S.Subramaniam Balaji, (the authorized representative of the company Directors viz., Mr.Sanjay Shah, Hirala, Mr. Y.S.Rawat and Mr. R.Baskar) has requested not to take any action and wait for the court orders. They are sure that programme for cleaning of the site will automatically emerge as a result of the court's orders. Further requested not to take any action till the issue of pollution control measures are settled.

20) Subsequently, the meeting was held at Chief Secretary's Conference Hall on 23.3.2007 on the presentation of Mahindra Acres consulting Engineers Limited on the containment facility at the site of Tamilnadu Chromates and Chemicals Ltd, SIPCOT Industrial Complex, Ranipet.

21) The representatives of MACEL made a presentation on two options for building the containment facility. Specifications for Option -A include walls on four sides and without for Option-B. Though Option B is of lower cost, the representatives of MACEL preferred Option - A as it has several additional safeguards.

22) Chief Secretary felt that if the chromium sludge stored in an unutilized area of about 12 acres upto the height of 4 meters from the ground level, the open space could not be used and therefore suggested a modification of Option -A (i.e) Confinement of the entire sludge below the ground level. This may be called as Option-C. After discussion, it was agreed that the unused area of 12 acres could be excavated upto a depth of 4 meters from the ground level and the chromium sludge could be dumped after building concrete base as per Option 'A' Specification. The top layer can be properly covered so that the top portion could be used either as park, playground, parking area etc., The representatives of MACEL informed that this method of containment is internationally accepted and

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estimated additional expenditure to the extent of about Rs.2 crores for excavation to the level of 4 meter depth and partial recovery of this cost by selling the excavated soil. The total cost for the entire containment process is estimated at Rs.16 Crores.

After discussion it was decided as follows :

- i) The proposed specification for containment facilities may be referred to an Institution like Centre for Environment studies, Anna University, for their report, as NEERI may take a long time to give their report. TNPCB may arrange to get the new specification (Option-C) vetted by Anna University and then (in view of the pending case) file an affidavit before Madras High Court for orders before implementation.
- ii) TIDCO may send necessary proposals to Government for sanctioning financial assistance for implementation of the proposed containment facilities under Option 'C'.
- iii) After getting the sanction from the Government and after High Court orders, tender be invited by TIDCO for building the containment facilities and also for engaging owner's engineers for monitoring the execution and certification for payment of bills.
- iv) MACEL may be engaged for preparing the tender documents including bill of quantities.

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v) The action proposed above is without prejudice to the rights of the Agencies (i.e TIDCO/SIPCOT) involved in the case pending before the High Court.

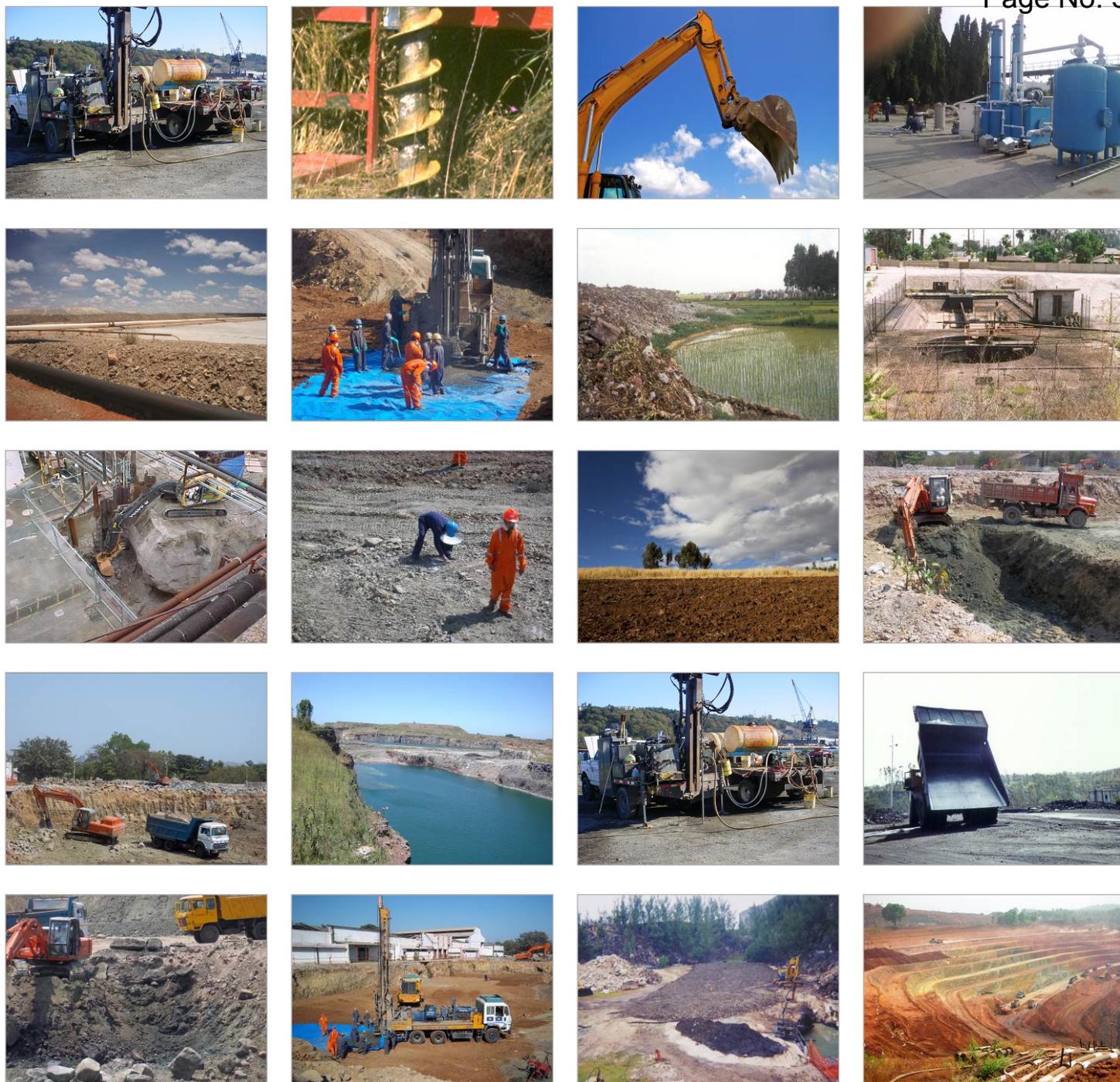
vi) SIPCOT may also initiate necessary action for demolishing the building by canceling the lease deed given to Tamilnadu Chromates and Chemicals Ltd (TCCL) after giving a legal notice to TCCL.

vii) TNPCB and TIDCO may continue to take further action with the private promoters of TCCL for recovering the expenses based on the orders of the High Court.

As per the direction of Government, the cancellation order was issued on 24.07.2007 to the Directors of the company viz., Mr.Sanjay Shah Hiralal, Mr.R.Bhaskar, Mr.Y.S Rawat and Mr.S.Subramanian Balaji (Authorized representative of Mr. Sanjay Shah Hiralal, Mr.R.Bhaskar, Mr.Y.S Rawat) on the ground that the company has failed to observe the conditions of the allotment order/lease deed. which amounts to non-observance and breach of the conditions of lease deed. Hence, they were requested to rectify the above defaults within 90 days from the date of receipt of this letter failing which SIPCOT will cancel the allotment and then proceed to resume the plot under TNPPE Act.

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Now one of the directors of the company Thiru R. Bhaskar filed a writ petition (WP. No. 31626/07) at High Court Madras stating that the cancellation order has been issued only to the Director and not to the company. Since, the company is aggrieved person, is filing the writ petition. SIPCOT has filed counter petition on 16.07.11. The company is having arrears of Rs.33.35 Lakhs as on 31.10.08. It is noted that the possession of the company has been taken by Indian Bank, ARM Branch, Chennai 8 under SURFEASI Act. We have informed our dues position to Indian Bank on 07.11.08.



Preparation of DPR and Providing Consultancy Services for Remediation of Contaminated Area: *Ranipet, Vellore, Tamil Nadu, India*

Central Pollution Control Board

Final Report - Step 6: Design of Remedial Plan and Submission of DPR along with technical documents and detailed specifications

January 2019

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FINAL REPORT

Central Pollution Control Board

**Preparation of DPR and
Providing Consultancy
Services for Remediation of
Contaminated Area: *Ranipet,
Vellore, Tamil Nadu, India***

**Step 6: Design of Remedial Plan and
Submission of DPR along with technical
documents and detailed specifications**

09 January 2019

Reference # I9729/0244871

Project Coordinator	Vipul Mehra <i>Principal Consultant</i>
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Remediation Expert:	Ravi Costa <i>Partner</i>
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INTRODUCTION

ERM India Private Limited (ERM) was commissioned by the Central Pollution Control Board and Tamil Nadu Pollution Control Board (hereinafter referred to as 'CPCB' and 'TNPCB' respectively, or the 'Client') for *Preparation of Detailed Project Report and Providing Consultancy Services for Remediation of Contaminated Site* (hereinafter referred to as the 'Project') in and around M/S Tamil Nadu Chromates and Chemicals Limited (TCCL), situated in SIPCOT industrial complex, Ranipet, Vellore, Tamil Nadu (hereinafter referred to as 'Site' or 'Subject Site' or 'facility').

The entire Project is divided in two parts; Phase I and Phase II, as detailed below:

- Phase I: developing a detailed project report (DPR) in the first phase (Phase I) based on assessment studies and a technical bidding document with specifications for the approved remediation option. The Phase I of the project comprises of the following steps:
 - Step-1: Reconnaissance & Preliminary Assessment;
 - Step-2: Preliminary Investigation & Development of Conceptual Site Model and Sampling Protocol;
 - Step 3: Detailed Site Investigation & Characterization;
 - Step 4: Risk Assessment;
 - Step 5: Identification of Remediation Goals/Objectives and Preparation of Remedial Plan; and
 - Step 6: Design of Remedial Plan and Submission of DPR along with technical documents and detailed specifications.
- Phase II: providing consultancy services for assessment and monitoring of the remediation works as per the technical specifications and standards set for remediation in the second phase (Phase II).

This Report presents the Detailed Project Report (DPR) as a part of the Step 6 of Phase I of the Project.

1.1

PROJECT BACKGROUND

The CPCB, a statutory body under Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India is the implementing agency for the project which comprises remediation of 12 priority hazardous waste contaminated areas spread across the country. This remediation work is taken up under National Clean Energy Fund (NCEF) project initiated by MoEF&CC, with support from the respective state pollution control boards. The hazardous sites which pose risks to human health and the environment were selected to be remediated as part of this initiative.

ERM conducted Step 1 (Reconnaissance and Preliminary Assessment) and Step 2 (Preliminary Investigation of the Contaminated Site and Development

of Site Conceptual Plans and Sampling Protocols) for the Project between November and December 2014. The findings of Step 1, Step 2 and further investigation plan were documented in the ERM Report '*Final Preliminary Assessment & Investigation Report, Ranipet, Vellore, Tamil Nadu India*' submitted in March 2015.

The Step 3 (Detailed Site Characterisation) was conducted between May and June 2015. The findings of Step 3 were documented in the ERM Report '*Final Report - Step 3: Detailed Site Investigation & Characterization, Ranipet, Vellore, Tamil Nadu, India*', submitted in September 2016.

Based on the findings from Step 3 activities, Tier 2 Risk Assessment (Step 4) was carried out for quantification of potential risks to human health. The findings of this assessment were documented in the ERM Report '*Human Health Risk Assessment (HHRS) Report: Ranipet, Vellore, Tamil Nadu, India - Final Report, Step 4,*' submitted in September 2016.

Following the investigation phases Step 1 to 4, the Remedial Action Plan (Step 5) was developed to present the Remedial Goals/Objectives, Approach and Methodology adopted for screening and selection of the most suited approach for remediation of the Site. This RAP was presented to CPCB and the Technical Evaluation Committee (TEC) in two separate meetings, one in Ranipet, Tamil Nadu on 3 March 2017 and a second meeting on 16 March 2017 at Rania, Kanpur Dehat, UP.

Based on the recommendations of the CPCB and TEC, as provided in the Minutes of the Meeting (MoM, *Annex C*)⁽¹⁾, ERM has prepared this Detailed Project Report (DPR) for Remediation of Contaminated Site in Ranipet, Tamil Nadu. The DPR presents the approach and methodology for the implementation of the selected remedial options and magnitude of order estimates of associated costs, in accordance with the recommendations of CPCB and TEC.

ERM would like to thank CPCB, Tamil Nadu State Pollution Control Board (TNPCB) and the members of the TEC for their kind support and guidance provided during the course of the technical discussions and field visit to the subject Site.

1.2 OBJECTIVES OF THE DETAILED PROJECT REPORT

The objectives of the DPR are as follows:

- Present the environmental status for *Ranipet* Site based on the previous investigations conducted at the Site;
- Based on the nature and extent of contamination identified at the Site, perform a Remedial Alternatives Analysis;

(1) Minutes of Twelfth and Thirteen Meeting of TEC held on 19 December 2017 and 02 July 2018.

- Evaluate and shortlist the most suitable and feasible remedial alternatives; and
- For the shortlisted remedial approach, prepare the overall remedial design along with implementation plan and order of magnitude cost estimates for the selected technology.

The scope of the DPR includes the following:

- Define the remediation objectives and goals;
- Preliminary screening of remedial technologies potentially applicable at the sites for soil and groundwater remediation;
- Identify and evaluate the potential remedial alternatives to meet the remediation goals;
- Evaluation of the most suitable and feasible approach;
- Developing an implementation plan for the most appropriate selected remediation approach;
- Provide broad level cost estimates for the remedial approach;
- Provide outline of the areas requiring remediation;
- Define the primary functional elements of the remediation process;
- Provide basis for the design of plant and equipment including the input and output parameters;
- Provide indicative layout of the treatment plant including equipment and ancillary units;
- Indicative design and specification of the equipment and ancillary units;
- Specify the performance requirements for meeting the remedial goals;
- Specify the site restoration requirements (if any) post remediation;
- Present the monitoring and verification protocols during and after completion of remedial work;
- Present the roles and responsibilities of the various project stakeholders including remediation contractors; and
- Provide indicative timelines for implementation of the remedial and restoration works and duration of monitoring post remediation.

1.3 *LIMITATIONS OF THE STUDY*

1.3.1 *General Limitations*

The report is based upon the application of scientific principles and professional judgment to certain facts with resultant subjective interpretations. Professional judgments expressed herein are based on the facts currently available within the limits of the existing data, scope of work, budget and schedule. To the extent that more definitive conclusions are desired by client than are warranted by the currently available facts, it is specifically ERM's intent that the conclusions and recommendations stated herein will be intended as guidance and not necessarily a firm course of action except where explicitly stated as such. We make no warranties, expressed or implied, including, without limitation, warranties as to merchantability or fitness for a

particular purpose. In addition, the information provided to client in this report is not to be construed as legal advice.

1.3.2 *Limiting Conditions at Ranipet Site*

During Step 2 investigation, (25 x 25) meters grid was considered and trial pitting was carried out across the TCCL Site. During the trial pitting activities, the following limitations were encountered:

- Trial pitting was carried out up to a maximum depth of 3 m bgl;
- Trial pitting was terminated in the event that groundwater was encountered. Considering these limitations, the estimate was calculated using a constant depth across the waste dump Site.

The following limitations were identified during the calibration processes of the site scale model;

- Considered uniform recharge on the Site scale model as the recharge data for surrounding areas was not available; and
- Off-Site groundwater withdrawal data is not available; this might impact groundwater levels and model calibration accuracy.

Although exposure from consumption of fish was also identified for these receptors, the collection of fish tissue data was out of scope for this assessment. Based on the laboratory analytical data, Total and Hexavalent Chromium were the only widespread CoC's identified in the Subject area in the sampled matrices (i.e., soil, groundwater, surface water and sediment). Hexavalent Chromium is significantly bio-accumulative in nature. The use of conservative assumptions for input of maximum site-specific concentrations into the model, and consideration of direct incidental ingestion as well as dermal contact to both soil and groundwater, by all identified receptors; are expected to provide conservative SSTLs protective of these exposures.

1.4 *STRUCTURE OF THE REPORT*

- Section 1* General Introduction to the DPR (Step 6);
- Section 2* Summary fo Findings from Steps 1 to Step 4 of the Project.
- Section 3* Remedial Objective and Goals for the Site; and the areas identified for remediation and institutional management for the different matrices are defined;
- Section 4* Approach and Methodology adopted for screening followed by shortlisting of the most suited technological approach for remediation for the different matrices to be remediated at the Site;
- Section 5* Remedial approach and remedial design for the different matrices, and respective implementation strategies and cost estimates of the remedial works.

Annexures

<i>Annex A</i>	Exceedance Maps
<i>Annex B</i>	Exceedance Tables
<i>Annex C</i>	Minutes of Ninth and Tenth Meeting of TEC
<i>Annex D</i>	Figures
<i>Annex E</i>	Receptor Survey Results

SUMMARY OF KEY FINDINGS FROM STEP 1 TO 4**2.1 REVIEW OF INFORMATION FROM SITE SETTING**

The Site, (TCCL) is located within the SIPCOT industrial complex located along the National Highway (NH) 4, in SIPCOT industrial complex, Ranipet, Vellore, Tamil Nadu. Another undeveloped land parcel identified by CPCB, located immediately to the northeast of the TCCL Site was identified as "TCCL Suspected Waste Dump Area (TCCL - SWDA)".

