TALCHER THERMAL POWER PROJECT, STAGE-III (2X660 MW) NEAR TALCHER TOWN, TEHSIL TALCHER SADAR, ANGUL DISTRICT, ODISHA

HALF-YEARLY COMPLIANCE STATUS OF ENVIRONMENTAL CLEARANCE CONDITIONS
EC Ref. No. No. J-13012/31/2009-IA.II(T) Dated: 12.09.2018
EC Amendment Ref. No. F.No. J-13012/31/2009-IA.II (T) Dated: 16.03.2022

S.No.	EC Conditions	Status as on 31.03.2024
A	**SPECIFIC CONDITIONS**	
(i)	Ash ponds near Village Jhadiamba (133.848 acres) and Village Santhapada (156.538 acres) shall not be taken up as the ash is proposed todispose it in the abandoned mine voids	Ash Dyke Construction works have been short closed and hence condition has been complied. Ash will be disposed in abandoned mine voids.
(ii)	The Ash content and Sulphur contents in the Coal shall not exceed 34% and 0.55%, respectively. In case of change in coal characteristics', a fresh reference is to be made to Ministry for reviewing the incremental impact, if any and adequacy of the conditions	The said stipulation will be complied during construction phase of the project.
(iii)	The capital CSR/ CER budget shall be in line with Ministry's OM dated 1.5.2018 or Rs.19.5 crores whichever is higher. The amount shall be implemented during project construction in the surrounding villages.	The said stipulation will be complied during construction phase of the project. CSR/CER details with implementation status is attached as Annexure-I
(iv)	As the coal source is to be determined, the details regarding characteristics of coal along with transport mode shall be submitted to Ministry. Coal transportation shall be done by rail and conveyor system only.	The said stipulation will be complied during construction phase of the project. Coal Characteristics report will be submit to Ministry after getting coal allocation by Ministry of Coal. Coal transported will be done by rail mode only.
(v)	The ash which is sent to South Balanda mines shall be mixed with 8% lime before disposing into the mines.	The condition deleted in EC Amendment Ref. No. F.No. J-13012/31/2009-IA.II (T) Dated: 16.03.2022
(vi)	The new emission standards notified vide Ministry's S.O.3305(E) dated 7.12.2015 shall be achieved for existing units as per the extended timelines given by CPCB. Further, the proposed units shall achieve new emissions standards from the date of commissioning of the plant.	Operations of existing units have been discontinued w.e.f 31.03.2021. The new emissions standards of proposed units will be complied from the date of commissioning of the plant.

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(vii)	Considering the proposed project is located in the Talcher Critically Polluted Area, the stack height of 275 m shall be erected to achieve maximum dispersion	275 M height stack is under construction as mentioned in EIA report.
(viii)	The ash pond near Village Santhapada shall not be used as it is near to Brahmani River and high chances of breaching and contaminating the water body.	Ash Dyke Construction works have been short closed and hence condition has been complied. Ash will be disposed in abandoned mine voids.
(ix)	As per the Revised Tariff Policy notified by Ministry of Power vide dated 28.01.2016, project proponent shall explore the use of treated sewage water from the Sewage Treatment Plant of Municipality/ local bodies/ similar organization located within 50 km radius of the proposed power project to minimize the water drawl from River Brahmani/other surface water bodies	Same has been explored & as per Local bodies within 50km, there is not enough water available with them to be spared for NTPC'TTPP use.
(x)	Compliance of EC conditions, E(P) Act, 1986, Rules and Mo EF&CC(WS) Notifications issued time to time shall be achieved by a qualified environment officer to be nominated by the Project Head of the Company who shall be responsible for implementation and necessary compliance	An Environment Management Group (EMG) headed by AGM (EMG) is already functional at the Talcher Thermal Power Station. AGM (EMG) will be responsible for implementing and monitoring the stipulations. EMG will have sufficient trained manpower for environmental monitoring and other environmental related activities to ensure compliance with statutory requirements. It will interact regularly with the State Pollution Control Board.
(xi)	Thermal Power Plant shall achieve specific water consumption, zero liquid discharge and emission standards as per Mo EF&CC Notification S.O. 3305(E) dated 7.12.2015 or subsequent notifications issued time to time.	The said stipulation considered during design of the project as mentioned EIA. The same will be complied during operation phase of plant.
(xii)	MoEF&CC Notification G.S.R 02(E) dated 2.1.2014 regarding use of raw or blended or beneficiated or washed coal with ash content not exceeding 34% shall be complied with, as applicable.	The said stipulation will be complied during operation phase of the project.

S.No.	EC Conditions	Status as on 31.03.2024
(xiii)	MoEF&CC Notifications on fly ash utilization S.O. 763(E) dated 14.09.1999, S.O. 979(E) dated 27.08.2003, S.O. 2804(E) dated 3.11.2009, S.O. 254(E) dated 25.01.2016 and subsequent amendments issued from time to time shall be complied with.	All MoEF&CC Notifications on Fly ash utilization will be complied during operation phase of the project.
(xiv)	Construction and inert waste generated during phasing out of existing plants shall be disposed as per Construction and Demolition Waste Management Rules, 2016	Operations of existing units have been discontinued wef 31.03.2021. Demolition of existing units is in progress. The applicable rules are being complied.
(xv)	Vision document specifying prospective plan for the site shall be formulated and submitted to the Regional Office of the Ministry within six months.	Talcher TPS has already submitted a project vision document to the Regional Office of MOEF&CC at Bhubaneswar.
(xvi)	Harnessing solar power within the premises of the plant particularly at available roof tops and floating solar plants on raw water reservoir shall be carried out and status of implementation including actual generation of solar power shall be submitted along with half yearly monitoring report	Solar plant of 150KW has been installed & running successfully. In St-III another solar plant of capacity 1400KW is envisaged in the EPC package.
(xvii)	Online continuous monitoring system for stack emission, ambient air and effluent shall be installed.	For the expansion project the same/similar system will be utilized/installed.
(xviii)	High Efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 30 mg/Nm3 or as would be notified by the Ministry, whichever is stringent. Adequate dust extraction system such as cyclones/bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided along with an environment friendly sludge disposal system.	The High Efficiency Electrostatic Precipitators (ESP) will be designed in order to comply with the direction. Besides, dust extraction systems and suitable water spray systems are included in the design of the plant to suppress/avoid dust emissions from the coal and ash handling areas.

S.No.	EC Conditions	Status as on 31.03.2024
(xix)	Adequate dust extraction system such as cyclones/ bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided.	Adequate no. of dust suppression and dust extraction systems will be provided in coal handling area including coal stock yard area, ash handling area and other vulnerable dusty area for control of fugitive dust emissions.
(xx)	Monitoring of surface water quantity and quality shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall also be undertaken and results/findings submitted along with half yearly monitoring report	Monitoring of Surface and ground water quality is being carried out as per Stipulations and half yearly reports is submitted herewith as Annexure-II. Heavy metal monitoring in ground water is being undertaken and results are included in the above report.
(xxi)	A well designed rain water harvesting system shall be put in place within six months, which shall comprise of rainwater collection from the built up and open area in the plant premises and detailed record kept of the quantity of water harvested every year and its use.	Rainwater harvesting system will be put in place before commissioning of plant and records shall be maintained.
(xxii)	No water bodies including natural drainage system in the area shall be disturbed due to activities associated with the setting up/operation of the power plant	The said stipulation will be complied both during the construction as well as operation phase of the project.
(xxiii)	Additional soil for leveling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.	All additional soil levelling of the project site will be done from within the sites only with all necessary precautions to protect natural drainage system of the area.

S.No.	EC Conditions	Status as on 31.03.2024
(xxiv)	Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Mercury and other heavy metals (As, Hg, Cr, Pb etc.) shall be monitored in the bottom ash. No ash shall be disposed off in low lying area.	An ash management & disposal scheme will be implemented consisting of dry ash extraction system (DAES) for dry collection of fly ash with storage facility (silos), supply of ash to entrepreneurs for utilization and promoting ash utilization to maximum extent and safe disposal of unused ash in slurry form to the abandoned mine void area. The plant shall also have ash water re-circulation system for bringing back decanted water from abandoned mine voids for reuse inside plant for ash slurry making. Periodic monitoring for mercury & heavy metals in the bottom ash will be done during the operation phase of the extension project.
(xxv)	No mine void filling will be undertaken as an option for ash utilization without adequate lining of mine with suitable media such that no leachate shall take place at any point of time. In case, the option of mine void filling is to be adopted, prior detailed study of soil characteristics of the mine area shall be undertaken from an institute of repute and adequate clay lining shall be ascertained by the State Pollution Control Board and implementation done in close co-ordination with the State Pollution Control Board	The condition deleted in EC Amendment Ref. No. F.No. J-13012/31/2009-IA.II (T) Dated: 16.03.2022
(xxvi)	Fugitive emission of fly ash (dry or wet) shall be controlled such that no agricultural or non- agricultural land is affected. Damage to any land shall be mitigated and suitable compensation provided in consultation with the local Panchayat.	Fugitive emission of fly ash & dust will be controlled with the aid of suitable pollution control devices such as dust extraction system and dust suppression system, etc. Extensive plantation will be undertaken in all available spaces including coal handling, ash handling areas etc. selectively with Air Pollution Tolerant (APTI) plant species.

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(xxvii)	Green Belt consisting of three tiers of plantations of native species all around plant and at least 50 m width shall be raised. Wherever 50 m width is not feasible a 20 m width shall be raised and adequate justification shall be submitted to the Ministry. Tree density shall not be less than 2500 per ha with survival rate not less than 80%.	More than 4,18,000 trees of different species were already planted by Talcher project in and around its existing area. Plantation would be developed in the available and feasible areas of Main plant, cooling towers, new admin building, around stockpile of the coal and other material, roadsides, internal roads. Extensive afforestation will be undertaken at all available spaces in and around project, after construction is complete.
(xxviii)	The project proponent shall formulate a well laid Corporate Environment Policy and identify and designate responsible officers at all levels of its hierarchy for ensuring adherence to the policy and compliance with the conditions stipulated in this clearance letter and other applicable environmental laws and regulations.	Corporate Environment Policy is already existing and the same will be adhered to so as to comply with the conditions stipulated in this clearance letter and other applicable environmental laws and regulations. Submitted earlier.
(xxix)	CER schemes identified based on need based assessment shall be implemented in consultation with the village Panchayat and the District Administration starting from the development of project itself. As part of CER prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken. Company shall provide separate budget for community development activities and income generating programs.	CER/CSR schemes are being implemented as per guidelines. NTPC is providing employment to local employable persons through various contractors. Separate budget has been earmarked for implementing CER-CD activities for the project and shall be utilized in accordance with the said stipulations. NTPC is already providing solar lights & toilets in villages, providing education in schools inside TTPS premises to children

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		from villages in the periphery & organized medical camp for local population.
(xxx)	CER activities will be carried out as per OM No. 22-65/2017-IA.II dated 01.05.2018 or as proposed by the PP in reference to Public Hearing or as earmarked in the EIA/EMP report along with the detailed scheduled of implementation with appropriate budgeting	The said stipulation is being complied. CSR/CER details with implementation status is attached as Annexure-I.
(xxxi)	For proper and periodic monitoring of CSR activities, a CSR committee or a Social Audit committee or a suitable credible external agency shall be appointed. CSR activities shall also be evaluated by an independent external agency. This evaluation shall be both concurrent and final.	In-built mechanism will be adopted for the monitoring of CSR schemes through any Government institute or agency of repute in the region.
B	**GENERAL CONDITIONS**	
(i)	The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed	The concept of Zero Liquid Discharge (ZLD) shall be adopted through reuse of plant effluents. An independent plant effluent drainage system will be constructed to ensure that plant effluents do not mix with storm water drainage.
(ii)	A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation	All domestic sewage emanating from plant and township will be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation & raising greenbelt to the extent possible.
(iii)	Storage facilities for auxiliary liquid fuel such as LDO/ HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, Nagpur. Sulphur content in the liquid fuel will not exceed 0.5%. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil	Storage facilities for auxiliary liquid fuel LDO/HFO are designed conforming to the safety standards and where risk is minimal. A detailed Disaster Management Plan & Risk assessment including fire and explosion issues will be prepared and finalized in consultation with Department of Explosives, Nagpur and regular mock drills shall be conducted as per plan in order to address any

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		eventuality in case of an accident.
(iv)	First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase	All arrangements related to first aid, health & safety and sanitation for workers/drivers during construction phase of the project have been kept under the scope of EPC contractor. However, NTPC will ensure effective compliance of the said stipulations.
(v)	Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dB(A) from source. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non-noisy/less noisy areas.	Design specification for the equipment has been made to comply with the stipulation. Personal protective equipment has been arranged through contractors during construction phase. Periodic examination of workers during operation phase shall be done as stipulated. The workers of generator hall and other high noise area will be provided with appropriate ear protection devices.
(vi)	Regular monitoring of ambient air ground level concentration of S02, NOx, PM2.5 & PM10 and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.	Ambient Air Quality is being monitored by third Party Agency as per guidelines of CPCB/SPCB & reports are being sent to appropriate authorities at regular intervals.
(vii)	Utilization of 100% Fly Ash generated shall be made from 4th year of operation. Status of implementation shall be reported to the Regional Office of the Ministry from time to time	Ash Utilization shall be implemented in compliance to fly ash gazette notification by MOEF&CC dt 14.09.1999 and its subsequent amendments and status of ash utilization plan implementation shall be intimated to the RO of Ministry, of Mo EF&CC at Bhubaneswar after operation of project.

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(viii)	Provision shall be made for the housing of construction labour (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project	A labour colony with necessary infrastructure facilities such as housing, sanitation, mobile toilet, fuel, medical facilities, safety, drinking water supply, etc. will be provided for construction labour through EPC contractor. NTPC will ensure effective compliance of the said stipulation by contractors.
(ix)	The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the Delhi Pollution Control Committee and may also be seen at the Website of MoEF&CC at http://envfor.nic.in.	The information of Environment Clearance was widely circulated in the region in two newspapers, i.e. in English Newspaper –The New Indian Express, and in vernacular language newspaper, i.e. in Sambad, on 19.09.2018.
(x)	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad I Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent	Copy of Clearance letter has been submitted to Panchayat, Zila Parishad and NGO. The Environmental Clearance was also uploaded in NTPC website.
(xi)	The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM (PM2.5 & PM10), S02, NOx (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the public domain	The HYC status of the stipulated Environmental Clearance conditions is being uploaded on the NTPC website of the company. The display of ambient air quality in terms of PM10, PM2.5, SO2 and NOx for expansion project will be displayed at a convenient location near the main gate as mentioned in CPA action plan during operation of plant.

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(xii)	The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail	The environment statement for each financial year ending 31st March in Form – V will be submitted to the Odisha State Pollution Control Board, once the plant becomes operational and will be upload on NTPC website.
(xiii)	The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to Mo EF&CC, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, MoEF&CC.	Six monthly EC compliance report for the period Oct 2023 to March 2024 is submitted herewith.
(xiv)	The progress of the project shall be submitted to CEA on six monthly basis.	Same is being Complied.
(xv)	Regional Office of the Mo EF&CC will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and up-date the same from time to time at least six-monthly basis. Criteria pollutants levels including NOx (from stack & ambient air) shall be displayed at the main gate of the power plant.	Shall be complied.