The total area for TCCL Site is approximately 18.27 acres (73,916 m²), and that of TCCL SWDA is approximately 12.63 acres (51,108 m²). Based on the initial information provided to ERM by CPCB, the TCCL Site was operational from 1975 to 1995. The manufacturing operations stopped in 1995 and the Site has been abandoned since then. Reportedly, the Site generated and disposed huge quantities of Hexavalent Chromium bearing waste on the open land within its premises during its twenty years of operation.

Following is the summary of the key findings from the investigation on the Site setting:

TCCL Site:

- Haphazard disposal of approximately 2.27 lakh tonnes of waste over 20 year period has resulted in piling of waste up to 3 to 5 meter height over 20,000 to 40,000 m² area (2-4 hectare area).
- Primary contaminant: Hexavalent Chromium;
- Time period of active waste disposal: 20 years (1975 to 1995);
- Samples from the dump revealed the presence of hexavalent chromium in the range of 5,753 milligram per kilogram (mg/kg) to 25,510 mg/kg; and
- The groundwater samples collected downstream of the Site indicated up to 214 milligram per litre (mg/L) concentration of hexavalent chromium.

TCCL Suspected Waste Dump Area:

Not detailed information was available for this area prior to commencement of field activities.

ERM also reviewed the following reports as part review of previous investigations:

- Demonstration Project for the Bioremediation of Chromium Contaminated Soil and Aquifer in Ranipet Area: IIT Madras: March 2011.
- Assessment and Remediation of Hazardous Waste Contaminated Areas in and around M/s Tamil Nadu Chromates and Chemicals Limited, Ranipet: National Environmental Engineering Research Institute (NEERI) March 2010; and
- Geoenvironmental Investigations for Developing Comprehensive Remediation Plan in and around Tamil Nadu Chromate and Chemicals

Limited (TCCL) Ranipet, Vellore District, Tamil Nadu: National Geographical Research Institute (NGRI) October 2008..

The findings from the report pertaining to Site operations and waste disposal are mentioned below.

TCCL Site

Based on the above report the Site (TCCL) was operational from 1976 and 2001. During this period, the Site manufactured:

- Sodium Dichromate: 150 MT/ month;
- Basic Chromium Sulphate: 300 MT/ month; and
- Sodium Sulphate: 200 MT/ month (as a by-product).

Raw materials included:

- Chromites ore;
- Limestone; and
- Soda ash

2.1.1

The Principal Manufacturing Process Involved:

- Grinding of Chromites ore, limestone and leached residue recycled from process. The ground raw material and soda ash were mixed and fed to a rotary kiln to react at 1,200°C to form sodium chromate;
- The roasted sodium chromate was cooled and leached in a series of leaching batteries;
- The sodium chromate liquor from leaching batteries was further acidified using sulphuric acid to get sodium dichromate liquor;
- After acidification, sodium sulphate present in the liquor was removed by centrifuging and was collected as a by-product;
- The sodium dichromate liquor was evaporated, clarified and crystallized to get sodium chromate crystals;
- Spent liquor obtained after crystallization was treated with sulphuric acid and molasses to get basic chromium sulphate liquor, which was spray dried to get basic chromium sulphate powder.

2.1.2

Waste Generation:

- Chromite ore contains impurities such as silica, vanadium and alumina;
- Limestone was therefore added so that calcium complexes of these impurities were formed;
- In addition, calcium chromate was also formed and got encapsulated in the complexes;
- The residue/ waste generation process was called Chromate Ore Processing Residue (COPR);
- Concentration of calcium chromate, in the form of hexavalent chromium, in COPR was reported to be at least 3%;

- The quantum of waste generation of COPR was reported to be 50 MT per day.

2.2 *SUMMARY OF SITE INVESTIGATION & HUMAN HEALTH RISK ASSESSMENT*

2.2.1 *Findings from the Investigations*

The objective of the Site investigation (Step 2 and Step 3) was to delineate the contamination in soil, groundwater, sediment, surface water and waste at the TCCL site as well as the micro-watershed, within which the TCCL site is located. Based on the investigations, some of the key findings are as below.

- In total, 63 soil boreholes, 30 monitoring wells and 12 sediment boreholes were drilled and sampled, and 5 existing open wells, 2 hand pumps, eleven (11) bore water and 14 surface water samples were collected and sampled, as presented in Table 2.1 below;
- The contaminants of potential concern; i.e. Total Chromium and Hexavalent Chromium, have been identified in soils, groundwater and surface waters. The data indicates that the Total and Hexavalent Chromium contamination is mainly limited to the onsite waste dump area. The Hexavalent Chromium groundwater contamination plume is migrating south of site; whereas surface water impacts are seen in the site's effluent drains leading offsite; and
- There is active contamination in open drains due to contaminated runoff waters/wastewaters from the TCCL site.

Table 2.1 Sampling locations for soil, groundwater, surface water and sediment

Area	No of Soil locations			No of Groundwater locations			No of Surface Water locations			No of Sediment locations		
	Field Readings (XRF)	Laboratory Samples SGS (Site specific suite)	Laboratory Samples Jones (brownfield suite)	Field Readings (multi-parameter & colorimeter)	Laboratory Samples SGS (Site specific suite)	Laboratory Samples Jones (brownfield suite)	Field Readings (multi-parameter & colorimeter)	Laboratory Samples SGS (Site specific suite)	Laboratory Samples Jones (brownfield suite)	Field Readings (multi-parameter & colorimeter)	Laboratory Samples SGS (Site specific suite)	Laboratory Samples Jones (brownfield suite)
TCCL Site	99 locations, 205 samples	18 samples	5 samples	-	14 samples	3 sample	-	-	-	-	-	-
Suspected waste dump Site	53 locations, 88 samples	10 samples	4 samples	-	2 samples	1 sample	-	-	-	-	-	-
Off-Site	65 locations, 92 samples	35 samples	9 samples	56 locations	35 samples	12 samples	14 samples	14 samples	5 samples	12 samples	12 samples	4 samples

2.2.2

Subject Site Use and Risk Assessment

The objective of the Human Health Risk Assessment (HHRA) was to assess whether observed soil, groundwater, surface water and sediment impacts (if any) resulting from the discharge of effluents have the potential to represent a risk to human health under the current and possible future land-use.

A Tier-I Screening Assessment was undertaken of all laboratory analytical data from the Preliminary and Detailed Site Investigations carried out by ERM. Based on the laboratory analytical data Total and Hexavalent Chromium were the only widespread CoCs identified in the Study Area in all sampled matrices (soil, groundwater, surface water and sediment). Cobalt, Nickel and Vanadium were reported in exceedance of Tier 1 screening criteria in soil and Lead, Manganese and Zinc were reported in groundwater.

In accordance with best practice, a child was assumed to be the most sensitive receptor in residential areas, whereas an adult was the most sensitive receptor as commercial employees and intrusive maintenance workers.

Depending on the nature of the chemical of concern, impacted medium and receptor, exposure pathways included:

- Inhalation of vapours generated from contaminated media;
- Dermal contact with impacted media;
- Incidental ingestion of impacted media;
- Inhalation of dust particles; and
- Ingestion through consumption of vegetables grown in impacted areas.

The complete Source-Pathway-Receptor (SPR) Linkages are detailed in *Table 2.1* below for.

Table 2.1 *Summary of Source-Pathway-Receptor Linkages*

Source	Pathway	Receptors			Justification
		Off-Site	Off-Site	On-Site & Off-Site	
		Residents	Fishermen & Herdsmen	Intrusive Maintenance Workers	
Soil (Waste Dumps)	Inhalation of dust/vapours	✓	✓	✓	Not Applicable (NA)
	Incidental ingestion/dermal contact	✓	✓	✓	NA
Secondary source of contamination from Soil (Waste Dump)	Consumption of dairy produce (cattle grazing on waste dump)	✓	✓	✓	NA

Source	Pathway	Receptors			Justification
		Off-Site	Off-Site	On-Site & Off-Site	
		Residents	Fishermen & Herdsmen	Intrusive Maintenance Workers	
Groundwater	Ingestion (Consumption of drinking water)	✓	✓	✓	Maintenance workers are day labourers who do not reside within the study area, hence unlikely to consume groundwater within the study area
	Incidental Ingestion / Dermal contact	✓	✓	✓	NA
Surface water	Incidental ingestion/dermal contact	✓	✓	✓	NA
	Consumption of fish	✓	✓	✓	NA Note: Fish tissue not sampled/ analysed.
Sediments	Dermal contact	✓	✓	✓	NA
	Consumption of fish	✓	✓	✓	NA Note: Fish tissue not sampled/ analysed.

✓ = SPR linkage complete

X= SPR linkage incomplete

Considering the above detailed SPR linkages, the HHRA was undertaken and Site Specific Target Levels (SSTLs) were derived for each matrix. The SSTLs for soil based Hazard Index (HI) are summarized below;

Table 2.2 *Summary of Human Health SSTLs for Soil based on Hazard Index (HI), Non Cancer (all numbers are in mg/kg)*

Soil (mg/kg)	Off-Site Residents (Child)	Off-Site Fishermen and Herdsmen (Adult)	On-Site and Off-Site Intrusive Maintenance Worker (Adult)
Chromium III	110,000	182,000	182,000
Chromium VI	128	260	260
Cobalt	160	324	324
Nickel	560	1,390	1,390
Vanadium	690	1,460	1,460

Table 2.3 *Summary of Human Health SSTLs for Groundwater based on Hazard Index (HI), Non Cancer (all numbers are in mg/L)*

Groundwater (mg/L)	Off-Site Residents (Child)	Off-Site Agricultural Worker/Fisherman (Adult)	On-Site Intrusive Maintenance Worker (Adult)
Chromium III	8.9	46.3	127
Chromium VI	0.0086	0.0411	0.687
Lead	0.034	0.162	3.35

Groundwater (mg/L)	Off-Site Residents (Child)	Off-Site Agricultural Worker/Fisherman (Adult)	On-Site Intrusive Maintenance Worker (Adult)
Manganese	0.77	3.67	68.4
Zinc	0.48	2.30	44.9

Refer to *Annex A* for the exceedance maps with respect to SSTLs and *Annex B* for the exceedance tables with respect to SSTLs.

3 REMEDIAL OBJECTIVES, GOALS & INTERVENTION

3.1 REMEDIAL OBJECTIVES & GOALS

The Site specific remediation objectives and goals were developed based on the findings from the investigations and risk assessment conducted for the Sites. The overall objectives of the remediation are to mitigate the risk to human health and to continue the beneficial uses of land. These objectives are listed below:

- To be protective of Human Health & Environment;
- To prevent exposure risk (dermal, ingestion and vapour inhalation) to off-Site (adults and children) living in villages and near subject site.
- To prevent exposure risk such as inhalation of dust/vapor and incidental ingestion and dermal contact from impacted soil/ surface water/sediments for the primary receptors that includes industrial workers, intrusive maintenance workers and agricultural workers in the study area.

A nominated criterion has been decided on the advice of the TEC and this has been used for determining the contaminated areas requiring remediation for the site. The nominated criteria is presented in the following section.

To meet the project objectives and goals, a combination of active remediation and regulatory interventions are required to eliminate or limit the risk of exposure to for the receptors identified at the subject Site. The approach adopted for screening and selection of the remedial technology options is discussed in *Section 4* of this report.

This chapter presents the approach adopted for determining the remedial areas and regulatory intervention areas.

3.2 NATURE & EXTENT OF CONTAMINATION & INTERVENTION AREAS

Based on the Human Health Risk Assessment (HHRA) Site Specific Target Levels (SSTLs) were derived for Hexavalent and Total chromium in the various matrixes. Based on the discussions with the TEC, depending on the nature of contaminated source, its proximity to the source and potential exposure to human and environmental receptors, the nominated criteria was defined. The nominated criteria are either the SSTLs derived for the site or the most suited available reference standards. The matrix specific nominated criteria are as given in *Table 3.1* below:

Table 3.1 Nominated Criteria for Defining Remedial Goals

	Nominated Criteria for Determining Remedial Areas	Nominated Criteria for Defining the Remedial/Clean-up Goals	Remarks
Soil	Hexavalent Chromium concentrations in exceedance of 128 mg/kg	The residual concentration in soil for Hexavalent Chromium to be lower than 128 mg/kg	SSTL for soil exposure to child in a Residential setting.
Surface water	Hexavalent Chromium in exceedance of 0.0086 mg/L	The concentration in treated Surface for Hexavalent Chromium to be lower than 0.0086 mg/L	SSTL for surface water exposure to a child in a Residential setting
Groundwater	Hexavalent Chromium in exceedance of 0.0086 mg/L	The concentration in treated groundwater for Hexavalent Chromium to be lower than 0.0086 mg/L	SSTL for groundwater exposure to a child in a Residential setting

Based on a comparison of the analytical data collected from the various investigations with the Nominated Remediation Criteria, the following areas were identified for remediation.

- Hexavalent Chromium contaminated Waste:
 - On-site: Waste dump areas and abandoned building;
- Hexavalent Chromium contaminated Soil:
 - On-site native soil that is underlying the Chromium waste dump onsite and also within the built up area.
- Hexavalent Chromium contaminated Groundwater:
 - On-site: All onsite monitoring wells showed exceedances.
 - Off-site: Localized groundwater impacts observed downstream of site.
- Hexavalent Chromium contaminated Surface water:
 - On-site: In the drains and channels, as well as ponded water.
 - Off-site: the storm water drain flowing along the east boundary of the site upto the culvert near the approach road, and localised impacts in surface water channels leading into Pulliankannu and Karai lake.

3.2.1 Chromium Contaminated Waste:

The focus of the study is to address any potential contamination in the study area on account of hexavalent chromium waste dump located in the northern portion of the site. The remedial plan is focused on addressing the contaminated soil, waste, sediments, surface and groundwater at the site. However, the other waste / scrap materials need to be handled and disposed separately as per regulatory requirements.

During the course of the investigations, more than seventy (99) trial boreholes/pits were drilled at the site at various locations. It was found that

the thickness of the waste varied across different section of the site, from north to south. Additionally, part of the waste was piled in heaps above the natural surface level and in the old production buildings. Based on the subsurface investigation and a topographic survey of the waste heaps, quantity of the waste was established. The estimated quantity of waste exceeding the nominated criteria and requiring remedial intervention are presented in *Table 3.2* below:

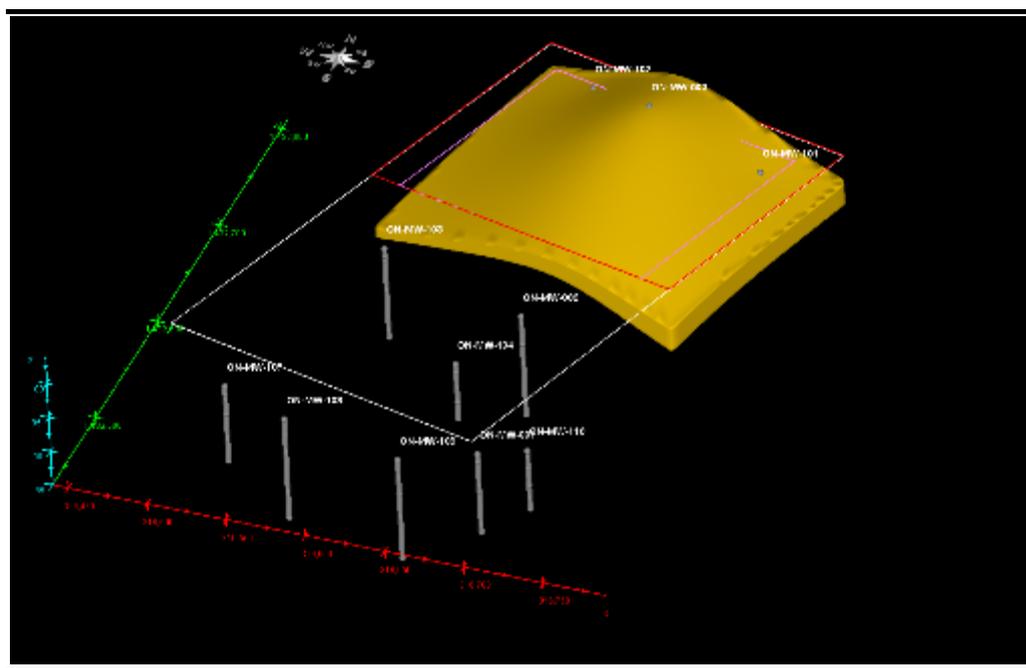
Table 3.2 *Soil and Waste Quantities Exceeding Nominated Criteria for Chromium*

Location	Estimated Volume (m ³)	Estimated Weight (MT)*
Waste dumped along the Northern portion of the site	~151,760	~203,358
Soil below the Waste in the Northern portion of the site.	~37,350	~69,098
Soil exceeding SSTL located south of the waste dump	~40,500	~74,925
Total Quantity	~229,610	~347,381

*Assumed density of 1.34 Kg/m³ of waste and 1.85 Kg/m³ for soil

The estimated waste dump area for hexavalent chromium Waste Remediation is presented in *Figure 3.1* below.

Figure 3.1 *Chromium Waste Dump Area*



3.2.2 *Soil Remediation:*

The subsoil under the waste comprises of sandy silt underlain by weathered rock. The overall soil thickness at the site is thin and covered with waste majorly in the northern section of the site. Based on the analytical data from the investigation, it is found the soil under the waste heaps is impacted with hexavalent chromium and needs to be remediated. For evaluating the volume

of contaminated soil, the analytical data from laboratory, geological cross-sections based on the soil boreholes logs from the seventy (99) trial pits has been used for determining the volume estimates for contaminated soil.

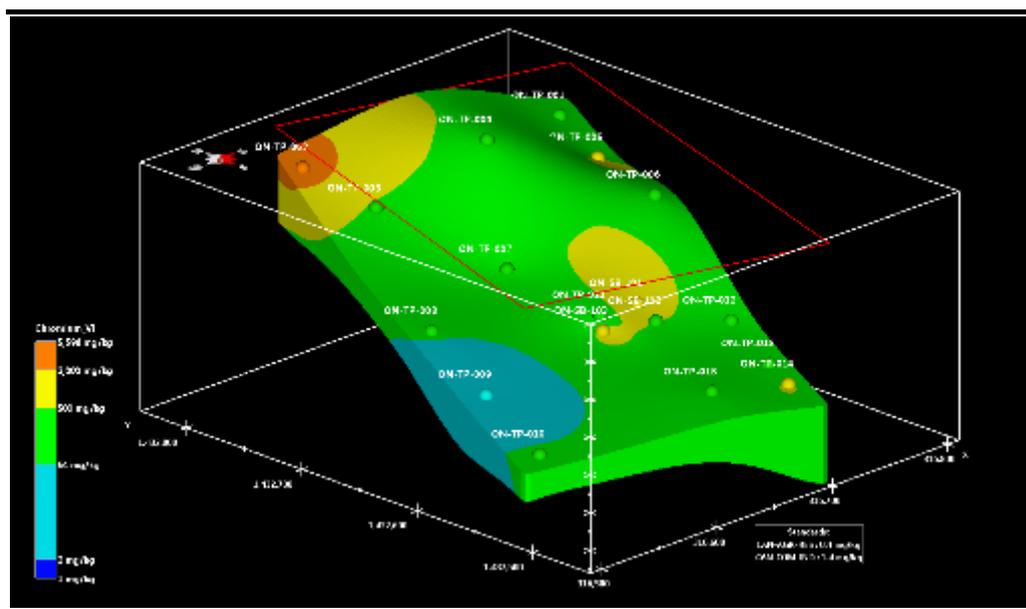
Based on the samples collected along the periphery of the old abandoned buildings, it is anticipated that the soil under the footprint of the buildings is anticipated to be impacted. However, since laboratory analytical data for soil under the plant footprint is not available, the soil under the footprint of the old production building has not been considered for the volume estimating the remediation purposes. Based on the comparison of the findings analytical results from the investigation phases of the project, the quantity of soil exceeding the nominated criteria and requiring remedial intervention is presented in *Table 3.3* below

Table 3.3 *Soil Remediation Quantity*

Location	Estimated Volume (m3)	Estimated Weights (MT)
On-Site Waste Dump	~151,760	~203,358
On-Site Soil	~37,350	~69,098
Soil exceeding SSTL south of waste dump	~40,500	~74,925

The footprint of the main production building is anticipated to be ~4,896m² the anticipated depth of impact under the old plant building is approximately 2m. The estimated maximum volume of soil under the footprint of the old plant building can be expected to be approximately 9,792m³. This is based on theoretical estimates anticipated for under the footprint of the old production building and has been considered in the estimated volume for soil exceeding SSTL south of waste dump above.

Figure 3.2 *Soil Remediation Area*



3.2.3

Groundwater Remediation:

The groundwater at the site under the historical waste dumping areas, production areas of the site is reportedly contaminated with hexavalent chromium and need to be remediated. Hexavalent Chromium concentration increases towards south-southwest of the Site, in the direction of groundwater flow. The elevation difference between the northern and southern portion of the Site is approximately 11m and run off collects in the southern portion of the Site leaching into the ground resulting in potential elevated levels of chromium concentration.

The groundwater in the off-site area immediately downstream of site is reported to have concentrations in exceedance of hexavalent chromium and needs to be remediated.

At all other locations, the concentrations were reported to be below the nominated criteria and hence, no remedial intervention is anticipated in these areas.

Figure 3.3 *Groundwater Remediation Areas: Onsite*

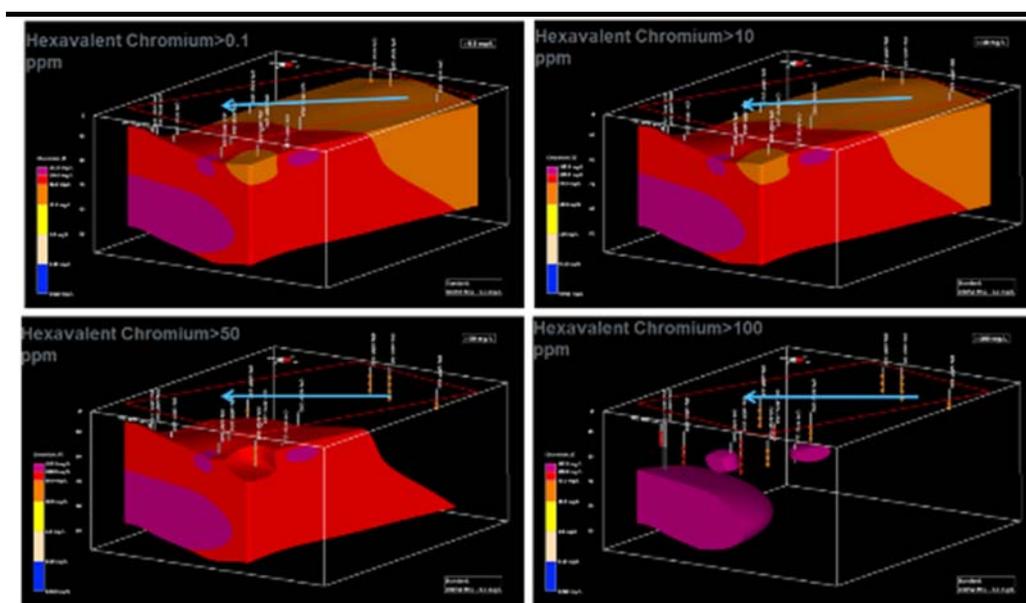
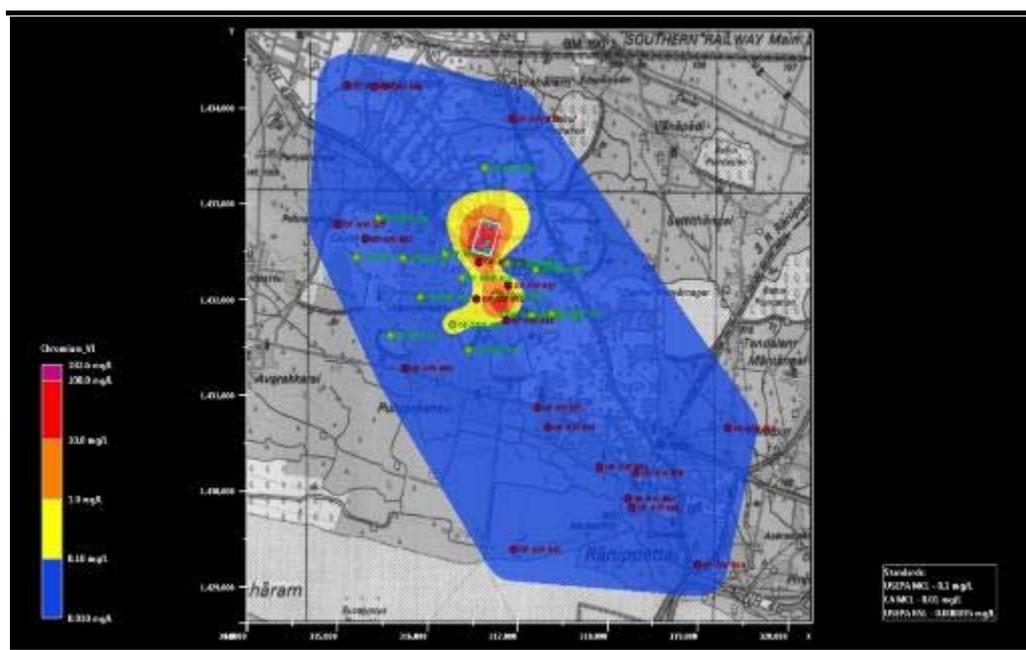


Figure 3.4 Groundwater Remediation Areas: Offsite



3.3 Regulatory Intervention Measure

The objective of the remediation is to remove the contamination sources at the site and prevent any exposure of hexavalent chromium to the receptors in the area. Additionally, to prevent any future contamination and/or migration of contaminants, TEC has advised the concerned stakeholders to undertake certain specific actions. These actions need to be implemented through regulatory action on the directions of the local regulatory agency.

- Sealing of existing offsite dugwells and borewells;
- Prevent access to any surface water body in the surrounding area that might have reported chromium VI impacts; and
- Provision of alternate water supply to offsite areas that may be using groundwater from identified/ impacted wells.

Please refer to *Annex E* for a list of major groundwater and surface water abstraction locations within 5km radius of the Site.

APPROACH AND METHODOLOGY FOR SCREENING OF REMEDIATION TECHNOLOGIES

As part of the Remedial Alternatives Analysis, a two tiered approach was adopted for the shortlisting of the remedial technological approach. This chapter presents a discussion on the various technologies considered for the remediation of hexavalent chromium in soil, water and waste.

The first tier of evaluation was conducted for all the available proven technology options based on international practices and principles applied for remediation of the contaminant of concern. These potential alternatives were evaluated at first level of screening based on the following parameters:

- Technical feasibility,
- Complexity,
- Applicability & Effectiveness,
- Health & Safety,
- Economic Feasibility (Cost), and
- Duration of Remediation

After the initial screening most suited technology options were evaluated for a second set of parameters and three most applicable technology options were shortlisted before selection of final option for remediation. The second level of screening was based on the following parameters:

- Health & Environmental risk of the option;
- Performance of the technology to meet remedial goals; and
- Techno-Economic feasibility.

The details regarding the technological options and the approach adopted for selection is presented in the following sections.

4.1

INITIAL EVALUATION

In order to screen the various technological options for soil and groundwater remediation and to determine the most suitable/viable option a technology screening matrix was prepared. The list of technology options considered for the initial evaluation was based on the following considerations:

- *Contaminant of Concern:* The technologies which have been reported or are adopted locally or internationally for remediation of hexavalent Chromium;
- *Type of Application of the Technology:* Based on the mode of implementation vis-à-vis in its natural state (In-Situ) or by removing/extracting it from its natural state (Ex-Situ);

- *Type of Treatment Process*: Based on the type of principles and processes being applied for treatment vis-à-vis Physical, Chemical, Biological or a combination of one or more processes.
- *Type of Matrix*: Based on its application for Soil, Waste and Water. For the purpose of evaluation Soil & Sediment remedial options were evaluated together similarly groundwater and surface water remedial options were evaluated together. Therefore, the technology applied would similar but the mode of implementation would vary depending on the nature of the matrix.

The initial evaluation was done based on six initial parameters considering the above aspects with regards to which are described in *Table 4.1* below.

Table 4.1 *Parameters for Initial Evaluation (Screening 1)*

Parameter	Description
Technical Feasibility	The technologies considered are technically feasible options and not limited to theoretical applicability with respect to the matrix, chemical of concern and availability of technology for implementation; volume of material to be handled.
Complexity	The level of complexity associated with implementation and operation considering the local conditions, availability of resources and skilled personnel.
Applicability & Effectiveness	The applicability and effectiveness of the technology in the local (site specific) conditions considering the location, geology, hydrogeology, climatic conditions, chemical concentrations, nature of matrix, resource availability (water, electricity, chemicals etc.) and other such local factors
Health & Safety	If the technology is associated with high level of H&S hazards, chemical handling & exposure, highly skilled resources
Economic Feasibility (Cost)	If the technology is available locally or needs to be imported; If the its economically feasible considering the volume of contaminated material to be treated; ,
Duration of Remediation	Considering the volume of material to be handled and the need for immediate intervention for the site, the technologies were evaluated based on their ability to achieving the remedial goals either in short, medium and longer duration of implementation and operation.

The list of technologies considered for the first level of screening are as follows:

- **Soil & Waste:**
 - Excavation & Off-site Disposal
 - Excavation and Ex-Situ Treatment with Backfilling
 - Excavation & Ex-situ treatment and Landfilling
 - In-Situ Chemical Treatment
 - Biological Treatment
 - Engineered Capping
- **Groundwater & Surface Water**
 - Monitored Natural Attenuation
 - Chemical Treatment
 - Biological Treatment

- Pump & Treatment with Hydraulic Containment
- Containment by Impermeable Reactive Barriers

These technology options were screened against the parameters given in *Table 4.2* and were evaluated qualitatively based on their suitability to each parameter as either *Highly suitable* (green), *Moderately suitable* (Yellow) and *Less suitable* (Orange). Following this, the option which are most suited are shortlisted for second level of screening. A comparative summary of the screening is presented in *Table 4.2* below.

Table 4.2 Available Technology Options for Hexavalent Chromium Remediation

Technology	Matrix	Technical Feasibility	Complexity	Applicability & Effectiveness	Health & Safety	Duration of Remediation	Economic Feasibility
Excavation & Off-site Disposal	Soil and Waste	Highly Suitable	Highly Suitable	Highly Suitable	Highly Suitable	Highly Suitable	Moderately Suitable
Excavation and Ex-Situ Treatment with Backfilling	Soil and Waste	Highly Suitable	Moderately Suitable	Moderately Suitable	Less Suitable	Moderately Suitable	Moderately Suitable
Excavation & Ex-situ treatment and Landfilling	Soil and Waste	Highly Suitable	Moderately Suitable	Moderately Suitable	Less Suitable	Moderately Suitable	Moderately Suitable
In-Situ Chemical Treatment	Soil and Waste	Moderately Suitable	Moderately Suitable	Less Suitable	Less Suitable	Highly Suitable	Less Suitable
Biological Treatment	Soil and Waste	Less Suitable	Less Suitable	Less Suitable	Moderately Suitable	Less Suitable	Less Suitable
Engineered Capping	Soil and Waste	Highly Suitable	Highly Suitable	Moderately Suitable	Highly Suitable	Highly Suitable	Moderately Suitable
Monitored Natural Attenuation	Groundwater	Highly Suitable	Highly Suitable	Less Suitable	Highly Suitable	Less Suitable	Highly Suitable
Chemical Treatment	Groundwater	Moderately Suitable	Less Suitable	Moderately Suitable	Less Suitable	Highly Suitable	Moderately Suitable
Biological Treatment	Groundwater	Less Suitable	Less Suitable	Less Suitable	Moderately Suitable	Less Suitable	Less Suitable
Pump & Treatment with Hydraulic Containment	Groundwater	Highly Suitable	Moderately Suitable	Highly Suitable	Moderately Suitable	Moderately Suitable	Moderately Suitable
Containment by Impermeable Reactive Barriers	Groundwater	Less Suitable	Less Suitable	Moderately Suitable	Moderately Suitable	Moderately Suitable	Less Suitable

4.2 SECONDARY EVALUATION

Based on the initial level of screening, the following technology options were screened for a second level of screening for the following parameters presented in *Table 4.3* below.

Table 4.3 *Second Level of Screening*

Parameter for Screening	Description
Health & Environmental Risk	Based on the human health risk and environmental risk associated with the application of the technology, the option was assessed to determine the potential risks during and/or after the implementation the technology for achieving the remedial goals.
Performance of the Technology	The performance of the technology options was evaluated to understand the technological, practical limitations/boundaries of the option. The performance of the technology is highly contingent on it being able to meet the remedial goals/targets considering the volume of contaminated material, the removal efficiency based on geology/hydrogeology and other material properties of the contaminant and the matrix.
Techno-Economic Feasibility	Typically the most advanced technologies may be very expensive and not easily available hence, there is significant costs involved with technology transfer and/or implementation of highly resource intensive technique. Therefore the options were evaluated based on their ability to achieve the required remedial objectives while still being economical.

Based on the second level of screening, the following technologies were shortlisted.

- Soil, Sediment & Waste:
 - Excavation & Off-site Disposal
 - Excavation and Ex-Situ Treatment with Backfilling
 - Excavation & Ex-situ treatment and Landfilling
- Groundwater & Surface Water
 - Hydraulic Containment by Pump & Treatment

4.3 SELECTION OF REMEDIATION TECHNOLOGY

To further evaluate the feasibility of implementation and understand the overall challenges associated with the technology, a field visit was made by the TCE members including CPCB, TNPCB and ERM representatives. Based on the meeting on 02 July 2018, the recommendations made by the TEC are presented in *Table 4.4* below.