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(xvi)	Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. This cost shall be included as part of the project cost. The funds earmarked, for the environment protection measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry	Separate funds for Environment Protection measures are allocated in project cost. Funds earmarked towards Env. Protection measures will not be diverted for any other purpose.
(xvii)	The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.	Shall be complied.
(xviii)	Full cooperation shall be extended to the Scientists/Officers from the Ministry/ Regional Office of the Ministry / CPCB/ SPCB who would be monitoring the compliance of environmental status	Full cooperation shall be extended to the Scientists / officers from the Ministry / Regional Office of the Ministry / CPCB / SPCB during monitoring of the project.
C	An as built or as completed report on EMP to be submitted stating the scope/extent of work envisaged in the EIA along with estimated cost vis-à-vis the actual completed works and cost incurred. A certificate/completion certificate accordingly, shall have to be submitted before Commissioning of the TPP.	Shall be complied before Commissioning of the plant.
33.	The ministry reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction. The Ministry may also impose additional environmental conditions or modify the existing ones, if necessary.	Noted.
34.	The environmental clearance accorded shall be valid for a period of 7 years from the date of issue of this letter to start operations by the power plant.	Noted.
35.	Concealing factual data or submission of false /fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environmental (Protection) Act, 1986.	Noted.

S.No.	EC Conditions	Status as on 31.03.2024
36.	In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the conditions (s) imposed and to add additional environmental protection measures required, if any.	Noted.
37.	The above stipulations would be enforced among others under the water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environmental (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management, Handling & Transboundary Movement) Rules, 2008 and its amendments, the Public. Liability Insurance Act, 1991 and its amendments.	Noted.
38.	Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Noted.
Additional terms & conditions (As per EC amendment)		
(A)	Environmental Management	
(i)	Coal transportation shall be done by rail only and closed conveyor system only. In any event, coal shall not be transported by road. Further, PP shall follow the provisions of the Ministry's Notification S.O (E) 1561 dated 21st May, 2020.	The said stipulation will be complied during operation phase
(ii)	PP shall complete 33% tree plantation in the periphery of the project are with Miyawaki technique within strict timelines.	Shall be complied.
(B)	Miscellaneous	
(iii)	PP shall install solar power within premise of the plant at available roof tops and floating solar plants on raw water reservoir within certain timeline and status report shall be submitted to Minitry's IRO with its six monthly monitoring report.	The scheme for harnessing solar power from roof tops and floating solar plants within the premises of the upcoming plant will be implemented and report will be submitted along with half yearly monitoring report.
(iv)	Other conditions of the EC letter dated 12th September, 2018 shall remain unchanged.	Noted.
(v)	PP shall follow Ministry's guidelines vide OM dated 28th August, 2019 for ash filling in mine voids and monitor the heavy metal in Groundwater and Surface water quarterly. PP shall also check pH of supernatant water in mine void and if required mixing of lime with ash may be done.	Monitoring of Surface and ground water quality will be carried out regularly as per Stipulations and reports will be submitted during operation stage of expansion project.

Community Development Expenditure 2023-25

S. NO.	THEMATIC HEAD	TENTATIVE ACTIVITIES	Proposed Budget (In Cr. Rs)	Approved Amount (in Rs.)	Notesheet Ref. No.	Amount Released (in Rs.)
		Construction of additional classrooms, boundary walls, development of playground, play equipments etc.		2,025,024.22	Bantol School renovation (PO: 4600077145)	2,033,284.19
1	EDUCATION	Renovation and refurbusment of 34 Aganwari Centers of peripheral villages		16,901,400.00	Upgradation of Agawnwari centers (Ref:TTPS/R & R/2024-25/TTPP-CD/70887)	
				12,000,000.00	Gurujanguali school renovation (TTPS/CSR & R&R/2024-25/CSR CD/444830)	
				5,100,000.00	Santhapada school renovation (TTPS/R & R/2024-25/TTPP-CD/203088)	
			3	6,000,000.00	Jagganthapur School renovation (TTPS/R & R/2024-25/TTPP-CD/203088)	
				42,026,424.22		**2,033,284.19**
		Provision of Mobile Medical Unit (MMUs) alongwith Maternal & Child Health Care, Distribution of free medicines to economically weaker families.		36,457,862.00	Hiring of MMU & MCH Services for NTPC TTPS for a period of 04 years with a provision for extension for 01 year (PR No: 800059762)	
2	HEALTH	Mega Multi-Speciality Health Camps		1,975,088.00	Expenses incurred for treatmet of patients in Ashalok Hospital under CD *April to Oct 2023-24* (PRADIP Notesheet Ref: TTPS/R&R/2023-24/TTPP-CD/760048)	1,975,088.00
				1,032,470.00	Expenses incurred for treatmet of patients in Ashalok Hospital under April to August CD 2024-25 (PRADIP Notesheet Ref: TTPS/CSR & R&R/2024-25/CSR CD/477607)	
		PHC/CHC upgradation	2	840,000.00	1. Mega Health Camp at 03 GP's 2. 02 nos. health camps were arranged in Asha Mission-Talcher & Blind School-Balram Prasad	489,806.26
				40,305,420.00		**2,464,894.26**
3	DRINKING WATER AND	Drinking water facilities through RWSS in surrounding villages		2,760,531.87	Development work of pond at Shiv mandir complex village Jagannathpur, Jagannathpur GP (PO- 4600077484)	
		Conservation of natural water bodies, rainwater harvesting.	2	255,407.10	DIG office plantation (PO No: 4600073863)	301,382.00
				3,015,938.97		**301,382.00**
		Conduct awareness session / Knowledge partners for local government bodies and villagers on waste segregation, storage, handling and disposal practices including distribution of wastebins etc.		116,800.00	Street play for creating awareness w.r.t Dengue, Malaria, Jaundice etc. in 4 Panchayats (PO: 8200391644)	116,800.00
4	SANITATION	Periodic cleaning of drains and insect control, Bleaching powder distribution etc.		63,000.00	Bleaching powder distribution on all 4 GP's 2023	63,000.00
				63,000.00	Bleaching powder distribution on all 4 GP's 2024	63,000.00
		Ananda Bazar housekeeping	0.8	1,440,678.35	Sweeping and cleaning of weekly market area near to TTPS Plant. (PO No: 4600075533)	758,873.83
				1,683,478.35		**1,001,673.83**
		Road renovation and new road construction for connectivity to main road.		81,000,000.00	Kali Mandir-Bantol Road (PO No: 5500042740)	32,400,000.00
				6,544,630.00	Relocation of bi-weekly Haat	6,544,630.00
		Drainage construction/repair works etc.				
		Construction of community centers/recreational centers etc.				
		Installation of Solar High mast light/solar street light etc.		3,380,400.00	Supply, erection and commissioning of 4 no. of 30 mhigh-mast light 4 GP's (PR No: 800058291)	
		Restoration of pastures/crematories etc.		13,800,000.00	Various infrastructure works at Jagganthapur GP	
		Construction of Community toilets/anganwari centers etc.		35,750,000.00	Various infrastructure works at Santhapada GP	
5	INTERNAL ROADS & OTHER VILLAGE INFRASTRUCTURE	Various Community development works at GPs		10,925,000.00	Various Community Developmental works in Bantol Panchayat of Talcher Thermal (Ref:TTPS/R & R/2024-25/TTPP-CD/70887)	
		Construction of boundary walls				
		Renovation of embankments		2,760,531.87	Renovation of pond at Shiv mandir complex village Jagannathpur (PO No: 4600077484)	
		Renovation of Panchayat buildings and provision for furnitures etc.		663,479.45	Renovation of Santhapada Cremation ground (PO No: 4600076928)	782,911.46
				607,268.24	Repairing of Kukudola Village internal road (PO No: 4600076927)	716,576.24
				1,627,786.66	Renovation of community centre at Santhapada (PO No: 4600076938)	1,574,117.08
				336,001.48	Renovation of Jagannathpur Panchayat Office (PO No: 4600076791)	392,836.06
				2,597,998.08	Const. of Structural shed for Kalyan Mandap at Jagannathpur Village (PO No: 4600077611)	
			10	2,000,000.00	Deposit of Rs. 20 lacs to BDO Talcher for installation of CCTV along the Jaganathpur Bypass Road	2,000,000.00
				161,993,095.78		**44,411,070.84**
		Training on Self Employment for women including Awareness and Mobilisation to empower rural women with opportunities for skill development, employment, digital literacy, health and nutrition.		265,335.00	Beautician Training (PO No: 8200397615)	265,335.00
6	WOMEN EMPOWERMENT			280,032.00	Sewing Training (PO No: 4600076996)	219,812.00
				164,000.00	Training to SHG's of peripheral villages w.r.t millets processing, preservation and marketing for enhanced economic opportunity	
			0.75	586,440.00	Setting up of Sanitary Napkins unit at Bantol GP (PR no: 7000711871)	
				1,295,807.00		**485,147.00**
		Livelihood enhancement and Skill Development Training for Youths including training on English Language, Digital Literacy, personality development, etc				
7	LIVELIHOOD	Skill Development Training for Youths in construction activities such as mason, barbending etc.	0.75			
		Promoting rural sports among youths of Project Affected Villages		472,100.00	1. Volleyball Tournament 2. District Badminton Association	472,100.00
		Promoting cultural events in project affected villages.		1,000,000.00	Cultural Event for District Administration	1,000,000.00
				1,000,000.00	Cultural Event for District Administration	1,000,000.00
				30,000.00	Rath yatra Bhajan Sandhya Samiti	30,000.00
				63,490.00	Approval for providing support to Angul District United Badminton Association	63,490.00
				30,000.00	Financial Support to District Administration for celebration of Independence Day 2023	30,000.00
				140,000.00	Purchase of 5000 nos. National Flag for distribution to the communities as part of "Har Ghar Tiranga" Campaign of GoI (Independance Day 2023)	140,000.00
				100,000.00	Flags distribution in communities (Independenace day 2024)	100,000.00

8	PROMOTION OF RURAL SPORTS AND CULTURAL ACTIVITIES			125,675.00	Refreshments for students in Aganwari and govt. schools (Republic day 2024)	125,675.00
				150,000.00	Refreshments for students in Aganwari and govt. schools (Independance day 2024)	150,000.00
				93,127.00	Refreshments for students in Aganwari and govt. schools (Independance day 2023)	93,127.00
				41,360.60	Drawing & rangoli activities for children and women to promote cultural cohesion	41,360.60
				37,370.00	Annual sports meet at Santhapada GP	37,370.00
				227,000.00	Cultural Event at Gurujanguali GP	227,000.00
				131,927.00	Volleyball Tournament at Sathapada GP	116,527.00
				71,000.00	Assistance in celebrating Rajo Festivals 2024 in 04 GPs	55,825.00
				150,000.00	Extending support for holding block level NUA-O Sports Competition (Ref:TTPS/R & R/2023-24/TTPP-CD/786329)	150,000.00
				289,074.00	Long term volleyball coaching for rural youths 2024 (Ref:TTPS/R & R/2024-25/TTPP-CD/144927)	
				249,250.00	Assistance to National Young Women Shooter Ms. Ms. Dibyasha Priyadarshini Chopdar	
				267,179.00	Assistance to National Young men Reowned Shooter Mr. Swayam Pattnaik from Peripheral area	
				381,216.00	Financial Assistance to International Mountaineer Ms. Bibharani Priyadarshani	381,216.00
				377,900.00	Volleyball Tournament and Coaching for 04 GPs	377,900.00
			0.7	153,552.00	Welfare measures during General Election 2024	153,552.00
				5,581,220.60		**4,745,142.60**
	TOTAL		**20**	**255,901,384.92**		**55,442,594.72**

Interim Report

HYDRO GEOLOGICAL STUDY FOR TALCHER THERMAL POWER PROJECT, STAGE-III (2X660MW)

Submitted to

NATIONAL THERMAL POWER CORPORATION TTPP TALCHER (ANGUL)

By

GEOSCIENCE CONSULTANCY SERVICES
(CGWA ACCREDITED & ISO 9001:2015)
ROORKEE – 247667 (UTTARAKHAND)

November 2024

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1 INTRODUCTION

NTPC Limited, which was set up in November 1975 with the objective of planning, promoting and organizing integrated development of thermal power in India, has been playing a key role in the power sector of the country. The total installed capacity of the company is 72,304 MW (including JVs) own stations include 26 coal based, 7 gas based, 1 Hydro, 1 Wind, 18 Solar and 1 Small hydro plant. Under JV, NTPC has 9 coal based, 4 gas based, 8 hydro based and 4 renewable energy projects (one small hydro, two wind-powered, and one Solar PV)

Talcher Thermal Power Station (TTPS) is situated near Talcher town in Angul district of Odisha. TTPS which having existing capacity of 460 MW [Stage-I (4x60 MW) + Stage-II (2x110 MW)]. The project was implemented by erstwhile Orissa State Electricity Board (OSEB) and was subsequently taken over by NTPC on 03.06.1995 and Its units are not in operation since 31.03.2021. Therefore, NTPC is establishing 2x660 MW (Stage-III, Expansion) Coal based Ultra Super Critical Talcher Thermal Power Project over an area of 446 Acres, within the existing premises of TTPS. The water requirements of the power plant are met from the Samal Barrage on Brahmani River. The coal requirement for TTPP is met from MCL mines.

Ministry of Environment, Forests and Climate Change (MoEF&CC) had accorded Environment Clearance (EC) for 2X660 MW (Stage-III, Expansion) Coal based Ultra Super Critical Talcher Thermal Power Project, Vide letter no. J-13012/31/2009-IAII(T), Dated 12.09.2018 and amendments on16.03.2022.

SPCB Odisha, issued Consent to established (CTE) on 28.03.2023. In order

to fulfill the requirements of Consent to Establish condition as well as NTPC's concern towards conservation of surface and ground water resources for the benefit of the project as well as for general population, a detailed Hydro-geological Study is proposed to be undertaken. The study would include geological and hydrological framework of area, groundwater condition including groundwater quality.

In compliances to the order dated 12.02.2020 of Honorable NGT Principal Bench New Delhi in OA number 117,499 and 102 of 2014; published "*Updated list of abandoned mines identified for ash filling*" on 18.02.2022. The ash generated from the Talcher Stage-III is proposed to be disposed in the mine voids of Jagannath Mines. Jagannath mine is located about 14 km away from the plant.

MOEF & CC through its Office Memorandum dated 28.08.2019 has stipulated guidelines for disposal of fly ash utilization in low-lying areas and mine voids, mentioning to maintain a clearance of 500m safe distance from river and water bodies to prevent failure of the embankment and fly ash flowing to nearby water bodies. Surface runoff and supernatant water, in any case shall not be let into the surrounding areas. Collection can be done by providing adequate drains around the mine.

2 OBJECTIVES AND SCOPE OF WORK

2.1 OBJECTIVES

The main objectives envisage for the present consultancy study is Hydro-geological Status of the Project area and mine voids area of TTPP Stage-III on Surface Water & Ground Water Regime (especially around Mine Voids). The specific objectives of the study are as follows:

2.1.1 Surface Water Hydrology

Any change in the drainage pattern of the study area with respect to previous years.

a) Status of identified surface water bodies, if any (including degenerated water bodies) within the study area (12 km radius from the plant boundary), their exploitation and potential for development of degenerated water bodies. Recommendations by consultant to improve the condition of degenerated water bodies by NTPC.

b) To study the surface water quantity & quality at identified location and current sources of contamination, if any.

c) Status of rainwater harvesting at NTPC premises and Status of watershed management at study area.

d) Recommendation/suggestions to NTPC for taking site specific mitigation measures

2.1.2 Ground Water Hydrology

a) Define the present hydro-geological scenario of the study area through water table contour map & ground water flow direction map.

b) Assessment of groundwater depletion if any.

c) Estimation of annual recharge and utilization of ground water during operation of TTPP.

d) Status of Implementation of NTPC Rainwater harvesting Policy.

e) Enumerate any increase/decrease in the potentials for rain water harvesting and suggestions for augmenting ground water recharge

f) To study on groundwater quality at identified locations and current sources of contamination, if any.

g) Data collection from existing monitoring network for annual review and monitoring of ground water levels and quality. In case monitoring network is not available, work of same needs to be executed by the agency.

h) Coordinates of tube wells of Plant & Township area & their locations shall be provided on Geo reference maps

i) Recommendation/suggestions to NTPC for taking site specific mitigation measures. However, the consultant is free to recommend any additional observation/finding apart from reviewing the hydrogeological condition with respect to previous study.