Table 4.4 *Recommendations by TCE*

Matrix	Suggested Approach
Soil and Waste	Interim: Capping of existing waste dump along the northern portion of the site and with provision for storm water management. As recommended by TEC in its 13th meeting, shall incorporate a proposal for interim measure of capping the contaminated sites with

Matrix	Suggested Approach
Groundwater	<p>2mm HDPE liner, Geo-synthetic membrane with soil cover all around the dumpsites with proper toe anchoring, peripheral drainage, surface drainage system along with installation and commissioning of Pump & Treat system for remediation of groundwater as well as surface run-off from the dumpsite.</p> <p>Full Scale: Entire waste should be excavated and treated on-site and backfilled into an on-site engineered secure landfill. The treatment of contaminated waste would involve reduction using Sodium Meta Bisulphate (SMBS). The on-site engineered secure landfill to have RCC pit, single liner system and capping on top with HDPE liner followed by geo-synthetic membrane covered with soil. RCC structure with 20m walls is recommended so as to minimize surface area required for landfill.</p> <p>Pump and treat the groundwater near the monitoring wells where groundwater contamination was found beyond the SSTL value of 0.086 mg/l. Consultant should suggest appropriate number of extraction wells for pump and treat.</p> <p>The chemical treatment may include reduction using SMBS. Chromium will be removed by precipitation and settling. Treated water can be discharged or to storm water drain after complying with a limit of 0.086 mg/l.</p>

REMEDIAL APPROACH AND DESIGN

Based on the findings of the initial technology screening and the recommendation TEC, the following approach has been selected for remediation of Soil, Waste, Surface water and Groundwater in Ranipet. The final minutes of meeting wherein the TEC made their final recommendation is provided as Annex C to this report.

5.1**REMEDIAL APPROACH FOR WASTE AND SOIL**

Based on the multi-criteria evaluation of the shortlisted techniques proposed for Waste and Soil remediation, excavation with on-site treatment and backfilling on and on-site engineered landfill has been found to be the most sustainable option. This approach is intended to reduce the concentration of chemical of concern down to an acceptable level and eliminates further migration of Hexavalent Chromium from waste and/or soil into groundwater or surface water as applicable. This does not remediate the contaminants in the groundwater or surface water and therefore groundwater and surface impacts need to be addressed simultaneously.

Table 5.1**Summary of Remedial Technology for the Site**

Matrix	Location	Selected Option
INTERIM		
Soil and Waste	Onsite	Capping of existing waste dump with provision for storm water collection
FULL SCALE		
Waste and Soil	Onsite	Excavation, Treatment, and Backfilling in on-site engineered landfill
Groundwater	Onsite and Offsite	Pump and Treat with Source Removal and Hydraulic Containment System

As directed by CPCB (Minutes of 13th TEC Meeting of TEC; 02 July 2018), an interim remedial plan for limiting the surface runoff and limiting leaching of hexavalent chromium into groundwater is also presented in sections below. The interim plan consists of capping the existing waste on-site by grading and engineering a cap to limit any contamination from leaching into groundwater during monsoons. Along with the cap, a storm water drainage network is also proposed prevent any surface water runoff from the site.

5.2**SITE PREPARATION**

Based on ERMs understanding of the remediation program, prior to conducting the actual remedial works, there are a few preliminary works and support activities that need to be conducted.

5.2.1 *Site Preparation*

Prior to initiating remedial works, the site needs to be prepared for undertaking the remedial activities, these activities comprise of the following

- Identification & Mapping of the various works areas: all the areas that require remediation activities need to be barricaded and marked for remediation;
- In case some of these areas are part of current operational activities, alternative areas, access points are to be created such that neither the operations nor the remedial activities are obstructing each other. Provisions for water, wastewater (generated during remediation) to be identified and appropriate provisions to be made; and
- Areas to be marked for installation of remediation systems such as groundwater abstraction wells, groundwater treatment system, laboratory, offices, area for temporary stockpiling of contaminated material, treatment area for soil and waste, etc. to be identified.
- Demolition, decommissioning and decontamination of existing process equipment, buildings, and other structures onsite.

5.2.2 *Health & Safety Planning*

During the course of the remedial works, a detailed health & safety plan needs to be prepared to prevent potential exposure to contaminated material including dust and vapours. A task specific Job Hazard Analysis (JHA) should be prepared prior to undertaking all hazardous activities and appropriate hazard mitigation measures should be implemented.

Typical Hazards & Risks Associated with Contractor Activities

During the course of excavation works, there are many risks/hazards associated with various activities being undertaken by the contractors. Most of these may be limited to the site; however, there are other potential risks in the off-site areas. Some of the common H&S hazards associated with such works are as given below.

- Traffic hazards within the core excavation and material transport areas;
- Equipment toppling/damage due to use of incorrect practices and/or lack of planning of work;
- Personnel injury/incident/accident while supervising work activity;
- Exposure to contaminated vapor and insufficient or improper use of PPE;
- Lack of planned access and material movement causing inappropriate excavation, material spills etc. resulting in unwanted excavation, cross contamination and further contamination of groundwater;
- Insufficient safety measures for barricading the excavation pit causing fall issues, caving of the excavation pit;

- Exposure to dust within and immediate outside the subject site due to excavation works impacting workers and nearby residents/occupants;
- Accidents, spillages of contaminated soil in the off-site areas resulting in traffic issues, regulatory issues and complaints by local people.

PPE Matrix

All the personnel working in these areas should use appropriate personal protection equipment (PPE). The minimum PPE requirements are as mentioned in *Table 5.2*.

Table 5.2 *PPE Requirement*

Activity	PPE Requirement
Evidently Waste and/ or Impacted Soil/ Waste/ Groundwater	i. Hard hat ii. Full Body Cover: Boiler Suite and/or Tyvek Suits iii. Vinyl gloves iv. Steel-toe chemical resistant boots v. Enclosed goggles vi. Respirator Protection: Dust mask
Uncontaminated Material	i. Cotton gloves ii. Steel-toe boots iii. Goggles iv. Dust mask v. Hard hat

Dust Control

Adequate precautionary measures for prevention of dust from excavation activities shall be undertaken at the Site. Some of these include (but are not restricted to) barricading of the area along with use of High Density Polyethylene (HDPE) sheets on the surface around the excavation zone and/or use of water sprinklers in order to prevent excessive dust in the work areas, as per requirement. This can be further mitigated using appropriate PPE.

5.3

INTERIM - SOIL AND WASTE REMEDIATION

As an interim remedial measure (as requested by CPCB and TNPCB), removal of contaminated waste as well as impacted soil from subject site would eliminate the scope of further leaching of contaminants into groundwater. This measure would gradually reduce concentrations in groundwater. This will also result in reclamation of about 58% of the contaminated land that can be utilized for industrial activities.

Upon on availability of adequate funds, the remediation technologies as envisaged in Detailed Project Report (DPR) can be implemented in conjunction with the interim measures.

The interim remedial measures will comprise of the following;

Table 5.3 *Interim Remedial Measures*

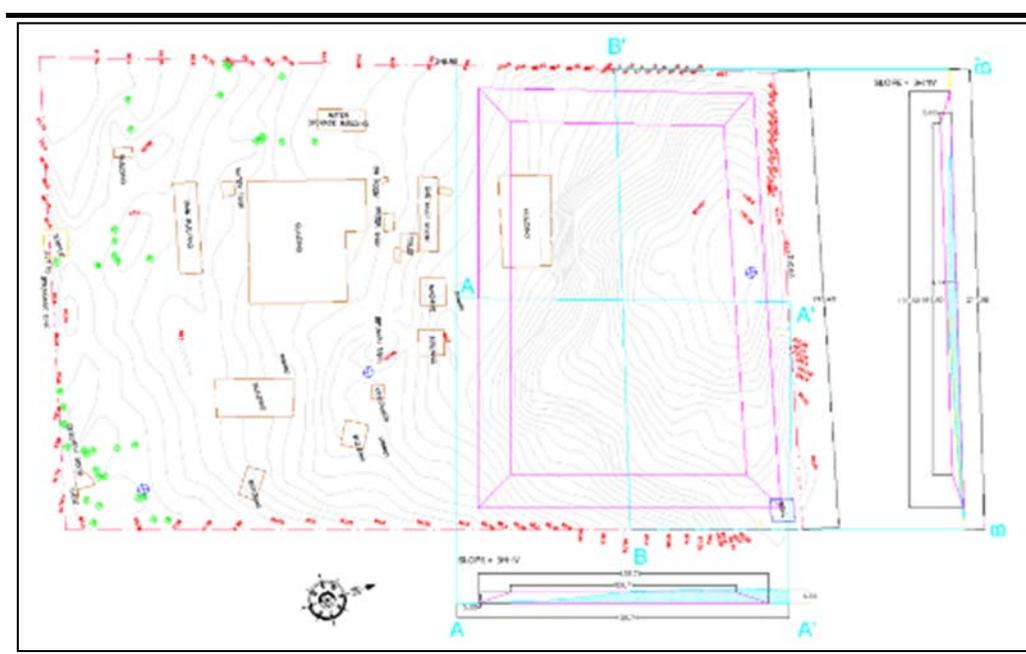
Matrix	Proposed Remedial Technique
Soil and Waste	Capping of existing waste dump with provision for storm water collection

5.3.1 *Capping of Waste*

The soil and waste will be capped in place with single layer liner system and capping consisting of 2mm HDPE liner followed by geo-synthetic membrane and covering with soil to facilitate vegetation. The activities anticipated to be implemented in the remedial approach for waste are given below.

The interim cap layout plan and elevations is provided below;

Figure 5.1 *Location of Interim Cap*



The schematic of the interim cap will be as per the guidelines provided under CPCB guidelines for cover systems. Estimated size of the proposed landfill cap is as follows;

- Length = 192 m (assuming 10m clearance from the boundary)
- Length inside = 161 m (assuming 15m clearance for 3H:1V)
- Width = 136 m (assuming 10m clearance from the boundary)
- With inside = 106 m (assuming 15m clearance for 3H:1V)
- Surface Area of Cap = 26,785 m² (with 10% buffer)

5.3.2 *Storm Water Drainage*

The storm water gutter is required to ensure that the rainwater run-off does not enter into the waste from the surrounding area and that the rainwater

from the cover area is properly drained into this drain. The drain slopes should be so maintained that under all circumstances the water from the surrounding and the cover area is drained out of the landfill area.

Additionally, storm water drainage has to be provided across the site to prevent the storm water from flowing offsite.

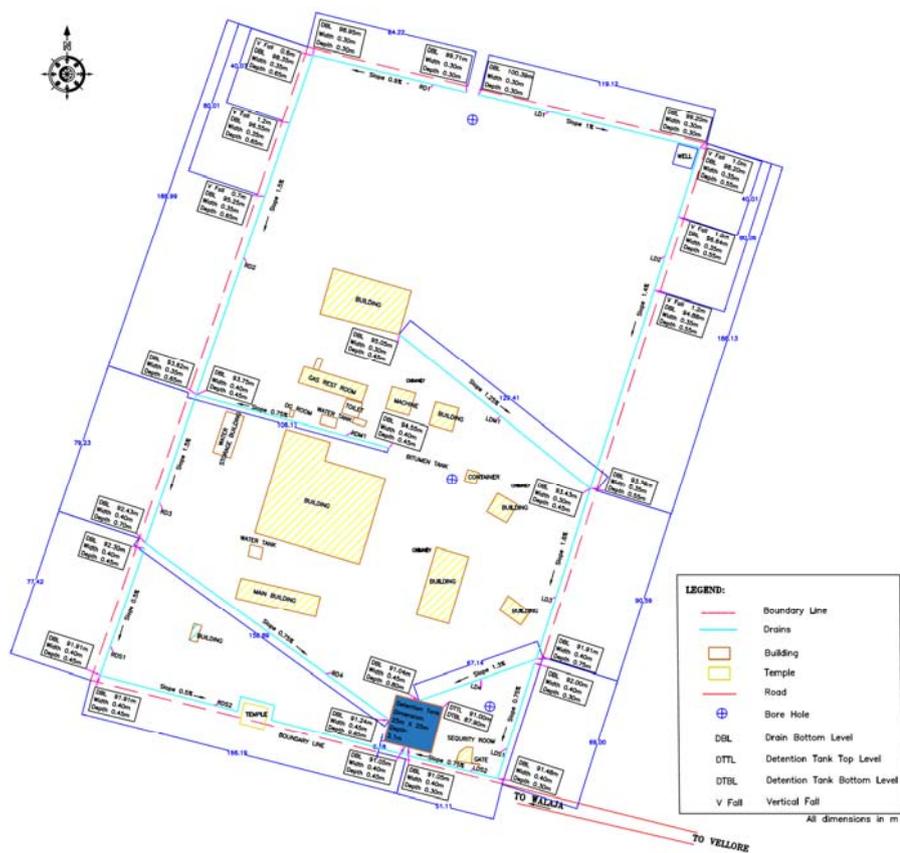
The design of the storm water drainage should consider estimated runoff, runoff coefficient, rainfall intensity, hydraulic design of the channels, and permissible velocities in the drain.

The following assumption were considered in preparing the layout and design of the storm water system.

- The 1 hours rainfall maps of India for various return periods as given in IRC:SP 42-1994 was used for determining rainfall intensity of the study area. The one hour rainfall maps of India for return period of 5, 25, 50 years are prepared in IRC guidelines. Based on the analysis of the data, rainfall intensity has been considered acceptable as 80 mm/hour for 25-year return period.
- In the design of the internal drainage system, concrete bed with brick masonry walls drains is proposed. These Manning's "n" are considered as 0.015 for calculations.
- The minimum self-cleansing velocity in the internal drains is kept as 0.5 m/sec and the maximum permissible velocity up to 6 m/sec may be allowed for constructed drains with RCC. The flow regime was kept as subcritical and appropriate vertical falls were planned at steeply sloping areas to keep the flow regime in subcritical flow.

The layout and specifications of drainage system are provide in the figure below.

Figure 5.2 Drainage System Layout



The final layout and sizing of the drainage network will be prepared by the subcontractor prior to start of activities.

5.3.3 *Schedule and Cost Estimate*

The schedule of implementation of the selected interim remedial technology is subject to limiting field conditions. Assuming that the tasks are implemented without undue hindrance of any kind, the anticipated schedule is presented in Table 5.7 below.

Table 5.4 *Interim Remedial Implementation Schedule - Waste*

Activities	Sub-Activities	Anticipated Duration (months)
Earth Moving and Grading	Preliminary Survey	
	Preliminary drainage plan	2
	Preparation of grading plan	
Backfilling and Compaction	Phase wise grading	1
	Preparation of toe drain plan	1
Installation of Cap including toe drain	Trenching for toe drain	
	Installation of Storm Water Drainage	2
Installation of Storm Water Drainage	Drainage layout plan	
	Trenching for storm drain	
	Installation of collection tank	

The cost for capping and providing a storm water drainage is estimated to be INR 12 Crores. The components of this cost are presented in *Table 5.5* below. The cost presented below is an estimate for conditions as on dates of Step 3 studies and does not consider inflation or other changes in conditions

Table 5.5 *Interim Remedial Implementation Schedule - Waste*

Element	Price (INR)/Unit	Estimated Cost (INR)
Earth Moving	Lump sum	1,65,32,490
Compaction	Lump sum	17,06,000
Toe Drain Labor	Per month	5,00,000
Material Handling	Lump sum	42,05,865
Survey	Lump sum	1,35,125
Storm Water Drainage	Lump Sum	2,00,00,000
Geo-Membrane	Per m2	3,07,72,390
HDPE Liner	Per m2	46,15,858
Concrete for toe drain	Per m3	77,84,235
Top Soil	Per m2	1,60,56,000
Health & Safety Measures	Lump sum	20,00,000
Anticipated Capital Cost	Lump sum	10,43,07,964
Cost for Project Management	10% of Capital Cost	1,04,30,796
Permitting, Engineering and other costs	5% of Capital Cost	52,15,398
Total		11,99,54,159

5.3.4 *Limitations:*

- The proposed remediation activity can be performed only in case free access is given to the premises of the contaminated site.
- Costs does not include cost of electricity, demolition and treatment of existing structures/equipment, infrastructure development, land acquisition/lease (if required), inflation, etc.
- Groundwater contamination will be remaining.

5.4 *FULL SCALE SOIL AND WASTE REMEDIATION*

Based on the evaluation of shortlisted techniques proposed for Soil and Waste, and the regulatory requirements, excavation, treatment and on-Site disposal in a secure landfill (SLF) was identified to be the most sustainable option. This approach removes the chemicals of concern (Source removal) and eliminates further migration to soil and groundwater. This does not remediate the CoC in groundwater. Therefore, the impacts in soil and groundwater need to be addressed simultaneously.

This section presents the approach adopted for the areas where soil and waste was observed to be stored. Waste was observed to be stored in the northern portion of the Site while soil was found in the southern portion of the Site.

5.4.1

Excavation

The management of soil and waste is proposed to be handled by excavation, treatment and on-Site disposal in an on-site constructed SLF.