2.2 SCOPE OF WORK

2.2.1 Literature Review

A detailed literature review for the documents/ reports has been already available for the study area with various agencies such as Geological Survey of India, State Department of Geology and Mining, Central and State Water Boards, State Water Resources/ Irrigation departments, Central Water Commission, India Meteorological Department, etc. The consultant will review the earlier reports/ data related to the study with all possible help from NTPC. Based on the review of the literature available, a detailed plan for the study covering all the objectives will be prepared.

2.2.2 Field Studies

The field studies will cover the following aspects:

1. The latest satellite imageries from IRS/NRSC will be used for geological mapping and to ascertain area covered by water bodies. Any reduction/increment in area covered by water body in study area will be given.

2. Drainage patterns and surface water bodies to be identified. The satellite imageries will be used for mapping LULC and water bodies.

3. Well logging for water level measurements as well as water quality monitoring to determine hydraulic gradients and groundwater flow characteristics using flow net analysis for Pre-monsoon and Post-Monsoon Seasons.

4. As there is no temporal changes on the aquifer characteristic therefore as

per TOR during the tenure of the study one time Pumping tests on existing/new wells at 3 locations will be carried out in order to estimate the hydraulic characteristics of the aquifer in the study area.

5. Infiltration studies for determining rate of infiltration using double ring infiltrometers at 5 locations in and around the mine void– Pre-monsoon and Post-monsoon seasons will be carried out.

6. Monitoring the surface and groundwater quality at 24 locations within the 12 Km radius from NTPC plant, with respect to parameters like pH, TSS, DO, BOD, COD, dissolved phosphate, nitrate and ammonia, Major ions (Na, K, Ca, Mg, HCO_3, Cl, SO_4 and F^-), Silica, oil & grease, Phenolic compound, Bacteriological, total coliform and Heavy metals (Cd, Zn, Hg, As, Cr, Pb, Cu, Se, Fe, B, Al, Mn, Co, Ni, Ag, Ba, Rh) during premonsoon and post-monsoon seasons.

7. Potential for rainwater harvesting will be investigated by studying the physiography of the area and identification of zones required for runoff generation, water harvesting, and recharge.

3 STUDY AREA

3.1 LOCATION

Talcher Thermal Power Station (TTPS) is situated near Talcher town in Angul district of Odisha (***Figure 3.1***).

The site is about 4 km from Talcher Town and about 25 km from district headquarters Angul. The nearest railway station, 'Talcher' is on Talcher-Cuttack section of North Eastern Railway (renamed East Coast Railway) at about 2 km. However, a small railway station named 'Talcher Thermal' is located near the project boundary. The area is accessible by NH-23 (renamed NH-149) at about 1 km. The nearest commercial airport is at Bhubaneshwar at an aerial distance of 90 km approx. and about 150 km by road. The co-ordinates of the proposed study area including 12 km buffer zone are: 85°12'10"E to 85°13'00"E longitude and from 20°54'02"N to 20°55'05"N latitude approximately.

3.2 PHYSIOGRAPHY

The study area constitutes northern part of Angul district. The area is mainly drained by the Brahmani River. The area constitutes various physiographic features such as alluvial plain, mountain ranges, flood plains and water bodies. The elevation of the area above mean sea level (amsl) ranges from 18 m to 191 m and the slope is towards the south-east direction (***Figure 3.2***).

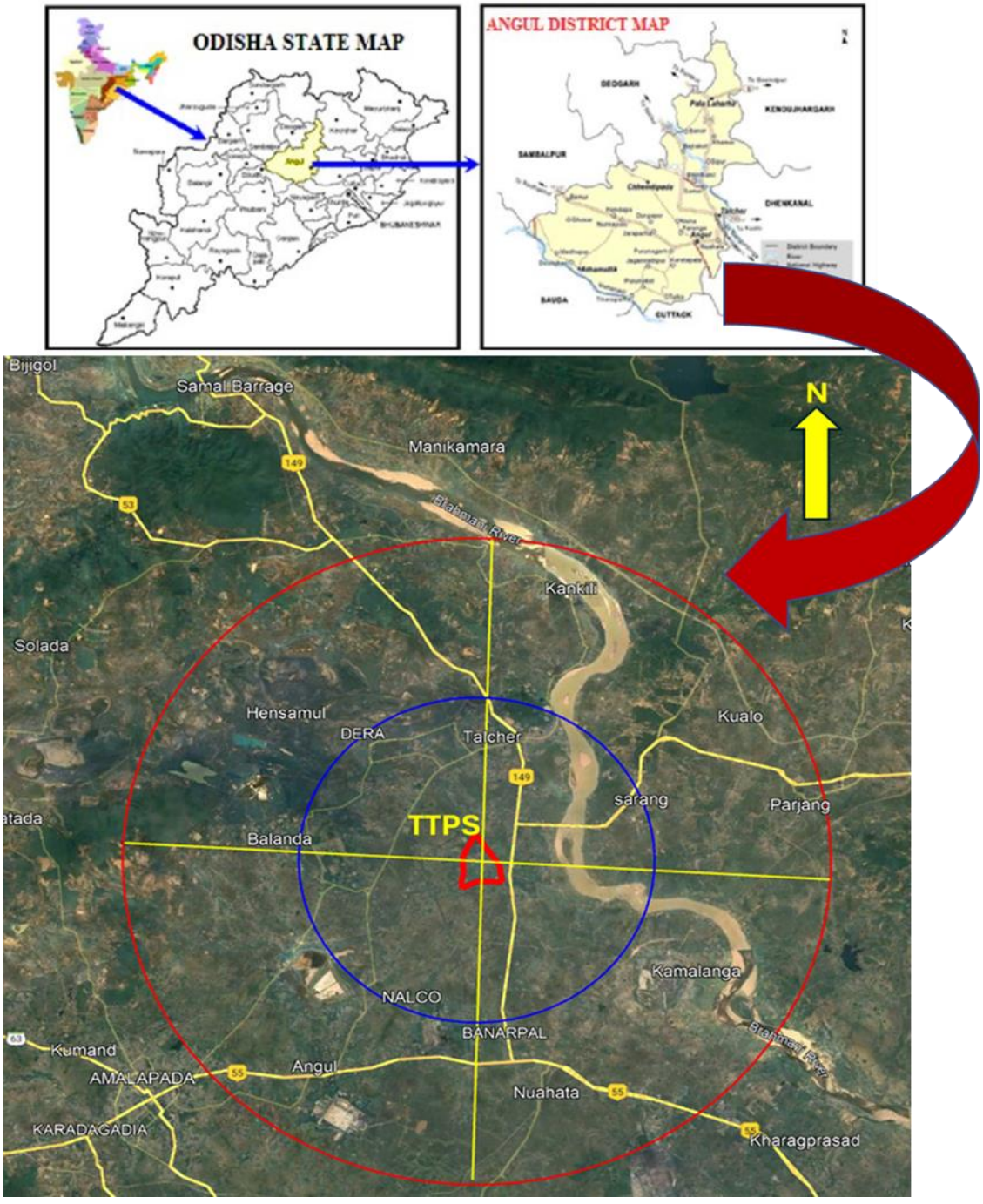

Figure 3.1: Location of the Talcher Thermal Power Station

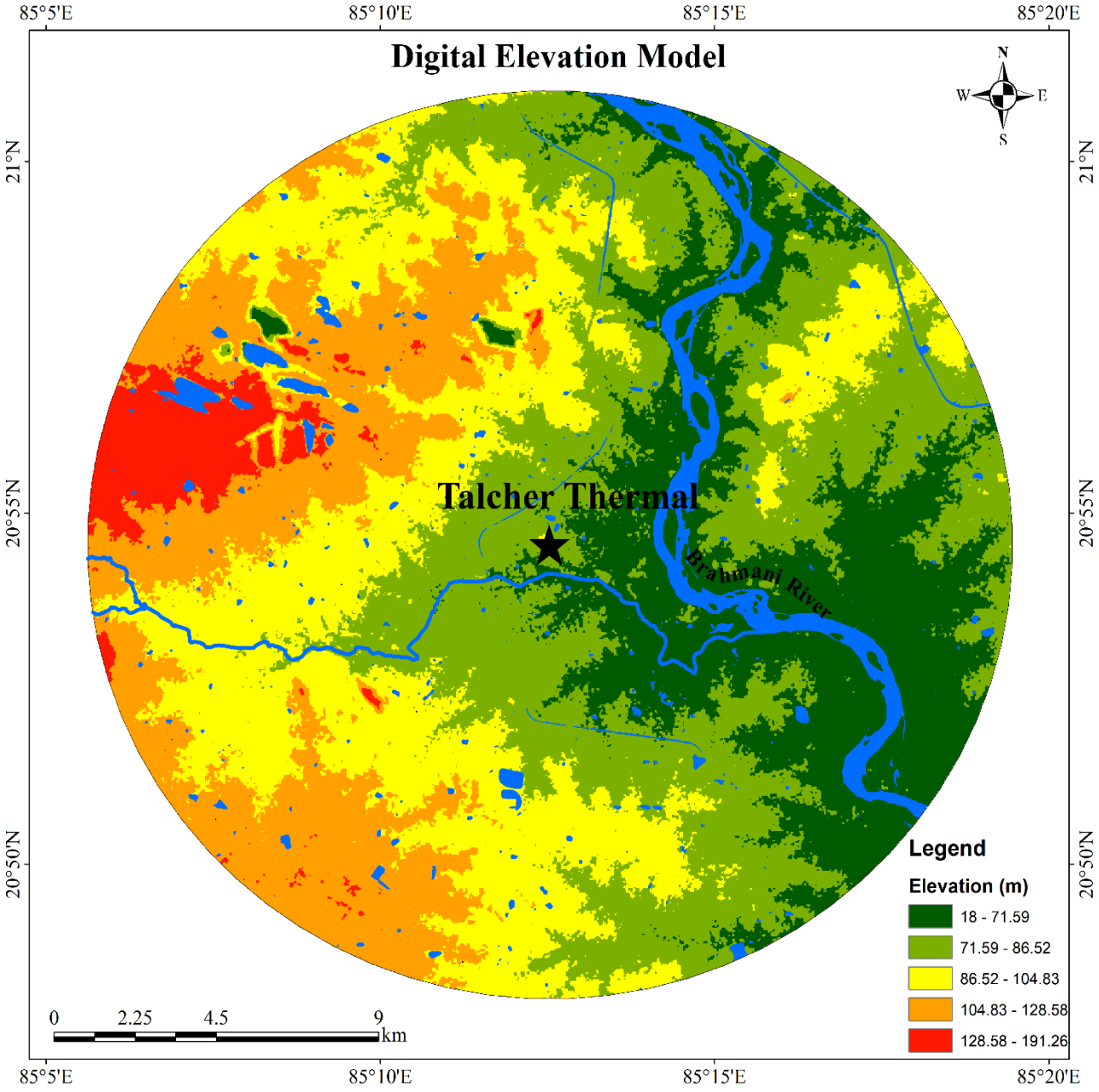

Figure 3.2: Digital Elevation Model of the Study Area

3.3 CLIMATE AND RAINFALL

The climate of the area is generally dry and arid except in monsoon season. The summer is severe during May-June when temperature rises as high as 490C accompanied by high humidity. Winter is very pleasant, prevails during December-January. The area experiences warm to hot climate with temperature varying from 9.9^{0}C to 44.4^{0}C. Average humidity varies from 26% to 83%. Generally, the humidity is highest in August and least in March. The climate of this region resembles with that of Deccan plateau. Climatic parameters of Angul district are given in ***Table 3.1***.

Table 3.1: Climatological parameters of Angul District, Odisha.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temperature (°C)	21.1	24.6	28.4	31.2	32.2	30	27.5	27.1	27	26.3	23.9	21.3
Min. Temperature (°C)	15.4	18.5	21.9	25	26.8	26.6	25.3	24.9	24.5	22.8	19.3	16.2
Max. Temperature (°C)	27.3	31.4	35.5	38.4	38.5	34.2	30.5	30.2	30.5	30.3	28.8	26.8
Precipitation (mm)	17	18	31	38	73	270	388	363	253	109	27	15
Humidity (%)	60	54	51	54	60	72	84	86	86	78	68	62
Rainy days (d)	2	2	4	7	9	15	19	20	17	9	3	1

The area has monsoon type climate with rainfall predominantly in the months of June to September and some in the other months. Average rainfall per annum is 1329 mm. Maximum rainfall per annum is 2200 mm and minimum is 700 mm as per records available.

Figure 3 shows the Monthly average Rainfall, average temperature variation in Angul district.

The wind speed in the area is light to moderate except in the early monsoon

period when it is generally strong. Annual mean wind velocity is 7 km/hr. with maximum speed of more than 20 km/hr. **Higher** speed wind blows during latter part of summer or rainy season in the direction of South-West or North-East.

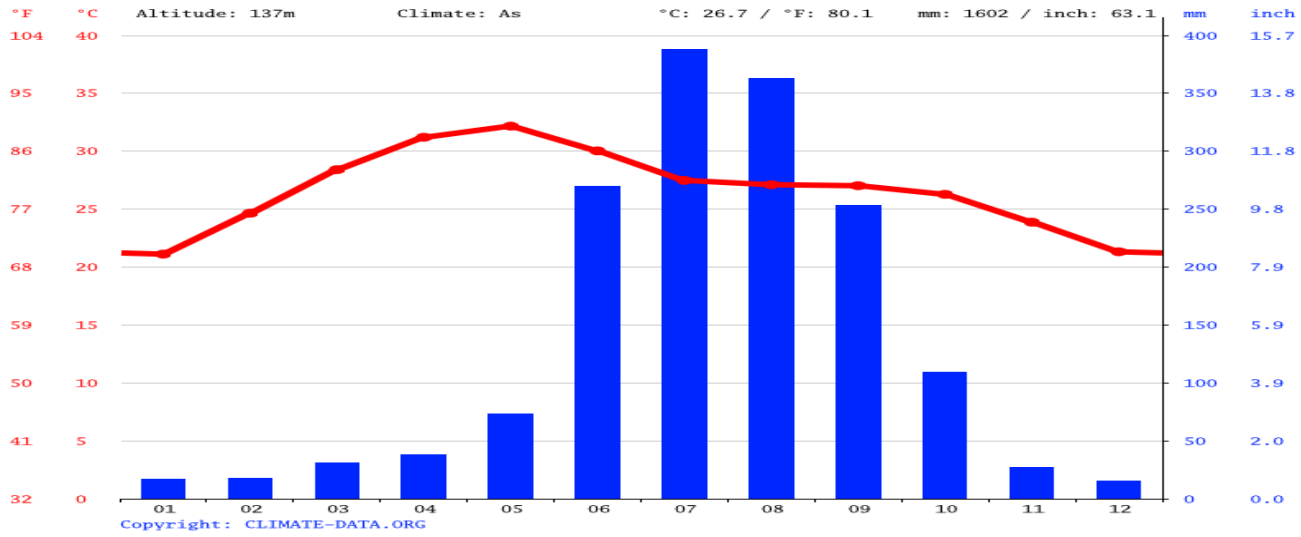

Figure 3.3: Average monthly Rainfall and Temperature variation in Angul District.

3.4 LANDUSE AND LAND COVER

Major landuse and land cover in the area includes, agricultural land, forest land, barren land, and water bodies. The landuse/landcover map of the area is shown in ***Figure 3.4***.

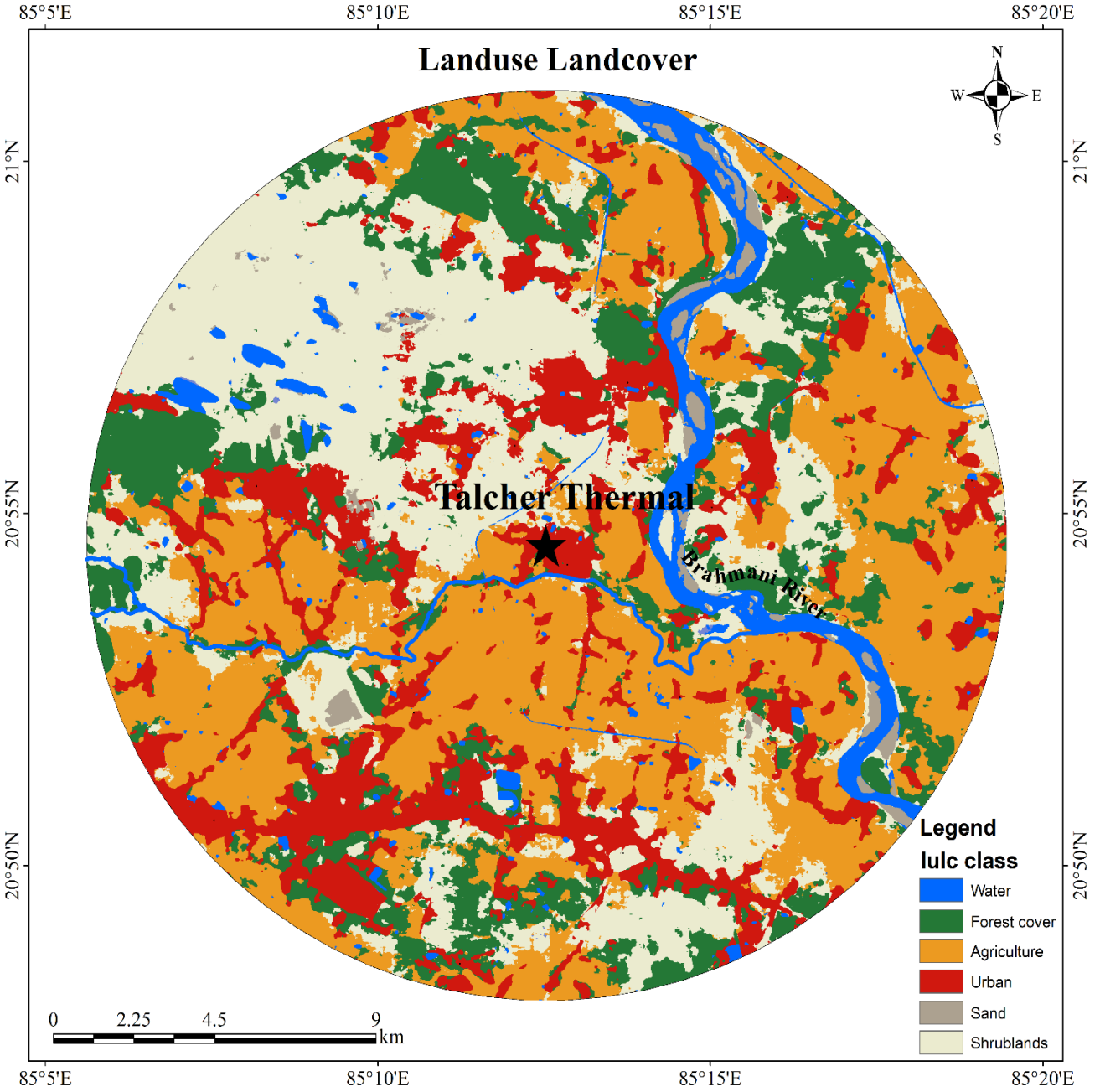

Figure 3.4: Landuse / Land cover map of the study area.

3.5 SOIL

Major part of the study area is occupied by Alfisols, which includes red sandy soil, red loamy soil and mixed red and black soils. Soils are porous and friable, tight textured, usually devoid of lime kankars and free of carbonates. It is usually suitable for cultivation of paddy and a large variety of other crops.

3.6 GEOLOGY

Geologically, the Angul district consists of rocks of Iron-Ore Super Group, Easternghat Super Group and Gondwana Super group. Besides these laterites and alluvial deposits of Quaternary period also occurs at places.

The rocks of Iron-Ore super group consist mainly of Quartzites (known as Tikra Quartzites) and Mica schists. Eastern Ghat Supergroup of rocks mainly comprising quartz-feldspar-garnet-sillimanite-graphite schist/gneiss, charnokite, pyroxene granulite and gneiss (augen, garnetiferous, biotite gneiss, migmatised khondalite).

Rocks of the Gondwana Super Group predominantly characterize the study area. The rock comprises of sandstone, carbonaceous shale and coal bands with pink clay and pebbly sandstones. Gondwana rocks are overlain by recent alluvium and valley fill materials at places and underlain by Precambrian basement.

The recent to sub-recent alluvium occur as flood-plain and channel deposits along the tributaries of Brahmani River. It comprises coarse to fine sand, gravel, silt and clay.

Geological map of the Talcher basin is shown in ***Figure 3.5***.

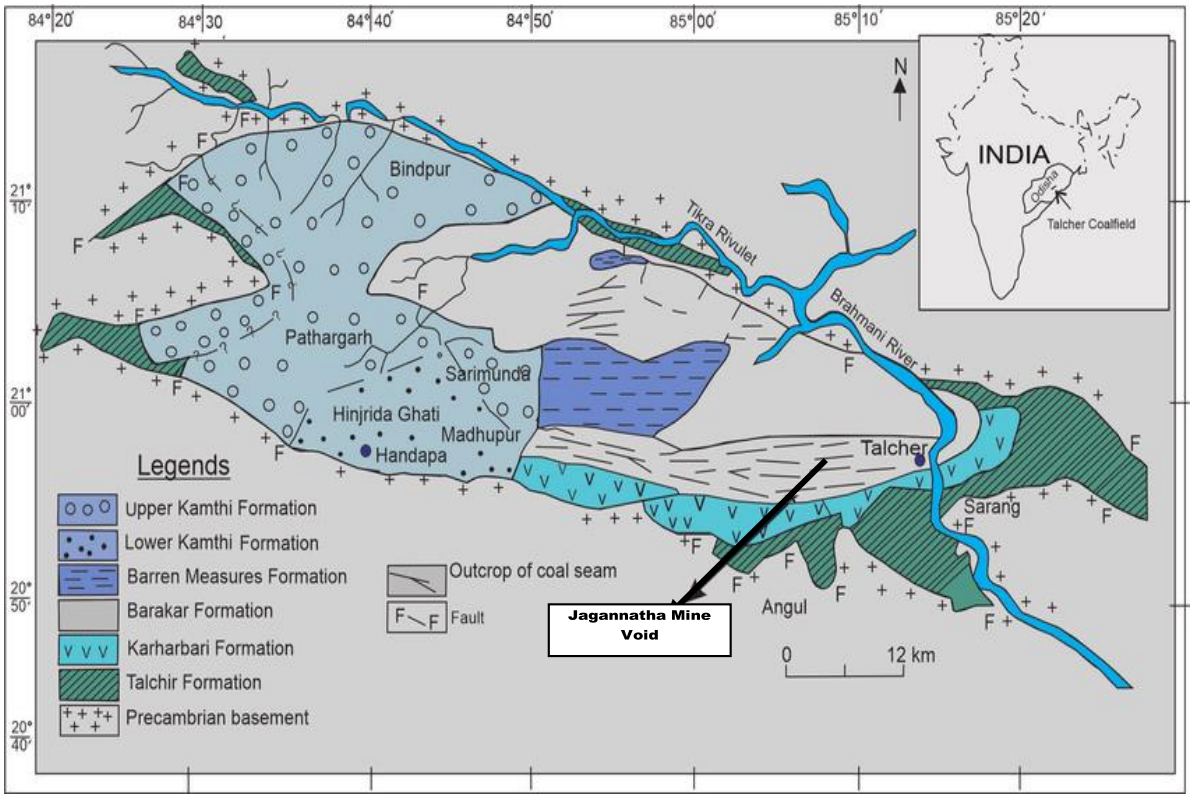

Figure 3.5: Geological Map of the Talcher Coal Field

The abandoned Jagannatha Mine is characterized by the Barakar formations underlain by pebbly sandstones and then the Karhabari formation (***Table 3.2***). The coal seams were found in the Barakar formations and the Karhabari formations. It is observed that granitoids appeared in South East and South West patches of the study area. Sandstone and Shale underlie the Karhabari formations.

Table 3.2: Stratigraphy in the study area.

Age	Formation	Lithology
Quaternary	Recent	Alluvium and Laterite
Lower Permian	Baraker	Sandstone, Pebbly sandstone and coal seams
Lower Permian	Karharbari	Sandstone and Coal Seam

Upper carboniferous to Lower Permian	Talchir	Sandstone and Shale
Precambrian	Eastern Ghat Supergroup	Schist/gneiss, charnokite, pyroxene granulite and gneiss

Geological map of the buffer zone of 12 km is shown in ***Figure 3.6***.

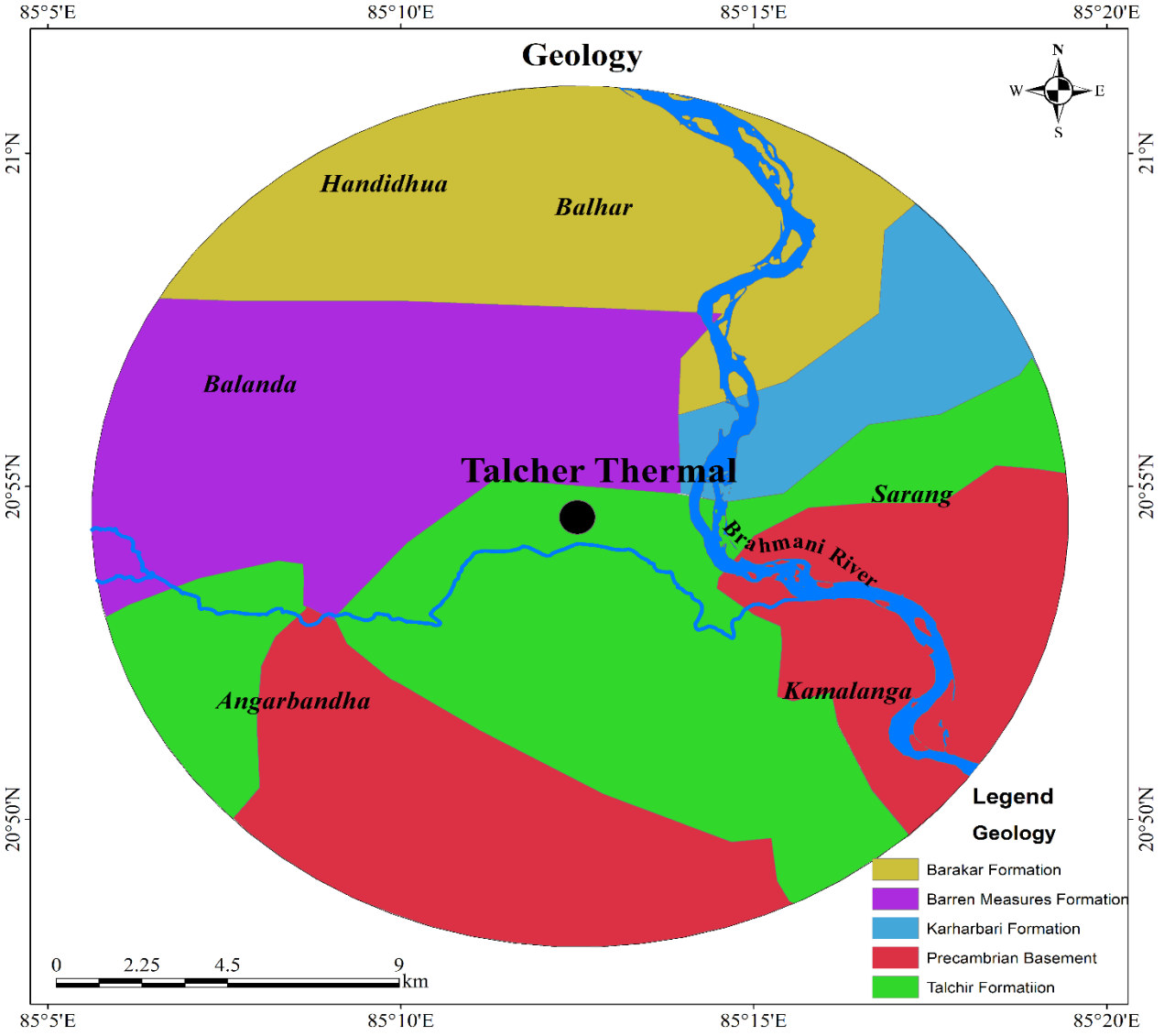

Figure 3.6: Geological map of the buffer zone

3.7 HYDROGEOLOGY

The hydrogeological condition of the study area can be broadly grouped into three units, i.e., Consolidated, Semi-Consolidated and Unconsolidated formations.

Consolidated Formation includes Granite, Granite gneiss, Charnockites, Khondalites, Quartzite, Phyllites, Mica schist etc. These rocks are devoid of primary porosity. The secondary porosity developed in the rocks due to intense weathering and fracturing, which forms repository and passage for movement of ground water. Groundwater occurs under water table condition in the weathered residuum and in semi-confined to confined condition in fractured rocks at deeper depths. The thickness of weathered residuum varies from 5 to 20 m. The weathered and semi-weathered granite gneiss form moderately potential aquifers.

Semi-consolidated Formation includes rocks of Gondwana group comprising mainly of sandstone and shale. The sandstone when weathered and fractured form good aquifer. Groundwater occurs under water table condition in the weathered zone and under semi-confined to confined condition in the fracture zone.

Unconsolidated Formation includes laterite and alluvium. In these formations groundwater occurs under water table condition and the aquifers have moderate to good yield.

The groundwater abstraction sources are mainly open wells and India Mark-II hand pumps, which are used to meet the domestic and drinking water requirements in the study area. The groundwater abstraction for agricultural requirement is almost insignificant.