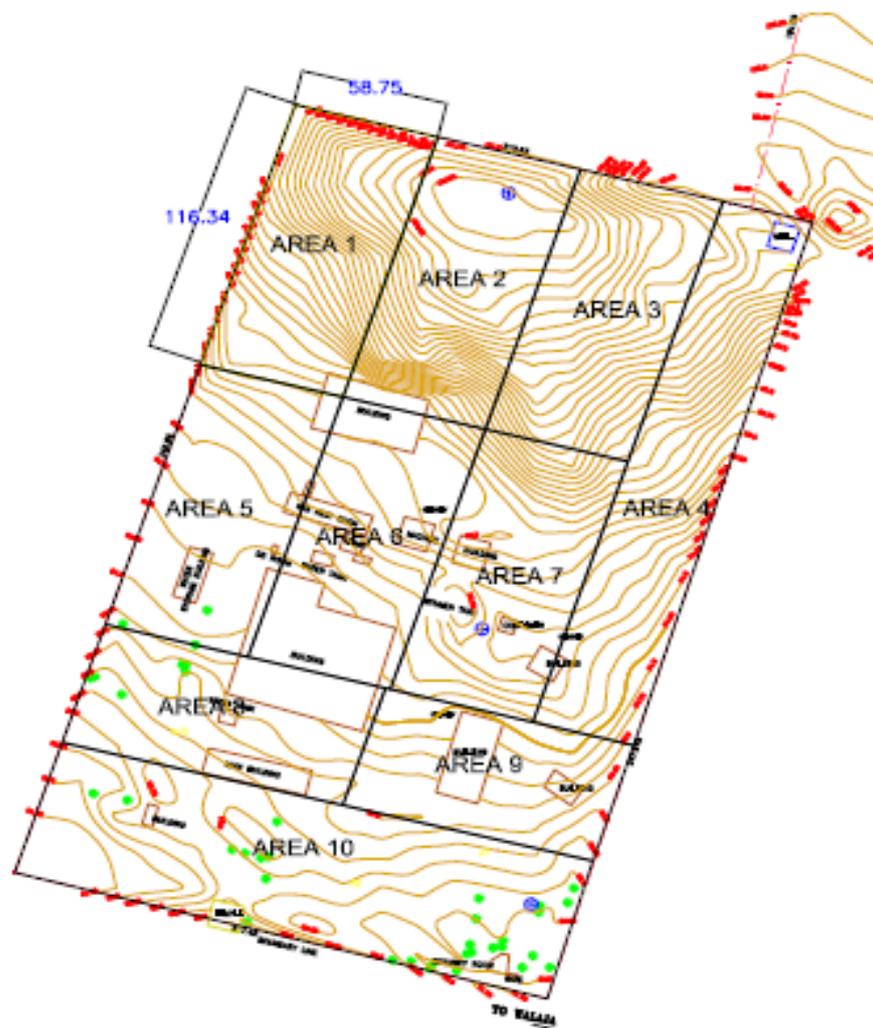
The soil and waste may be excavated, stored at a temporary location in the Site, treated and then stored in a constructed cell of a SLF in the Site. The activities anticipated to implement the proposed remedial approach are listed below.

- The excavation process shall be conducted using conventional earth moving equipment such as excavators, and dump trucks (tippers/dumpers);
- Excavation in shall be carried out in a stepped approach. Following is the methodology to be adopted:
 - Excavation of waste; the vertical extent of excavation shall be restricted to the termination depth as specified in earlier chapters of this document;
 - Wastes shall be stockpiled separately for stabilization and disposal. All stockpiles shall be located within designated areas and placed on impermeable surface (concrete lined surface/HDPE lined surface). Each of these stockpiles shall comprise approximately 250m³ of waste and shall be identified using a unique lot number reflected in the hazardous waste manifests;
 - One (1) sample from each stockpile shall be analysed to determine dosing rate of reductants and solidification agents: sodium metabisulphite, sulphuric acid, lime and cement. The chemicals shall be mixed with the batch of waste and then deposited in a cell of the secured landfill;
 - To limit waste being tracked off-Site, rumpers shall be installed at the exit point of the excavation/stockpile area. After the rumpers, the dumpers shall be directed towards a wheel wash station before leaving the Site. The wheel washing activity shall be performed using pressurized water jet equipment. Wash water generated from the wheel wash station shall be then pumped to the Groundwater Treatment Plant; and
 - Additional Health & Safety considerations such as a Health & Safety Plan, Excavation Plan, a Traffic Management Plan, and an Environmental and Social Management Plan; shall also be covered in the remediation plan, developed by the remediation contractor.

Excavation Plan

The excavation at the Site will be performed in a sequential manner. The site is divided in 10 separate areas and excavation will be performed simultaneously with soil and waste treatment and construction of SLF. The layout of the areas proposed for excavation are provided in figure below.

Figure 5.3 Excavation Plan



Closure of Excavation Zones

The excavated areas within the site are anticipated to be used for construction of a secured landfill. Therefore, backfilling operations shall not be performed till SLF is ready. Construction of SLF and treatment have to be performed simultaneously so that the treated soil and waste is backfilled without the need to excessive storage.

5.4.2 Soil and Waste Treatment

In order to eliminate the possibility of any further contamination of soil and groundwater it is proposed that the soil and waste mixture will be treated and stabilized prior to backfilling into a secured landfill. The following sections outline the process for treatment and stabilization of soil and waste.

Treatment System

The excavated soil and waste containing hexavalent chromium is to be treated by using Sodium Meta Bi-Sulphite (SMBS). The treatment process involves the following;

Crushing and Grading

The excavated soil and waste will be transferred to crushing (jaw crusher etc.) using conventional earth moving equipment such as excavators, and dump trucks (tippers/dumpers). The crushed mixture will then be passed through grading (sieves etc) equipment to remove any large boulders or rocks.

The graded mixture will be passed onto the mixer where it will be dosed. The oversize material will be segregated and staged separately. The oversize material will be analyzed for hexavalent chromium exceedance with respect to SSTL. Depending up on the results the oversize material will either be used onsite for construction activities or can be disposed in the on-site landfill.

Mixing

The mixtures (undersize) will be passed on to a mixer (twin shaft or similar) where it will be dosed with acid, SMBS, lime and cement. The dosing requirements as per laboratory tests is provided below.

- SMBS = 11% w/w
- Acid = 20% w/w
- Lime = 25% w/w
- Cement = 10% w/w

Initially acid will be added to the mixture and once required pH has been achieved SMBS will be added. In order to get complete reaction water may need to be added as well. Once sufficient reaction time is achieved the treated mixture will be dosed with lime and cement to reduce the moisture content. The final dosing will vary at the site considering the variability of the hexavalent chromium concentration.

The mixer is proposed to be sized to handle approximately 335 m³/day (500T/day). Additional capacity for mixer may be added to reduce the treatment time. The final design and sizing of the mixer will be determined by the subcontractor based on the estimated excavated volumes.

Multiple soil and waste samples will need to be collected for each batch during staging and treatment process for verification.

Dewatering

The mixture obtained post treatment may have a high moisture content. Although lime and cement are added to control the moisture, further moisture

reduction may be required. Contractor shall evaluate the possible need and options.

Pre and Post Treatment Staging

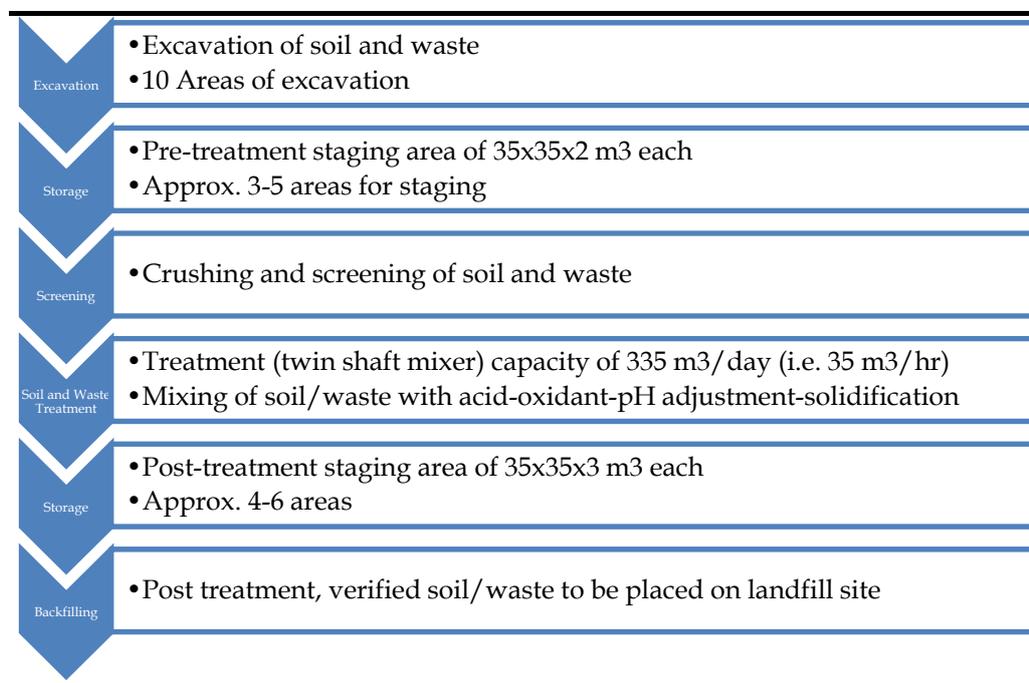
The excavated soil and waste from the Areas mentioned above will be staged in an area of 1,000m² each and approximately 3-5 such staging areas are to be provided, depending on space. The staging area shall be made with a 100mm thick PCC Cover/Geotextile cover and the stockpile height of 2m shall be maintained during staging of contaminated soil and waste.

Similarly, 4-6 post treatment staging areas are proposed with approximately 1,000 m³ area each. The height of stockpile is assumed to be 3m considering that the contamination has been treated. The staging areas shall be provided with properly sized leachate collection system which will discharge to the on-site treatment system.

Once dewatering is completed, the treated soil will be staged. Multiple samples will need to be collected and analyzed for hexavalent chromium as per CPCB guideline for verification. Only batches that clear the SSTL requirement shall be allowed to be backfilled into the SLF. Batches which fail will need to be treated again.

The following figure provides the process flow of the treatment system

Figure 5.4 *On-Site Ex-Situ Treatment System Process Flow*



5.4.3

Secured Landfill

The secured landfill (SLF) is expected to occupy an area of approximately 27,194m², a depth of 1 meter above the ground and rising to a height of less than 20 meters above the ground.

CPCB Guidelines on the design of a SLF for areas with shallow groundwater may be referred to for the design of the SLF. Broadly, the following are expected to be included in the design of the SLF:

- A double composite liner system at the bottom as the groundwater is shallow (4-5 mbgl);
- Leachate collection system including a trench;
- Top impermeable layer comprising HDPE liner and geomembrane;
- Clean top soil cover; and
- Concrete walls covered with geomembrane, not to exceed 20 meters in height, surrounding the secured landfill.

Site Layout

When designing a hazardous waste landfill, the site layout is one of the most critical aspects. The lay of the land dictates the approach to utilising the land judiciously.

Design of the Landfill

A typical landfill will have an “Active” period, a “Closure” period and a “Post Closure” period.

The active period designates the time when the waste is being filled in the landfill. While this typically ranges from 10-25 years for sanitary landfills based on the area available at the site.

The closure period designates the time when the landfill is closed and capped as per the design. For this site, the closure period is expected to be 36 to 48 months.

The post-closure period designates the time of monitoring that must be performed after closure of the landfill. This phase typically extends for up to 30 years after closure, in compliance with orders specified by the CPCBs Criteria for Hazardous Waste Landfills (2001) and/or in the consent to operate when received from the State Pollution Control Board. For this site, a similar or longer period is likely to be required.

Waste Volume and Landfill Design

In hazardous waste landfills, it is important to know the volume of the waste after processing the waste along with other geotechnical parameters of the waste.

The landfill capacity is based on the volume of waste that will be placed in the active period. It is necessary to consider, the present waste generation and future waste generation, if any, to estimate the total volume. As in the present case, the waste to be collected from a single area, treated and then backfilled, the question of future generation rates will not arise. The actual capacity will be determined by taking the volume of the waste after compaction and the density of the waste along with settlement due to degradation of waste, if any.

The volume of soil and waste has been estimated at 2,29,610 m³ and post treatment the total volume is estimated to be 4,39,552 m³. A 20% volume for margin is being considered, resulting in a total volume of 5,38,451 m³ for landfill design purposes.

It is also understood that the waste is a one-time waste and would need to be capped in 24 - 48 month's time period. This has a direct bearing on the leachate generation and the treatment.

Table 5.6 Preliminary Design of Hazardous Waste Landfill

Sr.	Item	Value	Unit
A.	Landfill Capacity		
i	Total Volume of Waste	4,39,552	m ³
ii	Bulk density of inert waste (Assumed for stabilised compacted waste)	1.0	tons/m ³
iii	Estimated Total Haz Waste to be landfilled including compaction	4,39,552	MT
iv	Volume of daily cover (0.1)	43,955	m ³
v	Volume within liner	54,944	m ³
vi	Available settlement volume		m ³
vii	First estimation of landfill capacity/ volume	5,38,451	m³
B.	Landfill Area (Rectangular in plan (length: width= 2:1))		
i	Possible Max. Height of landfill	20.00	m
ii	Area required for landfill	26,922	m ²
iii	Area required (ha)	2.69	ha
iv	Approximate plan dimensions (2:1::L:B)		
v	Length	232	m
vi	Breadth	116	m
C.	Landfill section		
i	Assumed Above ground level height (4:1 side slop)	Not to exceed 20 m	
D.	Landfill Phases		
i	Number of Phases (Batches of treated haz waste) assumed	10.00	
ii	Volume of one phase	53,845	m ³
iii	Assumed Height of one phase	10.00	m
iv	Plan area of one phase	5,384	m ²

Sr.	Item	Value	Unit
v	Dimension of one phase (assuming rectangle phase area 2:1::L:B)		
vi	Length of one phase	104	m
vii	Breadth	51.89	m
	Leachate Quantity		
	Planned area of one phase	5,384	m ²
E.	Average rainfall Ranipet	1,034	mm
i	80 % rainfall occurs in 3 months	827	mm
ii	Average rainfall for one month	275	mm
iii	Assuming 90 % rainfall turning to leachate	0.25	m
iv	Leachate generation	1,336	m ³ /month
v	Leachate generation	44.54	(m ³ /day)
vi	Quantity of minimum 3 days leachate storage capacity	134	m ³
vii	Height of Tank	2.00	m
viii	Area of leachate tank	67	m ²
ix	Dimension for Leachate storage tank		
x	Breadth	5.8	m
xi	Length	11.6	m

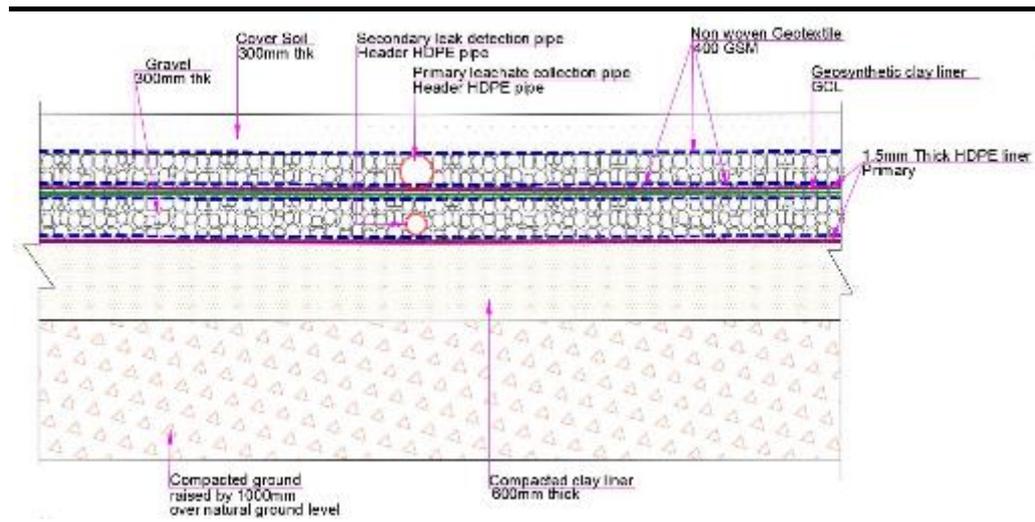
The assumption to install the landfill will be built with a vertical RCC wall and floor is provided as additional protection against flood and saturation by the shallow groundwater table. This assumption warrants further consideration for suitability, especially in view of the costs required for raising the existing grade.

Landfill Section

To comply with the CPCBs Criteria for Hazardous Waste Landfills (2001), a double liner system with a primary leachate collection system and a secondary leakage detection system is required. The shape of the landfill should be adapted based on the existing conditions with a minimum of fills and cuts volume. In this case, as the landfill design has to be considered because of shallow groundwater levels.

The treated soil and waste should be levelled and compacted to achieve 90-95% maximum dry density as obtained from Proctor tests. The base area must have a sufficient slope to guarantee draining of leachate and storm water. The soil bearing capacity of the soil is an important criterion. The minimum SBC should be approximately 30 T/sqm after compaction. The typical cross section of the landfill to be employed for the site is given below:

Figure 5.5 Typical Cross Section of Landfill



The layers within the liner section of the hazardous waste landfill, from bottom to top to be employed for the site, are as follows:

- Compacted ground should be elevated considering shallow groundwater levels.
- 600 mm thick compacted clay liner with Bentonite addition in case the soil is not having a permeability of 1×10^{-7} cm/s
- 1.5mm thick HDPE Liner
- 400 gsm Geotextile
- 300mm thick Gravel layer with HDPE pipe for secondary leachate collection
- 400 gsm Geotextile
- Geosynthetic Clay Liner (GCL)
- 1.5mm thick HDPE Liner
- 400 gsm Geotextile
- 300mm thick Gravel layer with HDPE pipe for primary leachate collection
- 400 gsm Geotextile
- Soil cover 300 mm thick

HDPE geomembrane with a standardized thickness less than 1.5 mm is not allowed. Only HDPE geomembranes should be used, which comply with the requirements of American Society for Testing and Materials (ASTM) or GRI GM 13 specifications.