4 DATA REQUIREMENT AND METHODOLGY

4.1 DATA REQUIREMENT

Following data are required for undertaking various studies to decipher the hydro-geology of the study area:

a) Physiographic Data /Maps

1. Topographical map (DEM) of the study area shall be prepared.
2. Location map showing the location of the plan site, villages etc.
3. Land use map
4. Map showing location of various surface and ground water sources
5. Drainage map of the area

b) Geological Data

1. Geological map of the area
2. Lithologs/geological information surrounding area,

c) Climate data

1. Daily/Monthly rainfall and temperature data for 10 years

d) Groundwater data and Surface water data

1. Water level data at different observation wells/ piezometers
2. Water quality data of ground water and surface water

4.2 METHODOLOGY

A brief of the methodology followed for achieving various objectives and scope elements of the study is given below in **Table 3**:

Table 3: Methodology vis-a-vis objective/scope of the study

S. No.	Objective/Scope	Methodology
SURFACE WATER HYDROLOGY		
S1	Review available study on water availability from the identified source.	All the available data / reports / literature available with NTPC and other organizations shall be collected and reviewed for various aspects such as source water availability, allocation, downstream users, trends in water utilization in the past etc.
S2	To study drainage patternof the study area	SoI toposheets / Satellite data shall be used for preparation of drainage map of the study area. Satellite data for pre- and post-monsoon periods.
S3	Identification of surface water bodies within study area	Surface water bodies shall be identified from Satellite data. Field survey shall be carried outfor ground verification and to check the health of the water bodies. Efforts shall be made to include information related to their location detail, present status, exploitation and potential for development etc.
S4	Review available study on surface water quality and current sources of contamination, if any	Available literature/studies shall be reviewed for water quality assessment and contamination of surface water sources. Water samples shall be collected and analysed. Inter-relationship between surface waterquality and current sources of contamination,if any, shall be evaluated based on water quality characteristics.
S5	To develop a plan for annual review and monitoring of surface water systems in the study area	Monitoring network shall be developed/ suggested based on the possible impact on water quality of surface water systems in the Mine Void area, if any. Specific locations of source for monitoring, parameters to be monitored, methodology for monitoring and assessment and frequency of monitoring will be suggested.

S. No.	Objective/Scope	Methodology
S6	Status for rainwater harvesting potential at NTPC premises.	The potential for rainwater harvesting will be assessed and suggestions for augmenting groundwater recharge will be provided.
GROUNDWATER HYDROLOGY		
G1	Define the present hydro-geological scenario of the study area through a water table contour map	Available data on groundwater levels will be collected and processed for the preparation of contour map. This map along with other hydro-geological data shall be used to analyses the present hydro-geological scenario of the study area.
G2	Identify aquifers, their characteristics and present levels of exploitation, assessment of Groundwater depletion, if any	Aquifers will be identified based on field surveys, bore logs/litho logs data, etc. Draft of groundwater shall be evaluated based on sample survey. Information/data from available reports and other literature shall be used.
G3	Review the available study on groundwater quality and current sources of contamination, if any	Available literature shall be reviewed and interrelationship between ground water quality and current sources of contamination, if any, shall be evaluated based on water quality characteristics.
G4	To evaluate overall impactof Ash disposal in Mine Void of power project on the groundwater systems	The impact shall be assessed based on groundwater level data, water quality assessment and hydro-geological conditions in the Mine Void area. During the study period at 3 locations pump test shall be carried out in the study area in order to estimate the lateral and vertical variations in hydraulic characteristics.
G5	To develop a monitoring network for annual reviewand monitoring of groundwater levels and quality	A monitoring network will be developed /suggested based on the variation in water levels and water quality data of groundwater. Specific locations of source, parameters to be monitored, methodology for monitoring and assessment, and frequency of monitoring shall also be suggested.

S. No.	Objective/Scope	Methodology
	FIELD STUDIES	
F1.	Geological mapping of the study area including identification of litho units, etc.	This shall be done based on the well logs/litho logs data, available reports and satellite imageries.
F2.	Well logging for water level measurements as well as water quality monitoring to determine hydraulic gradients and groundwater flow characteristics using flow net analysis: Pre-monsoon and post monsoon seasons	Water levels shall be measured using water level indicators. The RL of the wells shall be measured either through differential GPS or ground surveys. For determination of water quality, samples will be collected and analysed using standard methods. Water level and water quality shall be measured both in pre (March/April 2024-25) and post monsoon (Oct./Nov. 2024-25) seasons.
F3	Long-duration pumping tests on existing and new test wells.	To evaluate the aquifer conditions/ hydro-geological conditions / hydraulic characteristics in Mine Void area, pump test shall be carried out at 3 locations.
F4	Monitoring of surface and groundwater quality.	Water quality parameters like, pH, EC, DO, BOD, COD, NH_3, Major cations (Na, K, Ca, Mg, and Fe), major anions (CO_3, HCO_3, Cl, SO_4, NO_3, and PO_4), Silica, oil & grease, phenolic compound, Bacteriological, total coliform and Heavy metals (Cd, Zn, Hg, As, Cr, Pb, Cu, Se, Fe, B, Al, Mn, Co, Ni, Ag, Ba, Rh)

5 FIELD INVESTIGATIONS

A team of Geoscience Consultancy Services visited the NTPC Talcher in order to conduct preliminary investigation, site selection and pre-monsoon field sampling during 04.05.2024 to 11.05.2024. An official meeting was conducted with the NTPC official including Mr. Anjan Krushna Kamila (AGM-TS/EMG/FQA), Mr. Debajit Mohanty (DGM-EMG), Mr. Piyush Badgujer (Sr. Manager-Civil) and Mr. Narayan Moorty (Environmental Engineer) to discuss the project objectives and study plan. Field area was visited along with Mr. Debajit Mohanty and Mr. Narayan Moorty in order to locate the mine void area and identify the old monitoring network.

5.1 COLLECTION OF WATER SAMPLES

The water samples were collected in the periphery of 12 km from different sources were collected from surface water and groundwater sources. Total 48 water samples, which includes 24 samples from surface water and 24 samples from groundwater sources. Details of water samples collected are given in ***Table 5.1***.

Table 5.1: Details of samples collected for groundwater and surface water analysis.

S. No.	Code	Source	Location	Latitude (ºN)	Longitude (ºE)
Groundwater Stations					
1	TLGW-01	DW	Kulei	20.9927	85.2674
2	TLGW-02	HP	Pitiri High school	20.9461	85.2766
3	TLGW-03	DW	Parjang Aaganbai opposite police station	20.9217	85.3166
4	TLGW-04	HP	Lodhani	20.8767	85.3189
5	TLGW-05	HP	Sishu mandir	20.8444	85.2836

S. No.	Code	Source	Location	Latitude (ºN)	Longitude (ºE)
			Mangalpur		
6	TLGW-06	HP	Gov High School Nauhata	20.8314	85.2244
7	TLGW-07	HP	Primary school Dishahi	20.8108	85.1864
8	TLGW-08	HP	On Angul Road	20.8427	85.1314
9	TLGW-09	DW	Suksingha on road	20.8787	85.1096
10	TLGW-10	HP	Badasinghada	20.9215	85.1331
11	TLGW-11	DW	Dera	20.9494	85.1699
12	TLGW-12	DW	Goverdhan Pardhan House	21.0108	85.1778
13	TLGW-13	HP	On high way Sarang High school	20.9207	85.2541
14	TLGW-14	HP	Kanakdurga	20.9196	85.2312
15	TLGW-15	DW	Nityanada Ashram (Oppo. Police Stn.)	20.9485	85.2307
16	TLGW-16	HP	Jagannath temple NTPC	20.9013	85.2041
17	TLGW-17	HP	School on road	20.8819	85.2182
18	TLGW-18	HP	Outside Primary school	20.8738	85.2471
19	TLGW-19	HP	Kendupatana	20.8620	85.1692
20	TLGW-20	DG	On Road (Twin wells)	20.8900	85.1723
21	TLGW-21	DW	Shiv Mandir dug well	20.9027	85.1591
22	TLGW-22	DW	Home well	20.9228	85.1851
23	TLGW-23	HP	Ghantapada	20.9296	85.1638
24	TLGW-24	DW	On Road, BALUNGA	20.9688	85.1980
Surface Water Stations					
1	TLSW-01	Canal	Kulei	20.9949	85.2712
2	TLSW-02	Pond	Pitri	20.9494	85.2729
3	TLSW-03	Pond	Parjang	20.9245	85.3160
4	TLSW-04	Canal	Lodhani	20.8789	85.3203
5	TLSW-05	Canal	Mangalpur	20.8383	85.2669
6	TLSW-06	Pond	Park And Pond	20.8042	85.2083
7	TLSW-07	Pond	NALCO Pond	20.8446	85.1897
8	TLSW-08	Mine void	Mine Void 7	20.9534	85.1335

S. No.	Code	Source	Location	Latitude (ºN)	Longitude (ºE)
9	TLSW-09	Pond	Kurudol	20.8757	85.1394
10	TLSW-10	Pond	Badasinghada	20.9214	85.1326
11	TLSW-11	Mine void	Mine Void 4	20.9460	85.1448
12	TLSW-12	Pond	Behind Cineplex Angul	20.8400	85.1421
13	TLSW-13	Pond	Sarang	20.9233	85.2578
14	TLSW-14	Pond	Santhapada	20.9218	85.2302
15	TLSW-15	River	Brahamani River	20.9477	85.2416
16	TLSW-16	Pond	NTPC Pond	20.9126	85.2106
17	TLSW-17	Canal	Talchir Town Market	20.9482	85.2247
18	TLSW-18	Pond	Durgapur	20.8809	85.2543
19	TLSW-19	River	Downstream Nandira River	20.8807	85.2370
20	TLSW-20	River	Upstream Nandira River	20.8824	85.1719
21	TLSW-21	Pond	Near Baghamara High School	20.9293	85.1735
22	TLSW-22	Pond	Ghantapadu	20.9364	85.1911
23	TLSW-23	Pond	Mine Void	20.9329	85.1544
24	TLSW-24	River/Canal	Brahmani River (Samal Barrage)	21.0715	85.1326

HP- Hand Pump, DW - Dug Well

For groundwater, the samples were collected from dug well (open wells) and hand pumps (bode wells) (***Figure 5.1***). For surface water, the samples were collected from Canal / ponds / river and mine void (***Figure 5.2***).

Five samples were taken from each site, three for physico chemical analysis, one for heavy metal analysis and one for bacteriological analysis.

The water samples are collected in standard plastic wares. The water samples are collected directly from the sites, filtered and preserved as per standard procedures (BIS, 1988). In order to avoid any precipitation of trace

elements, the samples collected for metals were acidified using HNO_3 to pH≈2 in the field whereas unfiltered samples were collected for analysis of COD were preserved with H_2SO_4 (APHA, 2003). Samples for bacteriological analysis were collected in pre-sterilised screw-cap bottles.

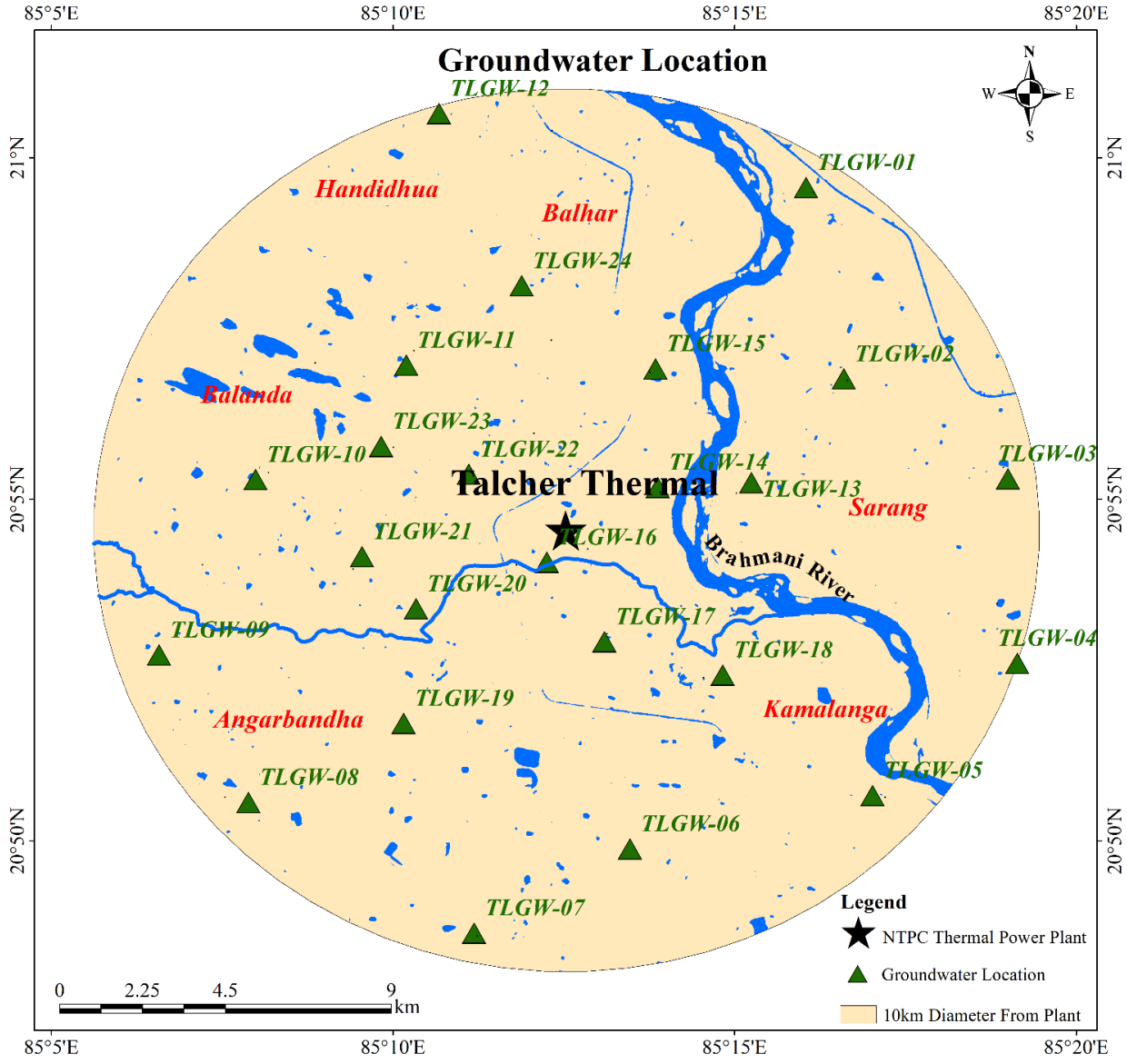

Figure 5.1: Groundwater sampling locations in the buffer zone.

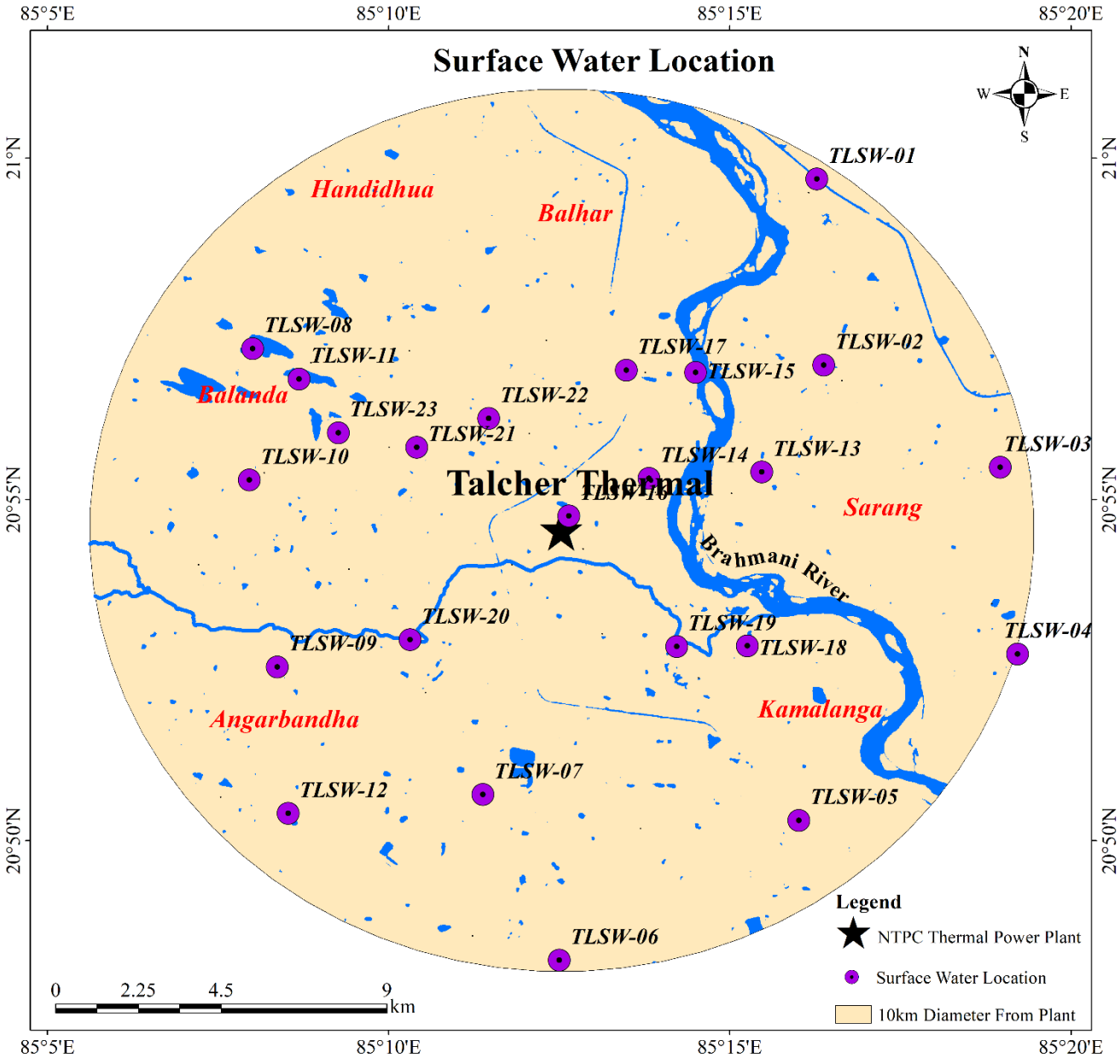

Figure 5.2: Surface water sampling locations in the buffer zone.

Photographs of water sample collection are shown in ***Figures 5.3 - 5.5***.

Figure 5.3: Water sampling from the surface water and groundwater within 12km buffer area.

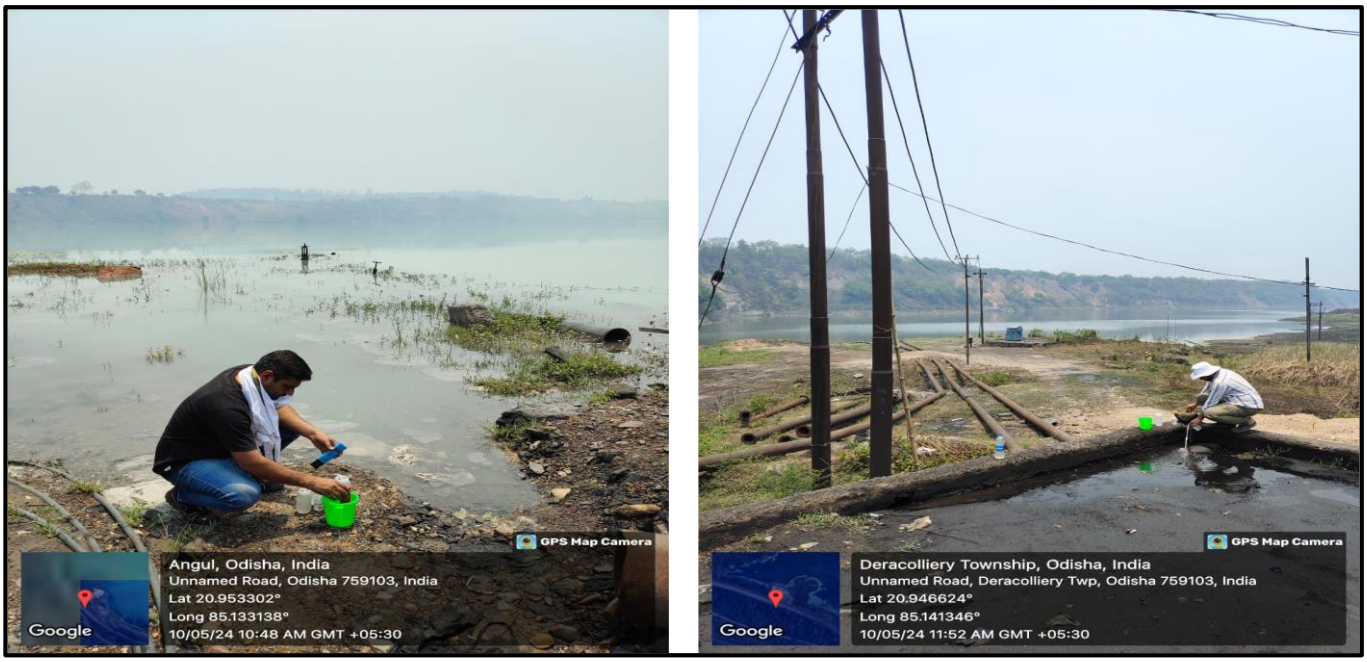

Figure 5.4: Surface water sampling from the mine void.

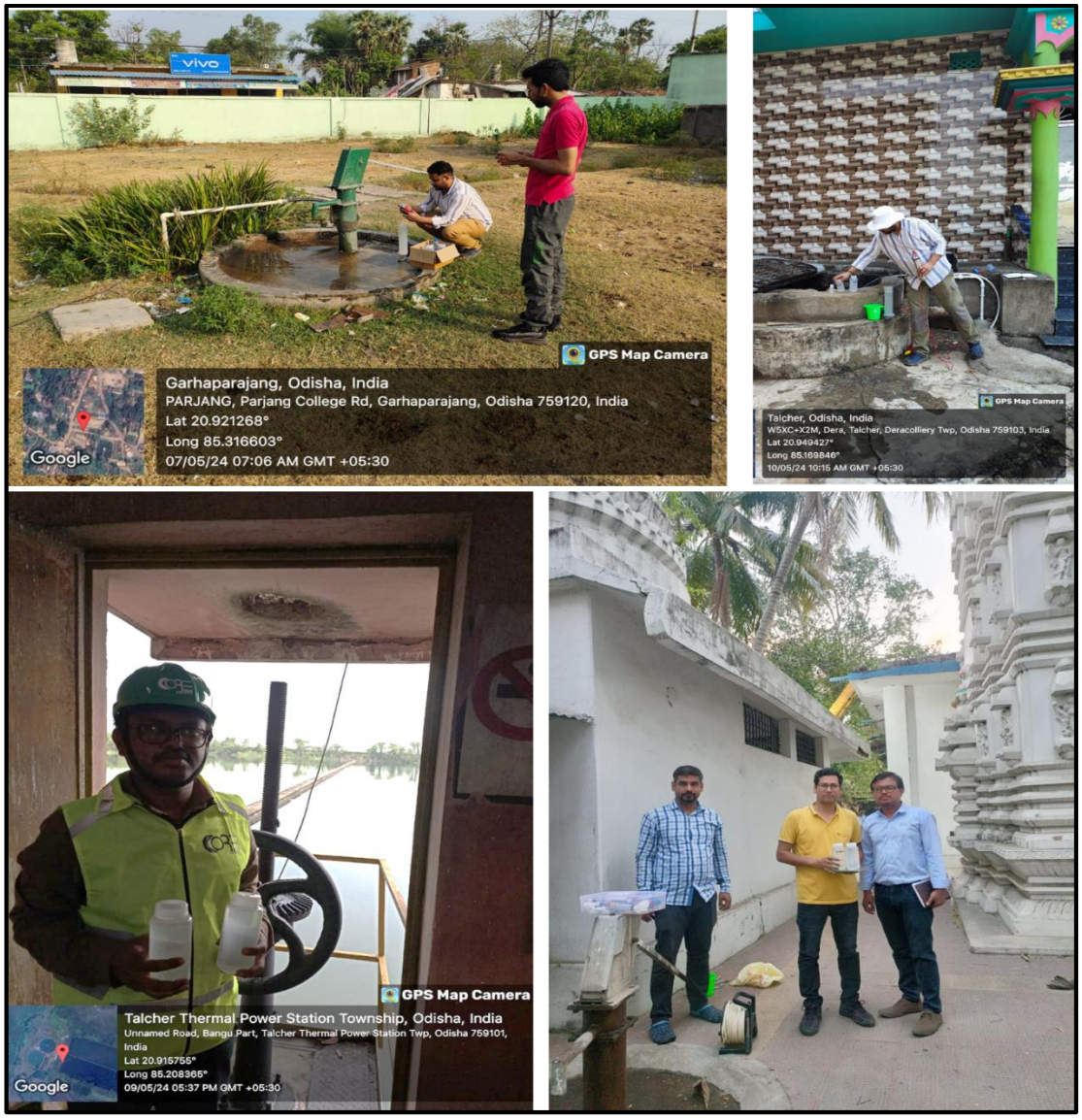

Figure 5.5: Groundwater/Surface water sampling from the reservoir and township.

5.2 SITE IDENTIFICATION FOR PUMP TEST

Long term pump test is to be carried out at three locations on existing wells in order to estimate the variations in hydraulic characteristics of the study area. For the same, reconnaissance survey was carried out during the first field visit and three locations were identified on the base of the groundwater flow direction obtained from the old reports (***Figure 5.6***). The finalization of the pumping test location and wells will be carried out after the preliminary results of the data collected.

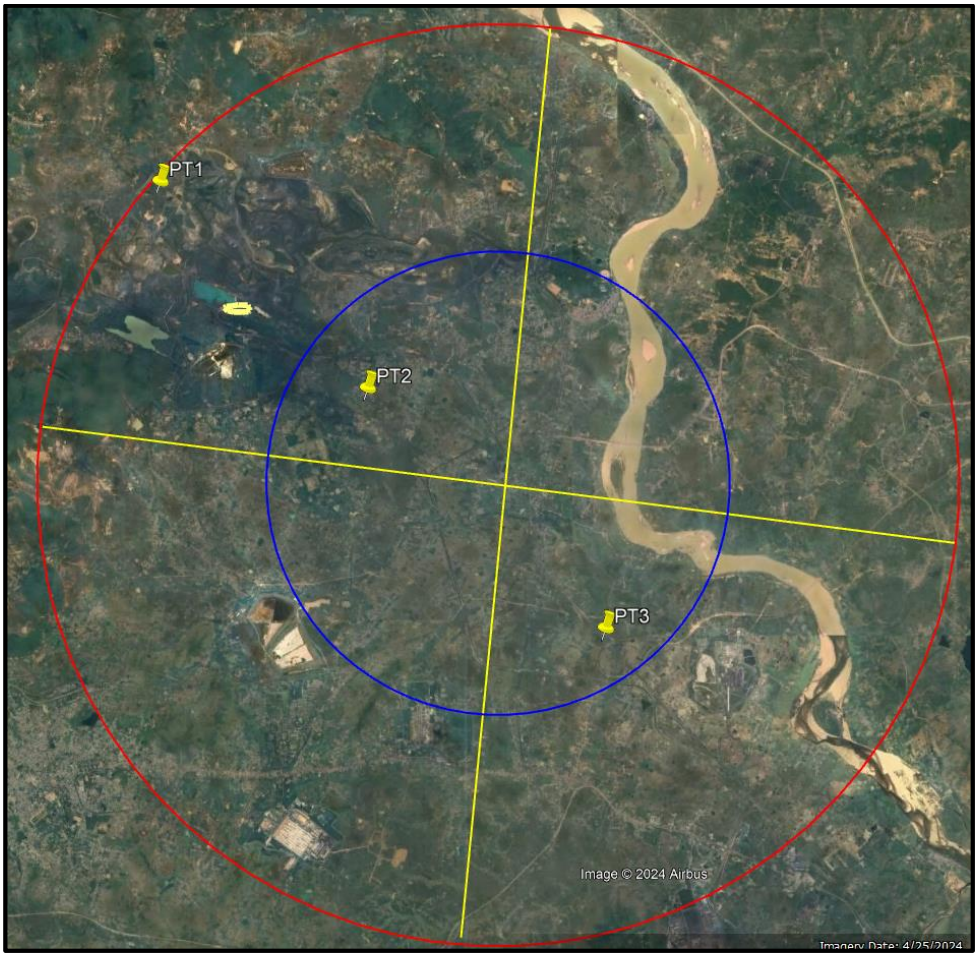

Figure 5.6: Proposed location identified for the three Pump Tests.

5.3 SITE IDENTIFICATION FOR INFILTRATION TEST

As per the scope of work, Infiltration studies for determining rate of infiltration using double ring infiltrometers at minimum 5 locations in and around ash disposal area during Pre-Monsoon and Post-Monsoon Seasons will be carried out.

The finalization of the infiltration test location was carried out during the first field visit along with Mr. Debajit Mohanty (DGM/EMG) and Mr. Narayan Moorty (Environmental Engineer) in and around the ash disposal area (***Figure 5.7***). Proposed five locations for the Double ring infiltrometer test to be conducted in post-monsoon season 2024 and pre-monsoon 2025 are shown in ***Figure 5.8***.