Leachate Collection and Treatment System

Estimation of Leachate

This is one of the important points that need to be considered during the preliminary design stage. It is important to ascertain the quantity of leachate that will be generated during the year and how the leachate will be collected and treated to discharge norms.

As it has been understood that the landfill will be filled and capped in a matter of 24-48 months, it should be remembered that the landfill should be constructed considering the monsoon period and provision should be made for temporary capping. This temporary capping will prevent any rainfall that enters the site from becoming leachate. Therefore, estimation of leachate includes only the water existing within the waste and soil.

Considering the average rainfall for the area, the leachate amount during rainfall event is estimated to be 44.54 m³/day (see Table 5.6). However, as that these projections are based on assumed filling rates, assumed moisture content, and assumed leachate generation rates (per m³ of waste deposited).

Details regarding the above assumptions and calculations are presented in Table 5.6. Note that these assumptions must be confirmed during the detailed design phase, and that the size of the holding tank must also be determined at the detailed design phase, as this directly impacts the treatment plant capacity.

Leachate collection system

The main objective of the leachate collection system is to collect the leachate formed in the landfill in the shortest time period and bring it to a single point from where it can be pumped/ drained to the treatment plant. The leachate collection system will comprise of a drainage layer, perforated pipes, a collection sump and a pumping system to remove the same. This being a hazardous waste landfill, the regulations require a double liner system with primary leachate collection system and a secondary leakage detection system. The drainage layer will of 30 cm thick gravel layer with 2% or more slope having a permeability of 10-2 cm/sec.

The primary leachate collection system header pipe (250mm OD HDPE pipe) has been proposed for the collection while the laterals are proposed of 160 mm OD HDPE. The secondary leakage detection system header pipe (160mm OD HDPE pipe) has been proposed for the collection while the laterals are proposed of 110 mm OD HDPE.

Method of Treatment of Leachate

The leachate treatment will be treated on the on-site groundwater treatment system. Based on the site conditions a decision will have to be taken from the above alternatives. On-site treatment involves the complete treatment of the leachate to meet the discharge standards approved by the State Pollution Control Board.

Landfill Gas

Landfill gas is formed due to the degradation of the organic content in the landfill under anaerobic conditions. The quantum of gas is directly proportional to the organic content in the landfill. As there may be organic content remaining in the waste, passive venting system has to be adopted to release the gases. As such, minimum 12 passive gas venting wells are designed for removal of the landfill gas.

Covering of Waste and Intermediate Cover

Cover material includes imported cover such as soil or other inert material as well as material such as fine portion of construction and demolition (C&D) waste; any fractions of the C&D waste passing through the 1-5mm sieve can be used as daily cover.

The cover soil should be pushed by a bulldozer or wheel loader up the slope and spread out as evenly as possible. The daily cover should be at least 10-15 cm thick. When constructing a body in an open area, the side slopes require soil cover also. When the capacity of the landfill is filled, the final closure should be directly carried out at site.

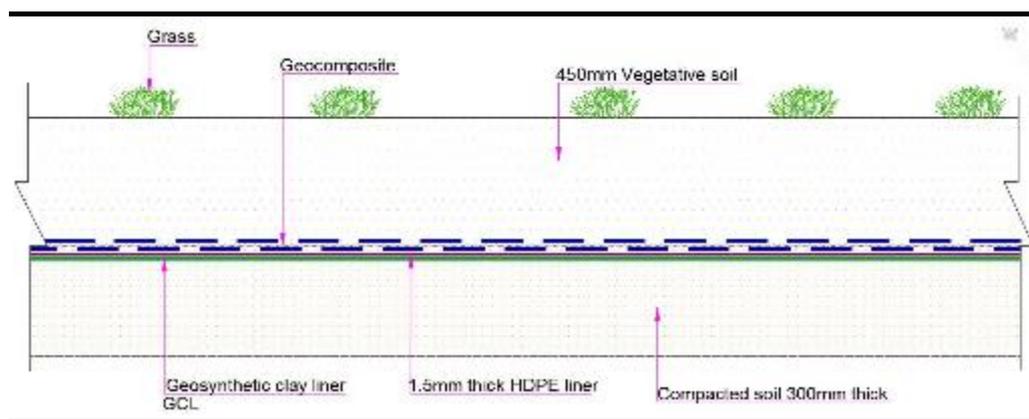
Final Cover/Closure

Once the waste is filled to the designed capacity in the landfill, the same has to be capped/closed to prevent any ingress of rainwater. As the rainfall is substantial in Ranipet, Tamil Nadu, it is essential to have a proper closure, which will prevent any ingress of water into the landfill.

To minimize infiltration of storm water in the landfill body and to allow storm water runoff, a surface sealing system has to be installed after the final completion of each landfill cell; this landfill is expected to be constructed and filled in a single cell. The main purposes of the final cover system are:

- To control the amount of storm water infiltration into the waste;
- To reduce leachate quantities;
- To prevent erosion;
- To minimise the migration of greenhouse gases into the atmosphere;
- To protect the base sealing (impermeable) layer;
- To minimise other emissions causing negative impacts on the environment like littering and odour.

Figure 5.6 Typical Cross Section of Landfill Final Cover



The layers within the landfill cap section, from bottom to top, are as follows:

- Soil layer: The soil layer (300 mm) shall be of natural soil compacted properly
- Geosynthetic Clay Liner (GCL)
- 1.5 mm thick HDPE liner
- Geocomposite layer for draining of the rain water (i.e., geonet with geotextile on both sides)
- Vegetative soil layer of 450 mm thickness for the local grass to grow.
- Interceptor drains will be provided in the top soil layer for erosion control and proper cross drainage of the storm water; all cross drains empty into the gutter at the periphery of the cell.
- Toe drain/open gutter at the periphery of the cell closure to divert any rainwater, which falls on the cell. This surface water is not polluted/contaminated and hence can be discharged into the nearby nala or storm drain or used for irrigation in the green belts.
- Passive gas wells will be provided at the sides and top of the closure, so that the gas, which is formed inside the closure, will be released naturally.

Support Facilities

The following additional features and support facilities are required for construction of the hazardous waste landfill:

- Laboratory: 1,000 square feet area required. Requires major equipment as well as minor equipment and consumables. Major equipment includes:
 - Gas Chromatograph;
 - Elemental Analysis (CHNSO); and
 - Atomic absorption spectroscopy (AAS) instrument.
- Perimeter Roadway: A perimeter roadway around the outside of the cell is required for filling the cell and maintaining the integrity of the liner, and will serve as a permanent service road.
- Support Buildings: In addition to the Laboratory building, an additional 1,000 square feet of support buildings will be required for

administration, maintenance, and other uses.

Other minor support facilities may be required depending on the processing requirements (if needed), truck maintenance, and whether support from the existing structures is possible. However, these items are not specifically identified in this cost estimate.

Post - Closure Care

Post-closure care of the site shall review the following conditions:

- Maintain the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover.
- Monitor leachate collection system in accordance with the standards specified
- Maintain groundwater quality and monitoring of ground water in accordance with standards specified
- Maintaining the passive gas venting system to meet standards
- Continual monitoring by third party or owner's environmental department.

The monitoring of the landfill has to be done on regular basis for short term and long term periods. The parameters that need to be monitored regularly are:

- Leachate head on liner;
- Leachate quality;
- Leachate treatment plant;
- Surface water monitoring;
- Gas quality from the landfill;
- Quality of ground water through bore wells and open wells. There should be minimum 4 ground water monitoring wells - 1 up-gradient and 3 down-gradient in each aquifer;
- Ambient air quality;
- Long term settlement of the closure.

5.4.4

Schedule and Cost Estimate

The schedule of implementation of the selected remedial technology is subject to limiting field conditions. Assuming that the tasks are implemented without undue hindrance of any kind, the anticipated schedule is presented in *Table 5.7* below.

Table 5.7 Remedial Implementation Schedule - Waste

Activities	Sub-Activities	Anticipated Duration (months)*
Excavation of waste	Mobilization, Preparation of the land for staging area, access, excavation Loading of trucks, staging, characterization sampling Chemical dosing, reduction and stabilization	24-48*
Secured Landfill	Disposal in the SLF	

*A range is provided considering that work may potentially be suspended during monsoons.

Assumptions

The cost associated with implementation of this remedial technology was estimated on the basis of the following design and market assumptions.

- The estimates on areas requiring remediation have been developed based on ERM's understanding of site specific geology and extent of impact exceeding the remedial goal;
- Based on Site Investigations, the nature of local soil is found to be sandy silt/silt. Based on literature review the density of such soils is found to be 1.34 tonnes/cubic meter. The same has been assumed for quantifications;
- The depth of contaminated soils that have been considered for quantity estimates have been detailed in Chapter 3 above;
- A stock pile area of 500m², where excavated waste shall be temporarily stored shall be made with a 100mm thick PCC Cover/Geotextile cover. A stockpile height of 2m has been assumed for this evaluation;
- Typical work day is assumed to be **minimum** 8-10 hours;
- Considering delays during the excavation due to movement of the equipment and stockpiling, it is assumed that excavation will be performed at 1,000m³/day. It is assumed that four (4) excavators will be able to excavate 1,000m³ per day;
- It is assumed that three tipper trucks of 5m³ capacities will transfer the waste to the staging area. A front end loader will be used at the staging area for loading and unloading including handling of stockpile;
- The rates for the excavator, tipper trucks and front end loader have been derived from Public Works Department (PWD) with a 20% buffer;
- Distance is assumed to be twenty (20) km, considering separate temporary locations where soil and waste is expected to be stored before and after treatment and during the construction of the secured landfill;
- The stabilization cost is basis internal and subcontracted studies conducted by ERM. The total cost is expected to vary as dosing rate shall vary with each batch of waste processed for stabilization. The dosing rate assumed for estimation of cost purposes is:
 - 11% weight by weight (w/w) Sodium metabisulphite;
 - 25% w/w Lime;
 - 10% w/w Cement;

- The unit rates for chemicals were taken from whole sale dealers available on the internet;
- Survey of excavation progress to happen without undue hindrance of any kind. Survey will be conducted before the start of the excavation, when the final excavation depth is reached. This task also includes preparation of maps, as built drawings; and
- A 10% buffer is assumed for the cost estimation.
- Demolition of existing structure shall be conducted prior to start of excavation and landfill construction activities.

The cost for excavation treatment and disposal of soil and waste on an on-site SLF is estimated to be INR 194 Crores (excluding Project Management and Engineering costs). The components of this cost are presented in *Table 5.8* below. The cost presented below is an estimate for conditions as on dates of Step 5 studies and does not consider inflation or other changes in conditions.

Table 5.8 *Cost Estimates with Stabilization and Solidification at HWMF - Waste*

Cost Estimates	Price (INR)/Unit	Estimated Cost (INR)
Excavators	Lump sum	28,07,270
Transportation – Movement of Waste and Soil (pre and post treatment)	Lump sum	2,28,20,533
Treatment at Site	Lump sum	92,19,03,209
Secured Landfill Construction	Lump sum	98,76,95,173
Survey	Lump sum	3,62,500
Health & Safety Measures	Lump sum	50,00,000
Anticipated Capital Cost	Lump sum	1,94,05,88,685
Cost for Project Management	10% of Capital Cost	19,40,58,865
Permitting, Engineering and other costs	5% of Capital Cost	9,70,29,434
Total		2,23,16,76,988

5.5

GROUNDWATER REMEDIATION

Based on the evaluation of the shortlisted techniques proposed for groundwater remediation, the pumping and ex-situ treatment (P&T) in conjunction with the above remedies is the recommended sustainable option.

This section presents the approach adopted for the areas, which were noted to be impacted with contaminated groundwater.

The proposed approach for treatment of contaminated groundwater at the Site comprises of installation of a hydraulic containment system (HCS) by the use of combination of:

- Groundwater containment wells, to prevent further migration of contaminated groundwater; and
- Groundwater source recovery wells, to expedite removal of contamination 'hot spots'.

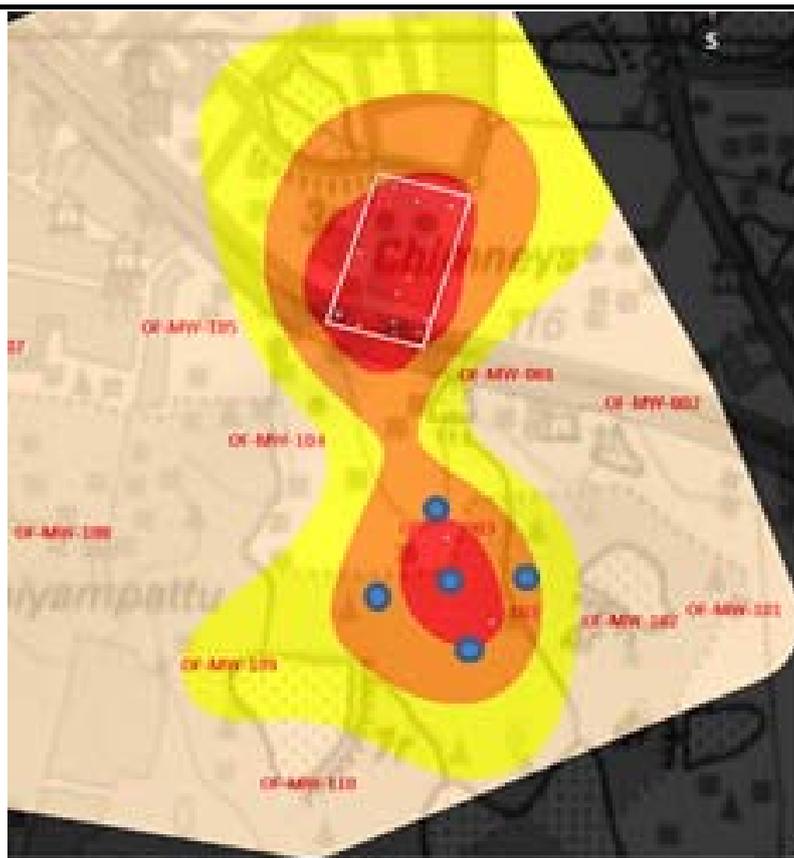
Principally, the HCS involves abstraction of sufficient quantity of water from abstraction wells along the down-gradient Site boundary to minimize or prevent further migration of impacted groundwater from this portion of the Site. The initial locations of the abstraction wells and optimum quantity of abstracted groundwater were evaluated using groundwater modelling. Based on the groundwater modelling scenarios, a hydraulic barrier can be created along the southern boundary of the Site. A total of fifteen (15) containment wells of which nine (9) operating wells shall be installed on the Site and five (5) wells off-Site. Based on the results of groundwater modelling, a total of 1,000 m³/day of groundwater will need to be abstracted for achieving containment and mass removal at hot-spots of contamination.

The abstracted groundwater shall be collected at a central location and subjected to treatment by installation and commissioning of a Groundwater Treatment System (GTS), to remove the CoC (dissolved Cr (VI)), prior to discharge. For reporting, it is expected that the GTS shall be installed in a southern portion of the Site. The proposed location for this treatment unit is expected to occupy 50m x 50m. The location is subject to finalization after involvement of the relevant stakeholders.

Figure 5.7 Proposed Layout for On-Site Abstraction Wells



Figure 5.8 Proposed Layout for Off-Site Abstraction Wells



● Proposed off-Site Abstraction Wells

5.5.1 Abstraction System Components

Installation of Abstraction Wells

Based on groundwater analytical data and groundwater modelling scenarios, the required well depth to create a vertical capture zone is around 50 m below ground level (bgl). This includes installation of barrier wells along the southern and central section of the Site. A total of fifteen (15) containment wells need to be installed on the Site.

The exact location of the wells will be evaluated based on the field conditions. Please refer to *Figure 5.7* and *Figure 5.8* for a proposed layout of the abstraction wells at the Site.

Well Installation Techniques

A 250mm diameter borehole (~ 52m deep) will be drilled, for installation of the abstraction wells, using a Mud Rotary drilling method. After completion of drilling, 150mm diameter well screen and casing (uPVC) will be installed within the drilled bore. An approximately 1m thick layer of uniform filter pack will be placed at the bottom of the drilled boreholes as a well cushion.

On top of this base layer, 42m length of screen, and slot size of 0.5-1 mm (3m sections) and about 3m length of casing will be installed (the casing will be encased in an appropriate and accessible well head structure).

The borehole annulus will be packed with a uniform filter pack containing well rounded gravels till 1m above the top of the screen. On top of this filter pack, top seal made of Portland cement/bentonite slurry will be installed. A sanitary/cover seal of Portland cement concrete will also be installed around the well. The seal will be contoured and graded to drain away from the well and to protect the well from direct surface water intrusion.