Figure 5.7: Field visit to the Ash disposal area in the Jagannath Mine void

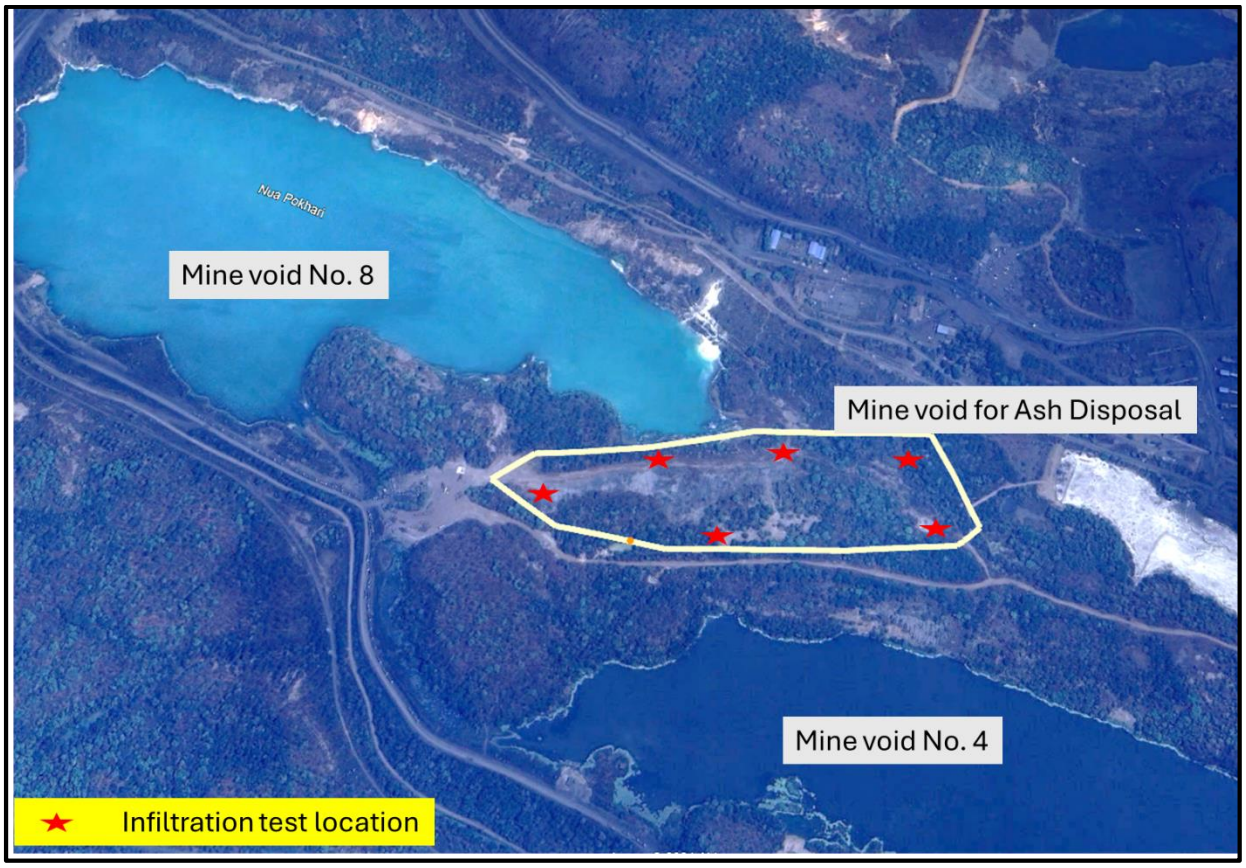

Figure 5.8: Proposed location for the double ring infiltrometer test

6 WATER QUALITY

The quality of water depends on many individual hydrological, physical, chemical and biological factors. Generally, higher proportions of dissolved constituents are found in groundwater than in surface water because of greater interaction of groundwater with various materials in geologic strata. The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may be hazardous to health. Some of the heavy metals are extremely essential to humans, for example, Cobalt, Copper, etc., but large quantities of them may cause physiological disorders. The contamination of groundwater by heavy metals has assumed great significance during recent years due to their toxicity and accumulative behavior. These elements, contrary to most pollutants, are not biodegradable and undergo a global eco-biological cycle in which natural waters are the main pathways. The determination of the concentration levels of heavy metals in these waters, as well as the elucidation of the chemical forms in which they appear is a prime target in environmental research today.

Quality of water is also influenced by anthropogenic factors. For example, overexploitation of groundwater in coastal regions may result in sea water ingress and consequent increase in salinity of groundwater and excessive use of fertilizers and pesticides in agriculture and improper disposal of urban/industrial waste can cause contamination of groundwater resources. Groundwater contains a wide variety of dissolved inorganic chemical constituents in various concentrations, resulting from chemical and biochemical interactions between water and the geological materials. Inorganic contaminants including salinity, chloride, fluoride, nitrate, iron and arsenic are important in determining the suitability of groundwater for

drinking purposes.

6.1 RESULTS OF WATER QUALITY ANALYSIS

Analysis results of detailed water quality monitoring (groundwater as well as surface water) are presented in ***Table 6.1***.

One of the main objectives of groundwater quality monitoring is to assess the suitability of groundwater for drinking purposes. The physical and chemical quality of groundwater is important in deciding its suitability for drinking and other purposes. As such, the suitability of groundwater for potable uses regarding its chemical quality must be deciphered and defined based on some vital characteristics of water. Bureau of Indian standards (BIS) formally known as Indian Standard Institute vide its document IS: 10500: 2012 has recommended the quality standards for drinking water and these have been used for finding the suitability of groundwater. Based on classification, groundwater has been categorized as desirable, permissible, and unfit for human consumption. From the analytical results, it is seen that majority of water samples collected from hand pumps and bore wells, fall under desirable or permissible category, and hence are suitable for drinking purposes. The chemical parameters like TDS, Chloride, Fluoride, Iron, Arsenic and Nitrate etc. are main constituents defining the quality of groundwater in unconfined as well as confined aquifers.

Table 6.1: Pre-monsoon (2024) physio chemical and bacteriological quality of surface water sources of Jagannath mine void buffer area.

Sample ID	Source	Temp (^{0}C)	pH	EC (mg/l)	TDS (mg/l)	TSS (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Alkalinity (mg/l)	Hardness (mg/l)	Bacteriological TC (MPN/100ml)	Oil & Grease (mg/l)	Phenolic Compound	Silica (mg/l)
TLSW-1	**Canal**	29.9	8.12	122	79	57	5.1	2.2	20	35.0	39.1	ND	ND	ND	14
TLSW-2	**Pond**	31.1	8.23	182	119	20	4.5	3.0	22	43.7	83.6	235	0.2	ND	17
TLSW-3	**Pond**	31.3	7.60	1067	670	53	4.9	2.5	17	244.7	356.7	280	ND	ND	13
TLSW-4	**Canal**	30.4	7.92	118	78	32	6.1	5.1	26	36.7	56.8	98	ND	ND	20
TLSW-5	**Canal**	30.8	8.16	125	81	50	6.4	3.3	30	38.3	48.5	62	ND	ND	10
TLSW-6	**Pond**	30.8	7.70	299	194	47	4.9	4.0	23	88.3	118.3	1236	ND	ND	15
TLSW-7	**Pond**	31.4	8.04	498	309	25	4.3	2.6	29	78.3	142.9	156	1.2	ND	12
TLSW-8	**Mine void**	29.9	7.44	605	360	16	7.2	2.9	24	37.5	254.3	16	0.6	ND	17
TLSW-9	**Pond**	31.8	8.30	642	390	42	4.1	2.7	22	163.3	138.0	110	ND	ND	22
TLSW-10	**Pond**	31.4	8.02	660	433	24	4.8	1.6	27	205.8	175.6	31	0.6	ND	11
TLSW-11	**Mine void**	30.2	6.9	704	439	47	6.7	4.0	30	65.0	304.6	23	ND	ND	22
TLSW-12	**Pond**	31.7	7.6	530	364	43	3.7	5.8	45	162.5	234.3	1650	1	ND	16
TLSW-13	**Pond**	31.0	7.8	353	248	36	3.8	3.1	23	95.8	121.6	110	0.2	ND	15
TLSW-14	**Pond**	31.2	7.3	185	111	20	4.2	3.0	26	48.0	68.2	174	0.8	ND	14
TLSW-15	**River D/s**	25.5	8.05	126	82	89	6.1	2.4	30	40.2	53.8	150	1.5	ND	18
TLSW-16	**Pond**	31.8	8.2	131	85	35	6.8	4.4	22	39.7	66.0	ND	0.3	ND	20
TLSW-17	**Canal**	30.9	8.0	122	78	70	5.6	3.2	31	33.6	54.2	41	ND	ND	18
TLSW-18	**Pond**	30.8	8.3	166	106	32	4.1	4.0	18	45.0	63.7	ND	ND	ND	14
TLSW-19	**River D/s**	26.7	8.2	498	290	110	5.9	2.6	20	73.5	149.8	716	0.8	ND	6
TLSW-20	**River U/S**	26.2	8.1	572	324	65	5.2	3.2	25	87.5	163.2	430	0.5	ND	11
TLSW-21	**Pond**	31.2	7.90	308	190	30	3.9	3.0	28	71.3	92.8	285	1.1	ND	10
TLSW-22	**Pond**	30.6	7.78	360	214	27	4.4	4.0	18	82.7	97.3	147	1.4	ND	8
TLSW-23	**Pond**	30.2	7.83	794	518	31	5.2	8.0	29	186.7	254.5	82	ND	ND	12
TLSW-24	**River U/s**	30.1	8.10	123	75	82	6.9	3.0	34	34.3	41.4	78	ND	ND	17
Acceptable Limit			**6.5-8.5**		**500**	**NS**		**NS**	**NS**	**200**	**200**	**Nil**	**Nil**	**0.5**	**0**
Permissible Limit			**NR**		**1000**	**NS**		**NS**	**NS**	**600**	**600**	**500***	**Nil**	**NR**	**0**
Detection Limit					**3**	**0.02**		**0.02**	**3**	**10**	**10**	**~10**	**0.5**	**0.00001**	

Table 6.2: Pre-monsoon (2024) Major ion concentration in surface water sources of Jagannath mine void buffer area.

Sample ID	Source	F^- (mg/l)	Cl^- (mg/l)	HCO^{3-} (mg/l)	SO_4^{2-} (mg/l)	NO_3^- (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^+ (mg/l)	K^+ (mg/l)
TLSW-1	**Canal**	0.2	10.0	42.0	5.8	0.0	10.4	3.2	5.8	1.4
TLSW-2	**Pond**	0.4	14.2	52.4	15.0	3.4	20.0	8.2	4.5	1.0
TLSW-3	**Pond**	1.2	46.5	293.6	149.0	7.0	115.0	17.0	30.4	10.6
TLSW-4	**Canal**	0.1	8.0	44	3.2	0.2	16.0	4.1	2.0	0.5
TLSW-5	**Canal**	0.2	7.6	46	7.2	0.0	14.5	3.0	1.4	1.2
TLSW-6	**Pond**	1.0	15.5	106	19.0	0.5	26.0	13.0	10.2	2.6
TLSW-7	**Pond**	0.8	35.0	94	89.1	10.6	37.5	12.0	25.6	5.1
TLSW-8	**Mine void**	1.0	31.8	45	162.0	1.5	64.0	23.0	18.7	12.8
TLSW-9	**Pond**	0.5	68.0	196	21.0	1.0	24.0	19.0	46.1	14.9
TLSW-10	**Pond**	0.6	30.0	247	40.0	0.4	44.0	16.0	40.6	14.1
TLSW-11	**Mine void**	1.2	25.0	78	202.0	0.3	84.2	23.0	16.7	9.4
TLSW-12	**Pond**	1.0	20.0	195	51.0	1.3	56.0	23.0	10.5	6.2
TLSW-13	**Pond**	0.8	32.0	115	21.0	1.6	24.0	15.0	24.6	14.3
TLSW-14	**Pond**	0.3	18.1	57.6	6.0	0.4	14.8	7.6	4.9	1.3
TLSW-15	**River D/s**	0.2	8.2	48.2	3.5	1.6	10.2	6.9	2.2	1.2
TLSW-16	**Pond**	0.4	12.0	47.6	2.4	0.1	14.4	7.3	1.0	0.0
TLSW-17	**Canal**	0.1	10.4	40.3	5.0	0.0	13.5	5.0	2.2	1.1
TLSW-18	**Pond**	1.0	10.0	54	16.0	0.0	12.0	8.2	3.0	1.8
TLSW-19	**River D/s**	1.2	49.3	88.2	60.0	2.6	32.0	17.0	26.8	12.4
TLSW-20	**River U/S**	1.8	58.2	105	69.0	3.4	38.2	16.5	22.3	10.1
TLSW-21	**Pond**	0.1	22.0	85.6	27.0	1.0	24.0	8.0	18.6	3.9
TLSW-22	**Pond**	0.7	43.0	99.2	16.0	0.0	22.5	10.0	15.3	7.7
TLSW-23	**Pond**	0.6	35.0	224	94.0	12.0	74.0	17.0	48.9	12.8
TLSW-24	**River U/s**	0.4	10.0	41.2	5.9	0.0	10.0	4.0	2.9	0.7
Acceptable Limit		**1**	**250**	**NS**	**200**	**45**	**75**	**30**	**NS**	**NS**
Permissible Limit		**1.5**	**1000**	**NS**	**400**	**NR**	**200**	**100**	**NS**	**NS**
Detection Limit		**10**	**10**	**10**	**0.02**	**3**	**3**	**3**	**3**	

Table 6.3: Pre-monsoon (2024) Heavy Metal concentration in surface water sources of Jagannath mine void buffer area.

Sample ID	Source	As	Hg	Pb	Cd	Total Cr	Cr-6	Cu	Zn	Se	Fe	Li	B	Al	Mn	Co	Ni	Sr	Ag	Ba	Rh
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
TLSW-1	Canal	0.003	ND	0.002	ND	0.015	ND	0.00	ND	ND	0.11	ND	0.32	0.01	0.01	ND	ND	0.01	ND	0.10	ND
TLSW-2	Pond	0.005	ND	0.003	ND	ND	ND	0.01	ND	0.000	0.21	ND	0.25	0.06	0.03	0.00	ND	0.04	ND	0.11	ND
TLSW-3	Pond	0.008	ND	ND	ND	0.013	ND	0.00	ND	0.000	0.80	ND	0.39	0.08	0.03	0.00	ND	0.07	ND	0.14	ND
TLSW-4	Canal	0.006	ND	0.005	ND	0.023	ND	ND	ND	ND	0.43	ND	0.24	ND	ND	ND	ND	0.10	ND	0.11	ND
TLSW-5	Canal	0.004	ND	0.002	ND	0.019	ND	0.01	0.01	ND	0.11	ND	0.23	0.01	ND	ND	ND	0.15	ND	0.20	ND
TLSW-6	Pond	ND	ND	ND	ND	ND	ND	0.00	ND	0.000	0.52	ND	0.32	0.08	0.00	0.00	ND	0.11	ND	0.16	ND
TLSW-7	Pond	0.004	0.0018	0.017	0.005	0.071	0.014	0.04	0.01	0.001	1.32	0.002	0.25	0.32	0.03	0.03	ND	0.13	ND	0.75	ND
TLSW-8	Mine void	0.007	0.0003	0.004	0.001	0.030	0.002	ND	0.01	0.001	0.16	0.001	0.31	0.13	0.23	0.00	0.02	0.14	ND	0.24	ND
TLSW-9	Pond	0.006	0.0002	0.001	ND	0.011	ND	ND	ND	ND	0.20	ND	0.10	0.03	0.02	ND	ND	0.19	ND	0.14	ND
TLSW-10	Pond	ND	ND	0.001	ND	0.020	ND	0.01	0.02	ND	0.60	ND	0.09	0.03	0.02	ND	ND	0.20	ND	0.19	ND
TLSW-11	Mine void	0.006	0.0007	0.007	0.002	0.033	ND	ND	0.40	0.003	0.80	0.001	0.10	0.05	0.03	0.00	ND	0.10	ND	0.15	ND
TLSW-12	Pond	0.008	ND	0.004	ND	0.011	ND	ND	0.32	ND	0.80	ND	0.36	0.06	0.07	0.00	ND	0.07	ND	0.20	ND
TLSW-13	Pond	0.003	0.0011	0.002	ND	0.009	ND	ND	ND	ND	0.41	ND	0.43	0.02	0.04	ND	ND	0.10	ND	0.12	ND
TLSW-14	Pond	ND	0.0014	0.002	ND	ND	ND	ND	ND	ND	0.32	ND	0.29	0.01	0.00	ND	ND	0.09	ND	0.12	ND
TLSW-15	River	0.006	ND	ND	ND	0.009	0.002	0.00	0.03	ND	0.41	ND	0.35	0.03	0.00	ND	ND	0.12	ND	0.13	ND
TLSW-16	NTPC Pond	0.005	0.0015	ND	ND	0.012	ND	ND	0.04	ND	0.90	ND	0.44	0.24	0.01	0.01	ND	0.20	ND	0.17	ND
TLSW-17	Canal	0.000	ND	0.002	ND	0.014	ND	ND	ND	ND	0.41	ND	0.45	ND	0.00	0.00	ND	0.12	ND	0.17	ND
TLSW-18	Pond	0.000	0.0001	ND	ND	ND	ND	ND	0.02	ND	0.50	ND	0.16	0.06	0.00	ND	ND	0.17	ND	0.07	ND
TLSW-19	RiverD/N	ND	0.0002	0.001	0.003	0.009	0.003	ND	0.05	0.002	0.48	ND	0.31	0.10	0.08	0.01	0.00	0.14	ND	0.38	ND
TLSW-20	RiverU/S	ND	0.0003	ND	0.002	ND	ND	0.00	0.01	0.001	0.39	ND	0.09	0.08	0.18	0.01	0.01	0.10	ND	0.23	ND
TLSW-21	Pond	0.007	0.0005	ND	ND	0.009	ND	0.01	0.05	ND	0.70	ND	0.04	0.16	0.12	0.00	0.01	0.11	ND	0.21	ND
TLSW-22	Pond	ND	ND	ND	ND	0.012	ND	ND	ND	ND	0.21	ND	0.08	0.01	0.01	ND	ND	0.18	ND	0.16	ND
TLSW-23	Pond	ND	ND	0.008	ND	0.008	ND	ND	0.03	ND	0.20	ND	0.38	0.18	0.10	ND	0.01	0.15	ND	0.23	ND
TLSW-24	River	0.004	ND	ND	ND	0.009	ND	ND	ND	0.003	0.32	ND	0.41	ND	0.01	0.00	ND	0.08	ND	0.19	ND
Acceptable Limit		**0.010**	**0.001**	**0.010**	**0.003**	**0.050**	**NS**	**0.050**	**5.00**	**0.010**	**0.30**	**NS**	**0.50**	**0.03**	**0.10**	**0.02**	**0.02**	**0.03**	**0.10**	**0.70**	**NS**
Permissible Limit		**0.050**	**NR**	**NR**	**NR**	**NR**	**NS**	**1.500**	**15.00**	**NR**	**NR**	**NS**	**1.00**	**0.20**	**0.30**	**NR**	**NR**	**0.00**	**NR**	**NR**	**NS**
Detection Limit		**0.0005**	**0.0000**	**0.0001**	**0.0001**	**0.0010**	**0.0001**	**0.0001**	**0.0010**	**0.0001**	**0.0020**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**

Table 6.4: Pre-monsoon (2024) physio chemical and bacteriological quality of ground water sources of Jagannath mine void buffer area.

S.No.	Sample ID	Source	pH	EC	TDS	Alkalinity	Hardness	TH	BOD	COD	TSS	Bacteriological		Oil & Grease	Phenolic Compound	Silica
				(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	TC	FC	(mg/l)		(mg/l)
1	TLGW-1	DW	7.6	560	325	200	115	164	1	6	4.0	ND	ND	0.4	ND	4
2	TLGW-2	HP	7.5	871	545	146	90	202	0	0	0.0	ND	ND	ND	ND	6
3	TLGW-3	DW	6.7	560	345	160	65	101	4	7	3.0	23	2	0.3	ND	12
4	TLGW-4	HP	7.2	759	470	310	120	208	0	0	0.0	ND	ND	ND	ND	3
5	TLGW-5	HP	7.1	678	443	345	100	150	0	1	4.3	43	ND	ND	ND	13
6	TLGW-6	HP	7.5	1145	735	60	112	281	0	0	0.0	ND	ND	ND	ND	12
7	TLGW-7	HP	7.4	837	503	350	100	191	0	0	0.0	35	ND	ND	ND	10
8	TLGW-8	HP	6.8	1171	736	375	120	307	0	0	0.0	ND	ND	ND	ND	20
9	TLGW-9	DW	7.1	1041	724	342	90	234	2	6	6.4	12	3	ND	ND	16
10	TLGW-10	HP	7.6	255	154	115	35	77	0	0	5.5	ND	ND	0.6	ND	10
11	TLGW-11	DW	7.3	494	318	108	75	120	1	4	3.2	ND	ND	ND	ND	5
12	TLGW-12	DW	7.4	368	288	72	68	153	0	0	4.5	ND	ND	ND	ND	6
13	TLGW-13	HP	6.8	1744	994	325	110	326	0	0	0.0	ND	ND	ND	ND	12
14	TLGW-14	HP	7.3	492	275	183	45	95	0	0	0.0	ND	ND	ND	ND	13
15	TLGW-15	DW	6.9	667	454	135	75	228	3	13	7.2	ND	ND	0.2	ND	16
16	TLGW-16	HP	7.6	754	433	355	65	112	0	0	0.0	ND	ND	ND	ND	8
17	TLGW-17	HP	7.3	803	480	365	50	217	0	0	0.0	51	ND	ND	ND	10
18	TLGW-18	HP	7.1	1220	782	350	53	226	0	0	0.0	ND	ND	ND	ND	6
19	TLGW-19	HP	7.5	1246	730	370	110	305	0	0	2.2	ND	ND	ND	ND	11
20	TLGW-20	DW	7.4	1105	645	320	60	253	2	6	6.0	ND	ND	0.2	ND	16
21	TLGW-21	DW	8.2	146	77	630	40	48	0	0	5.2	ND	ND	ND	ND	13
22	TLGW-22	DW	7.1	472	415	370	100	161	1	4	4.7	ND	ND	0.4	ND	7
23	TLGW-23	HP	7.8	411	252	125	53	80	0	0	0.0	17	ND	ND	ND	5
24	TLGW-24	DW	7.9	356	252	180	52	86	0	0	3.2	21	ND	0.2	ND	13
Acceptable Limit		**IS 10500- 2012**	**6.5-8.5**		**500**	**200**	**200**	**NS**	**NS**	**NS**	**NS**	**Nil**	**Nil**	**0.5**	**0.001**	**NS**
Permissible Limit			**NR**		**1000**	**600**	**600**	**NS**	**NS**	**NS**	**NS**	**Nil**	**Nil**	**NR**	**0.002**	**NS**
Detection Limit					**3**	**10**	**10**		**0.02**	**3**	**0.02**	**~10**	**~10**	**0.5**	**0.00001**	

Table 6.5: Pre-monsoon (2024) Major ion concentration in ground water sources of Jagannath mine void buffer area.

S.No.	Sample ID	Source	F-	Cl-	HCO3-	SO42-	NO3-	Ca2+	Mg2+	Na+	K+
			(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
1	TLGW-1	DW	0.0	50	170	35	1.0	46.0	12.0	24.0	5.0
2	TLGW-2	HP	0.2	140	206	41	0.6	51.2	18.0	85.0	2.8
3	TLGW-3	DW	0.0	60	140	53	0.0	30.5	6.0	57.0	5.0
4	TLGW-4	HP	0.0	89	210	30	2.3	62.0	13.0	64.5	3.0
5	TLGW-5	HP	0.4	45	238	58	0.0	44.0	9.7	67.0	10.7
6	TLGW-6	HP	0.9	95	390	40	3.5	65.0	28.9	86.4	12.0
7	TLGW-7	HP	0.2	55	250	78	4.2	48.0	17.2	57.0	6.6
8	TLGW-8	HP	0.4	160	275	99	1.2	74.0	29.7	78.5	8.1
9	TLGW-9	DW	1.4	112	310	106	4.1	50.2	26.4	95.0	10.3
10	TLGW-10	HP	0.3	22	92	6	2.0	25.0	3.6	20.0	1.0
11	TLGW-11	DW	0.0	55	108	41	7.6	36.3	7.2	42.0	15.0
12	TLGW-12	DW	0.0	47	92	38	0.0	46.0	9.2	30.0	1.2
13	TLGW-13	HP	0.4	215	325	115	0.0	92.0	23.3	174.0	13.5
14	TLGW-14	HP	0.2	52	123	21	1.9	28.3	6.0	44.0	2.2
15	TLGW-15	DW	0.0	78	165	69	0.0	62.8	17.2	56.0	3.7
16	TLGW-16	HP	0.9	120	155	43	1.4	22.8	13.3	89.0	6.2
17	TLGW-17	HP	0.8	45	226	66	4.3	44.0	26.0	56.0	2.5
18	TLGW-18	HP	0.6	135	300	124	7.2	29.5	37.2	135.0	10.0
19	TLGW-19	HP	0.3	125	290	115	0.0	76.0	28.0	100.0	13.0
20	TLGW-20	DW	0.2	95	260	106	3.2	46.0	33.6	84.0	8.0
21	TLGW-21	DW	0.0	12	53	10	1.1	8.0	6.8	16.0	1.0
22	TLGW-22	DW	0.0	33	132	57	1.6	38.0	16.0	23.0	3.0
23	TLGW-23	HP	1.0	42	115	28	0.0	24.2	4.8	40.0	10.2
24	TLGW-24	DW	0.0	40	126	21	0.0	26.8	4.6	32.4	2.4
Acceptable Limit		IS 10500- 2012	1.0	250	NS	200	45	75	30	NS	NS
Permissible Limit			1.5	1000	NS	400	NR	200	100	NS	NS
Detection Limit			0.02	10		10	0.02	3	3	3	3

Table 6.6: Pre-monsoon (2024) Heavy Metal concentration in ground water sources of Jagannath mine void buffer area.

S.No.	Sample ID	Source	As	Hg	Pb	Cd	Total Cr	Cr-6	Cu	Zn	Se	Fe	Li	B	Al	Mn	Co	Ni	Sr	Ag	Ba	Rh
			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1	TLGW-1	DW	ND	ND	ND	ND	ND	ND	0.02	0.03	ND	0.07	ND	0.06	0.02	ND	ND	ND	0.02	ND	0.12	ND
2	TLGW-2	HP	0.008	0.0014	ND	0.0004	ND	ND	0.03	0.14	0.003	0.03	ND	0.13	0.02	0.05	0.00	ND	0.04	ND	0.09	ND
3	TLGW-3	DW	ND	ND	0.002	ND	0.02	0.002	ND	0.08	0.002	0.57	ND	0.05	ND	0.81	0.00	0.00	0.13	ND	0.06	ND
4	TLGW-4	HP	0.007	ND	ND	0.0003	0.04	0.003	0.03	0.46	ND	0.67	ND	0.12	0.02	0.01	0.00	0.01	0.09	ND	0.59	ND
5	TLGW-5	HP	ND	ND	ND	0.0004	ND	ND	0.01	0.06	ND	0.59	ND	0.46	ND	ND	ND	ND	0.12	ND	0.35	ND
6	TLGW-6	HP	0.006	ND	ND	0.0004	ND	ND	0.01	0.82	ND	0.03	ND	0.14	0.02	0.11	0.00	0.00	0.09	ND	0.02	ND
7	TLGW-7	HP	0.005	ND	ND	0.0003	0.01	0.002	ND	0.02	0.002	0.03	ND	0.25	ND	0.01	ND	ND	0.08	ND	0.07	ND
8	TLGW-8	HP	ND	ND	0.006	ND	0.02	ND	0.01	0.14	0.005	3.10	ND	0.46	0.02	0.34	0.00	0.00	0.10	ND	0.04	ND
9	TLGW-9	DW	ND	ND	0.004	0.0004	0.03	0.003	0.04	ND	0.003	2.72	ND	0.87	ND	0.00	ND	ND	0.16	ND	0.08	ND
10	TLGW-10	HP	0.013	0.0018	0.008	0.0015	0.03	0.011	0.06	1.39	0.006	6.26	0.001	1.40	0.26	0.25	0.01	0.03	0.10	ND	0.94	ND
11	TLGW-11	DW	ND	ND	ND	0.0032	0.02	ND	ND	ND	0.004	0.06	0.002	0.51	0.01	0.01	0.00	ND	0.16	ND	0.02	ND
12	TLGW-12	DW	ND	ND	0.003	0.0005	0.02	ND	ND	ND	ND	1.85	ND	0.52	ND	ND	ND	ND	0.06	ND	0.05	ND
13	TLGW-13	HP	0.004	ND	ND	0.0006	0.04	0.001	0.04	0.27	ND	0.17	ND	0.87	0.20	1.27	ND	0.01	0.09	ND	0.57	ND
14	TLGW-14	HP	0.002	0.0006	0.005	0.0008	0.01	ND	ND	0.02	0.004	4.00	ND	1.24	ND	0.24	ND	ND	0.08	ND	0.09	ND
15	TLGW-15	DW	ND	ND	0.002	0.0009	ND	ND	ND	0.01	0.004	1.23	ND	0.38	0.01	ND	ND	0.01	0.11	ND	0.07	ND
16	TLGW-16	HP	0.003	ND	ND	0.0014	0.02	0.001	0.04	0.53	0.002	0.53	ND	0.46	ND	0.24	0.00	0.00	0.07	ND	0.02	ND
17	TLGW-17	HP	0.002	0.0030	0.004	ND	0.02	ND	0.04	1.15	0.006	1.43	ND	0.32	0.03	0.03	0.00	ND	0.10	ND	0.02	ND
18	TLGW-18	HP	0.004	ND	0.007	0.000	0.02	0.001	0.01	0.02	ND	1.25	ND	0.41	ND	0.00	ND	ND	0.15	ND	0.08	ND
19	TLGW-19	HP	0.008	ND	0.015	0.004	0.05	0.002	0.11	ND	0.003	1.03	0.001	0.69	0.03	0.31	0.00	0.00	0.13	ND	0.97	ND
20	TLGW-20	DW	ND	ND	ND	0.001	0.02	ND	0.01	0.01	ND	0.84	ND	0.03	0.02	ND	ND	ND	0.09	ND	0.08	ND
21	TLGW-21	DW	ND	ND	ND	0.001	0.02	0.001	0.01	0.00	ND	1.16	ND	0.05	0.04	ND	0.00	0.00	0.09	ND	0.08	ND
22	TLGW-22	DW	0.006	0.0004	0.010	ND	0.04	0.007	ND	ND	0.002	0.53	ND	ND	0.08	0.02	0.00	ND	0.13	ND	0.55	ND
23	TLGW-23	HP	0.002	0.0016	ND	0.005	0.02	0.002	ND	0.20	0.004	1.64	ND	0.22	0.02	0.10	0.00	0.00	0.09	ND	0.34	ND
24	TLGW-24	DW	ND	ND	ND	ND	0.02	ND	ND	ND	0.002	0.95	ND	ND	ND	ND	ND	0.00	0.07	ND	0.06	ND
Acceptable Limit			**0.01**	**0.001**	**0.010**	**0.003**	**0.05**	**NS**	**0.05**	**5.0**	**0.01**	**0.30**	**NS**	**0.50**	**0.03**	**0.10**	**0.02**	**0.02**	**0.03**	**0.10**	**0.70**	**NS**
Permissible Limit			**0.05**	**NR**	**NR**	**NR**	**NR**	**NS**	**1.50**	**15.0**	**NR**	**NR**	**NS**	**1.00**	**0.20**	**0.30**	**NR**	**NR**	**0.00**	**NR**	**NR**	**NS**
Detection Limit			**0.0005**	**0.0000**	**0.0001**	**0.0001**	**0.0010**	**0.0001**	**0.0001**	**0.0010**	**0.0001**	**0.0020**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**

7 PRELIMENARY REMARKS

During the premonsoon season (2024), 24 groundwater samples and 24 surface water samples were collected to determine the water quality of the area. The analysis of the samples indicates that

1. In general, the chemical constituents are with in desirable limit for drinking water.

2. Bacteriological contamination has been observed in most of the surface water bodies

3. Heavy metals are within desirable limits.