Following installation, the well will be developed by continuous flushing of the groundwater using air lift development techniques to develop the filter pack and to get good hydraulic continuity between the well and the aquifer.

As many associated connections, sample tapping points, valves (flow meters and flow regulators, etc.) as possible will be housed inside the treatment unit and the number of connections installed over the constructed underground well head would be kept minimal.

Abstraction Pump Units and Risers

A multi-stage submersible pump will be installed within each abstraction well to pump and transfer water to the treatment system. Each pump will be suspended upon a rigid HDPE pipeline riser (about 38 to 50mm diameter). A suitable wellhead will be installed at each well location.

At each well head, fittings will be installed which will include flowmeter (electromagnetic flow tube type with rate and total flow display), pressure gauge, gate valve, and sample point tapping.

A level control system will be installed within each well to control the operation of the pump. This level control system will be adjustable from the wellhead, without the requirement for removal of the pump and riser installation. A non-return valve will be installed at the pump discharge.

Wellhead Control Systems

The abstraction system will operate on a continuous 24-hour basis. In the event of failure or abnormal operation of any component, the system will auto shutdown in a 'safe' mode and shall trigger an alarm for manual interference for restarting the system.

The operation of each individual abstraction pump will be controlled by conductivity level sensors installed within the wells. In the event of a low level (L) within the wells, the pumps will be automatically shut-down. The pump will automatically re-start when a high level (H) is reached. The pump will

also shut-down in the event of motor overheat. Overload protection for each of the electrical motors shall be included.

A reliable three-phase power (415-440 V, 50 Hz) supply will be required at each wellhead location. Power supply isolators will be installed at the entry to each of the individual abstraction pumps.

The following external indications will be included on each of the individual abstraction pump wellheads:

- Power on/off;
- Pump on/off; and
- Visual alarm – low level within well.

The facility will be included to switch-off each of the abstraction pumps (on an individual basis) from the location of the main control panel. Overload protection for each of the electrical motors will be included. Power supply isolators will be installed at the entry to the main control panel and each of the individual abstraction pumps.

5.5.2 *Groundwater Treatment Process*

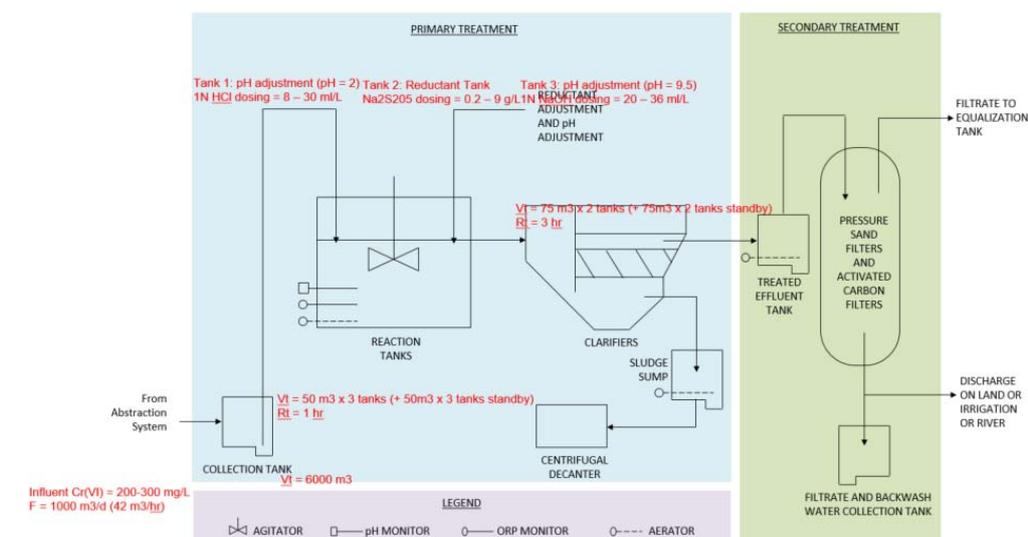
The treatment units anticipated to be installed along with the GTS include, at a minimum:

- *Collection Tank:* The groundwater from different abstraction wells shall be discharged into a Collection Tank;
- *Reaction Tank:* The collected groundwater shall then be conveyed to a Reaction Tank where it will be dosed with reductants including Sodium Meta-Bisulphite and Sulphuric Acid. Cr (VI) in the groundwater is expected to reduce to Cr (III), a less hazardous form and precipitate out of solution as sludge;
- *Clarifier:* The treated water shall be routed to a Clarifier where the sludge will be allowed to settle. The Clarifier shall be periodically emptied of the sludge at the bottom;
- *Filtration Units:* The overflow from the tank shall be routed through a Pressure Sand Filter (PSF) for further filtration, and subsequently through a series of Granular Activated Carbon (GAC) columns; and
- *Solids Handling Facilities:* The sludge from the Clarifier shall be conveyed to a Sludge Thickener to remove excess water, which shall then be routed to the equalisation tank. The final sludge shall then be disposed in a licensed HWMF.

The effluent water from this treatment system, once deemed compliant to the SSTLs, shall then be further treated to comply with the prevailing drinking water standards.

Please refer to *Figure 5.9* for the Groundwater Treatment System Schematic.

Figure 5.9 Process Flow Schematic - Proposed GTS



Pre-Treatment

The purpose of pre-treatment is to generally eliminate constituents, which could interfere with or hamper the main treatment processes. Pre-Treatment consists of the following units:

- Collection Tank; and
- Aeration using atmospheric air.

Groundwater abstracted from the HCS wells gets pumped to a Collection Tank. In the tank, homogenization, and oxidation (by aeration) are done. Homogenization of the abstracted groundwater will help prevent shock loads on the system as concentrations after equalization are usually reduced and stable because of dilution and equalization. For the precipitation of iron and manganese (to a much lesser extent) present in groundwater, atmospheric oxygen is added to the water in order to raise the redox potential. Reduced compounds such as iron are then oxidized in the presence of oxygen. The compressed air is supplied by an air compressor and conveyed in to the water by several diffusers installed in the tank. The pre-treated water would then be conveyed to the next set of treatment unit(s).

Primary Treatment

The primary treatment system would primarily consist of the following units:

- Reaction Tank; and
- Clarifier.

The groundwater shall be conveyed to the Reaction Tank where it will be dosed with reductants including Sodium Meta-Bisulphite and Sulphuric Acid.

Cr (VI) in the groundwater is expected to reduce to Cr (III), a less hazardous form and precipitate out of solution as sludge.

The sludge is separated out of solution in the Clarifier, where gravity settling is used to settle out the sludge and clear supernatant is carried over to the Clarified Water Tank and secondary treatment.

Secondary Treatment

The secondary treatment system would primarily consist of the following units:

- Clarified Water Collection Tank;
- Pressure Sand Filters;
- Granular Activated Carbon Filters; and
- Treated Water Collection Tank.

It is recommended to use Pressure Sand Filter and Granular Activated Carbon (GAC) Filters for the secondary treatment of groundwater. These units are proposed for the removal of any remaining Cr(VI) in the water.

From the Clarified Water Tank the water is pumped towards the sand filter. The sand filter is used to trap any remaining suspended particles in the water. The water enters the filter at the top end and flows through to the bottom of the filter.

Activated carbon is commonly used to adsorb natural organic compounds, taste and odor compounds, and synthetic chemicals in water treatment. Adsorption is both the physical and chemical process of accumulating a substance at the interface between liquid and solids phases. Activated carbon is an effective adsorbent because it is a highly porous material and provides a large surface area to which contaminants may adsorb.

Adsorption using activated carbon is particularly effective in treating low concentration waste streams and in meeting stringent treatment levels.

Primary factors in determining the required GAC volume for treatment are:

- Breakthrough time;
- Empty Bed Contact Time (EBCT); and
- Design flow rate.

The breakthrough time is the time when the concentration of a contaminant in the effluent of the GAC unit exceeds the treatment requirement. The EBCT is calculated as the empty bed volume divided by the flowrate through the carbon. The EBCT and the design flow rate define the amount of carbon to be contained in the adsorption units.

The backpressure on the filters is monitored to avoid clogging. Once the pressure has reached a predefined set point, the filters are backwashed. The Ancillary Facilities anticipated to be installed along with the GTS include, but are not limited to:

- Blowers for Compressed Air;
- Transfer Pumps and conveyance piping;
- Backwash Unit; and
- Chemical Dosing Units.

Installation of GTS

The installation of the GTS, involves the following activities:

- Installation of conveyance piping from the abstraction wells to the equalisation tank at a flow rate of 1000 m³/day (42 m³/hr);
- Installation of an equalisation tank of capacity 6000 m³;
- Installation of a total of six (6) tanks (capacity of 50 m³ each) with three (3) operational and three (3) as standby. The three tanks would be used for pH reduction by addition of acid, reduction chemical addition, and pH adjustment to neutral.
- Installation of two (2) Clarifiers (approx. 75 m³ each for a retention time of 3 hours)
- Centrifugal decanter to dewater sludge from Clarifier
- Installation of a PSF (sized for 1000m³/day);
- Installation of a GAC Column (sized for 1000m³/day);
- Filtrate and backwash system
- Installation of treated water collection tanks;
- Conveyance piping for discharge of treated water;
- Periodic maintenance of the instrumentation and equipment may be required, and it may be done by backwashing the units using clean water;
- Onsite laboratory to analyze water and soil samples for verification

Table 5.9 *List of Equipment for the Proposed Treatment System (1,000m³/day)*

Equipment	Quantity	Units
Bar Screen	1	No.
Pumps for Collection Tank	2	Nos.
Splitter Box - I	1	No.
Reaction Tanks	3+3	Nos.
Flash Mixing Tank	1	No.
Agitator for Flash Mixer	1	No.
Splitter Box - II	1	No.
Clarifiers with Media	4	Nos.
Sludge Pumps	2	Nos.
Centrifugal Decanter	4	No.
Dosing Tanks	6	Nos.
Agitators for Dosing Tanks	6	Nos.
Dosing Pumps	6+3	Nos.
Variable Frequency Drive for all Motors	As needed	No.

Equipment	Quantity	Units
Diffusers including piping & valves	As needed	Lot
Compressors (2W + 1S)	3	Nos.
Level Controllers	For all tanks	Nos.
MCC Panels with control gears	1	No.
Cabling & Earthing, etc.	As needed	Lot
Interconnecting Piping & Valves	As needed	Lot
Pressure Sand Filters	2	Nos.
Activated Carbon Filters	2	Nos.
Filter Feed Pumps (2W + 1S)	3	Nos.
Backwash Pumps (2W + 1S)	3	Nos.
RO units and equipment's (1W + 1S)	1	Nos.
Dosing Chemical Transfer Pumps	3	Nos.
Dosing Chemical Preparation Tanks	3	Nos.
Agitator For Dosing Chemical Preparation Tanks	3 + 1 S	Nos.
pH Controllers / indicators	6	Nos.
ORP controllers	6	Nos.
Solenoid Actuated Valves	6	Nos.
PLC	1	No.
HMI	1	No.
SCADA	1	No.
Screen Chamber	1	No.
Collection Tank	1	No.
Sludge Sump	1	No.
Treated Water Collection Tank	1	No.
Backwash Tank	1	No.
Platform for Centrifugal Decanter, Tanks, etc.	As needed	Set
Walkway & Stairs	As needed	Set

Implementation Schedule and Cost Estimates

The schedule of implementation of the selected remedial technology is subject to limiting field conditions. Assuming that the tasks are implemented without undue hindrance of any kind, the anticipated duration for each activity and the overall schedule for installation of the abstraction wells, and connection to the surface water treatment system are presented in *Table 5.1010* below for the schedule associated with installation of the water treatment system.

Table 5.10 Remedial Implementation Schedule - Groundwater

Anticipated Activity	Sub-activities	Anticipated Duration (months)
Installation of abstraction wells	Installation of abstraction wells	1
	Installation of conveyance piping	1
Installation of Treatment System	Procurement and Installation Instrumentation and Piping Testing and Commissioning	6-9
Operations	Long term monitoring of treatment system	15-20 years

A CAPEX is associated with drilling, installation of abstraction wells, and installation of the groundwater treatment system. The cost estimates are

presented below, on the basis of the following design and market assumptions.

Assumptions

The following assumptions were taken in to consideration for making quantitative estimates for the surface water remediation system:

- The estimates on areas requiring remediation have been developed based on ERM's understanding of Site specific geology and extents of contamination;
- The number of pumps, and abstraction rates were derived from modelling based on groundwater data from investigation, actual yield may vary;
- In total, the design consists of twenty (20) abstraction wells with pumps, pumping at 3-6m³/hr. Of these fifteen (15) abstraction wells are located on-site and five (5) off-site.
- The estimated dosages are as follows;
 - 1N Hydrochloric Acid = 8 - 30 ml/L
 - SMBS = 0.2 - 9 ml/L
 - 1N NaOH = 20 - 36ml/L
- It was assumed that the pumping system shall operate for 24 hours a day;
- Empty Bed Contact Time (EBCT) of PSF was assumed to be 10 minutes, based on Standard Practices.
- EBCT of GAC Column was assumed to be 20 minutes; based on Standard Practices.
- Cost of analysis was included for thirty (30) samples per day, with twenty (20) from monitoring wells and ten (10) from treatment system.
- Monitoring is assumed to be conducted over fifteen (15) years, or compliance with the SSTLs, whichever happens earlier.

Estimated CAPEX

In total, the cost of installation of the abstraction system, and connecting it with the surface water treatment system is estimated to be INR 12 Crore. The components of this cost are presented in *Table 5.11* below.

Table 5.11 *Estimated CAPEX - Groundwater*

Item	Price (INR)/Unit	Estimated Cost (INR)
Abstraction well - 20 Wells		
6" uPVC Screen	1000/m	10,75,000
6" uPVC Casing	1000/m	1,00,000
6" uPVC End Cap	150/m	3,000
Drilling Costs	1208/m	20,10,000
Submersible Pump	34,500 per	6,90,000
Control Panel near Aws	17,250 per	3,45,000
Flow controllers / sensors	25,300 per	5,06,000
Flow meters	40,250 per	8,05,000
Piping and Instrumentation Onsite (Valves, etc.)	1000/m	85,00,000
Groundwater Treatment System (100m ³ /hr)		
Mechanical and Electrical Work	LS	2,75,00,000

Item	Price (INR)/Unit	Estimated Cost (INR)
Installation and Civil Work	LS	3,50,00,000
Automation	LS	1,50,00,000
Laboratory		
Civil Work	LS	15,00,000
Instrumentation and Equipment's for Analysis	LS	50,00,000
TOTAL		9,80,34,000
Cost for Project Management	10% of Capital Cost	98,03,400
Permitting, Engineering and other costs	5 % of Capital Cost	49,01,700
TOTAL		11,27,39,100

Estimated OPEX

Assuming the life of the treatment system to be fifteen (15 years), the OPEX is estimated to be INR 1.29 crores per month. The components of this estimate are presented in *Table 5.122* below.

Table 5.12 *Estimated OPEX - Groundwater*

Cost Estimates	Unit Cost (INR)	Estimated Cost (INR)
Salaries and Fees		
Operators (1 per shift for 3 shifts per day)	per person per month	1,20,000
Chemists (2 per shift for 3 shifts per day)	per person per month	1,80,000
Technicians (5 per shift for 3 shifts per day)	per person per month	3,00,000
Security (4 for 3 shifts per day)	per person per month	1,20,000
Mechanical & Instrumentation		
Well maintenance (flushing) & pump maintenance	# per well per month	4,036
Pump replacements (submersible)	# per pump per month	67,265
Instrumentation (Flow Meter)	# per flow meter per month	40,359
	# per control panel per month	26,906
Instrumentation (Control Panel)	month	26,906
Instrumentation (including sensors, valves, pressure gauge)	L.S per month	1,61,435
Monitoring and Analysis		
GW Sampling and analysis	20 samples per day	6,20,000
Treatment System Sampling	10 samples per day	3,10,000
Consumables		
Chemicals (NaOH, 1N)	per ton @ per month	
	@30ml/L dosing	11,70,000
Chemicals (SMBS)	per Kg @ per month	
	@1g/L dosing	48,75,000
Chemicals (HCL, 1N)	per ton @ per month	
	@30ml/L dosing	3,44,000
GAC	Per Kg @ per month,	
	5000Kg (2 tanks of 2500Kg each) every 3 months	3,33,300
RO Membranes	LS	5,00,000

Cost Estimates	Unit Cost (INR)	Estimated Cost (INR)
Critical Mechanical Equipments	LS	5,00,000
Sludge Disposal	per ton @ per month, 10,000Kg (4 tanks of 2500Kg each) every 3 months	50,000
GAC & Sand	per ton @ per month, 148 tons (200g / 1000L)	22,20,222
Chromium sludge Waste (Haz and Non Haz)	LS	10,00,000
Total		1,29,42,733
Contingency (20%)		25,88,546
Total		1,55,31,280

Annex A

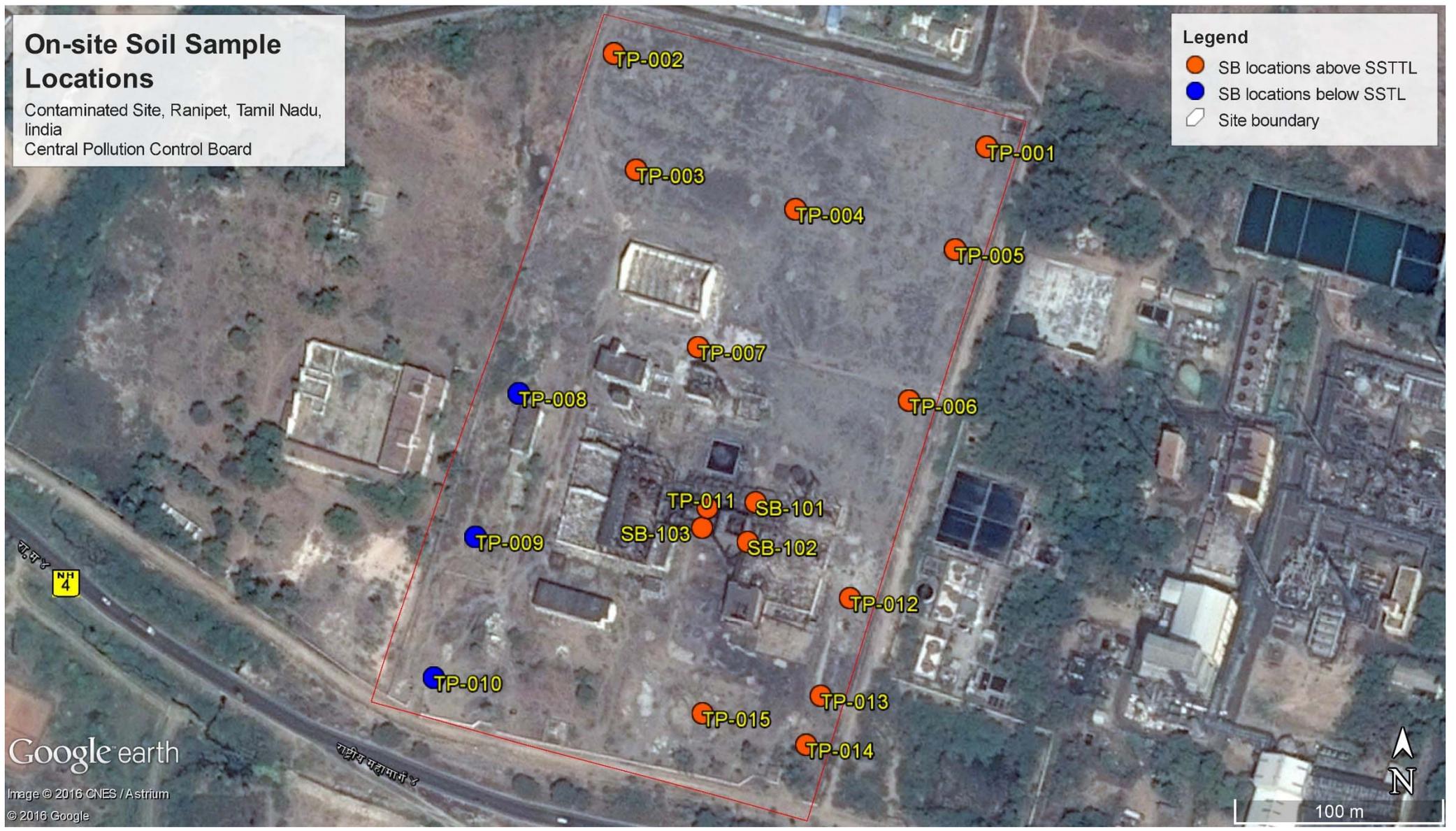
Exceedance Maps

On-site Soil Sample Locations

Contaminated Site, Ranipet, Tamil Nadu, India
Central Pollution Control Board

Legend

- SB locations above SSTL
- SB locations below SSTL
- Site boundary



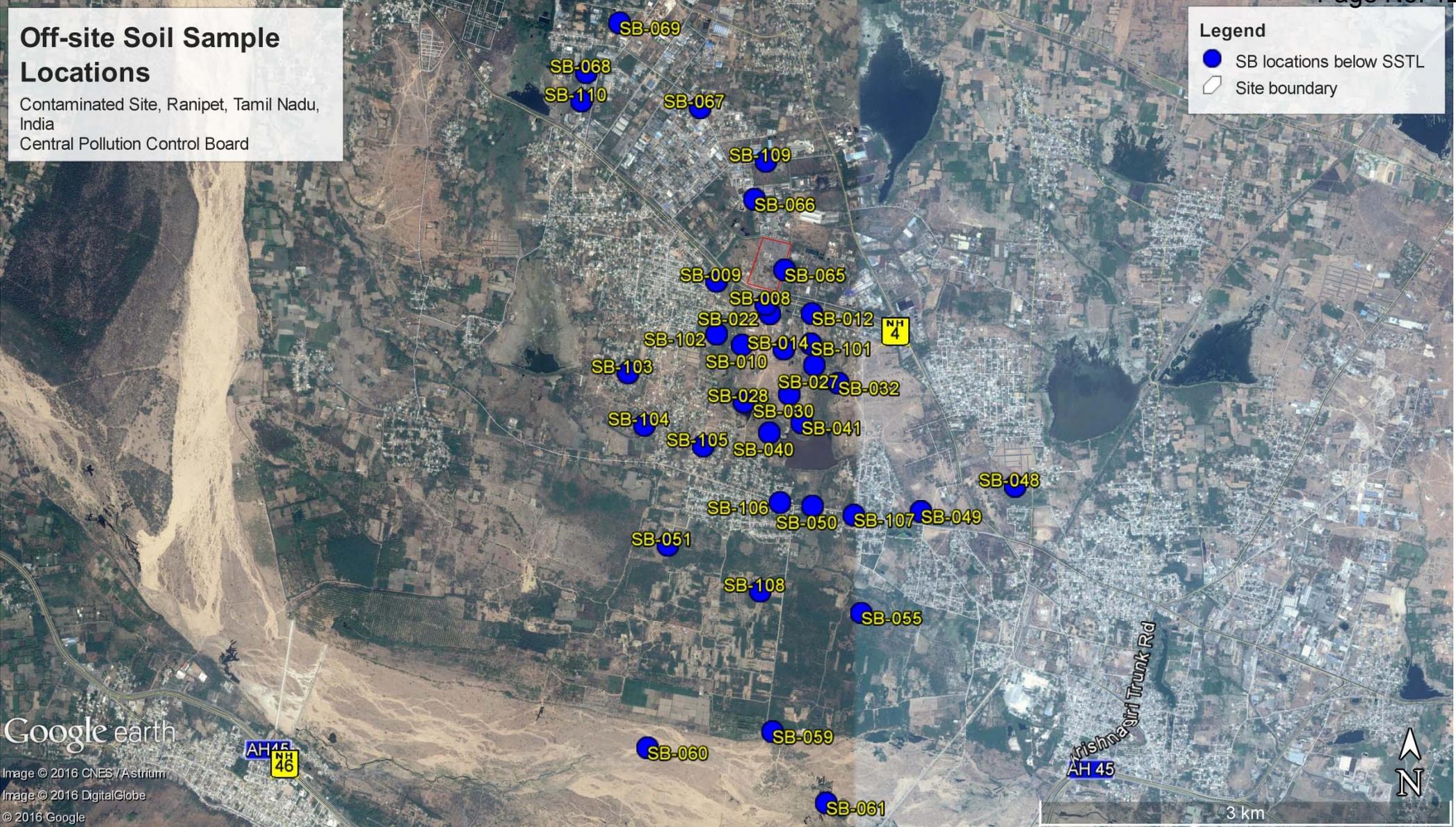
 <p>ERM Building 10, 4th Floor Tower A, DLF Cyber City Phase-III, Gurgaon - 122 002, India Tel: 91-124-4170300 Fax: 91-124-4170301</p>	Name:	Date:	<p>Title: Preparation of DPR and Providing Consultancy Services for Remediation of Contaminated Area: Ranipet, Vellore, Tamil Nadu, India</p> <p>Report:</p> <p>Client: Central Pollution Control Board - CPCB</p>	Project-No.:
	Drawn:	09/01/19		19729/0244871
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Off-site Soil Sample Locations

Contaminated Site, Ranipet, Tamil Nadu, India
Central Pollution Control Board

Legend

- SB locations below SSTL
- Site boundary



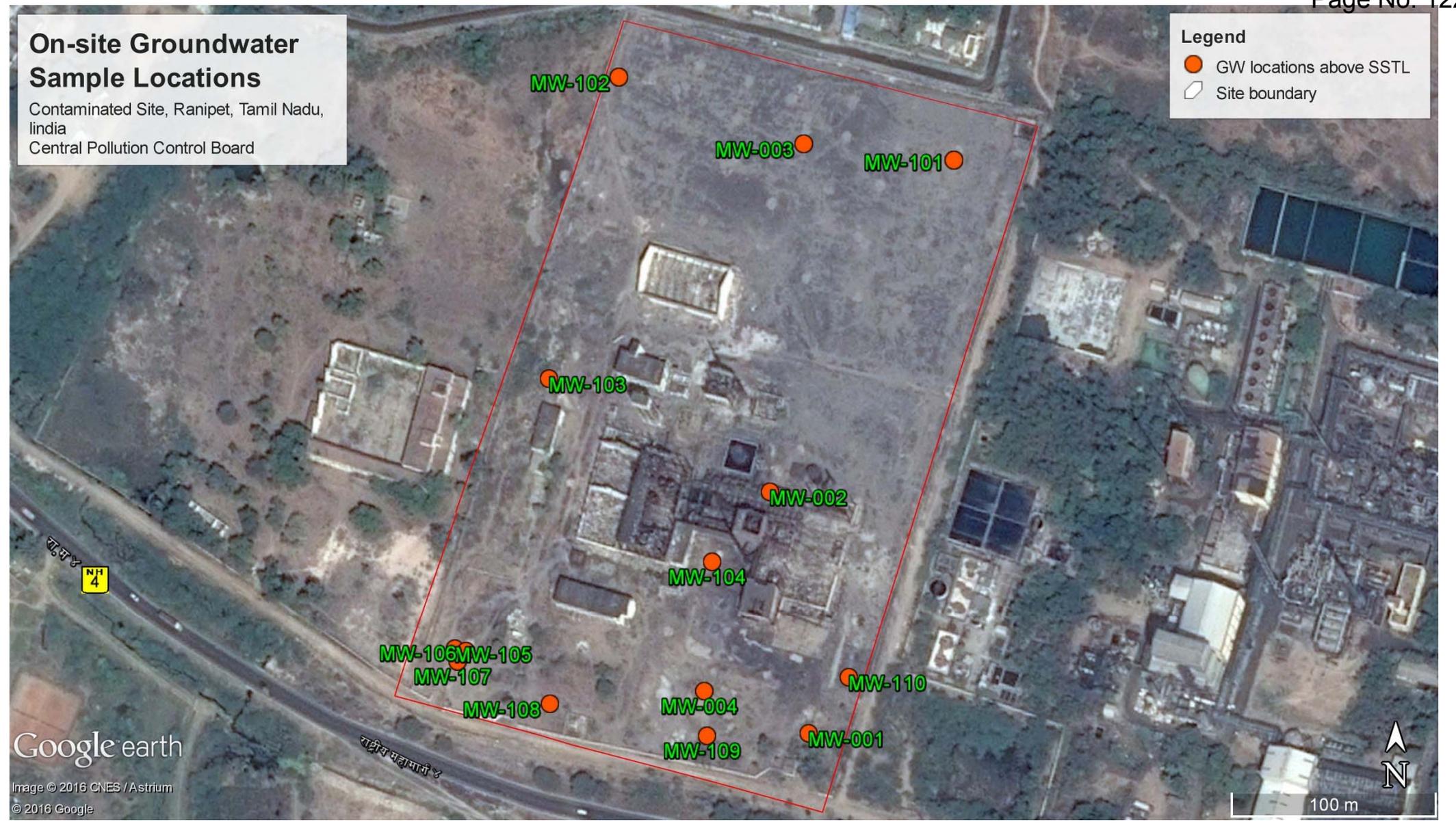
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	Approved:	RC		09/01/19	Size:	DIN A4

On-site Groundwater Sample Locations
 Contaminated Site, Ranipet, Tamil Nadu, India
 Central Pollution Control Board

Legend

- GW locations above SSTL
- Site boundary



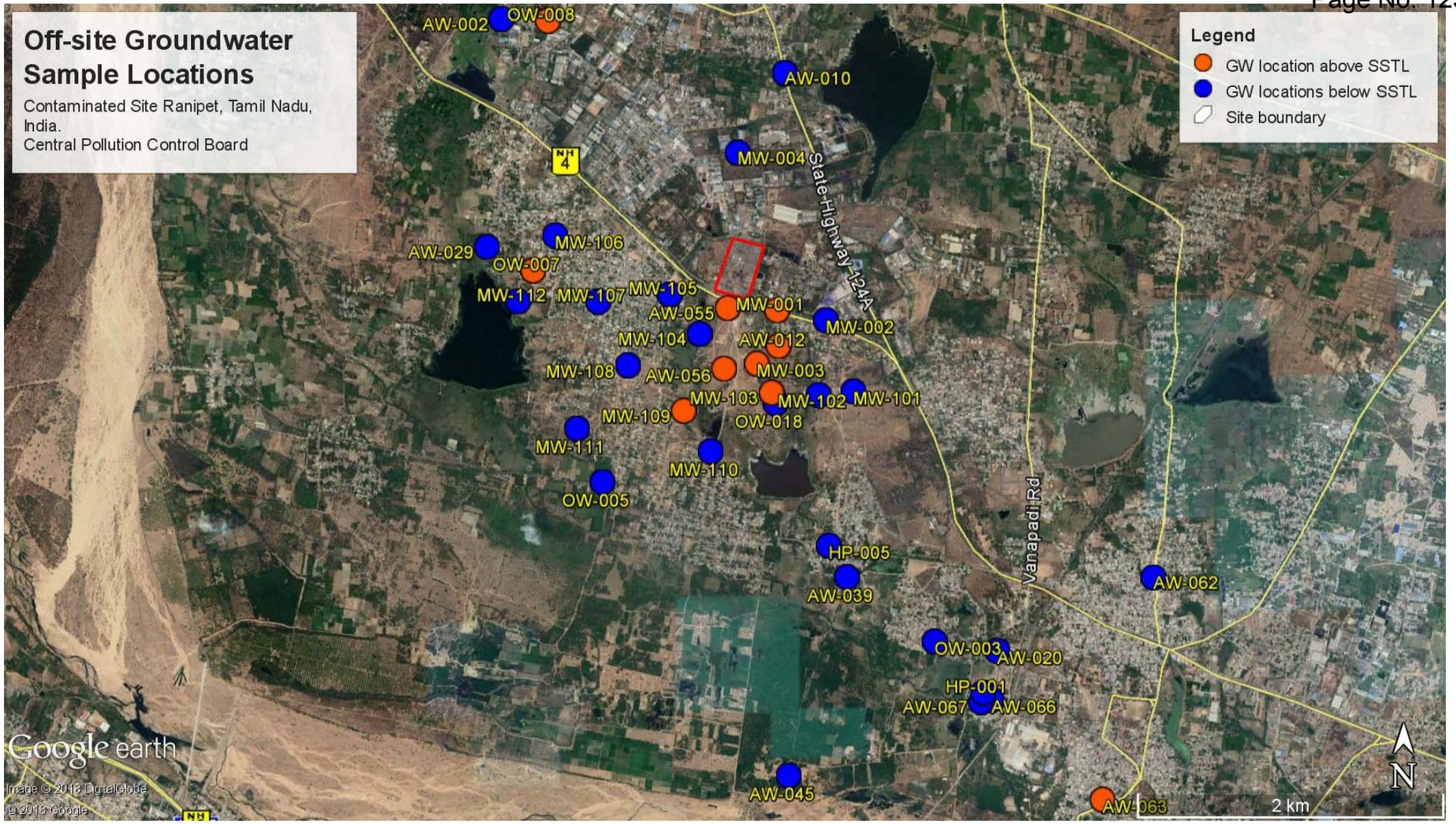
 <p>ERM Building 10, 4th Floor Tower A, DLF Cyber City Phase-III, Gurgaon - 122 002, India Tel: 91-124-4170300 Fax: 91-124-4170301</p>	Name:	Date:	Title: Preparation of DPR and Providing Consultancy Services for Remediation of Contaminated Area: Ranipet, Vellore, Tamil Nadu, India Report: Client: Central Pollution Control Board - CPCB	Project-No.:	I9729/0244871	
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	Checked:	VM		09/01/19	Figure A3	
	Approved:	RC		09/01/19	Size:	DIN A4

Off-site Groundwater Sample Locations

Contaminated Site Ranipet, Tamil Nadu, India.
Central Pollution Control Board

Legend

- GW location above SSTL
- GW locations below SSTL
- Site boundary



 <p>ERM Building 10, 4th Floor Tower A, DLF Cyber City Phase-III, Gurgaon - 122 002, India Tel: 91-124-4170300 Fax: 91-124-4170301</p>	Name:	Date:	<p>Title: Preparation of DPR and Providing Consultancy Services for Remediation of Contaminated Area: Ranipet, Vellore, Tamil Nadu, India</p> <p>Report:</p> <p>Client: Central Pollution Control Board - CPCB</p>	Project-No.:	19729/0244871	
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